Inference on the Champagne Model using a Gaussian Process

TODO

- Change outputs

Setting up the Champagne Model

Imports

```
import pandas as pd
import numpy as np
from typing import Any
import matplotlib.pyplot as plt

from scipy.stats import qmc
from scipy.stats import norm

import tensorflow as tf
import tensorflow_probability as tfp

tfb = tfp.bijectors
tfd = tfp.distributions
tfk = tfp.math.psd_kernels
# tfp_acq = tfp.experimental.bayesopt.acquisition
```

```
2024-04-25 18:39:56.728091: I tensorflow/core/platform/cpu_feature_guard.cc:210] This Tensorl
To enable the following instructions: AVX2 FMA, in other operations, rebuild TensorFlow with
2024-04-25 18:39:57.538915: W tensorflow/compiler/tf2tensorrt/utils/py_utils.cc:38] TF-TRT Wa
```

Model itself

```
np.random.seed(590154)

population = 1000
initial_infecteds = 10
epidemic_length = 1000
number_of_events = 15000

pv_champ_alpha = 0.4  # prop of effective care
pv_champ_beta = 0.4  # prop of radical cure
pv_champ_gamma_L = 1 / 223  # liver stage clearance rate
pv_champ_delta = 0.05  # prop of imported cases
pv_champ_lambda = 0.04  # transmission rate
pv_champ_f = 1 / 72  # relapse frequency
pv_champ_r = 1 / 60  # blood stage clearance rate


def champagne_stochastic(
    alpha_,
    beta_,
    gamma_L,
    lambda_,
    f,
    r,
    N=population,
    I_L=initial_infecteds,
    I_0=0,
    S_L=0,
    delta_=0,
    end_time=epidemic_length,
    num_events=number_of_events,
):
    if (0 > (alpha_ or beta_)) or (1 < (alpha_ or beta_)):
        return "Alpha or Beta out of bounds"
    if 0 > (gamma_L or lambda_ or f or r):
        return "Gamma, lambda, f or r out of bounds"

    t = 0
    S_0 = N - I_L - I_0 - S_L
    inc_counter = 0
```

```
    list_of_outcomes = [
        {"t": 0, "S_0": S_0, "S_L": S_L, "I_0": I_0, "I_L": I_L, "inc_counter": 0}
    ]

    prop_new = alpha_ * beta_ * f / (alpha_ * beta_ * f + gamma_L)
    i = 0

    while (i < num_events) or (t < 30):
        i += 1
        if S_0 == N:
            while t < 31:
                t += 1
                new_stages = {
                    "t": t,
                    "S_0": N,
                    "S_L": 0,
                    "I_0": 0,
                    "I_L": 0,
                    "inc_counter": inc_counter,
                }
                list_of_outcomes.append(new_stages)
            break

        S_0_to_I_L = (1 - alpha_) * lambda_ * (I_L + I_0) / N * S_0
        S_0_to_S_L = alpha_ * (1 - beta_) * lambda_ * (I_0 + I_L) / N * S_0
        I_0_to_S_0 = r * I_0 / N
        I_0_to_I_L = lambda_ * (I_L + I_0) / N * I_0
        I_L_to_I_0 = gamma_L * I_L
        I_L_to_S_L = r * I_L
        S_L_to_S_0 = (gamma_L + (f + lambda_ * (I_0 + I_L) / N) * alpha_ * beta_) * S_L
        S_L_to_I_L = (f + lambda_ * (I_0 + I_L) / N) * (1 - alpha_) * S_L

        total_rate = (
            S_0_to_I_L
            + S_0_to_S_L
            + I_0_to_S_0
            + I_0_to_I_L
            + I_L_to_I_0
            + I_L_to_S_L
            + S_L_to_S_0
            + S_L_to_I_L
        )
```

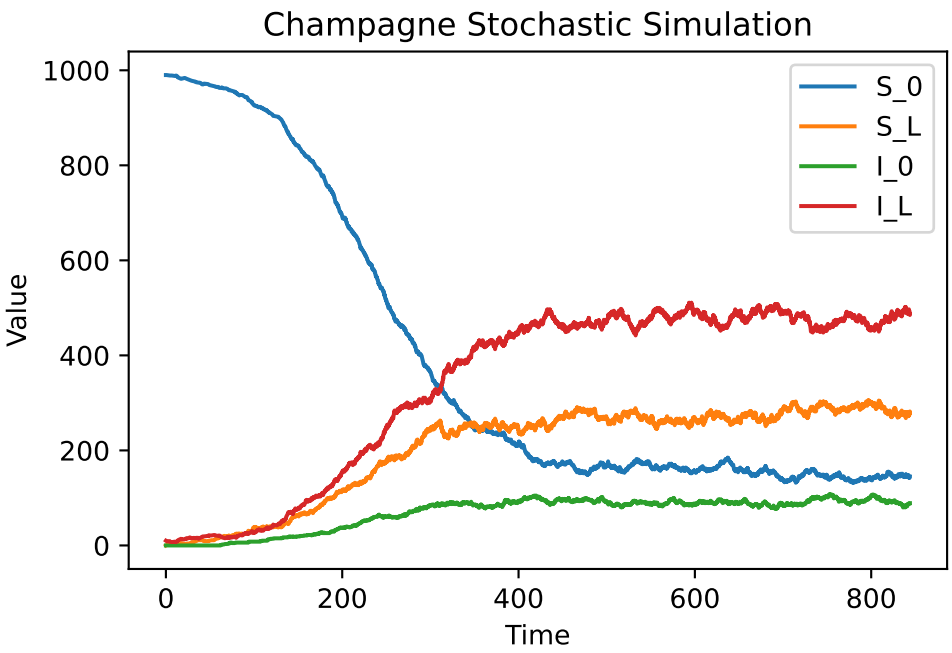
```
        delta_t = np.random.exponential(1 / total_rate)
        new_stages_prob = [
            S_0_to_I_L / total_rate,
            S_0_to_S_L / total_rate,
            I_0_to_S_0 / total_rate,
            I_0_to_I_L / total_rate,
            I_L_to_I_0 / total_rate,
            I_L_to_S_L / total_rate,
            S_L_to_S_0 / total_rate,
            S_L_to_I_L / total_rate,
        ]
        t += delta_t
        silent_incidences = np.random.poisson(
            delta_t * alpha_ * beta_ * lambda_ * (I_L + I_0) * S_0 / N
        )

        new_stages = np.random.choice(
            [
                {
                    "t": t,
                    "S_0": S_0 - 1,
                    "S_L": S_L,
                    "I_0": I_0,
                    "I_L": I_L + 1,
                    "inc_counter": inc_counter + silent_incidences + 1,
                },
                {
                    "t": t,
                    "S_0": S_0 - 1,
                    "S_L": S_L + 1,
                    "I_0": I_0,
                    "I_L": I_L,
                    "inc_counter": inc_counter + silent_incidences + 1,
                },
                {
                    "t": t,
                    "S_0": S_0 + 1,
                    "S_L": S_L,
                    "I_0": I_0 - 1,
                    "I_L": I_L,
                    "inc_counter": inc_counter + silent_incidences,
                },
```

```
                {
                    "t": t,
                    "S_0": S_0,
                    "S_L": S_L,
                    "I_0": I_0 - 1,
                    "I_L": I_L + 1,
                    "inc_counter": inc_counter + silent_incidences,
                },
                {
                    "t": t,
                    "S_0": S_0,
                    "S_L": S_L,
                    "I_0": I_0 + 1,
                    "I_L": I_L - 1,
                    "inc_counter": inc_counter + silent_incidences,
                },
                {
                    "t": t,
                    "S_0": S_0,
                    "S_L": S_L + 1,
                    "I_0": I_0,
                    "I_L": I_L - 1,
                    "inc_counter": inc_counter + silent_incidences,
                },
                {
                    "t": t,
                    "S_0": S_0 + 1,
                    "S_L": S_L - 1,
                    "I_0": I_0,
                    "I_L": I_L,
                    "inc_counter": inc_counter
                    + silent_incidences
                    + np.random.binomial(1, prop_new),
                },
                {
                    "t": t,
                    "S_0": S_0,
                    "S_L": S_L - 1,
                    "I_0": I_0,
                    "I_L": I_L + 1,
                    "inc_counter": inc_counter + silent_incidences + 1,
                },
```

```
            ],
            p=new_stages_prob,
        )

        list_of_outcomes.append(new_stages)

        S_0 = new_stages["S_0"]
        I_0 = new_stages["I_0"]
        I_L = new_stages["I_L"]
        S_L = new_stages["S_L"]
        inc_counter = new_stages["inc_counter"]

    outcome_df = pd.DataFrame(list_of_outcomes)
    return outcome_df


champ_samp = champagne_stochastic(
    pv_champ_alpha,
    pv_champ_beta,
    pv_champ_gamma_L,
    pv_champ_lambda,
    pv_champ_f,
    pv_champ_r,
)  # .melt(id_vars='t')
```

Plotting outcome

```
champ_samp.drop("inc_counter", axis=1).plot(x="t", legend=True)
plt.xlabel("Time")
plt.ylabel("Value")
plt.title("Champagne Stochastic Simulation")
plt.savefig("champagne_GP_images/champagne_simulation.pdf")
plt.show()
```



Function that Outputs Final Prevalence

```
def incidence(df, start, days):
    start_ind = df[df["t"].le(start)].index[-1]
    end_ind = df[df["t"].le(start + days)].index[-1]
    incidence_week = df.iloc[end_ind]["inc_counter"] - df.iloc[start_ind]["inc_counter"]
    return incidence_week


def champ_sum_stats(alpha_, beta_, gamma_L, lambda_, f, r):
    champ_df_ = champagne_stochastic(alpha_, beta_, gamma_L, lambda_, f, r)
    fin_t = champ_df_.iloc[-1]["t"]
    first_month_inc = incidence(champ_df_, 0, 30)
    fin_t = champ_df_.iloc[-1]["t"]
    fin_week_inc = incidence(champ_df_, fin_t - 7, 7)
    fin_prev = champ_df_.iloc[-1]["I_0"] + champ_df_.iloc[-1]["I_L"]

    return np.array([fin_prev, first_month_inc, fin_week_inc])


observed_sum_stats = champ_sum_stats(
```

```
    pv_champ_alpha,
    pv_champ_beta,
    pv_champ_gamma_L,
    pv_champ_lambda,
    pv_champ_f,
    pv_champ_r,
)


def discrepency_fn(alpha_, beta_, gamma_L, lambda_, f, r): # best is L1 norm
    x = champ_sum_stats(alpha_, beta_, gamma_L, lambda_, f, r)
    return np.sum(np.abs((x - observed_sum_stats) / observed_sum_stats))
```

Testing the variances across different values of params etc.

```
# samples = 30
# cor_sums = np.zeros(samples)
# for i in range(samples):
#     cor_sums[i] = discrepency_fn(
#         pv_champ_alpha,
#         pv_champ_beta,
#         pv_champ_gamma_L,
#         pv_champ_lambda,
#         pv_champ_f,
#         pv_champ_r,
#     )

# cor_mean = np.mean(cor_sums)
# cor_s_2 = sum((cor_sums - cor_mean) ** 2) / (samples - 1)
# print(cor_mean, cor_s_2)

# doub_sums = np.zeros(samples)
# for i in range(samples):
#     doub_sums[i] = discrepency_fn(
#         2 * pv_champ_alpha,
#         2 * pv_champ_beta,
#         2 * pv_champ_gamma_L,
#         2 * pv_champ_lambda,
#         2 * pv_champ_f,
#         2 * pv_champ_r,
#     )
```

```
# doub_mean = np.mean(doub_sums)
# doub_s_2 = sum((doub_sums - doub_mean) ** 2) / (samples - 1)
# print(doub_mean, doub_s_2)

# half_sums = np.zeros(samples)
# for i in range(samples):
#     half_sums[i] = discrepency_fn(
#         pv_champ_alpha / 2,
#         pv_champ_beta / 2,
#         pv_champ_gamma_L / 2,
#         pv_champ_lambda / 2,
#         pv_champ_f / 2,
#         pv_champ_r / 2,
#     )

# half_mean = np.mean(half_sums)
# half_s_2 = sum((half_sums - half_mean) ** 2) / (samples - 1)
# print(half_mean, half_s_2)

# rogue_sums = np.zeros(samples)
# for i in range(samples):
#     rogue_sums[i] = discrepency_fn(
#         pv_champ_alpha / 2,
#         pv_champ_beta / 2,
#         pv_champ_gamma_L / 2,
#         pv_champ_lambda / 2,
#         pv_champ_f / 2,
#         pv_champ_r / 2,
#     )

# rogue_mean = np.mean(rogue_sums)
# rogue_s_2 = sum((rogue_sums - rogue_mean) ** 2) / (samples - 1)
# print(rogue_mean, rogue_s_2)

# plt.figure(figsize=(7, 4))
# plt.scatter(
#     np.array([half_mean, cor_mean, doub_mean, rogue_mean]),
#     np.array([half_s_2, cor_s_2, doub_s_2, rogue_s_2]),
# )
# plt.title("variance and mean")
# plt.xlabel("mean")
# plt.ylabel("variance")
```

```
# plt.show()
```

Gaussian Process Regression on Final Prevalence Discrepency

```
my_seed = np.random.default_rng(seed=1795)  # For replicability

num_samples = 30

variables_names = ["alpha", "beta", "gamma_L", "lambda", "f", "r"]

pv_champ_alpha = 0.4  # prop of effective care
pv_champ_beta = 0.4  # prop of radical cure
pv_champ_gamma_L = 1 / 223  # liver stage clearance rate
pv_champ_lambda = 0.04  # transmission rate
pv_champ_f = 1 / 72  # relapse frequency
pv_champ_r = 1 / 60  # blood stage clearance rate

samples = np.concatenate(
    (
        my_seed.uniform(low=0, high=1, size=(num_samples, 1)),  # alpha
        my_seed.uniform(low=0, high=1, size=(num_samples, 1)),  # beta
        my_seed.exponential(scale=pv_champ_gamma_L, size=(num_samples, 1)),  # gamma_L
        my_seed.exponential(scale=pv_champ_lambda, size=(num_samples, 1)),  # lambda
        my_seed.exponential(scale=pv_champ_f, size=(num_samples, 1)),  # f
        my_seed.exponential(scale=pv_champ_r, size=(num_samples, 1)),  # r
    ),
    axis=1,
)

LHC_sampler = qmc.LatinHypercube(d=6, seed=my_seed)
LHC_samples = LHC_sampler.random(n=num_samples)
LHC_samples[:, 2] = -pv_champ_gamma_L * np.log(LHC_samples[:, 2])
LHC_samples[:, 3] = -pv_champ_lambda * np.log(LHC_samples[:, 3])
LHC_samples[:, 4] = -pv_champ_f * np.log(LHC_samples[:, 4])
LHC_samples[:, 5] = -pv_champ_r * np.log(LHC_samples[:, 5])

LHC_samples = np.repeat(LHC_samples, 3, axis = 0)

random_indices_df = pd.DataFrame(samples, columns=variables_names)
```

```
LHC_indices_df = pd.DataFrame(LHC_samples, columns=variables_names)

print(random_indices_df.head())
print(LHC_indices_df.head())
```

```
      alpha      beta   gamma_L    lambda         f         r
0  0.201552  0.081511  0.004695  0.017172  0.007355  0.021370
1  0.332324  0.374497  0.003022  0.020210  0.001350  0.002604
2  0.836050  0.570164  0.002141  0.043572  0.001212  0.008367
3  0.566773  0.347186  0.001925  0.016830  0.000064  0.003145
4  0.880603  0.316884  0.000425  0.012374  0.000358  0.003491
      alpha      beta   gamma_L    lambda         f         r
0  0.066680  0.570582  0.001707  0.002226  0.004358  0.003743
1  0.066680  0.570582  0.001707  0.002226  0.004358  0.003743
2  0.066680  0.570582  0.001707  0.002226  0.004358  0.003743
3  0.132042  0.551592  0.013131  0.036829  0.002851  0.002075
4  0.132042  0.551592  0.013131  0.036829  0.002851  0.002075
```

Generate Discrepencies

```
random_discrepencies = LHC_indices_df.apply(
    lambda x: discrepency_fn(
        x["alpha"], x["beta"], x["gamma_L"], x["lambda"], x["f"], x["r"]
    ),
    axis=1,
)

print(random_discrepencies.head())
```

```
0    1.720391
1    1.873389
2    1.916142
3    1.904911
4    1.950292
dtype: float64
```

Differing Methods to Iterate Function

```
# import timeit

# def function1():
#     np.vectorize(champ_sum_stats)(random_indices_df['alpha'],
#     random_indices_df['beta'], random_indices_df['gamma_L'],
#     random_indices_df['lambda'], random_indices_df['f'], random_indices_df['r'])
#     pass

# def function2():
#     random_indices_df.apply(
#         lambda x: champ_sum_stats(
#             x['alpha'], x['beta'], x['gamma_L'], x['lambda'], x['f'], x['r']),
#             axis = 1)
#     pass

# # Time function1
# time_taken_function1 = timeit.timeit(
#     "function1()", globals=globals(), number=100)

# # Time function2
# time_taken_function2 = timeit.timeit(
#     "function2()", globals=globals(), number=100)

# print("Time taken for function1:", time_taken_function1)
# print("Time taken for function2:", time_taken_function2)
```

Time taken for function1: 187.48960775700016 Time taken for function2: 204.06618941299985

Constrain Variables to be Positive

```
constrain_positive = tfb.Shift(np.finfo(np.float64).tiny)(tfb.Exp())
```

```
2024-04-25 18:40:33.176312: I external/local_xla/xla/stream_executor/cuda/cuda_executor.cc:99
2024-04-25 18:40:33.330092: W tensorflow/core/common_runtime/gpu/gpu_device.cc:2251] Cannot d
Skipping registering GPU devices...
```

Custom Quadratic Mean Function

```
class quad_mean_fn(tf.Module):
    def __init__(self):
        super(quad_mean_fn, self).__init__()
        # self.amp_alpha_mean = tfp.util.TransformedVariable(
        #     bijector=constrain_positive,
        #     initial_value=1.0,
        #     dtype=np.float64,
        #     name="amp_alpha_mean",
        # )
        # self.alpha_tp = tf.Variable(pv_champ_alpha, dtype=np.float64, name="alpha_tp")
        # self.amp_beta_mean = tfp.util.TransformedVariable(
        #     bijector=constrain_positive,
        #     initial_value=0.5,
        #     dtype=np.float64,
        #     name="amp_beta_mean",
        # )
        # self.beta_tp = tf.Variable(pv_champ_beta, dtype=np.float64, name="beta_tp")
        self.amp_gamma_L_mean = tfp.util.TransformedVariable(
            bijector=constrain_positive,
            initial_value=1.0,
            dtype=np.float64,
            name="amp_gamma_L_mean",
        )
        self.gamma_L_tp = tf.Variable(
            pv_champ_gamma_L, dtype=np.float64, name="gamma_L_tp"
        )
        self.amp_lambda_mean = tfp.util.TransformedVariable(
            bijector=constrain_positive,
            initial_value=1.0,
            dtype=np.float64,
            name="amp_lambda_mean",
        )
        self.lambda_tp = tf.Variable(
            pv_champ_lambda, dtype=np.float64, name="lambda_tp"
        )
        self.amp_f_mean = tfp.util.TransformedVariable(
            bijector=constrain_positive,
            initial_value=1.0,
            dtype=np.float64,
            name="amp_f_mean",
```

```
        )
        self.f_tp = tf.Variable(pv_champ_f, dtype=np.float64, name="f_tp")
        self.amp_r_mean = tfp.util.TransformedVariable(
            bijector=constrain_positive,
            initial_value=1.0,
            dtype=np.float64,
            name="amp_r_mean",
        )
        self.r_tp = tf.Variable(pv_champ_r, dtype=np.float64, name="r_tp")
        self.bias_mean = tfp.util.TransformedVariable(
            bijector=constrain_positive,
            initial_value=50.0,
            dtype=np.float64,
            name="bias_mean",
        )
        # self.bias_mean = tf.Variable(0.0, dtype=np.float64, name="bias_mean")

    def __call__(self, x):
        return (
            self.bias_mean
            # + self.amp_alpha_mean * (x[..., 0] - self.alpha_tp) ** 2
            # + self.amp_beta_mean * (x[..., 1] - self.beta_tp) ** 2
            + self.amp_gamma_L_mean * (x[..., 2] - self.gamma_L_tp) ** 2
            + self.amp_lambda_mean * (x[..., 3] - self.lambda_tp) ** 2
            + self.amp_f_mean * (x[..., 4] - self.f_tp) ** 2
            + self.amp_r_mean * (x[..., 5] - self.r_tp) ** 2
        )
```

Custom Linear Mean Function

```
class lin_mean_fn(tf.Module):
    def __init__(self):
        super(lin_mean_fn, self).__init__()
        # self.amp_alpha_lin = tfp.util.TransformedVariable(
        #     bijector=constrain_positive,
        #     initial_value=1.0,
        #     dtype=np.float64,
        #     name="amp_alpha_lin",
        # )
        # self.amp_beta_lin = tfp.util.TransformedVariable(
```

```
        #     bijector=constrain_positive,
        #     initial_value=0.5,
        #     dtype=np.float64,
        #     name="amp_beta_lin",
        # )
        self.amp_gamma_L_lin = tfp.util.TransformedVariable(
            bijector=constrain_positive,
            initial_value=1.0,
            dtype=np.float64,
            name="amp_gamma_L_lin",
        )
        self.amp_lambda_lin = tfp.util.TransformedVariable(
            bijector=constrain_positive,
            initial_value=1.0,
            dtype=np.float64,
            name="amp_lambda_lin",
        )
        self.amp_f_lin = tfp.util.TransformedVariable(
            bijector=constrain_positive,
            initial_value=1.0,
            dtype=np.float64,
            name="amp_f_lin",
        )
        self.amp_r_lin = tfp.util.TransformedVariable(
            bijector=constrain_positive,
            initial_value=1.0,
            dtype=np.float64,
            name="amp_r_lin",
        )
        # self.bias_lin = tfp.util.TransformedVariable(
        #     bijector=constrain_positive,
        #     initial_value=1.0,
        #     dtype=np.float64,
        #     name="bias_lin",
        # )
        self.bias_lin = tf.Variable(0.0, dtype=np.float64, name="bias_mean")

    def __call__(self, x):
        return (
            self.bias_lin
            # + self.amp_alpha_lin * (x[..., 0])
            # + self.amp_beta_lin * (x[..., 1])
```

```
            + self.amp_gamma_L_lin * (x[..., 2])
            + self.amp_lambda_lin * (x[..., 3])
            + self.amp_f_lin * (x[..., 4])
            + self.amp_r_lin * (x[..., 5])
        )
```

Making the ARD Kernel

```
index_vals = LHC_indices_df.values
obs_vals = random_discrepencies.values

amplitude_champ = tfp.util.TransformedVariable(
    bijector=constrain_positive,
    initial_value=1.0,
    dtype=np.float64,
    name="amplitude_champ",
)

observation_noise_variance_champ = tfp.util.TransformedVariable(
    bijector=constrain_positive,
    initial_value=2,
    dtype=np.float64,
    name="observation_noise_variance_champ",
)
```

```
length_scales_champ = tfp.util.TransformedVariable(
    bijector=tfb.Sigmoid(),
    initial_value=[0.5, 0.5, 0.5, 0.5, 0.5, 0.5],
    dtype=np.float64,
    name="length_scales_champ",
)
```

```
kernel_champ = tfk.FeatureScaled(
    tfk.MaternFiveHalves(amplitude=amplitude_champ),
    scale_diag=length_scales_champ,
)
```

Define the Gaussian Process with Quadratic Mean Function and ARD Kernel

```
# Define Gaussian Process with the custom kernel
champ_GP = tfd.GaussianProcess(
    kernel=kernel_champ,
    observation_noise_variance=observation_noise_variance_champ,
    index_points=index_vals,
    mean_fn=quad_mean_fn(),
)

print(champ_GP.trainable_variables)

Adam_optim = tf.optimizers.Adam(learning_rate=0.01)
```

```
(<tf.Variable 'amplitude_champ:0' shape=() dtype=float64, numpy=0.0>, <tf.Variable 'length_s
```

Train the Hyperparameters

```
# predictive log stuff
@tf.function(autograph=False, jit_compile=False)
def optimize():
    with tf.GradientTape() as tape:
        K = (
            champ_GP.kernel.matrix(index_vals, index_vals)
            + tf.eye(index_vals.shape[0], dtype=np.float64)
            * observation_noise_variance_champ
        )
        means = champ_GP.mean_fn(index_vals)
        K_inv = tf.linalg.inv(K)
        K_inv_y = K_inv @ tf.reshape(obs_vals - means, shape=[obs_vals.shape[0], 1])
        K_inv_diag = tf.linalg.diag_part(K_inv)
        log_var = tf.math.log(K_inv_diag)
        log_mu = tf.reshape(K_inv_y, shape=[-1]) ** 2
        loss = -tf.math.reduce_sum(log_var - log_mu)
    grads = tape.gradient(loss, champ_GP.trainable_variables)
    Adam_optim.apply_gradients(zip(grads, champ_GP.trainable_variables))
    return loss
```

```
num_iters = 10000

lls_ = np.zeros(num_iters, np.float64)
tolerance = 1e-6  # Set your desired tolerance level
previous_loss = float("inf")

for i in range(num_iters):
    loss = optimize()
    lls_[i] = loss

    # Check if change in loss is less than tolerance
    if abs(loss - previous_loss) < tolerance:
        print(f"Hyperparameter convergence reached at iteration {i+1}.")
        lls_ = lls_[range(i + 1)]
        break

    previous_loss = loss
```

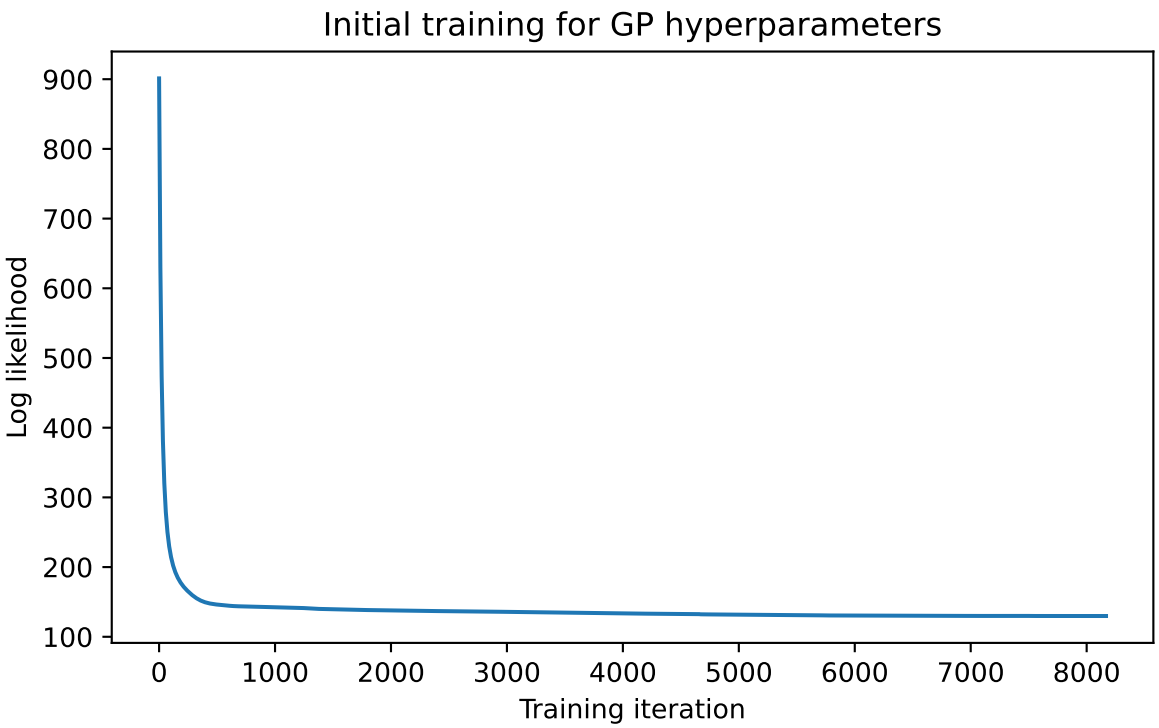
```
Hyperparameter convergence reached at iteration 8168.
```

```
print("Trained parameters:")
for var in champ_GP.trainable_variables:
    if "length" in var.name:
        print(
            "{} is {}\n".format(
                var.name, tfb.Sigmoid().forward(var).numpy().round(3)
            )
        )
    else:
        if "tp" in var.name: # or "bias" in var.name:
            print("{} is {}\n".format(var.name, var.numpy().round(3)))
        else:
            print(
                "{} is {}\n".format(
                    var.name, constrain_positive.forward(var).numpy().round(3)
                )
            )
```

```
Trained parameters:
amplitude_champ:0 is 0.043
```

```
length_scales_champ:0 is [0.989 0.989 0.941 0.5   0.986 0.993]

observation_noise_variance_champ:0 is 2.565

amp_f_mean:0 is 638.455

amp_gamma_L_mean:0 is 966.216

amp_lambda_mean:0 is 996.855

amp_r_mean:0 is 0.011

bias_mean:0 is 0.276

f_tp:0 is 0.007

gamma_L_tp:0 is -0.023

lambda_tp:0 is 0.044

r_tp:0 is 0.009
```

```
plt.figure(figsize=(7, 4))
plt.plot(lls_)
plt.title("Initial training for GP hyperparameters")
plt.xlabel("Training iteration")
plt.ylabel("Log likelihood")
plt.savefig("champagne_GP_images/hyperparam_loss_no_log.pdf")
plt.show()
```



Creating slices across one variable dimension

```
plot_samp_no = 21
plot_gp_no = 200
gp_samp_no = 50
```

```
slice_samples_dict = {
    "alpha_slice_samples": np.repeat(np.concatenate(
        (
            np.linspace(0, 1, plot_samp_no, dtype=np.float64).reshape(-1, 1),  # alpha
            np.repeat(pv_champ_beta, plot_samp_no).reshape(-1, 1),  # beta
            np.repeat(pv_champ_gamma_L, plot_samp_no).reshape(-1, 1),  # gamma_L
            np.repeat(pv_champ_lambda, plot_samp_no).reshape(-1, 1),  # lambda
            np.repeat(pv_champ_f, plot_samp_no).reshape(-1, 1),  # f
            np.repeat(pv_champ_r, plot_samp_no).reshape(-1, 1),  # r
        ),
        axis=1,
    ), 3, axis = 0),
    "alpha_gp_samples": np.concatenate(
```

```
        (
            np.linspace(0, 1, plot_gp_no, dtype=np.float64).reshape(-1, 1),  # alpha
            np.repeat(pv_champ_beta, plot_gp_no).reshape(-1, 1),  # beta
            np.repeat(pv_champ_gamma_L, plot_gp_no).reshape(-1, 1),  # gamma_L
            np.repeat(pv_champ_lambda, plot_gp_no).reshape(-1, 1),  # lambda
            np.repeat(pv_champ_f, plot_gp_no).reshape(-1, 1),  # f
            np.repeat(pv_champ_r, plot_gp_no).reshape(-1, 1),  # r
        ),
        axis=1,
    ),
    "beta_slice_samples": np.repeat(np.concatenate(
        (
            np.repeat(pv_champ_alpha, plot_samp_no).reshape(-1, 1),  # alpha
            np.linspace(0, 1, plot_samp_no, dtype=np.float64).reshape(-1, 1),  # beta
            np.repeat(pv_champ_gamma_L, plot_samp_no).reshape(-1, 1),  # gamma_L
            np.repeat(pv_champ_lambda, plot_samp_no).reshape(-1, 1),  # lambda
            np.repeat(pv_champ_f, plot_samp_no).reshape(-1, 1),  # f
            np.repeat(pv_champ_r, plot_samp_no).reshape(-1, 1),  # r
        ),
        axis=1,
    ), 3, axis = 0),
    "beta_gp_samples": np.concatenate(
        (
            np.repeat(pv_champ_alpha, plot_gp_no).reshape(-1, 1),  # alpha
            np.linspace(0, 1, plot_gp_no, dtype=np.float64).reshape(-1, 1),  # beta
            np.repeat(pv_champ_gamma_L, plot_gp_no).reshape(-1, 1),  # gamma_L
            np.repeat(pv_champ_lambda, plot_gp_no).reshape(-1, 1),  # lambda
            np.repeat(pv_champ_f, plot_gp_no).reshape(-1, 1),  # f
            np.repeat(pv_champ_r, plot_gp_no).reshape(-1, 1),  # r
        ),
        axis=1,
    ),
    "gamma_L_slice_samples": np.repeat(np.concatenate(
        (
            np.repeat(pv_champ_alpha, plot_samp_no).reshape(-1, 1),  # alpha
            np.repeat(pv_champ_beta, plot_samp_no).reshape(-1, 1),  # beta
            -10*pv_champ_gamma_L
            * np.log(
                np.linspace(0, 1, plot_samp_no + 2, dtype=np.float64)[1:-1]
            ).reshape(
                -1, 1
            ),  # gamma_L
```

```
            np.repeat(pv_champ_lambda, plot_samp_no).reshape(-1, 1),  # lambda
            np.repeat(pv_champ_f, plot_samp_no).reshape(-1, 1),  # f
            np.repeat(pv_champ_r, plot_samp_no).reshape(-1, 1),  # r
        ),
        axis=1,
    ), 3, axis = 0),
    "gamma_L_gp_samples": np.concatenate(
        (
            np.repeat(pv_champ_alpha, plot_gp_no).reshape(-1, 1),  # alpha
            np.repeat(pv_champ_beta, plot_gp_no).reshape(-1, 1),  # beta
            np.linspace(
                -10*pv_champ_gamma_L
                * np.log(
                    np.linspace(0, 1, plot_samp_no + 2, dtype=np.float64)[1:-1]
                ).reshape(-1, 1)[0],
                -10*pv_champ_gamma_L
                * np.log(
                    np.linspace(0, 1, plot_samp_no + 2, dtype=np.float64)[1:-1]
                ).reshape(-1, 1)[-1], plot_gp_no, dtype=np.float64
            ),  # gamma_L
            np.repeat(pv_champ_lambda, plot_gp_no).reshape(-1, 1),  # lambda
            np.repeat(pv_champ_f, plot_gp_no).reshape(-1, 1),  # f
            np.repeat(pv_champ_r, plot_gp_no).reshape(-1, 1),  # r
        ),
        axis=1,
    ),
    "lambda_slice_samples": np.repeat(np.concatenate(
        (
            np.repeat(pv_champ_alpha, plot_samp_no).reshape(-1, 1),  # alpha
            np.repeat(pv_champ_beta, plot_samp_no).reshape(-1, 1),  # beta
            np.repeat(pv_champ_gamma_L, plot_samp_no).reshape(-1, 1),  # gamma_L
            -pv_champ_lambda
            * np.log(
                np.linspace(0, 1, plot_samp_no + 2, dtype=np.float64)[1:-1]
            ).reshape(
                -1, 1
            ),  # lambda
            np.repeat(pv_champ_f, plot_samp_no).reshape(-1, 1),  # f
            np.repeat(pv_champ_r, plot_samp_no).reshape(-1, 1),  # r
        ),
        axis=1,
    ), 3, axis = 0),
```

```
    "lambda_gp_samples": np.concatenate(
        (
            np.repeat(pv_champ_alpha, plot_gp_no).reshape(-1, 1),  # alpha
            np.repeat(pv_champ_beta, plot_gp_no).reshape(-1, 1),  # beta
            np.repeat(pv_champ_gamma_L, plot_gp_no).reshape(-1, 1),  # gamma_L
            np.linspace(
                -pv_champ_lambda
                * np.log(
                    np.linspace(0, 1, plot_samp_no + 2, dtype=np.float64)[1:-1]
                ).reshape(-1, 1)[0],
                -pv_champ_lambda
                * np.log(
                    np.linspace(0, 1, plot_samp_no + 2, dtype=np.float64)[1:-1]
                ).reshape(-1, 1)[-1], plot_gp_no, dtype=np.float64
            ),  # lambda
            np.repeat(pv_champ_f, plot_gp_no).reshape(-1, 1),  # f
            np.repeat(pv_champ_r, plot_gp_no).reshape(-1, 1),  # r
        ),
        axis=1,
    ),
    "f_slice_samples": np.repeat(np.concatenate(
        (
            np.repeat(pv_champ_alpha, plot_samp_no).reshape(-1, 1),  # alpha
            np.repeat(pv_champ_beta, plot_samp_no).reshape(-1, 1),  # beta
            np.repeat(pv_champ_gamma_L, plot_samp_no).reshape(-1, 1),  # gamma_L
            np.repeat(pv_champ_lambda, plot_samp_no).reshape(-1, 1),  # lambda
            -10*pv_champ_f
            * np.log(
                np.linspace(0, 1, plot_samp_no + 2, dtype=np.float64)[1:-1]
            ).reshape(
                -1, 1
            ),  # f
            np.repeat(pv_champ_r, plot_samp_no).reshape(-1, 1),  # r
        ),
        axis=1,
    ), 3, axis = 0),
    "f_gp_samples": np.concatenate(
        (
            np.repeat(pv_champ_alpha, plot_gp_no).reshape(-1, 1),  # alpha
            np.repeat(pv_champ_beta, plot_gp_no).reshape(-1, 1),  # beta
            np.repeat(pv_champ_gamma_L, plot_gp_no).reshape(-1, 1),  # gamma_L
            np.repeat(pv_champ_lambda, plot_gp_no).reshape(-1, 1),  # lambda
```

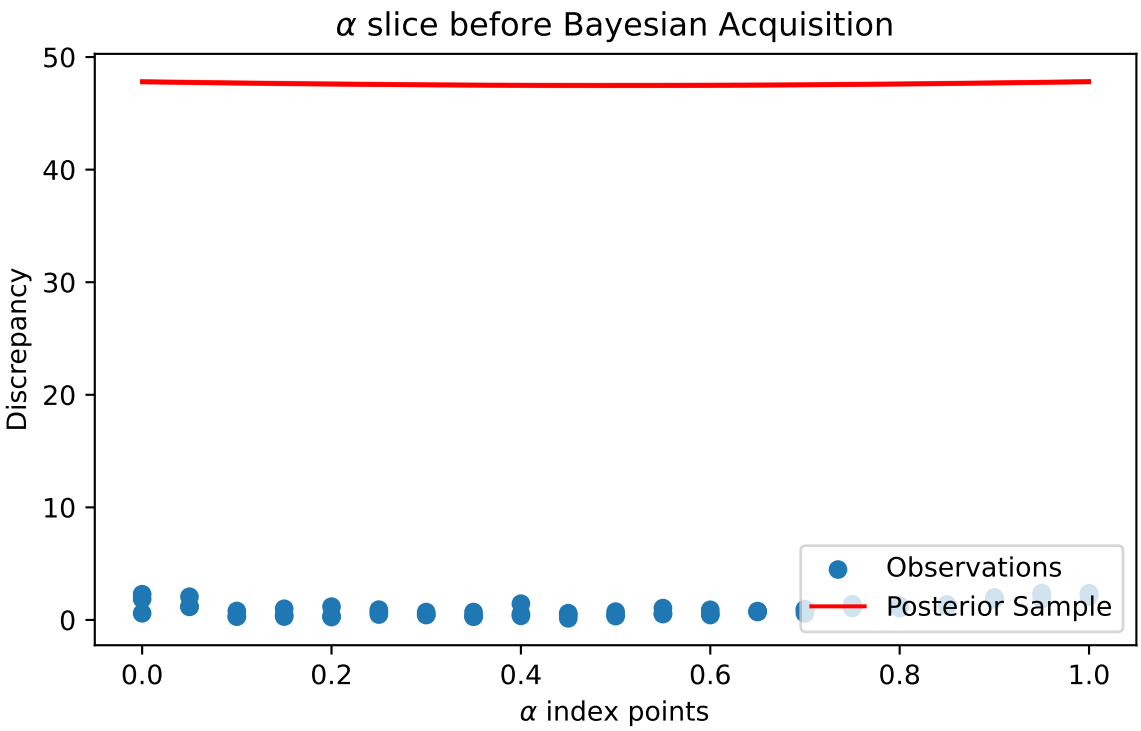
```
            np.linspace(
                -10*pv_champ_f
                * np.log(
                    np.linspace(0, 1, plot_samp_no + 2, dtype=np.float64)[1:-1]
                ).reshape(-1, 1)[0],
                -10*pv_champ_f
                * np.log(
                    np.linspace(0, 1, plot_samp_no + 2, dtype=np.float64)[1:-1]
                ).reshape(-1, 1)[-1], plot_gp_no, dtype=np.float64
            ),  # f
            np.repeat(pv_champ_r, plot_gp_no).reshape(-1, 1),  # r
        ),
        axis=1,
    ),
    "r_slice_samples": np.repeat(np.concatenate(
        (
            np.repeat(pv_champ_alpha, plot_samp_no).reshape(-1, 1),  # alpha
            np.repeat(pv_champ_beta, plot_samp_no).reshape(-1, 1),  # beta
            np.repeat(pv_champ_gamma_L, plot_samp_no).reshape(-1, 1),  # gamma_L
            np.repeat(pv_champ_lambda, plot_samp_no).reshape(-1, 1),  # lambda
            np.repeat(pv_champ_f, plot_samp_no).reshape(-1, 1),  # f
            -2*pv_champ_r
            * np.log(
                np.linspace(0, 1, plot_samp_no + 2, dtype=np.float64)[1:-1]
            ).reshape(
                -1, 1
            ),  # r
        ),
        axis=1,
    ), 3, axis = 0),
    "r_gp_samples": np.concatenate(
        (
            np.repeat(pv_champ_alpha, plot_gp_no).reshape(-1, 1),  # alpha
            np.repeat(pv_champ_beta, plot_gp_no).reshape(-1, 1),  # beta
            np.repeat(pv_champ_gamma_L, plot_gp_no).reshape(-1, 1),  # gamma_L
            np.repeat(pv_champ_lambda, plot_gp_no).reshape(-1, 1),  # lambda
            np.repeat(pv_champ_f, plot_gp_no).reshape(-1, 1),  # f
            np.linspace(
                -2*pv_champ_r
                * np.log(
                    np.linspace(0, 1, plot_samp_no + 2, dtype=np.float64)[1:-1]
                ).reshape(-1, 1)[0],
```

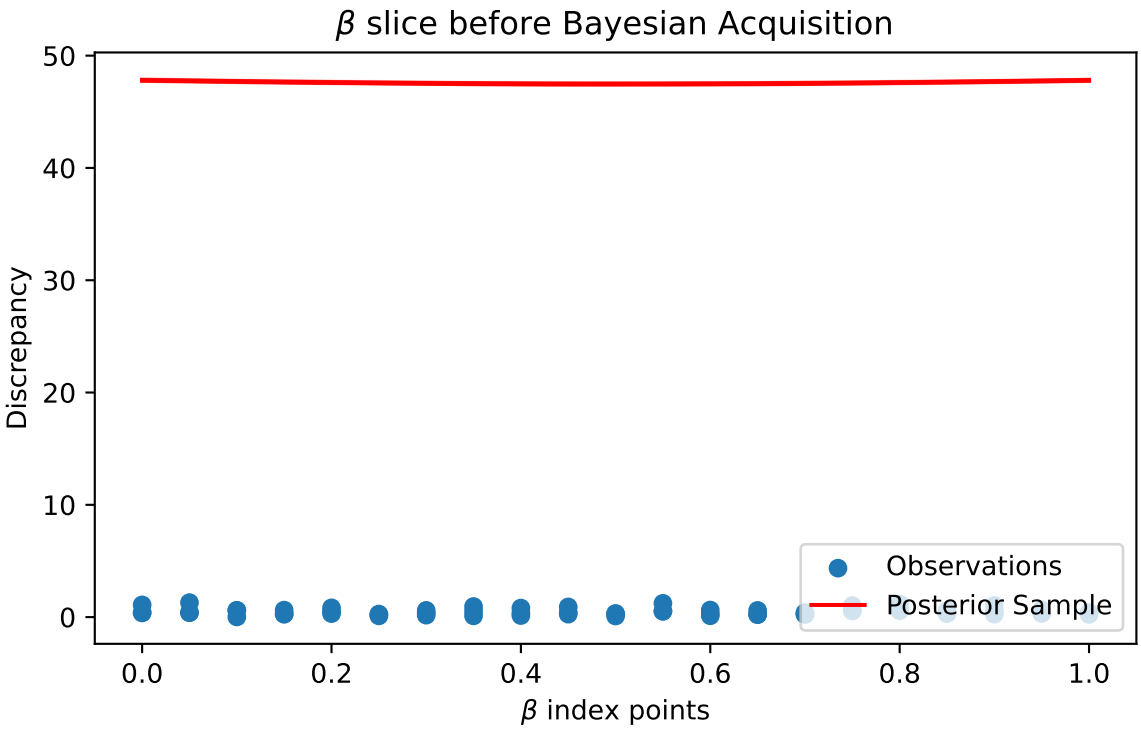
```
                -2*pv_champ_r
                * np.log(
                    np.linspace(0, 1, plot_samp_no + 2, dtype=np.float64)[1:-1]
                ).reshape(-1, 1)[-1], plot_gp_no, dtype=np.float64
            ),  # r
        ),
        axis=1,
    ),
}
```

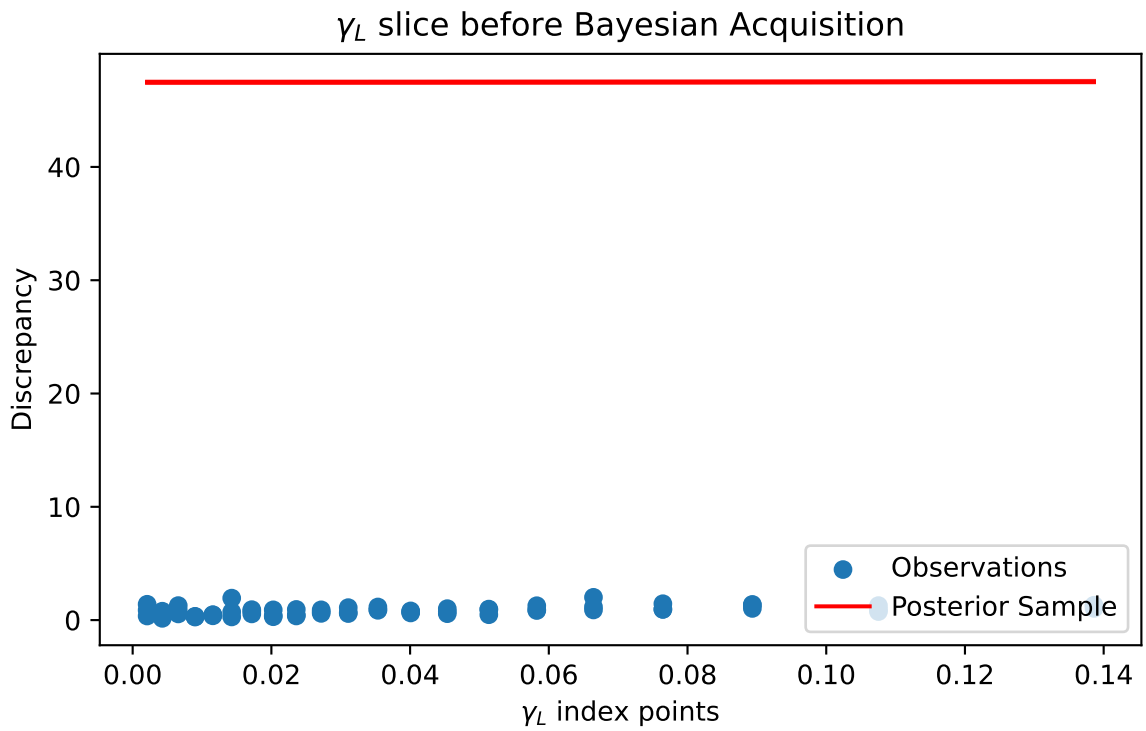
Plotting the GPs across different slices

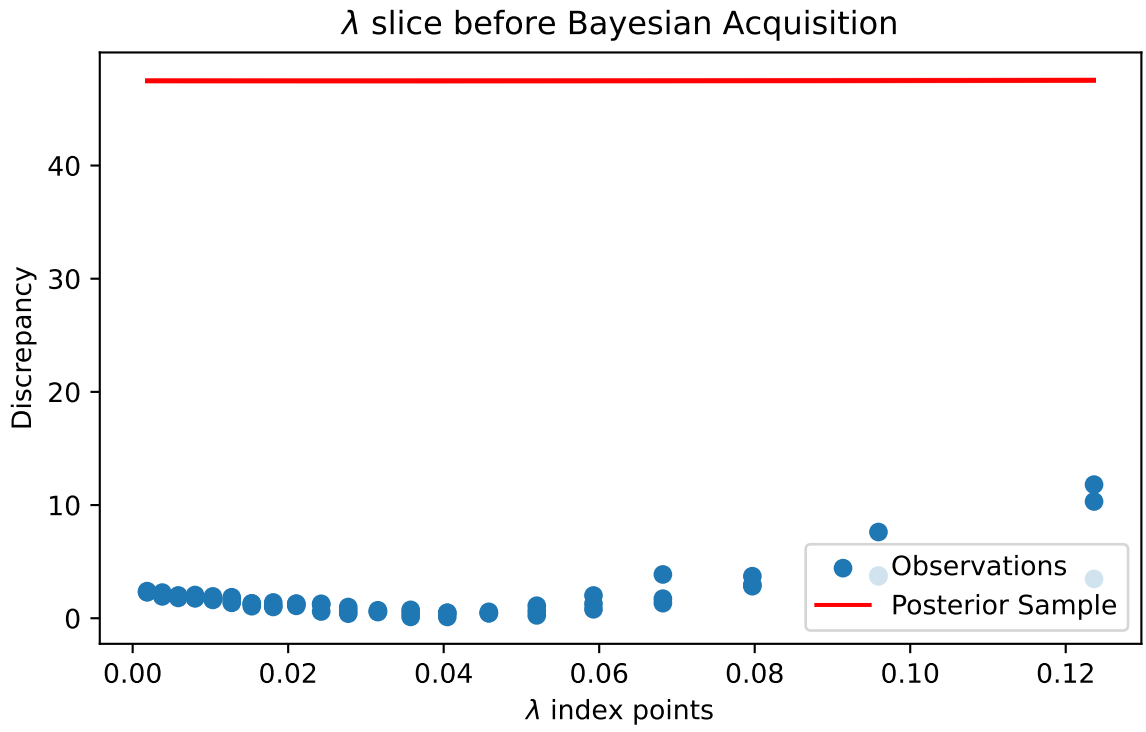
```
GP_seed = tfp.random.sanitize_seed(4362)
vars = ["alpha", "beta", "gamma_L", "lambda", "f", "r"]
slice_indices_dfs_dict = {}
slice_index_vals_dict = {}
slice_discrepencies_dict = {}

for var in vars:
    val_df = pd.DataFrame(
        slice_samples_dict[var + "_slice_samples"], columns=variables_names
    )
    slice_indices_dfs_dict[var + "_slice_indices_df"] = val_df
    slice_index_vals_dict[var + "_slice_index_vals"] = val_df.values
    discreps = val_df.apply(
        lambda x: discrepency_fn(
            x["alpha"], x["beta"], x["gamma_L"], x["lambda"], x["f"], x["r"]
        ),
        axis=1,
    )
    slice_discrepencies_dict[var + "_slice_discrepencies"] = discreps


    gp_samples_df = pd.DataFrame(
        slice_samples_dict[var + "_gp_samples"], columns=variables_names
    )
    slice_indices_dfs_dict[var + "_gp_indices_df"] = gp_samples_df
    slice_index_vals_dict[var + "_gp_index_vals"] = gp_samples_df.values

    champ_GP_reg = tfd.GaussianProcessRegressionModel(
```

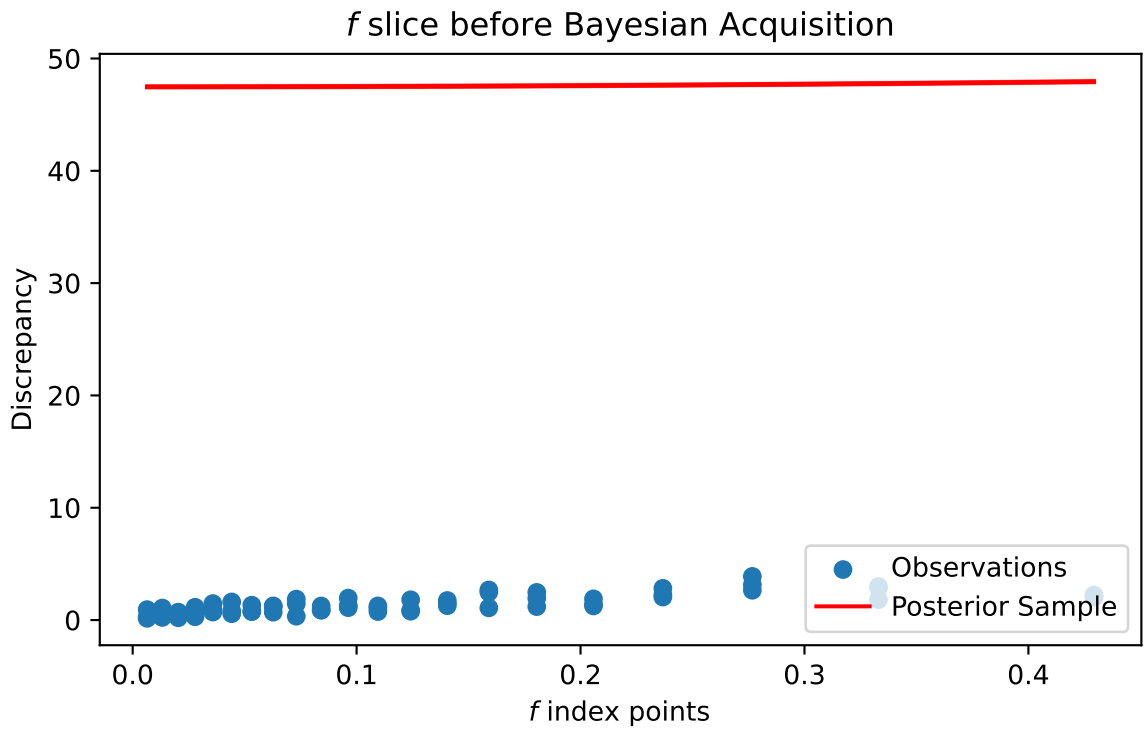
```
        kernel=kernel_champ,
        index_points=gp_samples_df.values,
        observation_index_points=index_vals,
        observations=obs_vals,
        observation_noise_variance=observation_noise_variance_champ,
        predictive_noise_variance=0.0,
        mean_fn=quad_mean_fn(),
    )
    GP_samples = champ_GP_reg.sample(gp_samp_no, seed=GP_seed)

    plt.figure(figsize=(7, 4))
    plt.scatter(
        val_df[var].values,
        discreps,
        label="Observations",
    )
    for i in range(gp_samp_no):
        plt.plot(
            gp_samples_df[var].values,
            GP_samples[i, :],
            c="r",
            alpha=0.1,
            label="Posterior Sample" if i == 0 else None,
        )
    leg = plt.legend(loc="lower right")
    for lh in leg.legend_handles:
        lh.set_alpha(1)
    if var in ["f", "r"]:
        plt.xlabel("$" + var + "$ index points")
        plt.title("$" + var + "$ slice before Bayesian Acquisition")
    else:
        plt.xlabel("$\\" + var + "$ index points")
        plt.title("$\\" + var + "$ slice before Bayesian Acquisition")
    # if var not in ["alpha", "beta"]:
    #     plt.xscale("log", base=np.e)
    plt.ylabel("Discrepancy")
    plt.savefig("champagne_GP_images/initial_" + var + "_slice_no_log.pdf")
    plt.show()
```

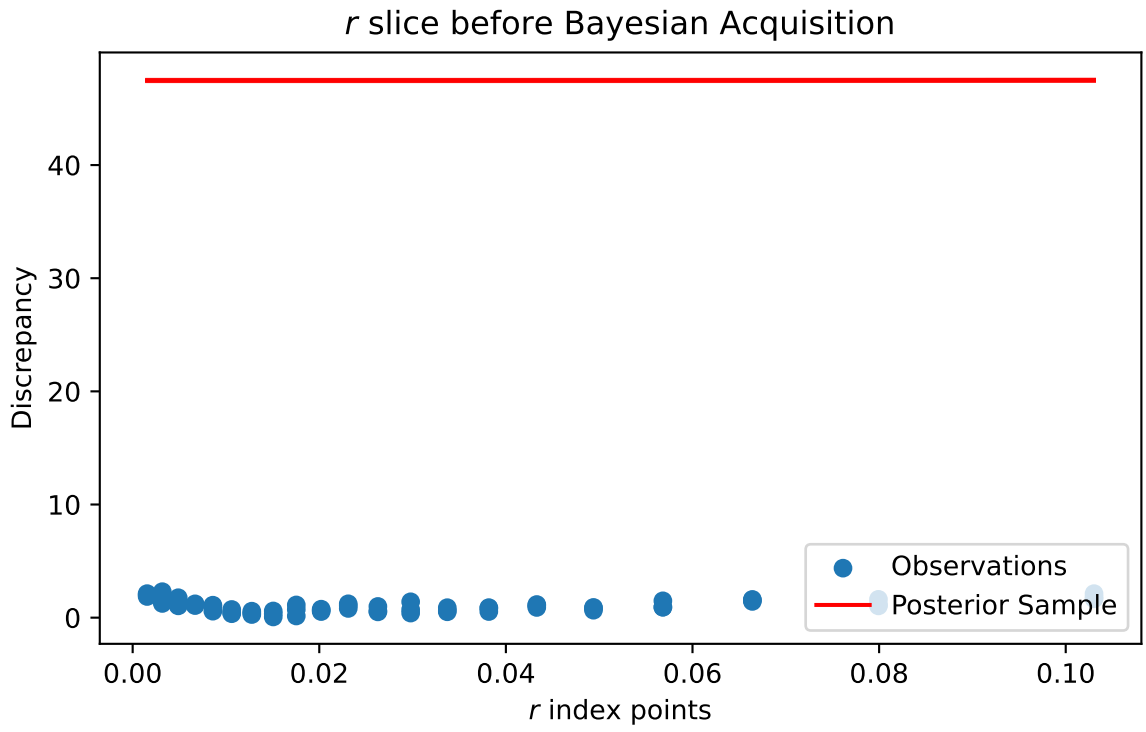

α slice before Bayesian Acquisition
Discrepancy
α index points
Observations
Posterior Sample
0
10
20
30
40
50
0.0
0.2
0.4
0.6
0.8
1.0


β slice before Bayesian Acquisition
Discrepancy
β index points
Observations
Posterior Sample
0
10
20
30
40
50
0.0
0.2
0.4
0.6
0.8
1.0


γ_L slice before Bayesian Acquisition
Discrepancy
0
10
20
30
40
0.00
0.02
0.04
0.06
0.08
0.10
0.12
0.14
γ_L index points
Observations
Posterior Sample


λ slice before Bayesian Acquisition
Discrepancy
0
10
20
30
40
0.00
0.02
0.04
0.06
0.08
0.10
0.12
λ index points
Observations
Posterior Sample


f slice before Bayesian Acquisition
Discrepancy
f index points
Observations
Posterior Sample
0
10
20
30
40
50
0.0
0.1
0.2
0.3
0.4


r slice before Bayesian Acquisition
Discrepancy
r index points
Observations
Posterior Sample
0
10
20
30
40
0.00
0.02
0.04
0.06
0.08
0.10

Acquiring the next datapoint to test

Proof that .variance returns what we need in acquisition function

```
new_guess = np.array([0.4, 0.4, 0.004, 0.04, 0.01, 0.17])
mean_t = champ_GP_reg.mean_fn(new_guess)
variance_t = champ_GP_reg.variance(index_points=[new_guess])

kernel_self = kernel_champ.apply(new_guess, new_guess)
kernel_others = kernel_champ.apply(new_guess, index_vals)
K = kernel_champ.matrix(
    index_vals, index_vals
) + observation_noise_variance_champ * np.identity(index_vals.shape[0])
inv_K = np.linalg.inv(K)
print("Self Kernel is {}".format(kernel_self.numpy().round(3)))
print("Others Kernel is {}".format(kernel_others.numpy().round(3)))
print(inv_K)
my_var_t = kernel_self - kernel_others.numpy() @ inv_K @ kernel_others.numpy()

print("Variance function is {}".format(variance_t.numpy().round(3)))
print("Variance function is {}".format(my_var_t.numpy().round(3)))
```

```
Self Kernel is 0.002
Others Kernel is [0.002 0.002 0.002 0.002 0.002 0.002 0.002 0.002 0.002 0.001 0.001 0.001
 0.001 0.001 0.001 0.002 0.002 0.002 0.002 0.002 0.002 0.002 0.002 0.002
 0.002 0.002 0.002 0.002 0.002 0.002 0.002 0.002 0.002 0.002 0.002 0.002
 0.001 0.001 0.001 0.001 0.001 0.001 0.002 0.002 0.002 0.001 0.001 0.001
 0.002 0.002 0.002 0.002 0.002 0.002 0.002 0.002 0.002 0.001 0.001 0.001
 0.001 0.001 0.001 0.001 0.001 0.001 0.002 0.002 0.002 0.002 0.002 0.002
 0.002 0.002 0.002 0.002 0.002 0.002 0.002 0.002 0.002 0.002 0.002 0.002
 0.002 0.002 0.002 0.002 0.002 0.002]
[[ 3.89623140e-01 -2.74984276e-04 -2.74984276e-04 ... -1.83930098e-04
  -1.83930098e-04 -1.83930098e-04]
 [-2.74984276e-04  3.89623140e-01 -2.74984276e-04 ... -1.83930098e-04
  -1.83930098e-04 -1.83930098e-04]
 [-2.74984276e-04 -2.74984276e-04  3.89623140e-01 ... -1.83930098e-04
  -1.83930098e-04 -1.83930098e-04]
 ...
 [-1.83930098e-04 -1.83930098e-04 -1.83930098e-04 ...  3.89624416e-01
  -2.73708258e-04 -2.73708258e-04]
 [-1.83930098e-04 -1.83930098e-04 -1.83930098e-04 ... -2.73708258e-04
```

```
   3.89624416e-01 -2.73708258e-04]
 [-1.83930098e-04 -1.83930098e-04 -1.83930098e-04 ... -2.73708258e-04
  -2.73708258e-04  3.89624416e-01]]
Variance function is [0.002]
Variance function is 0.002
```

Loss function

```
next_alpha = tfp.util.TransformedVariable(
    initial_value=0.5,
    bijector=tfb.Sigmoid(),
    dtype=np.float64,
    name="next_alpha",
)

next_beta = tfp.util.TransformedVariable(
    initial_value=0.5,
    bijector=tfb.Sigmoid(),
    dtype=np.float64,
    name="next_beta",
)

next_gamma_L = tfp.util.TransformedVariable(
    initial_value=0.1,
    bijector=constrain_positive,
    dtype=np.float64,
    name="next_gamma_L",
)

next_lambda = tfp.util.TransformedVariable(
    initial_value=0.1,
    bijector=constrain_positive,
    dtype=np.float64,
    name="next_lambda",
)

next_f = tfp.util.TransformedVariable(
    initial_value=0.1,
    bijector=constrain_positive,
    dtype=np.float64,
    name="next_f",
```

```
)

next_r = tfp.util.TransformedVariable(
    initial_value=0.1,
    bijector=constrain_positive,
    dtype=np.float64,
    name="next_r",
)

next_vars = [
    v.trainable_variables[0]
    for v in [next_alpha, next_beta, next_gamma_L, next_lambda, next_f, next_r]
]
```

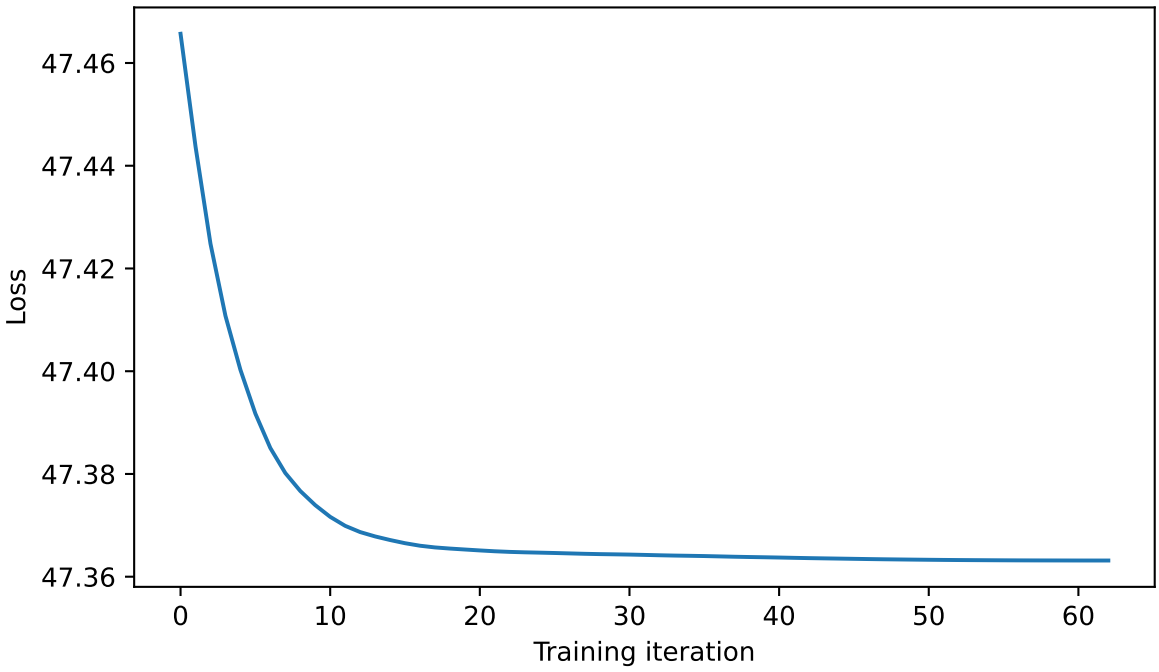
```
Adam_optim = tf.optimizers.Adam(learning_rate=0.1)


@tf.function(autograph=False, jit_compile=False)
def optimize():
    with tf.GradientTape() as tape:
        next_guess = tf.reshape(
            [
                tfb.Sigmoid().forward(next_vars[0]),
                tfb.Sigmoid().forward(next_vars[1]),
                constrain_positive.forward(next_vars[2]),
                constrain_positive.forward(next_vars[3]),
                constrain_positive.forward(next_vars[4]),
                constrain_positive.forward(next_vars[5]),
            ],
            [1, 6],
        )
        mean_t = champ_GP_reg.mean_fn(next_guess)
        std_t = champ_GP_reg.stddev(index_points=next_guess)
        loss = tf.squeeze(mean_t - 1.7 * std_t)
    grads = tape.gradient(loss, next_vars)
    Adam_optim.apply_gradients(zip(grads, next_vars))
    return loss


num_iters = 10000

lls_ = np.zeros(num_iters, np.float64)
```

```
tolerance = 1e-6  # Set your desired tolerance level
previous_loss = float("inf")

for i in range(num_iters):
    loss = optimize()
    lls_[i] = loss

    # Check if change in loss is less than tolerance
    if abs(loss - previous_loss) < tolerance:
        print(f"Acquisition function convergence reached at iteration {i+1}.")
        lls_ = lls_[range(i + 1)]
        break

    previous_loss = loss

print("Trained parameters:")
for var in next_vars:
    if ("alpha" in var.name) | ("beta" in var.name):
        print(
            "{} is {}".format(var.name, (tfb.Sigmoid().forward(var).numpy().round(3)))
        )
    else:
        print(
            "{} is {}".format(
                var.name, constrain_positive.forward(var).numpy().round(3)
            )
        )
```

```
Acquisition function convergence reached at iteration 63.
Trained parameters:
next_alpha:0 is 0.502
next_beta:0 is 0.508
next_gamma_L:0 is 0.012
next_lambda:0 is 0.037
next_f:0 is 0.014
next_r:0 is 0.016
```

```
plt.figure(figsize=(7, 4))
plt.plot(lls_)
plt.xlabel("Training iteration")
plt.ylabel("Loss")
```

```
plt.savefig("champagne_GP_images/bolfi_optim_loss_no_log.pdf")
plt.show()
```




```
def update_GP():
    @tf.function
    def opt_GP():
        with tf.GradientTape() as tape:
            K = (
                champ_GP.kernel.matrix(index_vals, index_vals)
                + tf.eye(index_vals.shape[0], dtype=np.float64)
                * observation_noise_variance_champ
            )
            means = champ_GP.mean_fn(index_vals)
            K_inv = tf.linalg.inv(K)
            K_inv_y = K_inv @ tf.reshape(obs_vals - means, shape=[obs_vals.shape[0], 1])
            K_inv_diag = tf.linalg.diag_part(K_inv)
            log_var = tf.math.log(K_inv_diag)
            log_mu = tf.reshape(K_inv_y, shape=[-1]) ** 2
            loss = -tf.math.reduce_sum(log_var - log_mu)
        grads = tape.gradient(loss, champ_GP.trainable_variables)
        optimizer_slow.apply_gradients(zip(grads, champ_GP.trainable_variables))
```

```
        return loss

    num_iters = 10000

    lls_ = np.zeros(num_iters, np.float64)
    tolerance = 1e-6  # Set your desired tolerance level
    previous_loss = float("inf")

    for i in range(num_iters):
        loss = opt_GP()
        lls_[i] = loss.numpy()

        # Check if change in loss is less than tolerance
        if abs(loss - previous_loss) < tolerance:
            print(f"Hyperparameter convergence reached at iteration {i+1}.")
            lls_ = lls_[range(i + 1)]
            break

        previous_loss = loss
    for var in optimizer_slow.variables:
        var.assign(tf.zeros_like(var))


def update_var_UCB():
    @tf.function
    def opt_var():
        with tf.GradientTape() as tape:
            next_guess = tf.reshape(
                [
                    tfb.Sigmoid().forward(next_vars[0]),
                    tfb.Sigmoid().forward(next_vars[1]),
                    constrain_positive.forward(next_vars[2]),
                    constrain_positive.forward(next_vars[3]),
                    constrain_positive.forward(next_vars[4]),
                    constrain_positive.forward(next_vars[5]),
                ],
                [1, 6],
            )
            mean_t = champ_GP_reg.mean_fn(next_guess)
            std_t = champ_GP_reg.stddev(index_points=next_guess)
            loss = tf.squeeze(mean_t - eta_t * std_t)
        grads = tape.gradient(loss, next_vars)
```

```
        optimizer_fast.apply_gradients(zip(grads, next_vars))
        return loss

    num_iters = 10000

    lls_ = np.zeros(num_iters, np.float64)
    tolerance = 1e-6  # Set your desired tolerance level
    previous_loss = float("inf")

    for i in range(num_iters):
        loss = opt_var()
        lls_[i] = loss

        # Check if change in loss is less than tolerance
        if abs(loss - previous_loss) < tolerance:
            print(f"Acquisition function convergence reached at iteration {i+1}.")
            lls_ = lls_[range(i + 1)]
            break

        previous_loss = loss
    print(loss)
    for var in optimizer_fast.variables:
        var.assign(tf.zeros_like(var))


norm_dist = tfd.Normal(0, 1)


def update_var_EI():
    min_obs = min(champ_GP_reg.mean_fn(index_vals))
    min_index = index_vals[champ_GP_reg.mean_fn(index_vals) == min(champ_GP_reg.mean_fn(index
    next_vars = tf.Variable(min_index)
    @tf.function
    def opt_var():
        with tf.GradientTape() as tape:
            next_guess = tf.reshape(
                [
                    tfb.Sigmoid().forward(next_vars[0]),
                    tfb.Sigmoid().forward(next_vars[1]),
                    constrain_positive.forward(next_vars[2]),
                    constrain_positive.forward(next_vars[3]),
                    constrain_positive.forward(next_vars[4]),
```

```
                    constrain_positive.forward(next_vars[5]),
                ],
                [1, 6],
            )
            mean_t = champ_GP_reg.mean_fn(next_guess)
            std_t = champ_GP_reg.stddev(index_points=next_guess)
            delt = min_obs - mean_t
            z_score = tf.squeeze((min_obs - mean_t) / std_t)
            loss = (
                delt * tfb.NormalCDF().forward(z_score)
                - std_t * tf.math.exp(-(z_score**2) / 2) / 2 / np.pi
            )
        grads = tape.gradient(loss, next_vars)
        optimizer_fast.apply_gradients(zip(grads, next_vars))
        return loss

    num_iters = 10000

    lls_ = np.zeros(num_iters, np.float64)
    tolerance = 1e-6  # Set your desired tolerance level
    previous_loss = float("inf")

    for i in range(num_iters):
        loss = opt_var()
        lls_[i] = loss

        # Check if change in loss is less than tolerance
        if abs(loss - previous_loss) < tolerance:
            print(f"Acquisition function convergence reached at iteration {i+1}.")
            lls_ = lls_[range(i + 1)]
            break

        previous_loss = loss
    print(loss)
    for var in optimizer_fast.variables:
        var.assign(tf.zeros_like(var))


# EI = tfp_acq.GaussianProcessExpectedImprovement(champ_GP_reg, obs_vals)


def new_eta_t(t, d, exploration_rate):
```

```
    return np.sqrt(np.log((t + 1) ** (d / 2 + 2) * np.pi**2 / (3 * exploration_rate)))
```

```
# min_obs = min(champ_GP_reg.mean_fn(index_vals))
# min_index = index_vals[
#     champ_GP_reg.mean_fn(index_vals) == min(champ_GP_reg.mean_fn(index_vals))
# ][
#     0,
# ]

# def EI(GP, indices):
#     mean_t = GP.mean_fn(indices)
#     std_t = GP.stddev(index_points=indices)
#     delt = min_obs - mean_t
#     z_score = tf.squeeze((min_obs - mean_t) / std_t)
#     EI = delt * tfb.NormalCDF().forward(z_score) - std_t * tf.math.exp(
#         -(z_score**2) / 2
#     ) / tf.cast(tf.math.sqrt(2 * np.pi), dtype=np.float64)
#     return EI

# def PI(GP, indices):
#     mean_t = GP.mean_fn(indices)
#     std_t = GP.stddev(index_points=indices)
#     delt = min_obs - mean_t
#     z_score = tf.squeeze((min_obs - mean_t) / std_t)
#     EI = tfb.NormalCDF().forward(z_score)
#     return EI

# num = 0
# for var in next_vars:
#     var.assign(min_index[num])
#     num += 1

# PI(champ_GP_reg, tf.reshape(tf.Variable(min_index, dtype = np.float64), [1, 6]))

# def opt_var():
#     with tf.GradientTape() as tape:
#         next_guess = tf.reshape(
#             [
#                 tfb.Sigmoid().forward(next_vars[0]),
#                 tfb.Sigmoid().forward(next_vars[1]),
#                 constrain_positive.forward(next_vars[2]),
#                 constrain_positive.forward(next_vars[3]),
```

```
#                 constrain_positive.forward(next_vars[4]),
#                 constrain_positive.forward(next_vars[5]),
#             ],
#             [1, 6],
#         )
#         loss = PI(champ_GP, next_guess)
#     grads = tape.gradient(loss, next_vars)
#     optimizer_fast.apply_gradients(zip(grads, next_vars))
#     return loss


# num_iters = 10000

# lls_ = np.zeros(num_iters, np.float64)
# tolerance = 1e-6  # Set your desired tolerance level
# previous_loss = float("inf")

# for i in range(num_iters):
#     loss = opt_var()
#     lls_[i] = loss

#     # Check if change in loss is less than tolerance
#     if abs(loss - previous_loss) < tolerance:
#         print(f"Acquisition function convergence reached at iteration {i+1}.")
#         lls_ = lls_[range(i + 1)]
#         break

#     previous_loss = loss
# print(loss)
# for var in optimizer_fast.variables:
#     var.assign(tf.zeros_like(var))
```

```
exploration_rate = 0.00000001
d = 6
update_freq = 20  # how many iterations before updating GP hyperparams
eta_t = tf.Variable(0,dtype=np.float64, name = "eta_t")

for t in range(801):
    optimizer_fast = tf.optimizers.Adam(learning_rate=0.01)
    optimizer_slow = tf.optimizers.Adam()
    eta_t.assign(new_eta_t(t, d, exploration_rate))
    print("Iteration " + str(t))
```

```
    print(eta_t)

    for var in next_vars:
        var.assign(my_seed.uniform(0,1))

    update_var_UCB()
    # update_var_EI()

    new_params = np.array(
            [
                next_alpha.numpy(),
                next_beta.numpy(),
                next_gamma_L.numpy(),
                next_lambda.numpy(),
                next_f.numpy(),
                next_r.numpy(),
            ]
        ).reshape(1, -1)
    print(new_params)

    new_discrepency = discrepency_fn(
        next_alpha.numpy(),
        next_beta.numpy(),
        next_gamma_L.numpy(),
        next_lambda.numpy(),
        next_f.numpy(),
        next_r.numpy(),
    )

    index_vals = np.append(
        index_vals,
        new_params,
        axis=0,
    )
    obs_vals = np.append(obs_vals, new_discrepency)

    if t % update_freq == 0:
        champ_GP = tfd.GaussianProcess(
            kernel=kernel_champ,
            observation_noise_variance=observation_noise_variance_champ,
            index_points=index_vals,
            mean_fn=quad_mean_fn(),
```

```
        )
        update_GP()

    champ_GP_reg = tfd.GaussianProcessRegressionModel(
        kernel=kernel_champ,
        observation_index_points=index_vals,
        observations=obs_vals,
        observation_noise_variance=observation_noise_variance_champ,
        predictive_noise_variance=0.0,
        mean_fn=quad_mean_fn(),
    )

    if (t > 0) & (t % 50 == 0):
        print("Trained parameters:")
        for train_var in champ_GP.trainable_variables:
            if "length" in train_var.name:
                print(
                    "{} is {}\n".format(
                        train_var.name, tfb.Sigmoid().forward(train_var).numpy().round(3)
                    )
                )
            else:
                if "tp" in train_var.name: # or "bias" in var.name:
                    print("{} is {}\n".format(train_var.name, train_var.numpy().round(3)))
                else:
                    print(
                        "{} is {}\n".format(
                            train_var.name, constrain_positive.forward(train_var).numpy().rou
                        )
                    )
        for var in vars:
            champ_GP_reg = tfd.GaussianProcessRegressionModel(
                kernel=kernel_champ,
                index_points=slice_indices_dfs_dict[var + "_gp_indices_df"].values,
                observation_index_points=index_vals,
                observations=obs_vals,
                observation_noise_variance=observation_noise_variance_champ,
                predictive_noise_variance=0.0,
                mean_fn=quad_mean_fn(),
            )
            GP_samples = champ_GP_reg.sample(gp_samp_no, seed=GP_seed)
```

```
            plt.figure(figsize=(7, 4))
            plt.scatter(
                slice_indices_dfs_dict[var + "_slice_indices_df"][var].values,
                slice_discrepencies_dict[var + "_slice_discrepencies"],
                label="Observations",
            )
            for i in range(gp_samp_no):
                plt.plot(
                    slice_indices_dfs_dict[var + "_gp_indices_df"][var].values,
                    GP_samples[i, :],
                    c="r",
                    alpha=0.1,
                    label="Posterior Sample" if i == 0 else None,
                )
            leg = plt.legend(loc="lower right")
            for lh in leg.legend_handles:
                lh.set_alpha(1)
            if var in ["f", "r"]:
                plt.xlabel("$" + var + "$ index points")
                plt.title("$" + var + "$ slice after " + str(t) + " Bayesian acquisitions")
            else:
                plt.xlabel("$\\" + var + "$ index points")
                plt.title("$\\" + var + "$ slice after " + str(t) + " Bayesian acquisitions")
            plt.ylabel("Discrepancy")
            plt.savefig(
                "champagne_GP_images/" + var + "_slice_" + str(t) + "_bolfi_updates_no_log.pd
            )
            plt.show()

print(index_vals[-600,])
print(index_vals[-400,])
print(index_vals[-200,])
print(index_vals[-80,])
print(index_vals[-40,])
print(index_vals[-20,])
print(index_vals[-8,])
print(index_vals[-4,])
print(index_vals[-2,])
print(index_vals[-1,])
```

```
Iteration 0
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=4.428490513367174>
```

```
Acquisition function convergence reached at iteration 5678.
tf.Tensor(47.24916099199815, shape=(), dtype=float64)
[[0.50308302 0.50769212 0.02654767 0.0368982  0.01934832 0.01988971]]
Iteration 1
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=4.803880111928563>
Acquisition function convergence reached at iteration 7140.
tf.Tensor(-1.2395678453826142, shape=(), dtype=float64)
[[4.96454024e-01 5.28159828e-01 8.75686389e-03 3.89129889e-04
  5.58977129e-03 1.31180386e-02]]
Iteration 2
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=5.010448050855692>
Acquisition function convergence reached at iteration 7675.
tf.Tensor(-1.2254689373250194, shape=(), dtype=float64)
[[4.97422909e-01 5.27116802e-01 1.04066785e-02 3.38655057e-04
  1.57691698e-03 1.28593897e-02]]
Iteration 3
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=5.15198990998454>
Acquisition function convergence reached at iteration 7208.
tf.Tensor(-1.1921694051326797, shape=(), dtype=float64)
[[4.96295564e-01 5.28375132e-01 9.35614219e-03 3.06311151e-04
  5.52681046e-03 1.48774109e-02]]
Iteration 4
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=5.259155615605376>
Acquisition function convergence reached at iteration 6833.
tf.Tensor(-1.1509959215093708, shape=(), dtype=float64)
[[4.97543527e-01 5.27197661e-01 1.12027809e-02 2.45416842e-04
  6.47176401e-03 1.65811124e-02]]
Iteration 5
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=5.345121661208782>
Acquisition function convergence reached at iteration 7236.
tf.Tensor(-1.107424055846325, shape=(), dtype=float64)
[[4.97576026e-01 5.27217743e-01 1.15117745e-02 1.77125182e-04
  8.77067827e-03 1.25493921e-02]]
Iteration 6
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=5.4167406225755>
Acquisition function convergence reached at iteration 7907.
tf.Tensor(-1.063119355422431, shape=(), dtype=float64)
[[4.96494137e-01 5.28395454e-01 8.30413997e-03 3.01982569e-04
  3.98164859e-03 1.24526591e-02]]
Iteration 7
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=5.478022995149093>
Acquisition function convergence reached at iteration 7226.
tf.Tensor(-1.0145202450246638, shape=(), dtype=float64)
```

```
[[4.97821554e-01 5.27208743e-01 1.00129297e-02 3.83033820e-04
  3.63769554e-03 1.35810824e-02]]
Iteration 8
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=5.531514359889536>
Acquisition function convergence reached at iteration 7003.
tf.Tensor(-0.971270823245381, shape=(), dtype=float64)
[[4.96638015e-01 5.28419142e-01 1.37811867e-02 2.04627406e-04
  7.58308180e-03 1.38413362e-02]]
Iteration 9
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=5.578929439592625>
Acquisition function convergence reached at iteration 7481.
tf.Tensor(-0.9270333452553499, shape=(), dtype=float64)
[[4.96725748e-01 5.28400813e-01 1.24200927e-02 3.13766465e-04
  2.43710949e-03 1.28327146e-02]]
Iteration 10
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=5.62147708266919>
Acquisition function convergence reached at iteration 7278.
tf.Tensor(-0.881307625060451, shape=(), dtype=float64)
[[4.97864216e-01 5.27477245e-01 8.09132597e-03 4.20869048e-04
  1.95009180e-03 1.51049401e-02]]
Iteration 11
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=5.660040766277488>
Acquisition function convergence reached at iteration 7543.
tf.Tensor(-0.8392096205932675, shape=(), dtype=float64)
[[4.98031599e-01 5.27377973e-01 6.78202913e-03 2.18087514e-04
  5.94481578e-03 1.57377747e-02]]
Iteration 12
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=5.695285332122592>
Acquisition function convergence reached at iteration 7880.
tf.Tensor(-0.7944625454123477, shape=(), dtype=float64)
[[4.98170936e-01 5.27326857e-01 7.53862867e-03 2.35582235e-04
  5.69413760e-03 1.43451630e-02]]
Iteration 13
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=5.7277233588101435>
Acquisition function convergence reached at iteration 7859.
tf.Tensor(-0.7482659263666596, shape=(), dtype=float64)
[[4.98172549e-01 5.27361857e-01 1.09396424e-02 3.16132897e-04
  1.69315145e-03 1.31411043e-02]]
Iteration 14
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=5.7577581776672515>
Acquisition function convergence reached at iteration 7387.
tf.Tensor(-0.7078138109359127, shape=(), dtype=float64)
[[4.97053786e-01 5.28656625e-01 9.94595486e-03 2.91008953e-04
```

```
  6.36754111e-03 1.31457943e-02]]
Iteration 15
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=5.785712733810931>
Acquisition function convergence reached at iteration 7481.
tf.Tensor(-0.6716655443506949, shape=(), dtype=float64)
[[4.98294152e-01 5.27444580e-01 1.21005568e-02 2.22732659e-04
  6.47810838e-03 1.29946256e-02]]
Iteration 16
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=5.811849528959274>
Acquisition function convergence reached at iteration 7700.
tf.Tensor(-0.6332375712588958, shape=(), dtype=float64)
[[4.98401886e-01 5.27468514e-01 8.19621385e-03 2.40330645e-04
  5.38928316e-03 1.41392783e-02]]
Iteration 17
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=5.836384755691136>
Acquisition function convergence reached at iteration 7811.
tf.Tensor(-0.5930506809824556, shape=(), dtype=float64)
[[4.97257128e-01 5.28671994e-01 9.11895558e-03 3.01112782e-04
  3.08091546e-03 1.21601282e-02]]
Iteration 18
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=5.8594985385112315>
Acquisition function convergence reached at iteration 8162.
tf.Tensor(-0.5572071406665509, shape=(), dtype=float64)
[[4.98564925e-01 5.27476136e-01 6.34738075e-03 3.01689548e-04
  2.11394934e-03 1.29527973e-02]]
Iteration 19
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=5.8813424993578645>
Acquisition function convergence reached at iteration 8151.
tf.Tensor(-0.5188204705426047, shape=(), dtype=float64)
[[4.98539076e-01 5.27535475e-01 9.80810393e-03 2.56846618e-04
  2.76952881e-03 1.20173815e-02]]
Iteration 20
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=5.9020454433696266>
Acquisition function convergence reached at iteration 8117.
tf.Tensor(-0.4839268542140487, shape=(), dtype=float64)
[[4.97471375e-01 5.28726983e-01 8.28012824e-03 2.17183431e-04
  4.70784624e-03 1.28641425e-02]]
Iteration 21
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=5.921717697912881>
Acquisition function convergence reached at iteration 5303.
tf.Tensor(-0.7998858597055842, shape=(), dtype=float64)
[[0.48980431 0.49657516 0.01640774 0.02649799 0.02521053 0.04324553]]
Iteration 22
```

```
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=5.940454469704217>
Acquisition function convergence reached at iteration 6690.
tf.Tensor(-0.7789750039622987, shape=(), dtype=float64)
[[0.48931681 0.49713562 0.00757096 0.02649295 0.01755848 0.0421491 ]]
Iteration 23
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=5.958338474669158>
Acquisition function convergence reached at iteration 6422.
tf.Tensor(-0.7503398492584508, shape=(), dtype=float64)
[[0.48939055 0.49724695 0.0072409  0.02643257 0.01743969 0.04029991]]
Iteration 24
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=5.975442021417667>
Acquisition function convergence reached at iteration 7136.
tf.Tensor(-0.7336919581789607, shape=(), dtype=float64)
[[0.48939434 0.49725173 0.00936457 0.0264189  0.01189644 0.03942164]]
Iteration 25
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=5.991828678883473>
Acquisition function convergence reached at iteration 6335.
tf.Tensor(-0.7127410206070917, shape=(), dtype=float64)
[[0.48945021 0.49735424 0.00899694 0.02636527 0.01204791 0.03901607]]
Iteration 26
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.007554623722093>
Acquisition function convergence reached at iteration 6395.
tf.Tensor(-0.6901367537945142, shape=(), dtype=float64)
[[0.48954707 0.497489   0.00705564 0.0263024  0.01700587 0.03629056]]
Iteration 27
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.022669738401656>
Acquisition function convergence reached at iteration 5329.
tf.Tensor(-0.6679262932089496, shape=(), dtype=float64)
[[0.48958879 0.49758771 0.00717555 0.02624707 0.0143041  0.03725916]]
Iteration 28
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.037218513265478>
Acquisition function convergence reached at iteration 5780.
tf.Tensor(-0.6456365094150509, shape=(), dtype=float64)
[[0.48966631 0.49766557 0.00691815 0.02620737 0.01605087 0.03309891]]
Iteration 29
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.051240793035246>
Acquisition function convergence reached at iteration 7258.
tf.Tensor(-0.6356846126033271, shape=(), dtype=float64)
[[0.48971501 0.4977438  0.00573887 0.02617201 0.01859479 0.03230679]]
Iteration 30
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.064772398813395>
Acquisition function convergence reached at iteration 6756.
tf.Tensor(-0.6177173502536204, shape=(), dtype=float64)
```

```
[[0.48978473 0.49785306 0.00414217 0.02611913 0.02021635 0.03105485]]
Iteration 31
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.0778456496510085>
Acquisition function convergence reached at iteration 5556.
tf.Tensor(-0.5986437832370719, shape=(), dtype=float64)
[[0.48979026 0.4978645  0.00677176 0.02610032 0.01380776 0.03120888]]
Iteration 32
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.090489802496632>
Acquisition function convergence reached at iteration 5921.
tf.Tensor(-0.5864153685310032, shape=(), dtype=float64)
[[0.48984713 0.49800662 0.0044553  0.02603804 0.01691527 0.03310346]]
Iteration 33
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.102731425358965>
Acquisition function convergence reached at iteration 7067.
tf.Tensor(-0.5684504480241745, shape=(), dtype=float64)
[[0.48991772 0.49803739 0.00486943 0.02601917 0.01782774 0.02707479]]
Iteration 34
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.114594715468076>
Acquisition function convergence reached at iteration 7623.
tf.Tensor(-0.5611743929465134, shape=(), dtype=float64)
[[0.48992829 0.49805725 0.0054774  0.02600666 0.01644859 0.02715135]]
Iteration 35
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.126101771866315>
Acquisition function convergence reached at iteration 7523.
tf.Tensor(-0.5477490155285416, shape=(), dtype=float64)
[[0.48998105 0.49814319 0.00458087 0.02596587 0.01764576 0.02626916]]
Iteration 36
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.137272830028349>
Acquisition function convergence reached at iteration 7455.
tf.Tensor(-0.5312444760085857, shape=(), dtype=float64)
[[0.49019302 0.49820343 0.00638697 0.02592576 0.01372097 0.02927261]]
Iteration 37
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.148126464673201>
Acquisition function convergence reached at iteration 8364.
tf.Tensor(-0.5179210215634844, shape=(), dtype=float64)
[[0.49002817 0.49817146 0.00714186 0.02593279 0.00976918 0.02317652]]
Iteration 38
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.158679765796505>
Acquisition function convergence reached at iteration 7998.
tf.Tensor(-0.5049537431928264, shape=(), dtype=float64)
[[0.4900478  0.49819728 0.00814081 0.02590914 0.00539072 0.02289602]]
Iteration 39
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.168948492048927>
```

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Acquisition function convergence reached at iteration 6955.
tf.Tensor(-0.48744935062108374, shape=(), dtype=float64)
[[0.49008749 0.49841179 0.00642603 0.02581806 0.00706135 0.03008172]]
Iteration 40
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.178947204864643>
Acquisition function convergence reached at iteration 6944.
tf.Tensor(-0.4651795858009655, shape=(), dtype=float64)
[[0.48979412 0.49876296 0.00692053 0.02568833 0.02232585 0.02907931]]
Iteration 41
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.188689386162461>
Acquisition function convergence reached at iteration 5765.
tf.Tensor(-0.5018198720855156, shape=(), dtype=float64)
[[0.49333999 0.50398489 0.00921372 0.03561812 0.01455186 0.02158382]]
Iteration 42
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.198187541971514>
Acquisition function convergence reached at iteration 5464.
tf.Tensor(-0.4999820885788353, shape=(), dtype=float64)
[[0.49371504 0.50399262 0.00526904 0.03560351 0.01617337 0.02045869]]
Iteration 43
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.207453293950294>
Acquisition function convergence reached at iteration 6807.
tf.Tensor(-0.49303246413422275, shape=(), dtype=float64)
[[0.49370792 0.50395967 0.00960345 0.03558278 0.0135574  0.01767402]]
Iteration 44
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.216497460454292>
Acquisition function convergence reached at iteration 5894.
tf.Tensor(-0.488520307153981, shape=(), dtype=float64)
[[0.49371557 0.50396635 0.00922716 0.03556148 0.01378473 0.01779134]]
Iteration 45
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.225330128549692>
Acquisition function convergence reached at iteration 5928.
tf.Tensor(-0.4817332906633951, shape=(), dtype=float64)
[[0.49373988 0.50399024 0.00697483 0.0355242  0.01626856 0.0177377 ]]
Iteration 46
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.233960718157706>
Acquisition function convergence reached at iteration 5210.
tf.Tensor(-0.4749135114355867, shape=(), dtype=float64)
[[0.49374885 0.50400502 0.00618939 0.03549131 0.01617848 0.0190645 ]]
Iteration 47
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.242398039337328>
Acquisition function convergence reached at iteration 4970.
tf.Tensor(-0.4665541004482141, shape=(), dtype=float64)
[[0.49373318 0.50397452 0.00986866 0.03546427 0.01137441 0.0184632 ]]
```

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Iteration 48
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.2506503435671545>
Acquisition function convergence reached at iteration 5588.
tf.Tensor(-0.4506582226656177, shape=(), dtype=float64)
[[0.49377815 0.50403426 0.00566584 0.03537859 0.01555433 0.02072741]]
Iteration 49
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.2587253697637015>
Acquisition function convergence reached at iteration 5635.
tf.Tensor(-0.4441407436781948, shape=(), dtype=float64)
[[0.49377607 0.50402745 0.00729158 0.03535335 0.01376283 0.02090751]]
Iteration 50
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.2666303856701715>
Acquisition function convergence reached at iteration 5672.
tf.Tensor(-0.43475191472659525, shape=(), dtype=float64)
[[0.49379566 0.5040294  0.00765294 0.03531011 0.01500366 0.01874934]]
Trained parameters:
amplitude_champ:0 is 0.843

length_scales_champ:0 is [1.    1.    1.    0.197 1.    1.   ]

observation_noise_variance_champ:0 is 2.14

amp_f_mean:0 is 836.47

amp_gamma_L_mean:0 is 200.158

amp_lambda_mean:0 is 956.495

amp_r_mean:0 is 13.887

bias_mean:0 is 1.626

f_tp:0 is 0.011

gamma_L_tp:0 is -0.028

lambda_tp:0 is 0.041

r_tp:0 is 0.122

Iteration 51
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.274372225162466>
Acquisition function convergence reached at iteration 5330.
```

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tf.Tensor(-0.43016345168184555, shape=(), dtype=float64)
[[0.49328879 0.50458687 0.01158042 0.03527717 0.02027843 0.02397724]]
Iteration 52
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.28195732194542>
Acquisition function convergence reached at iteration 6954.
tf.Tensor(-0.4295379374525261, shape=(), dtype=float64)
[[0.49379935 0.50401276 0.00908728 0.03529041 0.01373094 0.01743217]]
Iteration 53
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.2893917400496235>
Acquisition function convergence reached at iteration 5144.
tf.Tensor(-0.4272411152932246, shape=(), dtype=float64)
[[0.4938039  0.50403564 0.00723141 0.03527548 0.01394933 0.02011181]]
Iteration 54
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.2966812014858595>
Acquisition function convergence reached at iteration 5272.
tf.Tensor(-0.4240025927743565, shape=(), dtype=float64)
[[0.49439813 0.50408008 0.00708377 0.03524572 0.02012481 0.02262444]]
Iteration 55
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.30383111136861>
Acquisition function convergence reached at iteration 6124.
tf.Tensor(-0.4226012384697566, shape=(), dtype=float64)
[[0.49381831 0.5040382  0.00682642 0.03525191 0.01585982 0.01776721]]
Iteration 56
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.310846580781045>
Acquisition function convergence reached at iteration 6538.
tf.Tensor(-0.4210257004127852, shape=(), dtype=float64)
[[0.49381041 0.50402871 0.00832768 0.03524892 0.01420045 0.01819307]]
Iteration 57
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.317732447620361>
Acquisition function convergence reached at iteration 6206.
tf.Tensor(-0.411832968399927, shape=(), dtype=float64)
[[0.49380843 0.50403305 0.00863073 0.03520798 0.01139196 0.02058081]]
Iteration 58
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.324493295633387>
Acquisition function convergence reached at iteration 6024.
tf.Tensor(-0.40518549195580744, shape=(), dtype=float64)
[[0.49383559 0.50404339 0.00785097 0.03517302 0.01471968 0.01757472]]
Iteration 59
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.331133471827423>
Acquisition function convergence reached at iteration 5163.
tf.Tensor(-0.4028945650802781, shape=(), dtype=float64)
[[0.49383993 0.50405142 0.00716506 0.03516068 0.01487412 0.01819443]]
Iteration 60
```

```
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.337657102419601>
Acquisition function convergence reached at iteration 4874.
tf.Tensor(-0.4004892412884511, shape=(), dtype=float64)
[[0.49382953 0.5040311  0.00897398 0.03515554 0.01223913 0.01784483]]
Iteration 61
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.344068107469253>
Acquisition function convergence reached at iteration 8747.
tf.Tensor(-0.8758611479601326, shape=(), dtype=float64)
[[0.50286958 0.51766193 0.00180136 0.04291076 0.00538615 0.11345999]]
Iteration 62
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.350370214321424>
Acquisition function convergence reached at iteration 7127.
tf.Tensor(-0.8346140018695349, shape=(), dtype=float64)
[[0.50458621 0.51735446 0.00319134 0.042449   0.10523827 0.00192034]]
Iteration 63
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.3565669699753355>
Acquisition function convergence reached at iteration 2478.
tf.Tensor(-0.7690176250662291, shape=(), dtype=float64)
[[0.50412979 0.51790176 0.04940569 0.04278543 0.06298315 0.06718771]]
Iteration 64
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.362661752479165>
Acquisition function convergence reached at iteration 8386.
tf.Tensor(-0.7860066068336475, shape=(), dtype=float64)
[[0.50454533 0.51733068 0.00074434 0.04249996 0.09707469 0.00330182]]
Iteration 65
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.3686577814414855>
Acquisition function convergence reached at iteration 8870.
tf.Tensor(-0.7752705575767678, shape=(), dtype=float64)
[[0.50261323 0.51655466 0.00178781 0.0423902  0.00170091 0.10787546]]
Iteration 66
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.374558127740141>
Acquisition function convergence reached at iteration 8608.
tf.Tensor(-0.7513928238103973, shape=(), dtype=float64)
[[0.50151142 0.51266599 0.09773086 0.04199497 0.00144412 0.00191355]]
Iteration 67
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.380365722500835>
tf.Tensor(-0.711957569559885, shape=(), dtype=float64)
[[0.50436465 0.51626471 0.00226668 0.04180031 0.09823516 0.00058456]]
Iteration 68
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.386083365410238>
Acquisition function convergence reached at iteration 9049.
tf.Tensor(-0.6912559253797759, shape=(), dtype=float64)
[[0.50144836 0.51223543 0.09265817 0.04178293 0.000618   0.00260962]]
```

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Iteration 69
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.3917137324218345>
Acquisition function convergence reached at iteration 9290.
tf.Tensor(-0.6681517479532726, shape=(), dtype=float64)
[[0.502167   0.51522294 0.00090061 0.04147736 0.0015503  0.10858766]]
Iteration 70
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.397259382906842>
Acquisition function convergence reached at iteration 8754.
tf.Tensor(-0.6242809339100039, shape=(), dtype=float64)
[[0.50137165 0.51187654 0.08552632 0.04154727 0.00076315 0.0015403 ]]
Iteration 71
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.4027227662974235>
Acquisition function convergence reached at iteration 8650.
tf.Tensor(-0.5933710456626116, shape=(), dtype=float64)
[[5.02254367e-01 5.15028930e-01 1.55750670e-03 4.14003943e-02
  4.14195275e-04 9.80941480e-02]]
Iteration 72
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.408106228264713>
Acquisition function convergence reached at iteration 7545.
tf.Tensor(-0.5906461102399998, shape=(), dtype=float64)
[[0.50367139 0.51398434 0.00079956 0.04026677 0.10693145 0.00119489]]
Iteration 73
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.413412016470165>
Acquisition function convergence reached at iteration 7279.
tf.Tensor(-0.5521275583988943, shape=(), dtype=float64)
[[0.50375259 0.51416427 0.0011945  0.0404703  0.09760611 0.0007323 ]]
Iteration 74
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.418642285925007>
Acquisition function convergence reached at iteration 8323.
tf.Tensor(-0.5350027420803714, shape=(), dtype=float64)
[[5.00561010e-01 5.09868672e-01 8.85627254e-02 4.06240292e-02
  1.37733821e-03 5.06844469e-04]]
Iteration 75
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.423799103989376>
Acquisition function convergence reached at iteration 8806.
tf.Tensor(-0.49849358989864867, shape=(), dtype=float64)
[[0.50369516 0.51389951 0.00112385 0.04030208 0.09229722 0.0006063 ]]
Iteration 76
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.4288844550397295>
tf.Tensor(-0.5154152275730532, shape=(), dtype=float64)
[[5.02523614e-01 5.14622780e-01 7.88309400e-04 4.24252895e-02
  3.35279313e-04 3.53727643e-04]]
Iteration 77
```

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<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.433900244830581>
Acquisition function convergence reached at iteration 8072.
tf.Tensor(-0.4721420547140529, shape=(), dtype=float64)
[[0.50028831 0.5117514  0.00116855 0.039696   0.00063703 0.11009746]]
Iteration 78
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.438848304574209>
Acquisition function convergence reached at iteration 8831.
tf.Tensor(-0.42950314012438473, shape=(), dtype=float64)
[[0.50297928 0.51225656 0.00079559 0.03953969 0.09474009 0.00092138]]
Iteration 79
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.443730394759891>
Acquisition function convergence reached at iteration 8410.
tf.Tensor(-0.4312541766637936, shape=(), dtype=float64)
[[0.49913171 0.50713531 0.09316408 0.03947288 0.00056935 0.00120076]]
Iteration 80
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.448548208732354>
Acquisition function convergence reached at iteration 8522.
tf.Tensor(-0.402206661752617, shape=(), dtype=float64)
[[0.49970245 0.50793254 0.08067217 0.03983181 0.0007632  0.00082984]]
Iteration 81
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.453303376047365>
Acquisition function convergence reached at iteration 4285.
tf.Tensor(40.80397138232611, shape=(), dtype=float64)
[[0.40220155 0.34589934 0.01532892 0.23440544 0.03237206 0.03716824]]
Iteration 82
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.457997465620906>
Acquisition function convergence reached at iteration 4974.
tf.Tensor(40.367864824680666, shape=(), dtype=float64)
[[0.40279402 0.34634706 0.01860156 0.23424024 0.0282826  0.03975704]]
Iteration 83
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.462631988686933>
Acquisition function convergence reached at iteration 6354.
tf.Tensor(41.57414495889308, shape=(), dtype=float64)
[[0.39577761 0.34120091 0.01723751 0.23620348 0.0284751  0.02906713]]
Iteration 84
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.467208401577502>
Acquisition function convergence reached at iteration 6234.
tf.Tensor(41.181665679810045, shape=(), dtype=float64)
[[0.39229525 0.33850248 0.01734338 0.23713563 0.02350194 0.03110805]]
Iteration 85
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.47172810833788>
Acquisition function convergence reached at iteration 6783.
tf.Tensor(42.17883979293243, shape=(), dtype=float64)
```

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[[0.43839562 0.37364658 0.02101894 0.2247197  0.02780088 0.02616135]]
Iteration 86
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.476192463188225>
Acquisition function convergence reached at iteration 4690.
tf.Tensor(40.306325904287526, shape=(), dtype=float64)
[[0.4546981  0.38607723 0.02105687 0.22033939 0.02992672 0.02984439]]
Iteration 87
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.480602772842515>
Acquisition function convergence reached at iteration 4690.
tf.Tensor(40.067661404167815, shape=(), dtype=float64)
[[0.45680181 0.38768954 0.01918634 0.21977547 0.03182475 0.03070146]]
Iteration 88
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.484960298694492>
Acquisition function convergence reached at iteration 5181.
tf.Tensor(38.784706954814325, shape=(), dtype=float64)
[[0.46507165 0.39402395 0.02235089 0.21755774 0.03324638 0.02972852]]
Iteration 89
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.489266258879688>
Acquisition function convergence reached at iteration 4672.
tf.Tensor(36.839579390059505, shape=(), dtype=float64)
[[0.47411314 0.40094974 0.02797525 0.21513332 0.03101596 0.02592556]]
Iteration 90
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.493521830221818>
Acquisition function convergence reached at iteration 3094.
tf.Tensor(34.27829137984866, shape=(), dtype=float64)
[[0.48289997 0.40768168 0.02839106 0.21277755 0.03144123 0.0278733 ]]
Iteration 91
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.497728150071243>
Acquisition function convergence reached at iteration 4194.
tf.Tensor(33.15159123850852, shape=(), dtype=float64)
[[0.48662014 0.41053309 0.02816573 0.21178051 0.03423353 0.02882965]]
Iteration 92
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.501886318042583>
Acquisition function convergence reached at iteration 4023.
tf.Tensor(31.661062282994646, shape=(), dtype=float64)
[[0.4910325  0.41391555 0.02437118 0.21059806 0.03916531 0.02610251]]
Iteration 93
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.505997397658032>
Acquisition function convergence reached at iteration 4579.
tf.Tensor(30.886591425314403, shape=(), dtype=float64)
[[0.49332866 0.41567627 0.02961923 0.20998284 0.03293004 0.03031965]]
Iteration 94
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.510062417902439>
```

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Acquisition function convergence reached at iteration 4455.
tf.Tensor(30.311679894971462, shape=(), dtype=float64)
[[0.49503291 0.41698333 0.02855735 0.20952627 0.03234267 0.03169631]]
Iteration 95
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.514082374695782>
Acquisition function convergence reached at iteration 4200.
tf.Tensor(29.43431909627018, shape=(), dtype=float64)
[[0.49753982 0.41890623 0.03147313 0.2088547  0.03214936 0.02959509]]
Iteration 96
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.518058232288199>
Acquisition function convergence reached at iteration 4034.
tf.Tensor(28.38612252916587, shape=(), dtype=float64)
[[0.50045112 0.42113973 0.03147572 0.20807488 0.03625139 0.02628946]]
Iteration 97
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.521990924582456>
Acquisition function convergence reached at iteration 2267.
tf.Tensor(28.041368647423784, shape=(), dtype=float64)
[[0.50146427 0.42191721 0.0298764  0.20780354 0.03421388 0.02971318]]
Iteration 98
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.52588135638827>
Acquisition function convergence reached at iteration 2749.
tf.Tensor(27.6695578213238, shape=(), dtype=float64)
[[0.50256369 0.42276102 0.03081783 0.20750912 0.03533187 0.02837152]]
Iteration 99
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.529730404612699>
Acquisition function convergence reached at iteration 3560.
tf.Tensor(27.183331179135752, shape=(), dtype=float64)
[[0.50400546 0.42386772 0.02836867 0.20712305 0.03694022 0.03035326]]
Iteration 100
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.533538919390422>
Acquisition function convergence reached at iteration 2991.
tf.Tensor(26.846312484494668, shape=(), dtype=float64)
[[0.50503369 0.42465713 0.02804704 0.20684774 0.03416518 0.03248565]]
Trained parameters:
amplitude_champ:0 is 2.617

length_scales_champ:0 is [1.    1.    1.    0.083 1.    1.   ]

observation_noise_variance_champ:0 is 3.105

amp_f_mean:0 is 173.04

amp_gamma_L_mean:0 is 29.405
```

```
amp_lambda_mean:0 is 1798.718

amp_r_mean:0 is 247.073

bias_mean:0 is 8.604

f_tp:0 is 0.037

gamma_L_tp:0 is -0.09

lambda_tp:0 is 0.04

r_tp:0 is 0.028

Iteration 101
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.537307725157537>
Acquisition function convergence reached at iteration 5809.
tf.Tensor(33.23174155345212, shape=(), dtype=float64)
[[0.99990326 0.9998983  0.02121194 0.57235914 0.0244086  0.0483191 ]]
Iteration 102
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.54103762167221>
Acquisition function convergence reached at iteration 3756.
tf.Tensor(12.274786971129457, shape=(), dtype=float64)
[[0.99881604 0.99842447 0.02678886 0.57236378 0.02743963 0.04626293]]
Iteration 103
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.544729384985289>
Acquisition function convergence reached at iteration 5631.
tf.Tensor(7.639168301451321, shape=(), dtype=float64)
[[0.99400363 0.99606716 0.03824614 0.57238631 0.03334205 0.03740308]]
Iteration 104
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.548383768363815>
Acquisition function convergence reached at iteration 4883.
tf.Tensor(6.723426059779505, shape=(), dtype=float64)
[[0.99210532 0.99353362 0.06172319 0.58174592 0.05420627 0.07342838]]
Iteration 105
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.552001503170111>
Acquisition function convergence reached at iteration 5909.
tf.Tensor(5.893941434439597, shape=(), dtype=float64)
[[0.98491376 0.84507354 0.03011988 0.5827134  0.03103546 0.03684194]]
Iteration 106
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.555583299699012>
Acquisition function convergence reached at iteration 3406.
```

```
tf.Tensor(5.8955246908760195, shape=(), dtype=float64)
[[0.97821077 0.99823296 0.10357231 0.56298653 0.12094487 0.12251314]]
Iteration 107
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.55912984797558>
Acquisition function convergence reached at iteration 5349.
tf.Tensor(5.083211515806967, shape=(), dtype=float64)
[[0.99492049 0.99936129 0.17484269 0.56092562 0.07224595 0.15445998]]
Iteration 108
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.562641818515527>
Acquisition function convergence reached at iteration 3716.
tf.Tensor(3.7344706009747775, shape=(), dtype=float64)
[[0.99799781 0.99955957 0.23318276 0.55829893 0.05106063 0.1800116 ]]
Iteration 109
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.56611986305041>
Acquisition function convergence reached at iteration 3093.
tf.Tensor(3.898618017460385, shape=(), dtype=float64)
[[0.997793   0.99964221 0.04116356 0.5591864  0.2067588  0.20748404]]
Iteration 110
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.569564615219545>
Acquisition function convergence reached at iteration 3644.
tf.Tensor(3.665358540678806, shape=(), dtype=float64)
[[0.7733671  0.99778025 0.11245953 0.55995709 0.09020602 0.13729297]]
Iteration 111
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.57297669123043>
Acquisition function convergence reached at iteration 5313.
tf.Tensor(5.736521065634003, shape=(), dtype=float64)
[[0.99987285 0.99959034 0.13740703 0.59348245 0.12464531 0.15330491]]
Iteration 112
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.576356690489405>
Acquisition function convergence reached at iteration 6636.
tf.Tensor(6.893045237500304, shape=(), dtype=float64)
[[9.99988056e-01 7.96017177e-01 1.40984883e-03 5.59029694e-01
  2.60861379e-03 7.12933938e-04]]
Iteration 113
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.579705196204123>
Acquisition function convergence reached at iteration 5419.
tf.Tensor(7.84815460097341, shape=(), dtype=float64)
[[0.99991676 0.99968534 0.00611192 0.56298115 0.21402899 0.00144548]]
Iteration 114
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.583022775959332>
Acquisition function convergence reached at iteration 7606.
tf.Tensor(7.966290350862701, shape=(), dtype=float64)
[[9.99990623e-01 9.99973042e-01 5.07385004e-04 5.65337443e-01
```

```
  2.34795886e-04 2.52201257e-01]]
Iteration 115
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.586309982267376>
Acquisition function convergence reached at iteration 6566.
tf.Tensor(6.363287576458986, shape=(), dtype=float64)
[[9.99980750e-01 9.99979236e-01 7.91691503e-04 5.64985303e-01
  1.60524336e-03 3.48591532e-01]]
Iteration 116
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.5895673530947265>
Acquisition function convergence reached at iteration 4222.
tf.Tensor(4.943634353887158, shape=(), dtype=float64)
[[0.99981355 0.99932375 0.00330942 0.56455036 0.00830069 0.41872414]]
Iteration 117
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.5927954123657875>
Acquisition function convergence reached at iteration 6438.
tf.Tensor(3.5859549926098984, shape=(), dtype=float64)
[[9.99961051e-01 9.99809134e-01 6.93239771e-04 5.64613711e-01
  1.62732668e-03 4.71191285e-01]]
Iteration 118
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.595994670445141>
Acquisition function convergence reached at iteration 6553.
tf.Tensor(2.696261397960142, shape=(), dtype=float64)
[[9.99956899e-01 9.99630790e-01 6.92547510e-04 5.64347924e-01
  1.46611980e-03 5.07125764e-01]]
Iteration 119
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.599165624599316>
Acquisition function convergence reached at iteration 6615.
tf.Tensor(2.0747067337316967, shape=(), dtype=float64)
[[0.99996211 0.99937876 0.00115905 0.56433518 0.00146765 0.53316973]]
Iteration 120
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.602308759439137>
Acquisition function convergence reached at iteration 7841.
tf.Tensor(1.6007753477238644, shape=(), dtype=float64)
[[9.99991237e-01 9.22939013e-01 8.51399527e-04 5.64667579e-01
  2.89087622e-04 5.48962466e-01]]
Iteration 121
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.6054245473435955>
Acquisition function convergence reached at iteration 6919.
tf.Tensor(-105.5669213441509, shape=(), dtype=float64)
[[9.99979742e-01 6.89441150e-05 2.33299247e-02 1.01524606e+00
  1.46812892e-02 2.32278492e-02]]
Iteration 122
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.608513448866177>
```

```
Acquisition function convergence reached at iteration 1954.
tf.Tensor(-108.74029434220871, shape=(), dtype=float64)
[[0.00479511 0.98763826 0.12435565 1.11621755 0.14607093 0.0984982 ]]
Iteration 123
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.611575913124513>
Acquisition function convergence reached at iteration 3138.
tf.Tensor(-104.19586698064496, shape=(), dtype=float64)
[[9.98917727e-01 1.19277697e-03 5.23982104e-02 1.59357149e+00
  4.50497974e-02 7.03023894e-02]]
Iteration 124
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.61461237817414>
Acquisition function convergence reached at iteration 1623.
tf.Tensor(-108.45588410230081, shape=(), dtype=float64)
[[0.9974328  0.99575474 0.53566123 1.50225073 0.41781298 0.17874761]]
Iteration 125
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.617623271367179>
Acquisition function convergence reached at iteration 3754.
tf.Tensor(-110.87117041271442, shape=(), dtype=float64)
[[5.38847066e-04 9.99022719e-01 2.01712857e-01 1.64357859e+00
  1.58503122e-01 4.67765027e-02]]
Iteration 126
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.620609009696617>
Acquisition function convergence reached at iteration 2200.
tf.Tensor(-113.19725985744847, shape=(), dtype=float64)
[[9.99115075e-01 1.06425273e-03 2.71174355e-02 1.45373151e+00
  2.90481971e-02 5.75926137e-01]]
Iteration 127
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.623570000126906>
Acquisition function convergence reached at iteration 2676.
tf.Tensor(-112.17377184550003, shape=(), dtype=float64)
[[9.98948860e-01 1.18173879e-03 1.22371744e+00 1.47542520e+00
  1.82621229e-03 3.14402699e-03]]
Iteration 128
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.626506639911517>
Acquisition function convergence reached at iteration 3140.
tf.Tensor(-112.77597404436516, shape=(), dtype=float64)
[[9.99156001e-01 9.46828779e-04 4.60458554e-03 1.48699536e+00
  1.24630392e+00 5.01706334e-03]]
Iteration 129
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.629419316898047>
Acquisition function convergence reached at iteration 3852.
tf.Tensor(-112.77996621462074, shape=(), dtype=float64)
[[9.99581483e-01 8.07884076e-04 1.29201621e-02 8.67733401e-01
```

```
  5.85762144e-03 9.38463023e-03]]
Iteration 130
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.632308409821486>
Acquisition function convergence reached at iteration 4297.
tf.Tensor(-102.96535303216368, shape=(), dtype=float64)
[[9.99448102e-01 5.72094791e-04 3.54668222e-02 2.05517525e+00
  4.97990825e-02 4.13002685e-02]]
Iteration 131
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.635174288586164>
Acquisition function convergence reached at iteration 2968.
tf.Tensor(-110.31405287516694, shape=(), dtype=float64)
[[9.99155196e-01 1.07001961e-03 3.21713353e-01 1.53729813e+00
  5.22717007e-01 1.46060610e+00]]
Iteration 132
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.638017314536911>
Acquisition function convergence reached at iteration 4083.
tf.Tensor(-108.16315761508407, shape=(), dtype=float64)
[[9.99708936e-01 5.64251825e-04 1.34670146e+00 9.17409426e-01
  1.24894785e-02 5.80621025e-03]]
Iteration 133
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.64083784071992>
Acquisition function convergence reached at iteration 1864.
tf.Tensor(-110.85848596103367, shape=(), dtype=float64)
[[0.99683115 0.80918578 0.29633131 1.4235582  0.81645348 1.51047566]]
Iteration 134
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.643636212133774>
Acquisition function convergence reached at iteration 3359.
tf.Tensor(-109.56645763008848, shape=(), dtype=float64)
[[9.99647401e-01 6.95048694e-04 3.52448693e-01 9.17145970e-01
  2.12018583e-02 1.37840602e+00]]
Iteration 135
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.646412765971077>
Acquisition function convergence reached at iteration 2868.
tf.Tensor(-103.62484617240075, shape=(), dtype=float64)
[[0.99931971 0.99908047 1.14153575 1.98906775 0.07051141 0.3097214 ]]
Iteration 136
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.649167831851116>
Acquisition function convergence reached at iteration 1924.
tf.Tensor(-111.15343863301403, shape=(), dtype=float64)
[[0.99699009 0.00367621 1.14767048 1.4540745  1.22651448 1.19651477]]
Iteration 137
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.6519017320439335>
Acquisition function convergence reached at iteration 3992.
```

```
tf.Tensor(-105.3054481097095, shape=(), dtype=float64)
[[1.66894285e-03 9.63410259e-01 3.88333076e-02 2.17968570e+00
  6.10910988e-02 3.52470250e-02]]
Iteration 138
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.654614781686203>
Acquisition function convergence reached at iteration 1782.
tf.Tensor(-104.79352838396565, shape=(), dtype=float64)
[[0.99792321 0.0039036  0.02145205 1.90941654 0.85842936 0.0475138 ]]
Iteration 139
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.657307288989263>
Acquisition function convergence reached at iteration 4405.
tf.Tensor(-104.30262819947012, shape=(), dtype=float64)
[[9.99788260e-01 4.67319176e-04 9.03256229e-03 1.95206155e+00
  7.20244512e-03 1.48714783e+00]]
Iteration 140
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.659979555439634>
Acquisition function convergence reached at iteration 3221.
tf.Tensor(-101.1464799151214, shape=(), dtype=float64)
[[9.98725592e-01 1.27229208e-03 7.54087018e-02 2.58575695e+00
  5.04626757e-02 6.60500219e-02]]
Iteration 141
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.662631875992352>
Acquisition function convergence reached at iteration 3090.
tf.Tensor(-31.751543603166716, shape=(), dtype=float64)
[[0.98840631 0.0148364  0.13351819 0.9232785  0.07494978 0.47253095]]
Iteration 142
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.665264539257432>
Acquisition function convergence reached at iteration 2336.
tf.Tensor(-37.24747162477059, shape=(), dtype=float64)
[[0.99191677 0.32377439 0.23173178 1.47987287 0.52688849 1.22684482]]
Iteration 143
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.667877827679738>
Acquisition function convergence reached at iteration 949.
tf.Tensor(-32.7321209718892, shape=(), dtype=float64)
[[0.94090196 0.61534692 0.33693316 1.44337167 0.67640631 0.68562966]]
Iteration 144
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.670472017712535>
Acquisition function convergence reached at iteration 4941.
tf.Tensor(-2.8726735195983863, shape=(), dtype=float64)
[[9.99358570e-01 6.05806058e-04 2.70413016e-02 2.34724313e+00
  3.64737382e-02 3.97860374e-02]]
Iteration 145
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.673047379985005>
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Acquisition function convergence reached at iteration 3390.
tf.Tensor(-25.36782703190197, shape=(), dtype=float64)
[[9.76272962e-01 1.78018311e-03 2.16818391e-02 1.96144779e+00
  8.58485035e-02 7.26651793e-01]]
Iteration 146
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.675604179463964>
Acquisition function convergence reached at iteration 3370.
tf.Tensor(-30.725535288544464, shape=(), dtype=float64)
[[0.97556115 0.44287747 0.50549858 0.89666083 0.08464797 0.76841812]]
Iteration 147
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.678142675610011>
Acquisition function convergence reached at iteration 2490.
tf.Tensor(-8.054360112318001, shape=(), dtype=float64)
[[0.89274805 0.97036914 0.06501853 2.3762379  0.14751524 0.0677955 ]]
Iteration 148
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.680663122528358>
Acquisition function convergence reached at iteration 2420.
tf.Tensor(-26.694195901359855, shape=(), dtype=float64)
[[0.76427333 0.01597801 0.11552772 1.93636095 0.04489093 1.01669386]]
Iteration 149
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.68316576911454>
Acquisition function convergence reached at iteration 4064.
tf.Tensor(-35.14807898007175, shape=(), dtype=float64)
[[0.99800337 0.00375261 0.06361243 1.52768054 0.17028154 0.62276571]]
Iteration 150
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.685650859195212>
Acquisition function convergence reached at iteration 2962.
tf.Tensor(-29.201922698194515, shape=(), dtype=float64)
[[0.99670757 0.00343702 0.28089426 1.43959846 0.30159034 1.54638661]]
Trained parameters:
amplitude_champ:0 is 8.742

length_scales_champ:0 is [0.435 1.    0.999 0.042 1.    1.   ]

observation_noise_variance_champ:0 is 2.985

amp_f_mean:0 is 1.845

amp_gamma_L_mean:0 is 0.548

amp_lambda_mean:0 is 0.126

amp_r_mean:0 is 1.215
```

```
bias_mean:0 is 9.329

f_tp:0 is 1.471

gamma_L_tp:0 is -3.678

lambda_tp:0 is 4.902

r_tp:0 is 6.508

Iteration 151
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.6881186316642465>
Acquisition function convergence reached at iteration 4871.
tf.Tensor(-5.98268644979494, shape=(), dtype=float64)
[[0.51337    0.02008015 0.07470543 2.61335281 0.04203226 0.04687811]]
Iteration 152
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.690569320614295>
Acquisition function convergence reached at iteration 1921.
tf.Tensor(-32.00620850771535, shape=(), dtype=float64)
[[0.99806232 0.00996057 0.04043283 1.98779005 0.08447072 1.28080677]]
Iteration 153
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.693003155464011>
Acquisition function convergence reached at iteration 1563.
tf.Tensor(-11.10687805093319, shape=(), dtype=float64)
[[0.99880545 0.00483132 0.07838601 2.54630028 0.08510428 0.114892  ]]
Iteration 154
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.695420361081094>
Acquisition function convergence reached at iteration 2659.
tf.Tensor(-28.57818555401898, shape=(), dtype=float64)
[[0.99860191 0.00648113 0.01289989 1.96991037 0.70161466 1.19195686]]
Iteration 155
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.697821157901332>
Acquisition function convergence reached at iteration 1459.
tf.Tensor(-29.329004204523585, shape=(), dtype=float64)
[[0.93697218 0.01725473 0.7532272  1.51644439 0.74948024 0.93289714]]
Iteration 156
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.700205762043774>
Acquisition function convergence reached at iteration 3011.
tf.Tensor(-29.220666528063944, shape=(), dtype=float64)
[[0.99804281 0.68600589 0.04318416 1.4547155  0.01523372 1.53436847]]
Iteration 157
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.702574385422208>
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Acquisition function convergence reached at iteration 2845.
tf.Tensor(-25.722257991981287, shape=(), dtype=float64)
[[0.99938421 0.00197861 0.57234757 1.97054107 0.20630426 1.27514318]]
Iteration 158
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.704927235853064>
Acquisition function convergence reached at iteration 4417.
tf.Tensor(-29.078701045788485, shape=(), dtype=float64)
[[0.99867277 0.38170971 0.00630899 1.45300288 0.83130944 1.8491745 ]]
Iteration 159
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.7072645171598975>
Acquisition function convergence reached at iteration 2381.
tf.Tensor(-5.619653870708163, shape=(), dtype=float64)
[[0.99917802 0.00336493 0.98157474 2.55653653 0.07180985 0.05395831]]
Iteration 160
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.709586429274562>
Acquisition function convergence reached at iteration 2582.
tf.Tensor(-26.8022958902541, shape=(), dtype=float64)
[[0.99897618 0.00250199 0.00702452 1.9940579  0.44618519 0.47427647]]
Iteration 161
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.7118931683352185>
Acquisition function convergence reached at iteration 1495.
tf.Tensor(-32.43652336429359, shape=(), dtype=float64)
[[0.99195326 0.00653921 0.17538531 1.66925107 0.14698185 0.18602717]]
Iteration 162
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.714184926781274>
Acquisition function convergence reached at iteration 8270.
tf.Tensor(-30.509183170981082, shape=(), dtype=float64)
[[0.98435293 0.02746499 0.035376   2.20281111 0.02683991 0.03455052]]
Iteration 163
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.716461893445391>
Acquisition function convergence reached at iteration 4435.
tf.Tensor(-34.00429537179794, shape=(), dtype=float64)
[[0.99809499 0.00155985 0.03699488 1.14266187 0.03687808 0.0471374 ]]
Iteration 164
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.718724253642648>
Acquisition function convergence reached at iteration 1422.
tf.Tensor(-30.715552367931807, shape=(), dtype=float64)
[[0.93051102 0.27115108 0.27948171 2.13476634 0.20898957 0.21379027]]
Iteration 165
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.7209721892569805>
Acquisition function convergence reached at iteration 6054.
tf.Tensor(-29.68247854865318, shape=(), dtype=float64)
[[0.02172796 0.01365099 0.02688157 2.40444574 0.02874594 0.03584855]]
```

```
Iteration 166
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.723205878824984>
Acquisition function convergence reached at iteration 6446.
tf.Tensor(-39.276608112646876, shape=(), dtype=float64)
[[0.52214656 0.69567085 0.04170695 1.66934639 0.02280482 0.024002  ]]
Iteration 167
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.725425497617184>
Acquisition function convergence reached at iteration 4945.
tf.Tensor(-34.90807676130316, shape=(), dtype=float64)
[[0.48996007 0.35791052 0.02952132 0.69544657 0.06193481 0.04173232]]
Iteration 168
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.7276312177168585>
tf.Tensor(-56.993773681879574, shape=(), dtype=float64)
[[0.99943381 0.42210923 0.44985668 1.4510411  0.29231779 1.20418944]]
Iteration 169
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.729823208096508>
Acquisition function convergence reached at iteration 3659.
tf.Tensor(-32.646620319651774, shape=(), dtype=float64)
[[0.99438108 0.00640233 0.04747763 1.69346267 0.06232105 0.07364009]]
Iteration 170
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.732001634692044>
Acquisition function convergence reached at iteration 389.
tf.Tensor(-37.77978368096803, shape=(), dtype=float64)
[[0.90236029 0.2705194  0.56091541 1.13813207 0.50877263 0.46456043]]
Iteration 171
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.7341666604748>
Acquisition function convergence reached at iteration 1601.
tf.Tensor(-40.19584866288276, shape=(), dtype=float64)
[[0.65039308 0.43234129 0.19430094 1.0193227  0.14086119 0.10159237]]
Iteration 172
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.736318445521407>
Acquisition function convergence reached at iteration 6802.
tf.Tensor(-29.7666327582031, shape=(), dtype=float64)
[[0.99091112 0.97149782 0.0259159  2.42753233 0.04035532 0.02542237]]
Iteration 173
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.738457147081645>
Acquisition function convergence reached at iteration 7644.
tf.Tensor(-28.74029713124782, shape=(), dtype=float64)
[[0.92640186 0.88054835 0.02508356 2.63885747 0.03244484 0.02070067]]
Iteration 174
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.740582919644311>
Acquisition function convergence reached at iteration 1698.
tf.Tensor(-30.717226829421342, shape=(), dtype=float64)
```

```
[[0.03248619 0.983782   0.14386087 2.22059274 0.16241703 0.09604628]]
Iteration 175
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.742695915001196>
Acquisition function convergence reached at iteration 5488.
tf.Tensor(-30.014352303702147, shape=(), dtype=float64)
[[0.01398684 0.01777231 0.02685477 2.43023224 0.04263941 0.04582409]]
Iteration 176
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.744796282309214>
Acquisition function convergence reached at iteration 6326.
tf.Tensor(-37.987389270983584, shape=(), dtype=float64)
[[0.98478985 0.01674491 0.04261619 1.6992332  0.04328623 0.14550452]]
Iteration 177
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.7468841681507685>
tf.Tensor(-42.696762433471406, shape=(), dtype=float64)
[[0.58409739 0.6707479  0.01487517 1.69750142 0.02226919 0.01717756]]
Iteration 178
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.74895971659239>
Acquisition function convergence reached at iteration 3137.
tf.Tensor(-46.07915718891502, shape=(), dtype=float64)
[[0.92700946 0.64355442 0.1343259  1.42686375 0.41002003 0.86018419]]
Iteration 179
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.751023069241736>
Acquisition function convergence reached at iteration 7363.
tf.Tensor(-29.618301670843188, shape=(), dtype=float64)
[[0.99892494 0.01812455 0.01080893 2.19112987 0.0220696  0.02635204]]
Iteration 180
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.753074365302975>
Acquisition function convergence reached at iteration 4447.
tf.Tensor(-34.66847984241369, shape=(), dtype=float64)
[[0.98671319 0.0169254  0.03557465 1.04864983 0.03513331 0.03894107]]
Iteration 181
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.755113741630635>
Acquisition function convergence reached at iteration 2144.
tf.Tensor(-33.69038737955527, shape=(), dtype=float64)
[[0.99588965 0.00370175 0.12799065 2.24283225 0.10670601 0.11625217]]
Iteration 182
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.757141332781945>
Acquisition function convergence reached at iteration 1578.
tf.Tensor(-32.850706852853364, shape=(), dtype=float64)
[[0.99370483 0.96823685 0.16136626 2.4396001  0.17734956 0.15690986]]
Iteration 183
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.759157271067746>
tf.Tensor(-38.208647902630744, shape=(), dtype=float64)
```

```
[[0.99936202 0.99913943 0.01444407 2.23852739 0.01785105 0.0119478 ]]
Iteration 184
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.761161686601991>
tf.Tensor(-38.32259480020819, shape=(), dtype=float64)
[[7.39231817e-01 2.71643930e-04 1.42065341e-02 2.24646198e+00
  2.34457631e-02 2.29209517e-02]]
Iteration 185
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.763154707349896>
Acquisition function convergence reached at iteration 5442.
tf.Tensor(-31.792198302057344, shape=(), dtype=float64)
[[2.53866841e-03 2.79439410e-03 2.95456597e-02 2.66373538e+00
  3.46347577e-02 4.36479460e-02]]
Iteration 186
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.765136459174788>
tf.Tensor(-56.70152304061581, shape=(), dtype=float64)
[[0.99635698 0.00546766 0.13178546 1.53426633 0.22833525 0.65241693]]
Iteration 187
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.767107065883678>
tf.Tensor(-54.860155055303785, shape=(), dtype=float64)
[[0.9974404  0.00378024 0.30596507 1.53124298 0.52294602 1.52854223]]
Iteration 188
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.7690666492716165>
Acquisition function convergence reached at iteration 1012.
tf.Tensor(-35.02347216249529, shape=(), dtype=float64)
[[0.77296941 0.80712288 0.14222674 2.58173666 0.25581088 0.15924538]]
Iteration 189
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.771015329164857>
Acquisition function convergence reached at iteration 2048.
tf.Tensor(-33.7650891933238, shape=(), dtype=float64)
[[2.08884116e-03 9.86806125e-01 9.46816875e-02 2.27015900e+00
  1.55011021e-01 1.40030785e-01]]
Iteration 190
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.772953223462879>
tf.Tensor(-40.163727093461354, shape=(), dtype=float64)
[[0.99976115 0.00255951 0.00888833 2.1852457  0.01664012 0.01812198]]
Iteration 191
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.774880448179286>
tf.Tensor(-57.965385573481974, shape=(), dtype=float64)
[[9.54141991e-01 3.24820402e-01 5.09818251e-04 9.17738088e-01
  2.49771477e-02 3.77143166e-01]]
Iteration 192
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.7767971174816415>
Acquisition function convergence reached at iteration 3210.
```

```
tf.Tensor(-37.23633160568121, shape=(), dtype=float64)
[[0.82120048 0.36814718 0.0509954  1.31693252 0.0615842  0.06439887]]
Iteration 193
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.7787033437302515>
tf.Tensor(-37.48813504829931, shape=(), dtype=float64)
[[0.72995289 0.00791757 0.0091     1.22742575 0.00992853 0.01141701]]
Iteration 194
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.780599237515943>
tf.Tensor(-56.33462453894241, shape=(), dtype=float64)
[[0.9995045  0.01129945 0.02178243 1.95502376 0.14181922 0.64514166]]
Iteration 195
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.782484907696857>
tf.Tensor(-31.924105098173676, shape=(), dtype=float64)
[[0.72625069 0.6621674  0.01194915 2.68732359 0.0171936  0.0172514 ]]
Iteration 196
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.784360461434298>
tf.Tensor(-44.721913573683054, shape=(), dtype=float64)
[[9.99974208e-01 3.01502302e-05 5.06511603e-04 1.14871509e+00
  9.35475022e-04 3.24019082e-04]]
Iteration 197
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.786226004227662>
Acquisition function convergence reached at iteration 1954.
tf.Tensor(-58.25317684979851, shape=(), dtype=float64)
[[0.90245735 0.39132493 0.05567472 1.45617283 0.78749633 1.01768796]]
Iteration 198
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.78808163994847>
Acquisition function convergence reached at iteration 618.
tf.Tensor(-41.88235890793673, shape=(), dtype=float64)
[[0.67965471 0.03455196 0.15907295 1.05106957 0.20959953 0.25178434]]
Iteration 199
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.789927470873547>
Acquisition function convergence reached at iteration 6108.
tf.Tensor(-31.880318197867304, shape=(), dtype=float64)
[[0.00715727 0.98778674 0.0325842  2.71366972 0.02740484 0.03994389]]
Iteration 200
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.791763597717344>
tf.Tensor(-35.280134108873206, shape=(), dtype=float64)
[[0.99825347 0.99753137 0.01634884 2.4485053  0.01311973 0.0166131 ]]
Trained parameters:
amplitude_champ:0 is 14.337

length_scales_champ:0 is [0.109 1.    1.    0.006 1.    1.   ]
```

```
observation_noise_variance_champ:0 is 2.101

amp_f_mean:0 is 4.797

amp_gamma_L_mean:0 is 0.078

amp_lambda_mean:0 is 61.821

amp_r_mean:0 is 2.065

bias_mean:0 is 15.712

f_tp:0 is 1.918

gamma_L_tp:0 is 0.365

lambda_tp:0 is 0.956

r_tp:0 is 4.81

Iteration 201
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.793590119663467>
Acquisition function convergence reached at iteration 3268.
tf.Tensor(-46.286376267470175, shape=(), dtype=float64)
[[0.9995496  0.99868104 0.09637824 1.08550848 0.05228387 0.04348391]]
Iteration 202
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.795407134395407>
Acquisition function convergence reached at iteration 3294.
tf.Tensor(-39.996562848451056, shape=(), dtype=float64)
[[0.46812474 0.00366279 0.04176388 2.65709771 0.05155632 0.0407138 ]]
Iteration 203
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.7972147381265025>
tf.Tensor(-50.670187594476566, shape=(), dtype=float64)
[[9.99966036e-01 7.19040831e-05 5.60200653e-03 1.69871883e+00
  1.23554084e+00 8.99048254e-04]]
Iteration 204
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.7990130256291685>
Acquisition function convergence reached at iteration 4332.
tf.Tensor(-44.14801131484814, shape=(), dtype=float64)
[[0.81169292 0.99241905 0.0489848  2.44255027 0.0508504  0.04180972]]
Iteration 205
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.800802090263395>
Acquisition function convergence reached at iteration 353.
```

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tf.Tensor(-61.50393494120688, shape=(), dtype=float64)
[[0.89342051 0.21491196 0.4656433  1.53304784 0.43848553 1.09155356]]
Iteration 206
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.802582024004555>
Acquisition function convergence reached at iteration 3496.
tf.Tensor(-42.49665950342457, shape=(), dtype=float64)
[[0.99765137 0.99625892 0.04148067 2.27757464 0.03879458 0.08538166]]
Iteration 207
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.804352917470525>
tf.Tensor(-41.65138840109155, shape=(), dtype=float64)
[[6.84800623e-04 9.99944696e-01 1.54334330e-02 2.46666425e+00
  1.46010712e-02 2.05208284e-02]]
Iteration 208
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.806114859948156>
Acquisition function convergence reached at iteration 3449.
tf.Tensor(-53.3625238707071, shape=(), dtype=float64)
[[0.880678   0.33204368 0.07580844 1.59022259 0.06246119 0.05716194]]
Iteration 209
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.807867939419095>
Acquisition function convergence reached at iteration 2302.
tf.Tensor(-52.397201572814986, shape=(), dtype=float64)
[[0.86472263 0.98508799 0.12351524 1.08898309 0.12059592 0.11787336]]
Iteration 210
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.809612242584991>
tf.Tensor(-41.64755066484386, shape=(), dtype=float64)
[[6.42237579e-01 3.71596488e-05 9.19223000e-03 2.48274913e+00
  1.55041477e-02 1.69927044e-02]]
Iteration 211
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.811347854892093>
tf.Tensor(-64.32686075757806, shape=(), dtype=float64)
[[0.99994433 0.01703591 0.02340475 1.95958308 0.68446828 1.54081291]]
Iteration 212
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.813074860555267>
Acquisition function convergence reached at iteration 5779.
tf.Tensor(-67.23353656922939, shape=(), dtype=float64)
[[0.99926046 0.43663179 0.25008667 1.4321937  0.54450611 1.30550997]]
Iteration 213
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.8147933425814395>
Acquisition function convergence reached at iteration 1687.
tf.Tensor(-41.55512396390563, shape=(), dtype=float64)
[[0.01710532 0.96669804 0.169758   2.5005374  0.1844057  0.14215529]]
Iteration 214
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.816503382792484>
```

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tf.Tensor(-50.77976244293866, shape=(), dtype=float64)
[[9.99880346e-01 2.37531669e-04 8.94955411e-03 1.66047993e+00
  1.69214326e-02 2.06766684e-02]]
Iteration 215
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.818205061847574>
tf.Tensor(-48.20306349221406, shape=(), dtype=float64)
[[9.99955879e-01 6.99016483e-05 4.71929994e-03 1.15953356e+00
  8.49177503e-03 1.29273592e-02]]
Iteration 216
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.819898459265017>
Acquisition function convergence reached at iteration 5077.
tf.Tensor(-40.5612886587431, shape=(), dtype=float64)
[[9.99591787e-01 1.26435285e-03 2.50799028e-02 2.72203204e+00
  4.64652659e-02 4.54950197e-02]]
Iteration 217
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.821583653443568>
Acquisition function convergence reached at iteration 2481.
tf.Tensor(-45.00936586996885, shape=(), dtype=float64)
[[5.13375887e-04 5.82590554e-04 6.99902835e-02 1.68610188e+00
  5.19617024e-02 6.20741959e-02]]
Iteration 218
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.82326072168326>
Acquisition function convergence reached at iteration 2291.
tf.Tensor(-46.552535878426426, shape=(), dtype=float64)
[[0.14228236 0.94330206 0.11168103 1.15530562 0.06602258 0.0891751 ]]
Iteration 219
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.824929740205746>
Acquisition function convergence reached at iteration 3547.
tf.Tensor(-44.99655999658409, shape=(), dtype=float64)
[[0.00676061 0.99825706 0.03638308 1.72442192 0.0412988  0.04770286]]
Iteration 220
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.826590784174178>
tf.Tensor(-64.41794475158413, shape=(), dtype=float64)
[[0.99976987 0.86147327 0.00318034 1.95810907 0.00360197 1.28578669]]
Iteration 221
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.828243927712633>
Acquisition function convergence reached at iteration 3472.
tf.Tensor(-67.44597474701723, shape=(), dtype=float64)
[[0.31945877 0.9628762  0.07337255 0.05373968 0.07252109 0.03409493]]
Iteration 222
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.829889243925091>
Acquisition function convergence reached at iteration 5073.
tf.Tensor(-44.123959507249864, shape=(), dtype=float64)
```

```
[[0.57385336 0.99941675 0.02982799 2.26671522 0.0345988  0.02901837]]
Iteration 223
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.831526804913983>
Acquisition function convergence reached at iteration 5479.
tf.Tensor(-46.70636651797527, shape=(), dtype=float64)
[[0.76008618 0.9996186  0.01699969 1.69388479 0.04340516 0.0181113 ]]
Iteration 224
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.83315668179833>
Acquisition function convergence reached at iteration 4629.
tf.Tensor(-46.81764566135709, shape=(), dtype=float64)
[[0.66751726 0.99972338 0.02837321 1.71821878 0.02565916 0.02630634]]
Iteration 225
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.834778944731459>
Acquisition function convergence reached at iteration 2494.
tf.Tensor(-37.76626738596234, shape=(), dtype=float64)
[[0.70901973 0.99896843 0.03145282 1.43190818 2.48592659 0.07744131]]
Iteration 226
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.836393662918343>
Acquisition function convergence reached at iteration 4957.
tf.Tensor(-39.975696293596314, shape=(), dtype=float64)
[[0.68390283 0.99957868 0.07343714 2.216679   0.06554941 1.11168775]]
Iteration 227
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.838000904632527>
Acquisition function convergence reached at iteration 3126.
tf.Tensor(-65.60181029138218, shape=(), dtype=float64)
[[0.54293812 0.14359325 0.11803413 0.05041956 0.05291675 0.04448034]]
Iteration 228
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.839600737232712>
Acquisition function convergence reached at iteration 6317.
tf.Tensor(-68.23994793285632, shape=(), dtype=float64)
[[7.10200399e-01 1.30417119e-04 1.35626939e-02 1.20776186e-01
  1.57537123e-02 2.10226195e-02]]
Iteration 229
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.841193227178943>
Acquisition function convergence reached at iteration 1909.
tf.Tensor(-67.27101985285458, shape=(), dtype=float64)
[[0.54275393 0.9957194  0.10012455 0.15854782 0.14688836 0.14223667]]
Iteration 230
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.842778440048459>
Acquisition function convergence reached at iteration 2193.
tf.Tensor(-67.30959230402743, shape=(), dtype=float64)
[[0.55916269 0.03641598 0.03073924 0.16380777 0.06935704 0.08322024]]
Iteration 231
```

```
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.844356440551194>
Acquisition function convergence reached at iteration 2452.
tf.Tensor(-66.53479695584588, shape=(), dtype=float64)
[[0.5521523  0.67386081 1.04573609 0.07473299 0.04205513 0.05750316]]
Iteration 232
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.84592729254493>
Acquisition function convergence reached at iteration 2787.
tf.Tensor(-68.68236966319296, shape=(), dtype=float64)
[[0.31869303 0.05430442 0.04560658 0.16519672 0.07372255 0.07691634]]
Iteration 233
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.847491059050137>
Acquisition function convergence reached at iteration 4671.
tf.Tensor(-68.40005013216275, shape=(), dtype=float64)
[[0.54275009 0.98945013 0.34349172 0.00936944 0.00696639 0.7922748 ]]
Iteration 234
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.849047802264476>
Acquisition function convergence reached at iteration 1434.
tf.Tensor(-69.0180808342145, shape=(), dtype=float64)
[[0.55097288 0.65798832 0.29990727 0.0531888  0.98515706 0.2948642 ]]
Iteration 235
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.850597583577006>
Acquisition function convergence reached at iteration 4045.
tf.Tensor(-39.25913851623031, shape=(), dtype=float64)
[[6.25469357e-01 5.39028295e-04 5.49426588e-02 2.04125711e+00
  1.66413787e+00 4.92212352e-02]]
Iteration 236
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.852140463582071>
Acquisition function convergence reached at iteration 1731.
tf.Tensor(-68.74924948662539, shape=(), dtype=float64)
[[0.29395156 0.99745451 0.14865683 0.12016164 0.10853673 0.07995263]]
Iteration 237
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.853676502092904>
Acquisition function convergence reached at iteration 3501.
tf.Tensor(-66.37606444837267, shape=(), dtype=float64)
[[0.25805813 0.20411185 0.07419697 0.09326973 0.06742521 0.05968571]]
Iteration 238
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.855205758154937>
Acquisition function convergence reached at iteration 5003.
tf.Tensor(-37.27916799457283, shape=(), dtype=float64)
[[7.14284283e-01 3.25026941e-04 2.27649353e+00 1.93239418e+00
  7.44350749e-03 6.72707123e-03]]
Iteration 239
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.8567282900588244>
```

```
Acquisition function convergence reached at iteration 2604.
tf.Tensor(-41.930551339442076, shape=(), dtype=float64)
[[7.83747809e-01 1.78486073e-03 1.24118638e-01 1.98035950e+00
  4.24834414e-02 2.04472881e+00]]
Iteration 240
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.8582441553532005>
Acquisition function convergence reached at iteration 2290.
tf.Tensor(-69.20307283423625, shape=(), dtype=float64)
[[0.56345288 0.2246424  0.41525588 0.01813977 0.15012206 0.77427776]]
Iteration 241
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.859753410857163>
Acquisition function convergence reached at iteration 4437.
tf.Tensor(-64.29821184550839, shape=(), dtype=float64)
[[0.28242272 0.000874   0.01427838 0.10895751 0.01526456 0.61777891]]
Iteration 242
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.861256112672503>
Acquisition function convergence reached at iteration 3906.
tf.Tensor(-65.39165571304737, shape=(), dtype=float64)
[[0.28468839 0.01807712 0.59787197 0.05165624 0.65760397 0.00223333]]
Iteration 243
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.862752316195673>
Acquisition function convergence reached at iteration 2059.
tf.Tensor(-65.17180515531842, shape=(), dtype=float64)
[[0.26987368 0.69270849 0.47692311 0.05294856 0.58460045 0.75366292]]
Iteration 244
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.864242076129504>
Acquisition function convergence reached at iteration 3546.
tf.Tensor(-66.15283655669434, shape=(), dtype=float64)
[[0.27457452 0.53975981 0.0055885  0.14066951 0.83377735 0.00643368]]
Iteration 245
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.865725446494702>
Acquisition function convergence reached at iteration 1588.
tf.Tensor(-66.19717616428915, shape=(), dtype=float64)
[[0.56136019 0.99431592 0.47934227 0.1352981  0.30349053 0.89735415]]
Iteration 246
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.867202480641075>
Acquisition function convergence reached at iteration 4542.
tf.Tensor(-66.18739301669154, shape=(), dtype=float64)
[[0.27449234 0.49802979 0.97917041 0.10918718 0.0012898  0.10496888]]
Iteration 247
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.8686732312585645>
Acquisition function convergence reached at iteration 3673.
tf.Tensor(-67.01520522280788, shape=(), dtype=float64)
```

```
[[0.29252325 0.58227739 0.59820568 0.00411913 0.14527111 0.81323705]]
Iteration 248
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.8701377503880225>
Acquisition function convergence reached at iteration 4284.
tf.Tensor(-66.10064815305893, shape=(), dtype=float64)
[[0.31984321 0.1043032  0.57956591 0.01049877 0.45968916 0.45691772]]
Iteration 249
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.871596089431791>
Acquisition function convergence reached at iteration 2603.
tf.Tensor(-52.88112073710613, shape=(), dtype=float64)
[[0.79977887 0.00363344 0.13277676 1.9368611  0.16550779 1.70627139]]
Iteration 250
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.87304829916406>
Acquisition function convergence reached at iteration 3633.
tf.Tensor(-64.6941905081157, shape=(), dtype=float64)
[[0.23371985 0.00475062 0.40946889 0.07694439 0.35505424 0.43463023]]
Trained parameters:
amplitude_champ:0 is 14.218

length_scales_champ:0 is [0.017 1.    1.    0.135 1.    1.   ]

observation_noise_variance_champ:0 is 2.058

amp_f_mean:0 is 28.256

amp_gamma_L_mean:0 is 1.504

amp_lambda_mean:0 is 47.779

amp_r_mean:0 is 5.256

bias_mean:0 is 7.724

f_tp:0 is -0.241

gamma_L_tp:0 is -1.526

lambda_tp:0 is 0.317

r_tp:0 is 4.081

Iteration 251
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.87449442974101>
```

```
Acquisition function convergence reached at iteration 7041.
tf.Tensor(-38.98512306198998, shape=(), dtype=float64)
[[0.59028626 0.9983262  0.02983295 2.90672431 0.03409004 0.0315798 ]]
Iteration 252
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.875934530710764>
Acquisition function convergence reached at iteration 708.
tf.Tensor(-65.7611961482618, shape=(), dtype=float64)
[[0.54038134 0.18742995 0.65304096 0.11223989 0.37441901 0.90003233]]
Iteration 253
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.877368651023132>
Acquisition function convergence reached at iteration 2406.
tf.Tensor(-56.656598831118394, shape=(), dtype=float64)
[[7.69356313e-01 2.35544495e-03 7.42233585e-02 2.00977852e+00
  1.32183737e-01 2.43455605e+00]]
Iteration 254
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.878796839039164>
Acquisition function convergence reached at iteration 3728.
tf.Tensor(-62.58017407979248, shape=(), dtype=float64)
[[0.80092644 0.0014466  0.04809919 0.14059372 0.05262371 0.07716094]]
Iteration 255
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.88021914254051>
Acquisition function convergence reached at iteration 4002.
tf.Tensor(-37.67954938221747, shape=(), dtype=float64)
[[6.68516967e-01 6.64447215e-04 2.81221573e-02 3.10162834e+00
  4.64897476e-02 5.05753023e-02]]
Iteration 256
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.8816356087386055>
Acquisition function convergence reached at iteration 4923.
tf.Tensor(-65.34433350569569, shape=(), dtype=float64)
[[0.22867033 0.83489392 0.00438829 0.14320543 0.00465124 0.01455892]]
Iteration 257
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.8830462842836635>
Acquisition function convergence reached at iteration 1032.
tf.Tensor(-31.60790144777897, shape=(), dtype=float64)
[[0.66766102 0.99286989 2.15565304 2.68102058 0.62975955 0.3518706 ]]
Iteration 258
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.884451215273498>
Acquisition function convergence reached at iteration 1720.
tf.Tensor(-66.8282810252272, shape=(), dtype=float64)
[[0.30376934 0.47731483 0.03922717 0.05892853 0.98828225 0.58465246]]
Iteration 259
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.885850447262175>
Acquisition function convergence reached at iteration 3775.
```

```
tf.Tensor(-65.45774138237606, shape=(), dtype=float64)
[[0.58469046 0.99825767 0.5281752  0.00280196 0.48956253 0.4574145 ]]
Iteration 260
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.88724402526849>
Acquisition function convergence reached at iteration 4732.
tf.Tensor(-64.78861208848704, shape=(), dtype=float64)
[[0.8336151  0.0026931  0.04531971 0.12092485 0.04488369 0.05154527]]
Iteration 261
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.8886319937842915>
Acquisition function convergence reached at iteration 1548.
tf.Tensor(-64.33078361105613, shape=(), dtype=float64)
[[0.57275835 0.28962328 0.83814442 0.09016239 0.80319661 0.0893772 ]]
Iteration 262
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.890014396782628>
Acquisition function convergence reached at iteration 1835.
tf.Tensor(-65.50044922404209, shape=(), dtype=float64)
[[0.59426805 0.0023713  0.29214797 0.0525953  0.26210992 0.48159944]]
Iteration 263
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.891391277725757>
Acquisition function convergence reached at iteration 7444.
tf.Tensor(-53.121049707011075, shape=(), dtype=float64)
[[7.76811539e-01 3.84402308e-04 9.85142139e-01 2.00394568e+00
  1.32730728e-02 2.04025697e+00]]
Iteration 264
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.892762679572986>
Acquisition function convergence reached at iteration 6273.
tf.Tensor(-65.73337694186408, shape=(), dtype=float64)
[[0.59669155 0.79664299 0.91206996 0.11696794 0.04009537 0.1644922 ]]
Iteration 265
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.894128644788371>
Acquisition function convergence reached at iteration 3649.
tf.Tensor(-66.6994032908215, shape=(), dtype=float64)
[[0.59639574 0.81737051 0.05813842 0.1243096  0.88740215 0.29907449]]
Iteration 266
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.89548921534827>
Acquisition function convergence reached at iteration 3482.
tf.Tensor(-53.060172230471835, shape=(), dtype=float64)
[[7.79559915e-01 1.06457668e-03 1.10464430e-03 1.90162198e+00
  2.61192199e-02 2.67417435e+00]]
Iteration 267
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.896844432748743>
Acquisition function convergence reached at iteration 4254.
tf.Tensor(-66.29465997408133, shape=(), dtype=float64)
```

```
[[0.59423112 0.93588945 0.10124414 0.09585883 0.00309013 1.06640463]]
Iteration 268
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.898194338012829>
Acquisition function convergence reached at iteration 400.
tf.Tensor(-64.72121816497992, shape=(), dtype=float64)
[[0.58264318 0.2226703  0.64825565 0.17489474 0.32226766 0.90399643]]
Iteration 269
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.89953897169767>
Acquisition function convergence reached at iteration 4530.
tf.Tensor(-61.772936855638775, shape=(), dtype=float64)
[[0.57602413 0.99969383 0.72065144 0.22887503 0.51963071 0.02288887]]
Iteration 270
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.900878373901511>
Acquisition function convergence reached at iteration 3434.
tf.Tensor(-65.11454140846632, shape=(), dtype=float64)
[[0.30710752 0.52326612 1.0983197  0.0799232  0.32078451 0.01067402]]
Iteration 271
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.902212584270572>
Acquisition function convergence reached at iteration 6117.
tf.Tensor(-63.71679308001171, shape=(), dtype=float64)
[[0.80502478 0.99927328 0.45027643 0.11825498 0.50111783 0.12345514]]
Iteration 272
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.90354164200578>
Acquisition function convergence reached at iteration 3667.
tf.Tensor(-54.59571378067883, shape=(), dtype=float64)
[[7.78562817e-01 6.33191357e-04 1.18046253e-03 1.94510669e+00
  8.47490726e-01 2.32916434e+00]]
Iteration 273
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.904865585869388>
Acquisition function convergence reached at iteration 1136.
tf.Tensor(-65.68646503131622, shape=(), dtype=float64)
[[0.62117909 0.45511499 0.3141149  0.10089044 0.21038487 0.50379739]]
Iteration 274
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.906184454191469>
Acquisition function convergence reached at iteration 2379.
tf.Tensor(-66.01402755414982, shape=(), dtype=float64)
[[0.60404755 0.22642862 0.0154539  0.19021136 0.00285858 0.22088959]]
Iteration 275
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.907498284876284>
Acquisition function convergence reached at iteration 7007.
tf.Tensor(-65.33301322450885, shape=(), dtype=float64)
[[2.58619751e-01 1.15776867e-04 7.54229569e-01 1.18968616e-04
  5.83611427e-04 6.26835117e-01]]
```

```
Iteration 276
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.908807115408545>
Acquisition function convergence reached at iteration 2514.
tf.Tensor(-64.33034907452816, shape=(), dtype=float64)
[[0.60652608 0.70482113 0.81421732 0.03528927 0.66483085 0.91300905]]
Iteration 277
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.910110982859554>
Acquisition function convergence reached at iteration 3322.
tf.Tensor(-65.99107437622587, shape=(), dtype=float64)
[[8.09595989e-01 6.64338527e-04 5.99624707e-01 3.78684278e-02
  6.59296007e-01 4.42068853e-01]]
Iteration 278
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.911409923893235>
Acquisition function convergence reached at iteration 477.
tf.Tensor(-64.38465832235099, shape=(), dtype=float64)
[[0.60705557 0.19960464 0.6748286  0.18190165 0.5263665  1.04208421]]
Iteration 279
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.91270397477205>
Acquisition function convergence reached at iteration 5447.
tf.Tensor(-63.82425922335162, shape=(), dtype=float64)
[[0.63427077 0.9990425  0.19522885 0.00192516 0.53577969 0.0020976 ]]
Iteration 280
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.913993171362826>
Acquisition function convergence reached at iteration 2114.
tf.Tensor(-63.8301120234937, shape=(), dtype=float64)
[[0.30334845 0.00696366 0.68637595 0.12408492 0.16821195 0.97348739]]
Iteration 281
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.915277549142451>
Acquisition function convergence reached at iteration 5025.
tf.Tensor(-61.91119029360675, shape=(), dtype=float64)
[[0.61628834 0.99830685 0.80446911 0.0791632  0.8601327  0.00263216]]
Iteration 282
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.916557143203492>
Acquisition function convergence reached at iteration 4918.
tf.Tensor(-62.79868956040916, shape=(), dtype=float64)
[[0.6485165  0.85116493 0.32051453 0.14898592 0.3527058  0.01451707]]
Iteration 283
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.917831988259695>
Acquisition function convergence reached at iteration 550.
tf.Tensor(-58.9527867475343, shape=(), dtype=float64)
[[0.28720823 0.413361   0.92213705 0.15219258 0.86315871 0.82017829]]
Iteration 284
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.919102118651401>
```

```
Acquisition function convergence reached at iteration 2509.
tf.Tensor(-61.233289787725035, shape=(), dtype=float64)
[[0.62018996 0.99918099 0.02576433 0.19652501 0.39826106 0.00946885]]
Iteration 285
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.920367568350855>
Acquisition function convergence reached at iteration 5705.
tf.Tensor(-55.83347770134618, shape=(), dtype=float64)
[[0.59685013 0.99896671 0.02066175 0.26664093 0.00472344 0.90728557]]
Iteration 286
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.921628370967424>
Acquisition function convergence reached at iteration 1697.
tf.Tensor(-61.452448243156226, shape=(), dtype=float64)
[[0.57492633 0.34754364 0.01158722 0.07713606 1.00725717 0.96881947]]
Iteration 287
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.922884559752733>
Acquisition function convergence reached at iteration 3788.
tf.Tensor(-57.50925143021559, shape=(), dtype=float64)
[[0.58986508 0.00228612 0.00080414 0.27959104 0.72932703 0.62252583]]
Iteration 288
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.92413616760569>
Acquisition function convergence reached at iteration 3413.
tf.Tensor(-60.98398325383195, shape=(), dtype=float64)
[[0.61136271 0.99993306 0.74084895 0.17829979 0.00177298 0.88388617]]
Iteration 289
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.9253832270774485>
Acquisition function convergence reached at iteration 1307.
tf.Tensor(-61.67080234091732, shape=(), dtype=float64)
[[0.64603233 0.99848552 0.08397729 0.03722878 0.07509145 0.97631974]]
Iteration 290
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.92662577037626>
Acquisition function convergence reached at iteration 4852.
tf.Tensor(-62.76382598156184, shape=(), dtype=float64)
[[0.6225844  0.99993708 0.00378725 0.04549294 0.97634612 0.94170587]]
Iteration 291
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.927863829372259>
Acquisition function convergence reached at iteration 4960.
tf.Tensor(-60.99295715658361, shape=(), dtype=float64)
[[6.21036045e-01 9.99968500e-01 3.42289303e-03 1.18018827e-03
  5.26735753e-04 1.07366661e+00]]
Iteration 292
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.9290974356021575>
Acquisition function convergence reached at iteration 7781.
tf.Tensor(-59.371575350101025, shape=(), dtype=float64)
```

```
[[6.27201753e-01 9.99931254e-01 3.61091038e-04 1.69824264e-01
  1.73706202e-01 1.44983393e+00]]
Iteration 293
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.930326620273857>
Acquisition function convergence reached at iteration 6644.
tf.Tensor(-57.31968516376595, shape=(), dtype=float64)
[[2.92415844e-01 1.26496675e-04 6.66250043e-01 2.13822155e-01
  1.04263910e-01 8.25723960e-03]]
Iteration 294
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.93155141427099>
Acquisition function convergence reached at iteration 2580.
tf.Tensor(-54.81564261781779, shape=(), dtype=float64)
[[7.85529807e-01 2.54166355e-03 1.96491078e-03 2.01861198e+00
  6.82669431e-04 2.85786709e+00]]
Iteration 295
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.93277184815737>
Acquisition function convergence reached at iteration 4473.
tf.Tensor(-63.76606773769766, shape=(), dtype=float64)
[[0.32061616 0.5331221  0.00457821 0.06999955 0.00297687 1.08066091]]
Iteration 296
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.933987952181382>
Acquisition function convergence reached at iteration 627.
tf.Tensor(-62.382845722318166, shape=(), dtype=float64)
[[0.32808206 0.82119565 0.68689317 0.12709101 0.59338113 0.60869658]]
Iteration 297
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.935199756280282>
Acquisition function convergence reached at iteration 2993.
tf.Tensor(-28.363260404551724, shape=(), dtype=float64)
[[0.71562623 0.99912475 0.00761911 2.09055777 2.9064931  0.00802202]]
Iteration 298
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.936407290084435>
Acquisition function convergence reached at iteration 1507.
tf.Tensor(-56.76365897131464, shape=(), dtype=float64)
[[0.6213319  0.9939434  0.04772249 0.32639535 0.00425489 1.078111  ]]
Iteration 299
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.937610582921476>
Acquisition function convergence reached at iteration 2638.
tf.Tensor(-64.90603536061026, shape=(), dtype=float64)
[[0.80796639 0.49778573 0.09437142 0.08074374 0.02826362 1.04046771]]
Iteration 300
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.938809663820404>
Acquisition function convergence reached at iteration 1649.
tf.Tensor(-63.707120287504786, shape=(), dtype=float64)
```

```
[[0.6350545  0.99950839 1.04808455 0.04355343 0.50555176 0.82685258]]
Trained parameters:
amplitude_champ:0 is 13.506

length_scales_champ:0 is [0.021 1.    1.    0.138 1.    1.   ]

observation_noise_variance_champ:0 is 2.152

amp_f_mean:0 is 13.748

amp_gamma_L_mean:0 is 24.611

amp_lambda_mean:0 is 40.138

amp_r_mean:0 is 3.137

bias_mean:0 is 24.975

f_tp:0 is -0.705

gamma_L_tp:0 is -0.273

lambda_tp:0 is 0.222

r_tp:0 is 4.603

Iteration 301
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.940004561515605>
Acquisition function convergence reached at iteration 1458.
tf.Tensor(-59.190150739933244, shape=(), dtype=float64)
[[0.63605816 0.99935518 0.61843266 0.1890936  0.96636688 1.00669828]]
Iteration 302
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.941195304450805>
Acquisition function convergence reached at iteration 1941.
tf.Tensor(-64.1357878391804, shape=(), dtype=float64)
[[0.83607933 0.74815638 0.4092675  0.04591513 0.44671183 0.57236011]]
Iteration 303
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.942381920782965>
Acquisition function convergence reached at iteration 6169.
tf.Tensor(-41.55657008671921, shape=(), dtype=float64)
[[0.55866274 0.99982295 0.01746919 1.00235053 0.02023726 0.02339166]]
Iteration 304
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.943564438386103>
```

```
Acquisition function convergence reached at iteration 5044.
tf.Tensor(-53.309061573812556, shape=(), dtype=float64)
[[3.36305014e-01 9.99877466e-01 5.53948556e-04 1.72225664e-01
  1.56047487e-03 5.06863640e-01]]
Iteration 305
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.944742884855058>
Acquisition function convergence reached at iteration 4898.
tf.Tensor(-57.3616736508894, shape=(), dtype=float64)
[[2.92586816e-01 9.43665275e-01 1.27932079e-03 1.25340292e-01
  1.77837576e-01 1.34999659e+00]]
Iteration 306
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.945917287509191>
Acquisition function convergence reached at iteration 2620.
tf.Tensor(-57.896759144678484, shape=(), dtype=float64)
[[0.31353854 0.99819275 0.00963067 0.20728302 0.40698544 0.99183205]]
Iteration 307
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.9470876733960205>
Acquisition function convergence reached at iteration 2543.
tf.Tensor(-33.050863781981974, shape=(), dtype=float64)
[[5.94150641e-01 1.17220609e-03 2.88576789e-01 1.31194037e+00
  2.90866505e-01 2.17074689e+00]]
Iteration 308
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.948254069294802>
Acquisition function convergence reached at iteration 7544.
tf.Tensor(-31.47125744426009, shape=(), dtype=float64)
[[5.98948760e-01 9.99881186e-01 2.50570926e+00 1.31872796e+00
  1.50063840e-03 2.40490253e-03]]
Iteration 309
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.949416501720056>
Acquisition function convergence reached at iteration 6078.
tf.Tensor(-56.9510594101988, shape=(), dtype=float64)
[[3.29809999e-01 5.66030025e-01 2.96610605e-04 8.63845755e-02
  1.04941321e+00 1.37041221e-03]]
Iteration 310
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.950574996925019>
Acquisition function convergence reached at iteration 6240.
tf.Tensor(-58.40144299649147, shape=(), dtype=float64)
[[3.31556908e-01 5.76783234e-04 1.52691790e-03 1.44294986e-01
  7.73570773e-01 9.63242884e-01]]
Iteration 311
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.951729580905062>
Acquisition function convergence reached at iteration 2222.
tf.Tensor(-55.85545297484693, shape=(), dtype=float64)
```

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[[0.32032904 0.99977858 0.02598977 0.20124087 0.7988705  0.00586934]]
Iteration 312
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.952880279401035>
Acquisition function convergence reached at iteration 3545.
tf.Tensor(-63.90332437187983, shape=(), dtype=float64)
[[0.64839973 0.16162234 0.3559014  0.04293951 0.86439049 0.67082488]]
Iteration 313
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.95402711790257>
Acquisition function convergence reached at iteration 3277.
tf.Tensor(-61.567576109208986, shape=(), dtype=float64)
[[0.30951493 0.99994367 0.81403644 0.11647294 0.00163798 1.04861046]]
Iteration 314
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.955170121651319>
Acquisition function convergence reached at iteration 4239.
tf.Tensor(-54.987878971779566, shape=(), dtype=float64)
[[0.32412226 0.99996654 0.34236149 0.20043076 0.00172308 1.72207522]]
Iteration 315
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.956309315644152>
Acquisition function convergence reached at iteration 2568.
tf.Tensor(-56.52634446957717, shape=(), dtype=float64)
[[0.30211479 0.68337169 0.38723924 0.25658455 0.00512945 1.68823335]]
Iteration 316
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.957444724636298>
Acquisition function convergence reached at iteration 3858.
tf.Tensor(-55.857630614236584, shape=(), dtype=float64)
[[3.20998429e-01 9.98956251e-01 9.08591602e-01 2.83475846e-01
  9.63882425e-04 1.08313856e+00]]
Iteration 317
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.9585763731444334>
Acquisition function convergence reached at iteration 6616.
tf.Tensor(-60.69773418164163, shape=(), dtype=float64)
[[2.46333531e-01 5.49546321e-01 3.21513828e-04 3.88250991e-02
  3.13560316e-03 1.13655942e+00]]
Iteration 318
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.9597042854497255>
Acquisition function convergence reached at iteration 5739.
tf.Tensor(-59.94038681933888, shape=(), dtype=float64)
[[0.26240585 0.33355877 0.54159218 0.15932252 0.00333284 1.24982146]]
Iteration 319
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.960828485600828>
Acquisition function convergence reached at iteration 5941.
tf.Tensor(-64.09294296878673, shape=(), dtype=float64)
[[8.19795303e-01 3.68182236e-01 1.00901815e+00 1.05902524e-01
```

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  7.37936015e-04 3.53808046e-01]]
Iteration 320
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.961948997416825>
Acquisition function convergence reached at iteration 5070.
tf.Tensor(-62.39944325414775, shape=(), dtype=float64)
[[0.24702924 0.96693155 0.93214089 0.06794609 0.00159415 0.55457415]]
Iteration 321
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.963065844490134>
Acquisition function convergence reached at iteration 5312.
tf.Tensor(-59.980704822875175, shape=(), dtype=float64)
[[0.22179987 0.77715483 0.63344958 0.00085961 0.01038671 0.79250007]]
Iteration 322
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.964179050189357>
Acquisition function convergence reached at iteration 4095.
tf.Tensor(-59.62913376045563, shape=(), dtype=float64)
[[0.23832336 0.82334754 0.41633135 0.00369349 0.93517577 0.5221459 ]]
Iteration 323
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.965288637662097>
Acquisition function convergence reached at iteration 6857.
tf.Tensor(-25.304099825389656, shape=(), dtype=float64)
[[6.61634725e-01 9.99784985e-01 4.71757385e-03 1.37929861e+00
  2.01679016e-03 3.11249528e+00]]
Iteration 324
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.966394629837715>
Acquisition function convergence reached at iteration 1618.
tf.Tensor(-62.57274369213972, shape=(), dtype=float64)
[[0.67271188 0.858901   0.43270832 0.0648035  0.57132945 0.56089793]]
Iteration 325
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.96749704943006>
Acquisition function convergence reached at iteration 1242.
tf.Tensor(-57.25287535019411, shape=(), dtype=float64)
[[0.24789201 0.99723566 0.25013492 0.15371408 0.72381551 0.87536396]]
Iteration 326
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.968595918940151>
Acquisition function convergence reached at iteration 3552.
tf.Tensor(-56.58384723460396, shape=(), dtype=float64)
[[2.67919167e-01 9.99741548e-01 2.74677845e-03 1.29976376e-01
  4.14109404e-04 7.02491674e-01]]
Iteration 327
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.969691260658809>
Acquisition function convergence reached at iteration 2020.
tf.Tensor(-53.29900371046763, shape=(), dtype=float64)
[[0.2786136  0.9985141  0.12907852 0.26542416 0.46149054 1.33133924]]
```

```
Iteration 328
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.970783096669263>
Acquisition function convergence reached at iteration 3547.
tf.Tensor(-56.23645686646489, shape=(), dtype=float64)
[[0.28021835 0.99990242 1.04023586 0.14805914 0.00236505 1.38265293]]
Iteration 329
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.971871448849705>
Acquisition function convergence reached at iteration 5398.
tf.Tensor(-52.81626109814635, shape=(), dtype=float64)
[[0.260546   0.99987869 1.02708617 0.24242089 0.01033381 0.66295704]]
Iteration 330
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.972956338875812>
Acquisition function convergence reached at iteration 4977.
tf.Tensor(-48.04787113874842, shape=(), dtype=float64)
[[2.99486444e-01 9.99960778e-01 7.78463461e-04 3.81924679e-01
  6.67455568e-04 1.28224688e+00]]
Iteration 331
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.974037788223225>
Acquisition function convergence reached at iteration 5386.
tf.Tensor(-55.5236758564545, shape=(), dtype=float64)
[[0.27379592 0.01340698 0.00394722 0.0114571  0.00373621 1.43379185]]
Iteration 332
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.975115818169995>
Acquisition function convergence reached at iteration 5056.
tf.Tensor(-54.2532180891299, shape=(), dtype=float64)
[[0.30549727 0.99991957 0.00257506 0.31168249 0.81954907 1.85689318]]
Iteration 333
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.976190449798985>
Acquisition function convergence reached at iteration 2600.
tf.Tensor(-52.933325197337, shape=(), dtype=float64)
[[0.2927169  0.99945642 0.80161842 0.37832959 0.60732652 1.69262182]]
Iteration 334
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.977261704000244>
Acquisition function convergence reached at iteration 3966.
tf.Tensor(-60.870443153159286, shape=(), dtype=float64)
[[0.82052715 0.33235208 0.02489486 0.14659513 0.84078965 0.57139123]]
Iteration 335
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.978329601473341>
Acquisition function convergence reached at iteration 6064.
tf.Tensor(-56.12192732002662, shape=(), dtype=float64)
[[3.20442828e-01 9.99892099e-01 1.16198685e-04 3.49160105e-01
  3.56134189e-03 1.81124436e+00]]
Iteration 336
```

```
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.979394162729661>
Acquisition function convergence reached at iteration 3714.
tf.Tensor(-50.301549548881816, shape=(), dtype=float64)
[[0.31833688 0.99928332 0.00201328 0.44219304 0.65665569 1.18950118]]
Iteration 337
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.980455408094672>
Acquisition function convergence reached at iteration 6353.
tf.Tensor(-48.701789556312484, shape=(), dtype=float64)
[[3.05480738e-01 9.99321466e-01 1.68256508e-03 5.57699681e-01
  9.72970115e-04 8.23870343e-01]]
Iteration 338
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.981513357710154>
Acquisition function convergence reached at iteration 6448.
tf.Tensor(-61.02718680422747, shape=(), dtype=float64)
[[0.8563555  0.36796444 0.65606387 0.11268422 0.48684873 0.00547433]]
Iteration 339
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.982568031536398>
Acquisition function convergence reached at iteration 7019.
tf.Tensor(-45.20092825645204, shape=(), dtype=float64)
[[0.6808195  0.99969638 0.04738528 1.3542881  0.00345594 3.20092453]]
Iteration 340
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.983619449354371>
Acquisition function convergence reached at iteration 6033.
tf.Tensor(-61.20488047680727, shape=(), dtype=float64)
[[8.50881894e-01 9.99861186e-01 8.42152280e-04 9.20286021e-02
  5.63632145e-04 1.55794868e-03]]
Iteration 341
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.984667630767843>
Acquisition function convergence reached at iteration 8481.
tf.Tensor(-42.22886211221973, shape=(), dtype=float64)
[[3.58452880e-01 1.55325305e-04 4.12761905e-03 1.31400489e+00
  1.23333552e-02 1.15045852e-02]]
Iteration 342
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.9857125952054995>
tf.Tensor(-41.79620521649705, shape=(), dtype=float64)
[[0.26481511 0.99847847 0.02207268 1.7792888  0.03517889 0.04593795]]
Iteration 343
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.986754361922999>
Acquisition function convergence reached at iteration 5902.
tf.Tensor(-39.53499075440281, shape=(), dtype=float64)
[[2.99823358e-01 2.49203158e-04 2.49042206e-02 2.23280741e+00
  1.52723282e-02 3.49144564e-02]]
Iteration 344
```

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<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.987792950005019>
Acquisition function convergence reached at iteration 5615.
tf.Tensor(-33.87397059501938, shape=(), dtype=float64)
[[0.41967805 0.99972933 0.12258367 1.97876439 0.04491257 1.88876828]]
Iteration 345
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.98882837836727>
Acquisition function convergence reached at iteration 6924.
tf.Tensor(-58.18240381205576, shape=(), dtype=float64)
[[2.52765896e-01 9.99723868e-01 4.75800235e-04 4.90483026e-01
  1.51152951e-02 5.26138468e-01]]
Iteration 346
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.989860665758464>
Acquisition function convergence reached at iteration 7581.
tf.Tensor(-60.35520101953004, shape=(), dtype=float64)
[[2.89693446e-01 6.58093798e-02 3.57402814e-04 4.88767808e-01
  6.48334633e-04 1.05454056e+00]]
Iteration 347
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.990889830762278>
Acquisition function convergence reached at iteration 7850.
tf.Tensor(-35.17212782474333, shape=(), dtype=float64)
[[0.19237143 0.99931001 0.00883338 1.48176252 0.01611899 2.02940623]]
Iteration 348
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.9919158917992705>
Acquisition function convergence reached at iteration 6558.
tf.Tensor(-36.887958013037476, shape=(), dtype=float64)
[[0.25320552 0.99918907 0.01179591 2.86693503 0.02864707 0.0286698 ]]
Iteration 349
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.992938867128781>
Acquisition function convergence reached at iteration 7234.
tf.Tensor(-60.34183885844491, shape=(), dtype=float64)
[[3.12423789e-01 5.70146086e-01 2.45984275e-04 4.76796981e-01
  6.15769045e-04 1.36043396e-01]]
Iteration 350
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.993958774850792>
Acquisition function convergence reached at iteration 250.
tf.Tensor(-50.97313714170122, shape=(), dtype=float64)
[[0.20579442 0.84819402 0.7350294  1.47583033 0.63310997 1.84255718]]
Trained parameters:
amplitude_champ:0 is 13.672

length_scales_champ:0 is [0.059 1.    1.    0.112 1.    1.   ]

observation_noise_variance_champ:0 is 2.755
```

```
amp_f_mean:0 is 14.889

amp_gamma_L_mean:0 is 15.574

amp_lambda_mean:0 is 31.945

amp_r_mean:0 is 0.037

bias_mean:0 is 4.93

f_tp:0 is -1.027

gamma_L_tp:0 is -1.258

lambda_tp:0 is -0.041

r_tp:0 is 2.807

Iteration 351
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.994975632907776>
Acquisition function convergence reached at iteration 1250.
tf.Tensor(-66.00445484396622, shape=(), dtype=float64)
[[0.74061393 0.28188078 0.61917745 0.13303674 0.44576818 0.90038149]]
Iteration 352
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.995989459086509>
Acquisition function convergence reached at iteration 8201.
tf.Tensor(-31.101465159036877, shape=(), dtype=float64)
[[4.07984763e-01 6.54863957e-05 2.62946594e+00 1.59555277e+00
  7.04318332e-04 1.22830011e-03]]
Iteration 353
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.997000271019855>
Acquisition function convergence reached at iteration 7678.
tf.Tensor(-55.809022687942345, shape=(), dtype=float64)
[[9.48472865e-01 7.08635806e-05 4.09085715e-04 8.23174019e-01
  8.24755358e-04 1.22885245e+00]]
Iteration 354
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.998008086188536>
Acquisition function convergence reached at iteration 5565.
tf.Tensor(-32.13764026912002, shape=(), dtype=float64)
[[0.28371212 0.99974873 0.0077698  2.52339544 1.79179273 0.02754594]]
Iteration 355
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=6.999012921922862>
```

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Acquisition function convergence reached at iteration 5805.
tf.Tensor(-78.20151989061999, shape=(), dtype=float64)
[[2.67330643e-01 8.63973335e-01 1.00108277e-03 5.26711836e-01
  2.61385780e-02 1.60727276e+00]]
Iteration 356
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.000014795404454>
Acquisition function convergence reached at iteration 6439.
tf.Tensor(-64.80549242297022, shape=(), dtype=float64)
[[0.2556143  0.43134695 0.00125665 0.59972801 0.34182876 0.95865952]]
Iteration 357
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.001013723667921>
Acquisition function convergence reached at iteration 8931.
tf.Tensor(-29.893804746594327, shape=(), dtype=float64)
[[4.12004632e-01 7.86978529e-05 2.68462038e+00 2.05606015e+00
  8.29283732e-03 1.54609029e-03]]
Iteration 358
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.002009723602535>
tf.Tensor(-28.807620564727927, shape=(), dtype=float64)
[[3.73416071e-01 9.99816933e-01 1.17635542e-02 2.44785906e+00
  1.67703264e-03 2.58197731e+00]]
Iteration 359
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.003002811953872>
Acquisition function convergence reached at iteration 3082.
tf.Tensor(-47.28654302517043, shape=(), dtype=float64)
[[0.37018458 0.9978601  0.95024933 2.44722006 0.01591497 2.42409708]]
Iteration 360
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.003993005325424>
Acquisition function convergence reached at iteration 7354.
tf.Tensor(-66.71711170671986, shape=(), dtype=float64)
[[0.69105899 0.81881582 0.00358278 0.23087571 0.00242269 0.88869121]]
Iteration 361
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.004980320180201>
Acquisition function convergence reached at iteration 9784.
tf.Tensor(-84.78858523522729, shape=(), dtype=float64)
[[4.22119176e-01 9.99972347e-01 8.94536707e-03 1.46170450e-04
  1.16301525e+00 5.31933670e-01]]
Iteration 362
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.005964772842304>
tf.Tensor(-92.90624778292212, shape=(), dtype=float64)
[[9.78907096e-01 9.99992031e-01 1.72742488e-03 3.30365323e-01
  2.62117102e-04 6.83036780e-01]]
Iteration 363
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.006946379498474>
```

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Acquisition function convergence reached at iteration 8564.
tf.Tensor(-85.75344472780849, shape=(), dtype=float64)
[[4.30061673e-01 9.99986420e-01 1.17205755e-03 6.71112117e-02
  1.48439356e-01 1.45362670e+00]]
Iteration 364
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.007925156199623>
Acquisition function convergence reached at iteration 6506.
tf.Tensor(-82.06816083649905, shape=(), dtype=float64)
[[0.41240864 0.99994594 0.0033055  0.25184227 0.8753819  1.86534723]]
Iteration 365
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.008901118862349>
Acquisition function convergence reached at iteration 5126.
tf.Tensor(-89.13506850103519, shape=(), dtype=float64)
[[3.34665077e-01 5.80706481e-04 1.20906348e-03 4.70415420e-01
  1.68830787e-03 1.98313833e+00]]
Iteration 366
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.009874283270414>
Acquisition function convergence reached at iteration 8290.
tf.Tensor(-86.96794364132396, shape=(), dtype=float64)
[[0.88457423 0.39145712 0.32133006 0.35845102 0.00241309 0.95034416]]
Iteration 367
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.010844665076221>
Acquisition function convergence reached at iteration 7416.
tf.Tensor(-87.20385317584675, shape=(), dtype=float64)
[[0.43186955 0.9992567  1.18388972 0.00310477 0.5196644  0.80751817]]
Iteration 368
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.011812279802255>
Acquisition function convergence reached at iteration 6966.
tf.Tensor(-82.14460648745458, shape=(), dtype=float64)
[[3.96065820e-01 1.66280145e-01 2.12022494e-03 2.23011148e-01
  2.83953697e-03 2.27743172e+00]]
Iteration 369
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.012777142842514>
Acquisition function convergence reached at iteration 7336.
tf.Tensor(-62.36056178981607, shape=(), dtype=float64)
[[5.79443670e-04 3.63558337e-04 1.15107850e-02 3.33186396e+00
  3.30568861e-02 2.68911061e-02]]
Iteration 370
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.013739269463916>
Acquisition function convergence reached at iteration 9549.
tf.Tensor(-85.79139391132269, shape=(), dtype=float64)
[[0.80045654 0.99995392 0.6799301  0.29474425 0.00213806 1.12325126]]
Iteration 371
```

```
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.014698674807692>
Acquisition function convergence reached at iteration 1021.
tf.Tensor(-86.56285347769446, shape=(), dtype=float64)
[[0.3836152  0.96482463 0.82416609 0.05650784 0.88329715 1.94806614]]
Iteration 372
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.015655373890748>
Acquisition function convergence reached at iteration 4085.
tf.Tensor(-84.27181410641656, shape=(), dtype=float64)
[[3.60254344e-01 9.98475029e-01 2.31456134e-03 1.40171050e-01
  5.94726048e-01 2.72797471e+00]]
Iteration 373
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.016609381607025>
Acquisition function convergence reached at iteration 3516.
tf.Tensor(-87.42953748105319, shape=(), dtype=float64)
[[0.44088937 0.96887066 1.01266456 0.18186105 0.04660323 2.0094212 ]]
Iteration 374
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.017560712728826>
Acquisition function convergence reached at iteration 6726.
tf.Tensor(-74.83135021915125, shape=(), dtype=float64)
[[6.98283864e-01 9.98911789e-01 1.69430459e-03 1.53233191e+00
  2.72736691e-03 3.57771629e+00]]
Iteration 375
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.018509381908136>
Acquisition function convergence reached at iteration 5742.
tf.Tensor(-90.12546243078677, shape=(), dtype=float64)
[[0.92716596 0.00180181 0.38259836 0.09332768 0.02648421 1.103355  ]]
Iteration 376
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.019455403677917>
Acquisition function convergence reached at iteration 8758.
tf.Tensor(-88.35465717605796, shape=(), dtype=float64)
[[4.17545623e-01 4.71032002e-04 9.29753443e-01 1.36484283e-02
  2.27432052e-03 1.65368214e+00]]
Iteration 377
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.020398792453388>
Acquisition function convergence reached at iteration 6604.
tf.Tensor(-87.08787391291698, shape=(), dtype=float64)
[[0.33972546 0.20792483 1.03218293 0.08947024 0.00249983 2.38378106]]
Iteration 378
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.021339562533291>
Acquisition function convergence reached at iteration 3356.
tf.Tensor(-89.1599430007494, shape=(), dtype=float64)
[[0.48155753 0.61458805 0.53919761 0.03326789 1.00665447 1.86148814]]
Iteration 379
```

```
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.022277728101133>
Acquisition function convergence reached at iteration 8806.
tf.Tensor(-89.08026200934337, shape=(), dtype=float64)
[[0.92105406 0.99995346 1.10230177 0.21286041 0.00119676 0.74011461]]
Iteration 380
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.02321330322642>
Acquisition function convergence reached at iteration 3959.
tf.Tensor(-87.36948644662968, shape=(), dtype=float64)
[[0.85451957 0.00316422 1.02142003 0.21539159 0.59191914 1.32987164]]
Hyperparameter convergence reached at iteration 9335.
Iteration 381
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.0241463018658665>
Acquisition function convergence reached at iteration 5302.
tf.Tensor(-73.8787811554421, shape=(), dtype=float64)
[[0.65228238 0.99928003 0.00960122 1.41237712 0.01265693 4.08687316]]
Iteration 382
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.025076737864597>
tf.Tensor(-59.53912492017972, shape=(), dtype=float64)
[[9.99949222e-01 1.10097033e-04 1.05961245e-02 3.12717854e+00
  1.54445622e-02 5.22416130e-02]]
Iteration 383
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.026004624957323>
Acquisition function convergence reached at iteration 9254.
tf.Tensor(-75.80087946261258, shape=(), dtype=float64)
[[6.77441169e-01 9.99845601e-01 8.92957612e-01 1.44400114e+00
  1.75160105e-03 3.58387770e+00]]
Iteration 384
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.026929976769512>
Acquisition function convergence reached at iteration 2999.
tf.Tensor(-99.17564605872036, shape=(), dtype=float64)
[[0.9136552  0.5150699  0.02653573 1.43465865 0.46544597 1.9425367 ]]
Iteration 385
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.027852806818538>
Acquisition function convergence reached at iteration 7436.
tf.Tensor(-83.67579735037415, shape=(), dtype=float64)
[[0.50907865 0.3814148  0.13650565 0.13128513 0.00822322 2.24882745]]
Iteration 386
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.028773128514817>
Acquisition function convergence reached at iteration 4778.
tf.Tensor(-71.93599013769872, shape=(), dtype=float64)
[[6.87957192e-01 9.99931516e-01 8.62116038e-04 1.42061259e+00
  8.62642676e-01 3.66179519e+00]]
Iteration 387
```

```
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.029690955162924>
Acquisition function convergence reached at iteration 4331.
tf.Tensor(-53.19794303835434, shape=(), dtype=float64)
[[6.24448775e-04 9.99598894e-01 3.18964764e-02 1.90416062e+00
  2.96645697e+00 1.03858991e-02]]
Iteration 388
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.030606299962706>
Acquisition function convergence reached at iteration 5400.
tf.Tensor(-74.3126324747035, shape=(), dtype=float64)
[[7.01979871e-01 1.41327189e-01 4.52157539e-04 1.42810637e+00
  1.81727628e-01 3.70861591e+00]]
Iteration 389
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.0315191760103675>
Acquisition function convergence reached at iteration 2213.
tf.Tensor(-84.89266380790845, shape=(), dtype=float64)
[[0.42802439 0.03959349 0.80542016 0.15806145 0.77184002 2.39545416]]
Iteration 390
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.032429596299552>
Acquisition function convergence reached at iteration 7710.
tf.Tensor(-73.93740659388617, shape=(), dtype=float64)
[[7.72883434e-01 9.35273150e-01 2.32570516e-04 1.42082704e+00
  2.37135265e-01 3.64350770e+00]]
Iteration 391
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.033337573722405>
Acquisition function convergence reached at iteration 7359.
tf.Tensor(-50.64356355948553, shape=(), dtype=float64)
[[3.12557556e-01 1.06468296e-04 3.70487003e-03 1.93077737e+00
  3.27715943e+00 2.89240720e-03]]
Iteration 392
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.034243121070622>
tf.Tensor(-83.72150452263396, shape=(), dtype=float64)
[[4.31438127e-01 4.28071555e-02 8.77849672e-01 2.65987913e-04
  1.16415840e+00 8.00907766e-03]]
Iteration 393
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.035146251036486>
Acquisition function convergence reached at iteration 4067.
tf.Tensor(-73.4843921904912, shape=(), dtype=float64)
[[0.78627535 0.16361552 0.00444325 1.57410456 0.00557578 3.32794313]]
Iteration 394
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.036046976213893>
Acquisition function convergence reached at iteration 8386.
tf.Tensor(-74.7824429608798, shape=(), dtype=float64)
[[8.01335278e-01 1.15300967e-04 5.22743432e-04 1.42227766e+00
```

```
  6.00802237e-01 3.05984464e+00]]
Iteration 395
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.036945309099358>
Acquisition function convergence reached at iteration 2572.
tf.Tensor(-74.83935178155747, shape=(), dtype=float64)
[[0.74980159 0.47848028 0.00688241 1.55181581 0.67820124 4.05368186]]
Iteration 396
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.037841262093015>
Acquisition function convergence reached at iteration 7044.
tf.Tensor(-89.79410962445526, shape=(), dtype=float64)
[[9.99889395e-01 4.74800915e-01 7.76576828e-04 1.74318559e+00
  2.21660570e-01 1.37303311e+00]]
Iteration 397
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.038734847499602>
Acquisition function convergence reached at iteration 6208.
tf.Tensor(-80.29007473142175, shape=(), dtype=float64)
[[9.44169678e-01 2.10046563e-04 3.63351985e-03 1.61866837e+00
  4.56021202e-03 2.27486762e+00]]
Iteration 398
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.039626077529428>
Acquisition function convergence reached at iteration 6669.
tf.Tensor(-76.25586582783143, shape=(), dtype=float64)
[[0.87493875 0.85982258 0.00863385 1.60375616 0.00813369 3.0878751 ]]
Iteration 399
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.040514964299342>
Acquisition function convergence reached at iteration 8632.
tf.Tensor(-81.60488263639328, shape=(), dtype=float64)
[[4.98855020e-01 9.99984819e-01 1.30108620e-03 2.99358629e-01
  9.56948477e-04 1.99452093e+00]]
Iteration 400
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.041401519833669>
Acquisition function convergence reached at iteration 8671.
tf.Tensor(-69.42506843792219, shape=(), dtype=float64)
[[6.48872666e-01 3.43465861e-01 1.88966781e-04 1.55638848e+00
  6.30039002e-01 3.89883682e+00]]
Trained parameters:
amplitude_champ:0 is 16.68

length_scales_champ:0 is [0.083 1.    1.    0.148 1.    1.   ]

observation_noise_variance_champ:0 is 2.864

amp_f_mean:0 is 9.446
```

```
amp_gamma_L_mean:0 is 18.48

amp_lambda_mean:0 is 13.435

amp_r_mean:0 is 0.004

bias_mean:0 is 1.254

f_tp:0 is -1.487

gamma_L_tp:0 is -1.685

lambda_tp:0 is 0.039

r_tp:0 is 0.702

Iteration 401
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.042285756065154>
Acquisition function convergence reached at iteration 4969.
tf.Tensor(-80.53858807362633, shape=(), dtype=float64)
[[0.9462521  0.9977721  0.01805397 1.5942974  0.69616663 2.0845933 ]]
Iteration 402
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.043167684835884>
Acquisition function convergence reached at iteration 1999.
tf.Tensor(-78.84557835694574, shape=(), dtype=float64)
[[0.93334637 0.57245552 0.91552958 1.55352547 0.16320962 2.46587472]]
Iteration 403
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.044047317898198>
Acquisition function convergence reached at iteration 5249.
tf.Tensor(-43.857037530329436, shape=(), dtype=float64)
[[4.26810549e-01 9.99854845e-01 2.29698566e+00 1.74135648e+00
  2.95702644e+00 1.13304674e-03]]
Iteration 404
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.044924666915591>
Acquisition function convergence reached at iteration 7426.
tf.Tensor(-75.06987626193501, shape=(), dtype=float64)
[[7.99445677e-01 9.99879541e-01 1.70203038e-03 1.56068681e+00
  7.27162098e-01 3.15665995e+00]]
Iteration 405
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.045799743463599>
Acquisition function convergence reached at iteration 2419.
tf.Tensor(-71.52710496666776, shape=(), dtype=float64)
```

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[[0.71808848 0.3985345  0.00362922 1.53338549 0.69769626 3.15049471]]
Iteration 406
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.046672559030683>
Acquisition function convergence reached at iteration 7342.
tf.Tensor(-58.68296035479278, shape=(), dtype=float64)
[[0.99949811 0.99805729 0.02100605 3.32638058 0.08798776 0.03492045]]
Iteration 407
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.047543125019092>
Acquisition function convergence reached at iteration 5227.
tf.Tensor(-85.73929359002999, shape=(), dtype=float64)
[[0.89985074 0.99947215 0.02654324 0.21336734 0.50391385 1.29960491]]
Iteration 408
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.0484114527457224>
Acquisition function convergence reached at iteration 2017.
tf.Tensor(-79.32751201130637, shape=(), dtype=float64)
[[0.91700208 0.0022283  0.03375545 1.5585779  1.118337   2.09676345]]
Iteration 409
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.049277553442964>
Acquisition function convergence reached at iteration 5358.
tf.Tensor(-76.02548539917645, shape=(), dtype=float64)
[[7.93951043e-01 7.46288180e-01 4.65612479e-03 1.73711548e+00
  6.98203049e-04 3.47518478e+00]]
Iteration 410
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.050141438259535>
Acquisition function convergence reached at iteration 7123.
tf.Tensor(-73.3706313391844, shape=(), dtype=float64)
[[8.12894461e-01 9.99964590e-01 1.90914930e-03 1.59047634e+00
  2.03152860e-03 3.96140339e+00]]
Iteration 411
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.051003118261308>
Acquisition function convergence reached at iteration 3002.
tf.Tensor(-72.06158807565285, shape=(), dtype=float64)
[[0.81916682 0.68056174 0.84579971 1.63442834 0.17247457 3.40806919]]
Iteration 412
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.051862604432124>
Acquisition function convergence reached at iteration 4136.
tf.Tensor(-80.88165593735214, shape=(), dtype=float64)
[[0.53501213 0.99969109 0.53686242 0.1970542  0.90987165 2.16185221]]
Iteration 413
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.052719907674601>
Acquisition function convergence reached at iteration 3843.
tf.Tensor(-72.29949976815388, shape=(), dtype=float64)
[[0.93021314 0.9998987  0.00582423 1.4735051  0.71642761 1.42289686]]
```

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Iteration 414
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.0535750388109255>
Acquisition function convergence reached at iteration 6102.
tf.Tensor(-80.07789153841499, shape=(), dtype=float64)
[[0.46014814 0.99996859 0.00581806 0.15599028 0.47862471 2.71139099]]
Iteration 415
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.054428008583642>
Acquisition function convergence reached at iteration 2881.
tf.Tensor(-73.20995910325342, shape=(), dtype=float64)
[[0.71262874 0.05914335 0.02649674 1.70313462 0.00692986 3.61094317]]
Iteration 416
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.055278827656428>
Acquisition function convergence reached at iteration 3371.
tf.Tensor(-72.01181248425829, shape=(), dtype=float64)
[[0.72313639 0.99836833 0.01996187 1.67339749 0.59777778 3.66153187]]
Iteration 417
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.056127506614859>
Acquisition function convergence reached at iteration 1884.
tf.Tensor(-78.09229872611411, shape=(), dtype=float64)
[[0.40854907 0.9842543  0.35307755 0.32852206 0.26605512 2.77757974]]
Iteration 418
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.056974055967171>
Acquisition function convergence reached at iteration 4053.
tf.Tensor(-84.13632783415483, shape=(), dtype=float64)
[[0.89931296 0.99908393 0.46753148 0.32419356 0.86933305 0.29898894]]
Iteration 419
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.057818486145002>
Acquisition function convergence reached at iteration 4508.
tf.Tensor(-78.73559539744244, shape=(), dtype=float64)
[[0.96222161 0.90206961 0.03232694 1.76571294 0.00354219 2.586923  ]]
Iteration 420
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.058660807504137>
tf.Tensor(-79.95386994807765, shape=(), dtype=float64)
[[9.99885679e-01 8.10088693e-01 1.23009676e-03 1.25375513e+00
  4.49863941e-03 1.23287264e+00]]
Hyperparameter convergence reached at iteration 8648.
Iteration 421
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.059501030325239>
Acquisition function convergence reached at iteration 2471.
tf.Tensor(-75.56038463729834, shape=(), dtype=float64)
[[8.81220320e-01 6.89038191e-03 1.30792776e-01 1.75450533e+00
  2.72833901e-03 3.23240612e+00]]
Iteration 422
```

```
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.060339164814566>
Acquisition function convergence reached at iteration 5251.
tf.Tensor(-71.06090690162117, shape=(), dtype=float64)
[[0.84192773 0.42877005 0.05042583 1.6509625  0.73048481 3.76036374]]
Iteration 423
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.061175221104689>
Acquisition function convergence reached at iteration 7861.
tf.Tensor(-77.78365603276639, shape=(), dtype=float64)
[[5.99126583e-01 9.99488243e-01 8.43104967e-01 2.84135999e-01
  4.78186871e-04 2.13057052e+00]]
Iteration 424
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.062009209255192>
Acquisition function convergence reached at iteration 7714.
tf.Tensor(-69.90897460485431, shape=(), dtype=float64)
[[7.83194876e-01 1.00500189e-04 6.66093364e-01 1.77297530e+00
  3.01463498e-04 3.75017305e+00]]
Iteration 425
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.062841139253375>
Acquisition function convergence reached at iteration 3426.
tf.Tensor(-80.52053369221572, shape=(), dtype=float64)
[[0.94938811 0.99937684 0.7860858  0.40196736 0.43118028 1.3713524 ]]
Iteration 426
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.063671021014935>
Acquisition function convergence reached at iteration 2953.
tf.Tensor(-78.22249810230053, shape=(), dtype=float64)
[[0.76271477 0.99945096 0.16218707 0.22595081 0.98521785 1.65613597]]
Iteration 427
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.064498864384652>
Acquisition function convergence reached at iteration 5771.
tf.Tensor(-77.31715610227025, shape=(), dtype=float64)
[[5.03258742e-01 1.43103826e-01 8.91188595e-01 2.96120390e-01
  1.33226406e-03 2.22634155e+00]]
Iteration 428
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.065324679137056>
Acquisition function convergence reached at iteration 3402.
tf.Tensor(-74.0296960288346, shape=(), dtype=float64)
[[0.47947219 0.99974814 0.96085776 0.35958623 0.75891566 2.03756884]]
Iteration 429
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.066148474977092>
Acquisition function convergence reached at iteration 2324.
tf.Tensor(-79.76227656518722, shape=(), dtype=float64)
[[0.84267192 0.618894   0.21393898 0.36101188 1.12047485 1.41989834]]
Iteration 430
```

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<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.066970261540782>
Acquisition function convergence reached at iteration 901.
tf.Tensor(-67.14588183869441, shape=(), dtype=float64)
[[0.74307872 0.16356139 0.67725382 1.64183152 0.64603433 3.55003177]]
Iteration 431
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.067790048395864>
Acquisition function convergence reached at iteration 3362.
tf.Tensor(-73.19240765908722, shape=(), dtype=float64)
[[0.89038075 0.9997385  0.76992221 1.73582466 0.00793039 3.40954076]]
Iteration 432
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.068607845042439>
Acquisition function convergence reached at iteration 5358.
tf.Tensor(-77.9932050028142, shape=(), dtype=float64)
[[3.64401762e-01 9.99944562e-01 1.46311565e-03 5.23495016e-01
  8.11594494e-04 1.80426303e+00]]
Iteration 433
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.0694236609136025>
Acquisition function convergence reached at iteration 3044.
tf.Tensor(-80.88304555058987, shape=(), dtype=float64)
[[0.82384414 0.99966359 1.07928829 0.22091184 1.21335823 1.02946114]]
Iteration 434
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.070237505376073>
Acquisition function convergence reached at iteration 7127.
tf.Tensor(-75.59408829255477, shape=(), dtype=float64)
[[2.74425433e-01 2.89417866e-03 1.37325712e-03 1.98411711e-01
  5.24820593e-02 2.60281545e+00]]
Iteration 435
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.071049387730808>
Acquisition function convergence reached at iteration 7593.
tf.Tensor(-72.06420794930848, shape=(), dtype=float64)
[[7.28887679e-01 3.86376672e-01 9.52411516e-04 1.87610284e+00
  2.05821196e-04 3.65443572e+00]]
Iteration 436
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.071859317213614>
Acquisition function convergence reached at iteration 4620.
tf.Tensor(-70.96217682277569, shape=(), dtype=float64)
[[7.28410091e-01 7.20474231e-01 2.41340255e-03 1.71997122e+00
  1.28383204e-03 4.41011142e+00]]
Iteration 437
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.072667302995757>
Acquisition function convergence reached at iteration 5567.
tf.Tensor(-64.51940673342611, shape=(), dtype=float64)
[[6.83096483e-01 6.69103300e-01 8.34090074e-04 1.27605310e+00
```

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  4.57787770e-01 4.05713974e+00]]
Iteration 438
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.073473354184556>
Acquisition function convergence reached at iteration 9374.
tf.Tensor(-77.39607868726729, shape=(), dtype=float64)
[[3.39085928e-01 1.76715941e-01 6.70691440e-04 3.08901501e-01
  7.80620572e-01 2.75109582e+00]]
Iteration 439
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.074277479823971>
Acquisition function convergence reached at iteration 765.
tf.Tensor(-77.95842463708453, shape=(), dtype=float64)
[[0.85819935 0.49971508 1.47320713 0.37588917 0.60062435 0.73251163]]
Iteration 440
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.075079688895192>
Acquisition function convergence reached at iteration 4926.
tf.Tensor(-79.92228719294508, shape=(), dtype=float64)
[[0.70963781 0.9993974  1.16476871 0.19477736 0.36373903 1.85188391]]
Iteration 441
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.0758799903172145>
Acquisition function convergence reached at iteration 6531.
tf.Tensor(-76.99629600553462, shape=(), dtype=float64)
[[0.49646881 0.55739826 0.91208863 0.00337956 0.29321243 0.7979048 ]]
Iteration 442
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.07667839294741>
Acquisition function convergence reached at iteration 2667.
tf.Tensor(-72.9860283506058, shape=(), dtype=float64)
[[0.57814042 0.5321335  0.96761186 0.10750133 0.10189498 1.33379897]]
Iteration 443
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.077474905582087>
Acquisition function convergence reached at iteration 2332.
tf.Tensor(-73.2870049795587, shape=(), dtype=float64)
[[0.87976372 0.99424422 0.95899491 0.32416851 0.40820673 0.87505144]]
Iteration 444
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.078269536957056>
Acquisition function convergence reached at iteration 5155.
tf.Tensor(-80.56162211628462, shape=(), dtype=float64)
[[0.37460949 0.53210194 1.05550958 0.00222297 0.35608375 1.14294288]]
Iteration 445
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.079062295748172>
Acquisition function convergence reached at iteration 1853.
tf.Tensor(-73.50488636625158, shape=(), dtype=float64)
[[0.74876879 0.81477133 1.04877798 0.16373864 0.36253851 1.11591756]]
Iteration 446
```

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<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.079853190571885>
Acquisition function convergence reached at iteration 1814.
tf.Tensor(-72.23833029344658, shape=(), dtype=float64)
[[0.83326419 0.83409633 1.10727667 0.3380516  0.06637462 1.05173262]]
Iteration 447
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.080642229985779>
Acquisition function convergence reached at iteration 2473.
tf.Tensor(-69.59513090903178, shape=(), dtype=float64)
[[0.83990641 0.48572184 0.80369666 0.10176517 0.40881486 0.8175077 ]]
Iteration 448
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.0814294224891015>
Acquisition function convergence reached at iteration 4037.
tf.Tensor(-70.52618495195567, shape=(), dtype=float64)
[[0.56869721 0.99893427 0.95780585 0.03661261 1.02631252 0.49224808]]
Iteration 449
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.082214776523293>
Acquisition function convergence reached at iteration 1439.
tf.Tensor(-68.44939439799722, shape=(), dtype=float64)
[[0.87901051 0.38239115 1.07098855 0.35326269 0.7658171  0.27660713]]
Iteration 450
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.082998300472509>
Acquisition function convergence reached at iteration 3214.
tf.Tensor(-69.42333858079789, shape=(), dtype=float64)
[[0.79250372 0.76973007 0.92540161 0.18333245 0.69312423 1.05019047]]
Trained parameters:
amplitude_champ:0 is 13.716

length_scales_champ:0 is [0.068 1.    0.11  0.608 1.    1.   ]

observation_noise_variance_champ:0 is 2.816

amp_f_mean:0 is 0.595

amp_gamma_L_mean:0 is 15.679

amp_lambda_mean:0 is 19.956

amp_r_mean:0 is 0.004

bias_mean:0 is 1.826

f_tp:0 is -2.401
```

```
gamma_L_tp:0 is -0.58

lambda_tp:0 is -0.675

r_tp:0 is 1.286

Iteration 451
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.083780002664129>
Acquisition function convergence reached at iteration 3053.
tf.Tensor(-71.33687099239253, shape=(), dtype=float64)
[[0.67068157 0.99235822 0.89991912 0.25596859 0.36409275 0.97617342]]
Iteration 452
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.084559891369275>
Acquisition function convergence reached at iteration 2390.
tf.Tensor(-69.4101231429359, shape=(), dtype=float64)
[[0.56685067 0.99263981 0.87021805 0.53496672 0.3744799  1.0111942 ]]
Iteration 453
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.085337974803305>
Acquisition function convergence reached at iteration 7322.
tf.Tensor(-73.62536094105553, shape=(), dtype=float64)
[[0.47755206 0.41931888 1.05783312 0.00136345 0.41715999 0.9029231 ]]
Iteration 454
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.08611426112632>
Acquisition function convergence reached at iteration 6320.
tf.Tensor(-70.06490048834823, shape=(), dtype=float64)
[[0.41595757 0.78081842 0.97964939 0.00176708 0.49490237 0.12113815]]
Iteration 455
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.08688875844365>
Acquisition function convergence reached at iteration 1991.
tf.Tensor(-68.03706141266895, shape=(), dtype=float64)
[[0.86720129 0.68811441 0.84827551 0.61969536 0.16552866 1.74304299]]
Iteration 456
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.087661474806347>
Acquisition function convergence reached at iteration 1429.
tf.Tensor(-64.85933057492741, shape=(), dtype=float64)
[[0.73669852 0.95179497 1.16918515 0.15019161 0.75391375 0.71486101]]
Iteration 457
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.088432418211659>
Acquisition function convergence reached at iteration 3729.
tf.Tensor(-66.19478695976579, shape=(), dtype=float64)
[[0.67730137 0.12902405 1.11290379 0.13066048 0.16266757 1.00943333]]
Iteration 458
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.089201596603512>
```

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Acquisition function convergence reached at iteration 6531.
tf.Tensor(-65.98162786379999, shape=(), dtype=float64)
[[0.6959006  0.54627322 1.08103454 0.01981065 1.19198457 1.37474996]]
Iteration 459
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.089969017872981>
Acquisition function convergence reached at iteration 4894.
tf.Tensor(-66.96518271211674, shape=(), dtype=float64)
[[0.91204773 0.17420713 0.87729959 0.13136192 0.00242283 1.11441586]]
Iteration 460
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.090734689858753>
Acquisition function convergence reached at iteration 381.
tf.Tensor(-66.4778944003002, shape=(), dtype=float64)
[[0.68541705 0.88328388 1.10039728 0.61698976 0.71137072 1.10021808]]
Hyperparameter convergence reached at iteration 9261.
Iteration 461
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.091498620347589>
Acquisition function convergence reached at iteration 8981.
tf.Tensor(-65.8938969212646, shape=(), dtype=float64)
[[0.40874653 0.41936346 1.11507761 0.0105862  0.00324143 0.02453716]]
Iteration 462
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.09226081707478>
Acquisition function convergence reached at iteration 1612.
tf.Tensor(-71.24321556744081, shape=(), dtype=float64)
[[0.76690873 0.17774182 1.14070499 0.01662194 0.63540078 1.44024759]]
Iteration 463
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.093021287724599>
Acquisition function convergence reached at iteration 5221.
tf.Tensor(-76.94688411229507, shape=(), dtype=float64)
[[0.3603738  0.16233679 0.80431054 0.00114989 0.629752   1.09450384]]
Iteration 464
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.093780039930745>
Acquisition function convergence reached at iteration 5882.
tf.Tensor(-64.82434171656875, shape=(), dtype=float64)
[[4.38676708e-01 9.99914243e-01 1.07700727e+00 3.42871200e-01
  3.31882841e-04 6.63399795e-01]]
Iteration 465
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.0945370812767825>
Acquisition function convergence reached at iteration 6275.
tf.Tensor(-63.37112560507838, shape=(), dtype=float64)
[[7.64100787e-01 9.99893580e-01 1.18993419e+00 4.30841976e-04
  5.79337869e-04 1.28368128e+00]]
Iteration 466
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.095292419296582>
```

```
Acquisition function convergence reached at iteration 7184.
tf.Tensor(-69.11561801949071, shape=(), dtype=float64)
[[3.58730937e-01 6.34262319e-05 9.88753575e-01 5.76863688e-04
  5.65670414e-01 7.49243695e-02]]
Iteration 467
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.096046061474748>
Acquisition function convergence reached at iteration 7763.
tf.Tensor(-61.80353528335355, shape=(), dtype=float64)
[[8.31245563e-01 9.92278408e-01 1.21001049e+00 1.03798820e-03
  8.01721590e-01 8.70059109e-01]]
Iteration 468
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.096798015247049>
Acquisition function convergence reached at iteration 977.
tf.Tensor(-61.333898820960364, shape=(), dtype=float64)
[[0.90724862 0.62888025 1.2588265  0.39851587 0.24704166 0.77588888]]
Iteration 469
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.0975482880008345>
Acquisition function convergence reached at iteration 6536.
tf.Tensor(-73.66745874361499, shape=(), dtype=float64)
[[6.28377685e-01 3.88464294e-02 9.72585143e-01 4.18216556e-04
  6.57278298e-01 4.76514598e-01]]
Iteration 470
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.098296887075459>
Acquisition function convergence reached at iteration 4518.
tf.Tensor(-70.87279901709809, shape=(), dtype=float64)
[[0.71376355 0.74176235 0.75991857 0.00731598 0.39170206 0.49908584]]
Iteration 471
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.09904381976269>
Acquisition function convergence reached at iteration 4982.
tf.Tensor(-70.1443007879388, shape=(), dtype=float64)
[[0.50666861 0.00145331 0.9803213  0.00202787 0.82889749 0.00647897]]
Iteration 472
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.099789093307119>
Acquisition function convergence reached at iteration 7264.
tf.Tensor(-67.53365070800098, shape=(), dtype=float64)
[[7.26337495e-01 4.61030572e-04 9.34510695e-01 3.87912678e-04
  6.40062090e-02 7.60459479e-01]]
Iteration 473
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.100532714906568>
Acquisition function convergence reached at iteration 6794.
tf.Tensor(-69.73281778643155, shape=(), dtype=float64)
[[0.77554699 0.99984789 0.6223165  0.00218292 0.44350466 0.07708056]]
Iteration 474
```

```
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.101274691712486>
Acquisition function convergence reached at iteration 8134.
tf.Tensor(-67.62323105703445, shape=(), dtype=float64)
[[7.53027106e-01 9.15657789e-02 1.03956524e+00 1.31035090e-04
  9.20849087e-01 4.42226192e-01]]
Iteration 475
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.102015030830345>
Acquisition function convergence reached at iteration 4876.
tf.Tensor(-67.957503510703, shape=(), dtype=float64)
[[0.41064799 0.26265227 1.09816555 0.00253966 1.16286903 0.2066626 ]]
Iteration 476
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.102753739320037>
Acquisition function convergence reached at iteration 4151.
tf.Tensor(-64.5451551467015, shape=(), dtype=float64)
[[0.76929221 0.21060206 1.14084267 0.00236022 0.00945296 0.32030313]]
Iteration 477
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.1034908241962516>
Acquisition function convergence reached at iteration 3693.
tf.Tensor(-63.770231660719354, shape=(), dtype=float64)
[[0.88843539 0.85827592 1.12031921 0.00921317 0.65216544 1.58673467]]
Iteration 478
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.104226292428869>
Acquisition function convergence reached at iteration 1258.
tf.Tensor(-62.37173882782237, shape=(), dtype=float64)
[[0.80895579 0.17674233 1.28122397 0.24409547 0.2577215  0.77989146]]
Iteration 479
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.104960150943335>
Acquisition function convergence reached at iteration 4760.
tf.Tensor(-66.06123364289083, shape=(), dtype=float64)
[[0.36519916 0.00752554 1.18008422 0.00396327 0.43256834 0.71636903]]
Iteration 480
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.105692406621037>
Acquisition function convergence reached at iteration 7751.
tf.Tensor(-61.872580975987056, shape=(), dtype=float64)
[[8.57477272e-01 9.99079347e-01 1.18866269e+00 2.01323890e-04
  4.17689628e-04 1.24129806e-01]]
Hyperparameter convergence reached at iteration 9267.
Iteration 481
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.106423066299674>
Acquisition function convergence reached at iteration 5394.
tf.Tensor(-59.06048797067581, shape=(), dtype=float64)
[[0.8635745  0.99925706 1.33942889 0.00526184 0.12872848 0.28710395]]
Iteration 482
```

```
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.107152136773626>
Acquisition function convergence reached at iteration 4965.
tf.Tensor(-64.75017895393376, shape=(), dtype=float64)
[[0.88995388 0.81368431 0.88200138 0.00344635 0.71092329 1.67706595]]
Iteration 483
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.107879624794318>
Acquisition function convergence reached at iteration 4135.
tf.Tensor(-68.30644878724175, shape=(), dtype=float64)
[[2.99447813e-01 7.78346729e-04 9.77206835e-01 1.40746565e-03
  1.49012885e-03 1.37079277e+00]]
Iteration 484
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.108605537070577>
Acquisition function convergence reached at iteration 3678.
tf.Tensor(-63.90574816640101, shape=(), dtype=float64)
[[0.30284029 0.24829561 1.09752453 0.00412879 0.64642849 1.54204029]]
Iteration 485
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.109329880268993>
Acquisition function convergence reached at iteration 8243.
tf.Tensor(-60.4723852863641, shape=(), dtype=float64)
[[8.85448994e-01 7.67774887e-02 1.27678427e+00 3.62403421e-04
  4.77570192e-01 9.02123213e-03]]
Iteration 486
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.110052661014263>
tf.Tensor(-61.18039089050282, shape=(), dtype=float64)
[[8.86742827e-01 2.47577218e-01 1.35592716e+00 5.26165615e-01
  5.26192557e-03 6.85459914e-04]]
Iteration 487
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.110773885889551>
Acquisition function convergence reached at iteration 907.
tf.Tensor(-64.76796783933943, shape=(), dtype=float64)
[[0.941629   0.61544164 0.95056976 0.52868829 0.3596899  1.69901278]]
Iteration 488
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.111493561436825>
Acquisition function convergence reached at iteration 1231.
tf.Tensor(-60.44833389729926, shape=(), dtype=float64)
[[0.94830955 0.29958889 1.12366421 0.61522717 0.47025993 1.41533287]]
Iteration 489
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.112211694157199>
Acquisition function convergence reached at iteration 9142.
tf.Tensor(-63.0162373687028, shape=(), dtype=float64)
[[9.26193218e-01 9.99754205e-01 1.22240850e+00 1.63905433e-04
  8.44607932e-01 4.10159629e-01]]
Iteration 490
```

```
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.112928290511276>
Acquisition function convergence reached at iteration 6844.
tf.Tensor(-66.23182312235068, shape=(), dtype=float64)
[[0.80515226 0.82465963 0.68157873 0.00233572 1.09567259 0.84322646]]
Iteration 491
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.113643356919477>
Acquisition function convergence reached at iteration 5026.
tf.Tensor(-63.26783483224589, shape=(), dtype=float64)
[[3.55914198e-01 9.98831183e-01 1.15666650e+00 1.10894970e-03
  8.93705566e-01 4.50720057e-01]]
Iteration 492
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.114356899762375>
Acquisition function convergence reached at iteration 4771.
tf.Tensor(-59.71118991891993, shape=(), dtype=float64)
[[0.90219508 0.99954977 1.16827419 0.5688093  1.11837885 1.17989455]]
Iteration 493
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.115068925381023>
Acquisition function convergence reached at iteration 4055.
tf.Tensor(-62.18284506222159, shape=(), dtype=float64)
[[0.88506992 0.49643448 1.32542536 0.00334284 1.01004461 0.90668708]]
Iteration 494
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.1157794400772785>
Acquisition function convergence reached at iteration 3288.
tf.Tensor(-61.926269448010714, shape=(), dtype=float64)
[[0.84466782 0.87469185 1.29183078 0.04634396 1.10115345 0.00356817]]
Iteration 495
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.1164884501141215>
Acquisition function convergence reached at iteration 6436.
tf.Tensor(-59.49164209886397, shape=(), dtype=float64)
[[0.92359332 0.99862862 1.35813981 0.00184427 0.93161214 0.01697406]]
Iteration 496
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.117195961715976>
Acquisition function convergence reached at iteration 3188.
tf.Tensor(-58.04522723465794, shape=(), dtype=float64)
[[0.89493968 0.99849085 1.31916287 0.50980093 1.25576364 0.39354695]]
Iteration 497
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.117901981069023>
Acquisition function convergence reached at iteration 4668.
tf.Tensor(-64.84587241249375, shape=(), dtype=float64)
[[8.85637946e-01 7.48969557e-03 1.17093464e+00 5.94855562e-04
  1.12067740e-01 9.82523911e-01]]
Iteration 498
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.1186065143215105>
```

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Acquisition function convergence reached at iteration 1917.
tf.Tensor(-65.52975873036728, shape=(), dtype=float64)
[[0.77812133 0.13073822 0.72586698 0.28062309 0.49565959 0.21076657]]
Iteration 499
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.119309567584065>
tf.Tensor(-61.484211690586804, shape=(), dtype=float64)
[[0.97491247 0.1531326  1.24693778 0.00301372 0.30790509 0.6679265 ]]
Iteration 500
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.120011146929995>
Acquisition function convergence reached at iteration 6256.
tf.Tensor(-61.28793333635405, shape=(), dtype=float64)
[[4.20455272e-01 3.61869137e-01 1.23013778e+00 1.99781618e-03
  7.03195925e-01 4.88473601e-04]]
Trained parameters:
amplitude_champ:0 is 13.113

length_scales_champ:0 is [0.071 1.    0.113 0.597 1.    1.   ]

observation_noise_variance_champ:0 is 2.878

amp_f_mean:0 is 0.511

amp_gamma_L_mean:0 is 15.378

amp_lambda_mean:0 is 18.8

amp_r_mean:0 is 0.007

bias_mean:0 is 2.144

f_tp:0 is -2.553

gamma_L_tp:0 is -0.687

lambda_tp:0 is -0.748

r_tp:0 is 2.191

Iteration 501
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.120711258395589>
Acquisition function convergence reached at iteration 3588.
tf.Tensor(-60.02974802814691, shape=(), dtype=float64)
[[0.81001804 0.0572649  1.18208498 0.00428131 1.0960405  0.32652079]]
```

```
Iteration 502
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.121409907980424>
Acquisition function convergence reached at iteration 3047.
tf.Tensor(-60.4933894023751, shape=(), dtype=float64)
[[0.92155461 0.00215347 1.19752875 0.01307671 1.15890392 0.97560115]]
Iteration 503
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.122107101647651>
Acquisition function convergence reached at iteration 7248.
tf.Tensor(-59.42870281179078, shape=(), dtype=float64)
[[9.52196150e-01 9.99711427e-01 1.34380355e+00 4.92303765e-04
  2.03346783e-01 8.99622965e-01]]
Iteration 504
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.122802845324294>
Acquisition function convergence reached at iteration 2982.
tf.Tensor(-57.378109046839946, shape=(), dtype=float64)
[[0.84859005 0.01115581 1.17186476 0.25221627 1.10874829 1.47974995]]
Iteration 505
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.12349714490154>
Acquisition function convergence reached at iteration 2375.
tf.Tensor(-54.01842350116478, shape=(), dtype=float64)
[[7.92441856e-01 1.07329278e-03 1.09673187e+00 4.09834759e-01
  5.72363302e-01 7.39237846e-01]]
Iteration 506
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.124190006235023>
Acquisition function convergence reached at iteration 8604.
tf.Tensor(-65.02555071229449, shape=(), dtype=float64)
[[8.37132756e-01 7.05395735e-01 9.63242264e-01 5.03296589e-04
  4.43171112e-04 1.59074468e+00]]
Iteration 507
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.124881435145111>
Acquisition function convergence reached at iteration 6539.
tf.Tensor(-58.5852389714851, shape=(), dtype=float64)
[[3.67380783e-01 7.99552787e-02 1.14427451e+00 4.38002861e-01
  7.10619730e-01 6.36388156e-04]]
Iteration 508
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.1255714374171895>
Acquisition function convergence reached at iteration 7831.
tf.Tensor(-60.826787793157564, shape=(), dtype=float64)
[[7.00427198e-01 3.41883640e-01 1.23999026e+00 4.29784795e-04
  4.87125454e-01 1.22551590e+00]]
Iteration 509
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.126260018801932>
Acquisition function convergence reached at iteration 5761.
```

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tf.Tensor(-59.62118348901756, shape=(), dtype=float64)
[[7.54817885e-01 9.98763713e-01 1.19442689e+00 9.05061250e-04
  1.22174394e+00 1.70347188e+00]]
Iteration 510
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.126947185015585>
Acquisition function convergence reached at iteration 3341.
tf.Tensor(-59.47687968118909, shape=(), dtype=float64)
[[0.76119082 0.96497991 1.31705102 0.00332967 0.7974228  0.54973123]]
Iteration 511
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.127632941740237>
Acquisition function convergence reached at iteration 7979.
tf.Tensor(-59.9025243365419, shape=(), dtype=float64)
[[7.67810800e-01 1.96713240e-01 1.26497203e+00 6.47352432e-04
  1.44110200e+00 9.46931552e-01]]
Iteration 512
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.12831729462409>
Acquisition function convergence reached at iteration 4276.
tf.Tensor(-58.39302658558703, shape=(), dtype=float64)
[[0.77615754 0.73096454 1.31072522 0.00833267 0.63090973 1.72108823]]
Iteration 513
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.129000249281724>
Acquisition function convergence reached at iteration 2100.
tf.Tensor(-56.20874888013166, shape=(), dtype=float64)
[[0.78068997 0.97910977 1.28447595 0.47005301 1.08510255 1.24388732]]
Iteration 514
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.129681811294368>
Acquisition function convergence reached at iteration 5138.
tf.Tensor(-59.419858795534346, shape=(), dtype=float64)
[[8.07967969e-01 6.43656400e-02 1.37360018e+00 7.90344017e-04
  9.98190980e-01 2.52129279e-01]]
Iteration 515
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.130361986210159>
Acquisition function convergence reached at iteration 7466.
tf.Tensor(-64.65063226666362, shape=(), dtype=float64)
[[5.70981900e-01 2.16235666e-01 1.09113426e+00 4.29695243e-04
  7.84127694e-01 8.11430879e-01]]
Iteration 516
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.1310407795444>
Acquisition function convergence reached at iteration 7175.
tf.Tensor(-59.450694025657484, shape=(), dtype=float64)
[[9.60719692e-01 9.43045789e-04 1.36789056e+00 1.49139922e-03
  8.21628151e-01 4.92651319e-01]]
Iteration 517
```

```
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.131718196779825>
Acquisition function convergence reached at iteration 5154.
tf.Tensor(-57.80832429373724, shape=(), dtype=float64)
[[7.48363066e-01 8.17658552e-02 1.38777655e+00 1.15791862e-03
  4.07822012e-01 1.00514419e+00]]
Iteration 518
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.132394243366845>
Acquisition function convergence reached at iteration 4969.
tf.Tensor(-68.59580180601539, shape=(), dtype=float64)
[[4.17984952e-01 2.77267819e-01 9.41432552e-01 1.02418354e-03
  1.16178519e+00 1.12039577e+00]]
Iteration 519
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.133068924723806>
Acquisition function convergence reached at iteration 3020.
tf.Tensor(-58.570501720607204, shape=(), dtype=float64)
[[0.80029088 0.9479465  1.41308178 0.00309281 0.1684211  0.99205967]]
Iteration 520
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.133742246237237>
Acquisition function convergence reached at iteration 1784.
tf.Tensor(-60.03287327188881, shape=(), dtype=float64)
[[0.73458434 0.20815652 1.28002476 0.01675889 0.14705536 0.02898424]]
Hyperparameter convergence reached at iteration 9600.
Iteration 521
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.134414213262099>
Acquisition function convergence reached at iteration 2800.
tf.Tensor(-58.339641845020275, shape=(), dtype=float64)
[[0.77230366 0.61322426 1.39900852 0.00613656 0.0236305  0.01062608]]
Iteration 522
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.135084831122029>
Acquisition function convergence reached at iteration 5246.
tf.Tensor(-60.051180420759955, shape=(), dtype=float64)
[[0.99651934 0.45010204 1.26692314 0.53324682 0.89708733 0.86895766]]
Iteration 523
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.135754105109583>
Acquisition function convergence reached at iteration 3980.
tf.Tensor(-57.018992627286586, shape=(), dtype=float64)
[[8.24942411e-01 9.99561837e-01 1.43675177e+00 1.36860083e-03
  8.84114360e-01 9.52223031e-03]]
Iteration 524
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.136422040486478>
Acquisition function convergence reached at iteration 4502.
tf.Tensor(-55.31876881390633, shape=(), dtype=float64)
[[9.34492252e-01 8.54574938e-01 1.47255958e+00 5.08709313e-04
```

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  4.02969138e-01 3.81582926e-01]]
Iteration 525
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.137088642483825>
Acquisition function convergence reached at iteration 2401.
tf.Tensor(-55.97240620380194, shape=(), dtype=float64)
[[0.73932747 0.69867848 1.46078659 0.01196975 0.89547981 0.36157474]]
Iteration 526
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.1377539163023735>
Acquisition function convergence reached at iteration 2131.
tf.Tensor(-59.04310797647758, shape=(), dtype=float64)
[[0.69949412 0.99638205 1.3663493  0.01943109 0.01790401 0.72345046]]
Iteration 527
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.138417867112738>
Acquisition function convergence reached at iteration 5150.
tf.Tensor(-59.83983114522566, shape=(), dtype=float64)
[[0.68853912 0.28453845 1.35085064 0.00247352 0.91507527 0.15019581]]
Iteration 528
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.1390805000556306>
Acquisition function convergence reached at iteration 691.
tf.Tensor(-57.671077927843434, shape=(), dtype=float64)
[[0.71398818 0.39799981 1.4020729  0.4727181  0.326249   0.17744065]]
Iteration 529
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.139741820242094>
Acquisition function convergence reached at iteration 7474.
tf.Tensor(-59.379497024711156, shape=(), dtype=float64)
[[9.99880508e-01 7.58620250e-01 1.35264982e+00 7.21633743e-02
  2.51052588e-01 4.00366433e-04]]
Iteration 530
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.140401832753724>
Acquisition function convergence reached at iteration 4854.
tf.Tensor(-65.12104757550586, shape=(), dtype=float64)
[[4.92836905e-01 6.83750885e-01 1.13183304e+00 8.02091439e-04
  9.74533100e-01 2.75991481e-03]]
Iteration 531
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.141060542642898>
Acquisition function convergence reached at iteration 2763.
tf.Tensor(-57.48952352268695, shape=(), dtype=float64)
[[0.99529199 0.79326821 1.42591115 0.39002213 0.72073386 0.67683714]]
Iteration 532
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.141717954932992>
Acquisition function convergence reached at iteration 8591.
tf.Tensor(-63.33479421252595, shape=(), dtype=float64)
[[4.78618382e-01 6.99167845e-05 1.19316482e+00 2.64574707e-04
```

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  2.57203263e-01 5.33235613e-01]]
Iteration 533
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.142374074618608>
Acquisition function convergence reached at iteration 4234.
tf.Tensor(-64.53059415596397, shape=(), dtype=float64)
[[0.65727542 0.35684844 1.17668176 0.00118863 0.65101013 0.00554401]]
Iteration 534
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.143028906665791>
Acquisition function convergence reached at iteration 5733.
tf.Tensor(-62.87384693749287, shape=(), dtype=float64)
[[6.36905589e-01 9.99779630e-01 1.21583360e+00 5.86916661e-04
  4.03187940e-03 7.08646534e-01]]
Iteration 535
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.14368245601224>
Acquisition function convergence reached at iteration 5364.
tf.Tensor(-61.083823056843315, shape=(), dtype=float64)
[[5.63730145e-01 5.66559894e-01 1.24104803e+00 8.83613130e-04
  5.54366264e-01 2.14276278e-01]]
Iteration 536
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.144334727567528>
Acquisition function convergence reached at iteration 5126.
tf.Tensor(-61.33514601157117, shape=(), dtype=float64)
[[0.55670791 0.97142888 1.13732028 0.00138455 0.01271058 1.08425481]]
Iteration 537
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.144985726213313>
Acquisition function convergence reached at iteration 4973.
tf.Tensor(-55.50057939822078, shape=(), dtype=float64)
[[8.96850929e-01 1.52038736e-01 1.45178659e+00 8.96863708e-04
  1.15351146e+00 5.67959612e-03]]
Iteration 538
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.145635456803547>
Acquisition function convergence reached at iteration 5346.
tf.Tensor(-55.95173810423569, shape=(), dtype=float64)
[[0.98926923 0.00275634 1.47415049 0.07261883 0.28504926 0.00418043]]
Iteration 539
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.146283924164688>
Acquisition function convergence reached at iteration 3162.
tf.Tensor(-62.061661818250435, shape=(), dtype=float64)
[[0.40790793 0.01044404 1.13202635 0.00315058 0.14177916 1.86008283]]
Iteration 540
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.146931133095901>
Acquisition function convergence reached at iteration 3717.
tf.Tensor(-62.07307483023463, shape=(), dtype=float64)
```

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[[0.4401244  0.17249403 1.17295238 0.0015057  1.20432742 1.14587308]]
Hyperparameter convergence reached at iteration 9832.
Iteration 541
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.1475770883692675>
Acquisition function convergence reached at iteration 6882.
tf.Tensor(-58.29668653972623, shape=(), dtype=float64)
[[5.27399152e-01 8.22114087e-01 1.21355024e+00 7.93946771e-04
  1.02423341e+00 1.10486089e+00]]
Iteration 542
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.148221794729983>
Acquisition function convergence reached at iteration 4763.
tf.Tensor(-59.921534467302564, shape=(), dtype=float64)
[[0.59441649 0.02089078 1.22343834 0.00137821 0.31747714 1.15572852]]
Iteration 543
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.148865256896563>
Acquisition function convergence reached at iteration 4182.
tf.Tensor(-60.563150426912976, shape=(), dtype=float64)
[[0.60267006 0.00175475 1.12848714 0.00127414 0.0022205  0.25143566]]
Iteration 544
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.149507479561041>
Acquisition function convergence reached at iteration 6110.
tf.Tensor(-57.057816277515585, shape=(), dtype=float64)
[[9.86834323e-01 5.77418809e-01 1.46116048e+00 9.68944704e-04
  1.24228894e+00 4.92382362e-04]]
Iteration 545
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.150148467389162>
Acquisition function convergence reached at iteration 562.
tf.Tensor(-53.883821211203866, shape=(), dtype=float64)
[[0.55086162 0.36979181 1.18017747 0.42806085 0.36643281 0.68889882]]
Iteration 546
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.150788225020579>
Acquisition function convergence reached at iteration 5496.
tf.Tensor(-60.10318335338201, shape=(), dtype=float64)
[[4.16015461e-01 2.57357094e-01 1.27836002e+00 8.82715104e-04
  2.65905485e-01 1.11539587e+00]]
Iteration 547
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.151426757069049>
Acquisition function convergence reached at iteration 3658.
tf.Tensor(-60.377102633197374, shape=(), dtype=float64)
[[4.80768515e-01 6.54736394e-01 1.30621151e+00 1.16497860e-03
  9.83174174e-01 4.50127864e-01]]
Iteration 548
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.152064068122622>
```

```
Acquisition function convergence reached at iteration 7170.
tf.Tensor(-56.154411048395225, shape=(), dtype=float64)
[[0.95381669 0.00270585 1.51297187 0.00395221 0.94021806 0.81827564]]
Iteration 549
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.152700162743832>
Acquisition function convergence reached at iteration 2248.
tf.Tensor(-56.87020746703966, shape=(), dtype=float64)
[[0.95902278 0.05426415 1.49206517 0.50079099 1.0017543  0.05006759]]
Iteration 550
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.153335045469884>
Acquisition function convergence reached at iteration 5724.
tf.Tensor(-64.87749461613754, shape=(), dtype=float64)
[[3.33385374e-01 8.21475992e-01 1.17359889e+00 4.85615567e-04
  4.01742500e-04 1.32177751e+00]]
Trained parameters:
amplitude_champ:0 is 12.832

length_scales_champ:0 is [0.073 1.    0.116 0.589 1.    1.   ]

observation_noise_variance_champ:0 is 2.925

amp_f_mean:0 is 0.423

amp_gamma_L_mean:0 is 15.372

amp_lambda_mean:0 is 17.985

amp_r_mean:0 is 0.007

bias_mean:0 is 2.123

f_tp:0 is -2.478

gamma_L_tp:0 is -0.66

lambda_tp:0 is -0.846

r_tp:0 is 2.078

Iteration 551
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.153968720812842>
Acquisition function convergence reached at iteration 5601.
tf.Tensor(-64.88906432813212, shape=(), dtype=float64)
```

```
[[3.43023068e-01 7.11496833e-01 9.43325926e-01 4.27720802e-04
  6.17084617e-01 2.01193906e+00]]
Iteration 552
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.154601193259812>
Acquisition function convergence reached at iteration 5270.
tf.Tensor(-59.92615120149754, shape=(), dtype=float64)
[[3.67826477e-01 9.99086398e-01 1.09647229e+00 1.25780245e-03
  5.45316939e-01 2.16051708e+00]]
Iteration 553
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.155232467273127>
Acquisition function convergence reached at iteration 3754.
tf.Tensor(-58.254574642741744, shape=(), dtype=float64)
[[3.66612744e-01 5.95450237e-01 1.21635118e+00 1.09265008e-03
  9.72834842e-01 1.51224335e+00]]
Iteration 554
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.155862547290524>
Acquisition function convergence reached at iteration 2587.
tf.Tensor(-56.729727483312516, shape=(), dtype=float64)
[[0.91957315 0.88247133 1.45705793 0.00579119 1.41975888 0.86159584]]
Iteration 555
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.156491437725331>
Acquisition function convergence reached at iteration 6573.
tf.Tensor(-58.67468915945765, shape=(), dtype=float64)
[[7.97639633e-01 5.84561714e-01 1.44666662e+00 9.49947210e-05
  1.34220588e+00 1.09866835e+00]]
Iteration 556
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.1571191429666365>
Acquisition function convergence reached at iteration 5507.
tf.Tensor(-56.60364808700855, shape=(), dtype=float64)
[[3.72324536e-01 9.99603748e-01 1.26386517e+00 4.43949619e-04
  5.51616259e-03 3.41214651e-01]]
Iteration 557
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.157745667379472>
Acquisition function convergence reached at iteration 4077.
tf.Tensor(-54.21488525388827, shape=(), dtype=float64)
[[0.9998455  0.82390587 1.55457828 0.00434265 0.58197534 0.56609362]]
Iteration 558
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.158371015304987>
Acquisition function convergence reached at iteration 1742.
tf.Tensor(-56.9078568770436, shape=(), dtype=float64)
[[0.39529586 0.9980545  1.29920978 0.00685641 1.09530481 0.67315463]]
Iteration 559
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.158995191060616>
```

```
Acquisition function convergence reached at iteration 4788.
tf.Tensor(-56.37609341583914, shape=(), dtype=float64)
[[9.05212166e-01 7.73275308e-01 1.57823646e+00 1.10377456e-03
  1.14369206e+00 2.92212395e-01]]
Iteration 560
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.159618198940258>
Acquisition function convergence reached at iteration 6683.
tf.Tensor(-59.13967341992315, shape=(), dtype=float64)
[[4.70167386e-01 9.99778308e-01 1.26828833e+00 2.38713357e-04
  1.92884913e-03 1.23734845e-03]]
Iteration 561
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.160240043214439>
Acquisition function convergence reached at iteration 6281.
tf.Tensor(-54.30016466993166, shape=(), dtype=float64)
[[9.04814468e-01 9.07666090e-01 1.55331618e+00 7.35712134e-04
  6.55857543e-01 1.34364171e+00]]
Iteration 562
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.160860728130489>
Acquisition function convergence reached at iteration 6267.
tf.Tensor(-55.851538413267676, shape=(), dtype=float64)
[[9.21968159e-01 2.09812298e-01 1.59873783e+00 7.50765179e-04
  1.08518405e-01 5.13700695e-01]]
Iteration 563
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.1614802579127>
Acquisition function convergence reached at iteration 9933.
tf.Tensor(-55.17943578170099, shape=(), dtype=float64)
[[4.23047023e-01 5.34315034e-01 1.37404493e+00 9.15671879e-04
  2.46285457e-01 1.30683442e-01]]
Iteration 564
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.1620986367625>
Acquisition function convergence reached at iteration 4074.
tf.Tensor(-63.33163556298584, shape=(), dtype=float64)
[[6.32253922e-01 9.07543641e-01 1.29636787e+00 7.47952946e-04
  1.08336811e+00 8.93303286e-01]]
Iteration 565
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.162715868858611>
Acquisition function convergence reached at iteration 1761.
tf.Tensor(-59.032875632440785, shape=(), dtype=float64)
[[0.56389783 0.98372761 1.34527536 0.00430183 0.21602216 0.92173727]]
Iteration 566
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.163331958357215>
Acquisition function convergence reached at iteration 1976.
tf.Tensor(-54.24633722982519, shape=(), dtype=float64)
```

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[[0.94455131 0.88407679 1.61042354 0.42154241 0.52682929 0.83209807]]
Iteration 567
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.163946909392114>
Acquisition function convergence reached at iteration 5005.
tf.Tensor(-59.27270988772395, shape=(), dtype=float64)
[[8.14914906e-01 4.68051321e-01 1.56330110e+00 8.73301937e-04
  6.36409528e-01 5.82054883e-01]]
Iteration 568
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.164560726074887>
Acquisition function convergence reached at iteration 3236.
tf.Tensor(-57.46908581639518, shape=(), dtype=float64)
[[0.46515634 0.99971731 1.35091339 0.00273237 0.09603562 1.00541317]]
Iteration 569
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.165173412495055>
Acquisition function convergence reached at iteration 8393.
tf.Tensor(-56.815388037663375, shape=(), dtype=float64)
[[8.66378153e-01 1.39519323e-04 1.53929555e+00 2.67641668e-04
  1.19922921e+00 1.01775427e+00]]
Iteration 570
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.165784972720233>
Acquisition function convergence reached at iteration 5390.
tf.Tensor(-53.778346270037886, shape=(), dtype=float64)
[[8.82673176e-01 3.27821502e-01 1.67014873e+00 1.17482394e-03
  7.89460054e-01 1.01670280e+00]]
Iteration 571
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.166395410796285>
Acquisition function convergence reached at iteration 6297.
tf.Tensor(-54.726572884535315, shape=(), dtype=float64)
[[0.96509488 0.05333468 1.6565519  0.00177523 0.96662352 0.46154612]]
Iteration 572
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.16700473074748>
Acquisition function convergence reached at iteration 3550.
tf.Tensor(-54.97533030384487, shape=(), dtype=float64)
[[0.83457408 0.99956386 1.57302361 0.0047115  1.41484336 1.02125651]]
Iteration 573
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.167612936576646>
Acquisition function convergence reached at iteration 3209.
tf.Tensor(-54.05389831723954, shape=(), dtype=float64)
[[0.36356782 0.9927881  1.3788104  0.00535567 0.26972497 1.03363235]]
Iteration 574
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.168220032265318>
Acquisition function convergence reached at iteration 8894.
tf.Tensor(-54.40476301896258, shape=(), dtype=float64)
```

```
[[0.43197284 0.99980007 1.44003137 0.00146394 0.88089161 0.80966491]]
Iteration 575
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.168826021773894>
Acquisition function convergence reached at iteration 3688.
tf.Tensor(-54.56847818768591, shape=(), dtype=float64)
[[0.41282481 0.99960565 1.38696916 0.46762333 0.42533874 0.67339373]]
Iteration 576
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.169430909041774>
Acquisition function convergence reached at iteration 3890.
tf.Tensor(-54.28444035719842, shape=(), dtype=float64)
[[8.73147294e-01 3.32870259e-04 1.64176694e+00 5.20469865e-03
  9.06224644e-01 1.31843399e-03]]
Iteration 577
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.170034697987517>
Acquisition function convergence reached at iteration 1486.
tf.Tensor(-53.54815329704467, shape=(), dtype=float64)
[[0.8931467  0.0736393  1.63456841 0.40743506 1.39639318 0.68040786]]
Iteration 578
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.170637392508984>
Acquisition function convergence reached at iteration 4893.
tf.Tensor(-59.125201428933984, shape=(), dtype=float64)
[[5.79127379e-01 3.36810213e-03 1.36070150e+00 4.75865912e-04
  8.42669248e-01 6.35274008e-01]]
Iteration 579
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.1712389964834795>
Acquisition function convergence reached at iteration 3405.
tf.Tensor(-59.95263315956082, shape=(), dtype=float64)
[[5.03083041e-01 4.10355634e-01 1.38997654e+00 9.70159165e-04
  8.69315603e-01 1.38716298e+00]]
Iteration 580
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.171839513767901>
Acquisition function convergence reached at iteration 2442.
tf.Tensor(-55.07466604589465, shape=(), dtype=float64)
[[0.87279308 0.9988216  1.67031511 0.01720421 0.29636148 0.18934674]]
Hyperparameter convergence reached at iteration 9599.
Iteration 581
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.172438948198879>
Acquisition function convergence reached at iteration 5757.
tf.Tensor(-62.88907002196045, shape=(), dtype=float64)
[[6.68536047e-01 4.96849322e-01 9.82170738e-01 6.15745130e-04
  5.73630340e-02 1.81485844e+00]]
Iteration 582
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.173037303592915>
```

```
Acquisition function convergence reached at iteration 3913.
tf.Tensor(-61.517455058440945, shape=(), dtype=float64)
[[5.03266706e-01 4.30669841e-02 1.36280794e+00 5.94954964e-04
  1.96546149e-02 3.84436487e-01]]
Iteration 583
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.173634583746526>
Acquisition function convergence reached at iteration 3720.
tf.Tensor(-59.102336811288936, shape=(), dtype=float64)
[[5.22344838e-01 7.94638104e-01 1.44698277e+00 9.93954295e-04
  7.72293882e-01 3.68900325e-01]]
Iteration 584
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.174230792436381>
Acquisition function convergence reached at iteration 8292.
tf.Tensor(-55.778405740052975, shape=(), dtype=float64)
[[9.55657433e-01 8.03162862e-01 1.69326010e+00 3.41407382e-04
  3.61364485e-01 2.43669972e-04]]
Iteration 585
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.174825933419439>
Acquisition function convergence reached at iteration 793.
tf.Tensor(-56.97847555390553, shape=(), dtype=float64)
[[0.85618962 0.94764478 1.00197468 0.45769999 0.75571841 2.04382504]]
Iteration 586
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.175420010433085>
Acquisition function convergence reached at iteration 5046.
tf.Tensor(-55.497653574039596, shape=(), dtype=float64)
[[8.07580990e-01 3.66303679e-01 1.52371380e+00 1.37915198e-03
  1.66627112e+00 1.07256463e-01]]
Iteration 587
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.176013027195268>
Acquisition function convergence reached at iteration 3790.
tf.Tensor(-54.53393150871829, shape=(), dtype=float64)
[[0.80742859 0.99739662 1.64642203 0.00438019 1.20386975 0.01084477]]
Iteration 588
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.1766049874046285>
Acquisition function convergence reached at iteration 4914.
tf.Tensor(-61.30546861580808, shape=(), dtype=float64)
[[6.21750937e-01 7.25016592e-01 1.12428013e+00 5.44423890e-04
  3.93466750e-01 1.90969707e+00]]
Iteration 589
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.177195894740639>
Acquisition function convergence reached at iteration 4478.
tf.Tensor(-52.53050174579742, shape=(), dtype=float64)
[[0.80068423 0.99972963 1.69317651 0.00497363 0.63213381 0.9425507 ]]
```

```
Iteration 590
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.1777857528637306>
Acquisition function convergence reached at iteration 3608.
tf.Tensor(-56.393797644841044, shape=(), dtype=float64)
[[0.74222069 0.9981464  1.5855631  0.00218043 1.23487608 0.81666982]]
Iteration 591
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.1783745654154245>
Acquisition function convergence reached at iteration 5215.
tf.Tensor(-55.993901531765765, shape=(), dtype=float64)
[[8.87102443e-01 8.73899067e-01 1.75096517e+00 1.69058784e-03
  1.13697051e+00 2.56945777e-01]]
Iteration 592
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.178962336018464>
Acquisition function convergence reached at iteration 3889.
tf.Tensor(-55.934317208621344, shape=(), dtype=float64)
[[0.82296534 0.26097828 1.75267727 0.01000084 0.52586294 0.1674926 ]]
Iteration 593
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.17954906827694>
Acquisition function convergence reached at iteration 6098.
tf.Tensor(-57.78501138972136, shape=(), dtype=float64)
[[0.91039111 0.04094839 1.76141056 0.00202765 0.25126014 0.24292818]]
Iteration 594
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.18013476577642>
Acquisition function convergence reached at iteration 2591.
tf.Tensor(-56.383683592584774, shape=(), dtype=float64)
[[0.8735388  0.56515615 1.73556057 0.49175734 0.47839207 0.1161803 ]]
Iteration 595
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.180719432084072>
Acquisition function convergence reached at iteration 5777.
tf.Tensor(-55.55226519928363, shape=(), dtype=float64)
[[9.42752801e-01 9.73878263e-01 1.72702710e+00 6.85517564e-04
  3.33573692e-01 1.02225170e+00]]
Iteration 596
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.181303070748795>
Acquisition function convergence reached at iteration 5385.
tf.Tensor(-64.30003044454725, shape=(), dtype=float64)
[[0.68571308 0.84567851 0.77895998 0.00300694 0.10042177 1.68557364]]
Iteration 597
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.181885685301334>
Acquisition function convergence reached at iteration 4964.
tf.Tensor(-58.690725499115466, shape=(), dtype=float64)
[[0.78741097 0.10570115 1.6665414  0.00196171 1.39145302 0.64237942]]
Iteration 598
```

```
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.182467279254414>
Acquisition function convergence reached at iteration 7174.
tf.Tensor(-59.59589580211984, shape=(), dtype=float64)
[[6.90520799e-01 9.99663348e-01 7.72121518e-01 1.02683862e-03
  1.22052100e+00 1.13609528e+00]]
Iteration 599
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.183047856102853>
Acquisition function convergence reached at iteration 455.
tf.Tensor(-50.47702941093514, shape=(), dtype=float64)
[[0.78785265 0.74576024 1.61252667 0.43117326 1.43957801 0.66929404]]
Iteration 600
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.183627419323687>
Acquisition function convergence reached at iteration 2709.
tf.Tensor(-56.71977633166852, shape=(), dtype=float64)
[[0.94304391 0.51293132 1.2365244  0.05973772 0.46649834 1.71199109]]
Trained parameters:
amplitude_champ:0 is 12.495

length_scales_champ:0 is [0.076 1.    0.121 0.572 1.    1.   ]

observation_noise_variance_champ:0 is 2.996

amp_f_mean:0 is 0.292

amp_gamma_L_mean:0 is 14.55

amp_lambda_mean:0 is 17.313

amp_r_mean:0 is 0.006

bias_mean:0 is 1.709

f_tp:0 is -2.317

gamma_L_tp:0 is -0.603

lambda_tp:0 is -0.956

r_tp:0 is 1.844

Iteration 601
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.18420597237629>
Acquisition function convergence reached at iteration 4515.
```

```
tf.Tensor(-58.299444079211625, shape=(), dtype=float64)
[[6.89203851e-01 8.72611809e-01 1.41536268e+00 7.78330775e-04
  9.05474795e-01 1.44404137e+00]]
Iteration 602
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.184783518702494>
Acquisition function convergence reached at iteration 2139.
tf.Tensor(-54.819115337723616, shape=(), dtype=float64)
[[0.74164052 0.4574029  1.66388852 0.0058695  0.53312341 0.1153931 ]]
Iteration 603
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.1853600617267>
Acquisition function convergence reached at iteration 4727.
tf.Tensor(-53.81386218148891, shape=(), dtype=float64)
[[7.54009404e-01 8.40029533e-01 1.76602334e+00 1.59083750e-03
  1.13758385e+00 2.87597697e-01]]
Iteration 604
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.185935604856007>
Acquisition function convergence reached at iteration 3720.
tf.Tensor(-53.620801777018045, shape=(), dtype=float64)
[[0.74540879 0.07348866 1.74479576 0.0036273  0.53047205 0.93897727]]
Iteration 605
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.186510151480316>
Acquisition function convergence reached at iteration 3718.
tf.Tensor(-53.98141705732842, shape=(), dtype=float64)
[[0.69227361 0.99151571 1.68529699 0.00440665 0.52172651 0.90898221]]
Iteration 606
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.187083704972452>
Acquisition function convergence reached at iteration 4081.
tf.Tensor(-57.626500271391734, shape=(), dtype=float64)
[[0.72531538 0.38743784 1.5703658  0.00168203 0.4064698  1.3449316 ]]
Iteration 607
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.1876562686882774>
Acquisition function convergence reached at iteration 5801.
tf.Tensor(-58.68402443667303, shape=(), dtype=float64)
[[6.25422024e-01 7.47183828e-01 1.51189078e+00 6.50126359e-04
  7.01584080e-01 8.85400067e-01]]
Iteration 608
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.188227845966803>
Acquisition function convergence reached at iteration 5763.
tf.Tensor(-58.50697480369422, shape=(), dtype=float64)
[[6.80780292e-01 7.60891117e-02 1.62005892e+00 7.02914115e-04
  1.12582717e+00 7.31658144e-01]]
Iteration 609
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.1887984401303004>
```

```
Acquisition function convergence reached at iteration 8517.
tf.Tensor(-54.51321057812841, shape=(), dtype=float64)
[[9.99672929e-01 1.46986892e-01 1.67930985e+00 1.08515673e-03
  6.84748505e-04 7.73577229e-01]]
Iteration 610
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.189368054484415>
Acquisition function convergence reached at iteration 2497.
tf.Tensor(-53.11262391310081, shape=(), dtype=float64)
[[0.67068084 0.22254275 1.75219953 0.01662905 0.79409069 0.2300998 ]]
Iteration 611
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.189936692318277>
Acquisition function convergence reached at iteration 487.
tf.Tensor(-53.38713865988993, shape=(), dtype=float64)
[[0.70004817 0.38664717 1.72094376 0.42465443 0.93225559 0.72122683]]
Iteration 612
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.190504356904605>
Acquisition function convergence reached at iteration 7533.
tf.Tensor(-53.366651140065784, shape=(), dtype=float64)
[[9.87948112e-01 3.79337743e-01 1.79590752e+00 6.41516076e-04
  7.11196666e-01 5.35378623e-01]]
Iteration 613
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.191071051499823>
Acquisition function convergence reached at iteration 3797.
tf.Tensor(-56.39092561118102, shape=(), dtype=float64)
[[0.57068766 0.99981227 1.41222245 0.00181042 1.40345339 1.05964368]]
Iteration 614
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.19163677934416>
Acquisition function convergence reached at iteration 5532.
tf.Tensor(-58.20587661997996, shape=(), dtype=float64)
[[6.23123690e-01 3.28811860e-01 1.37635289e+00 4.92146694e-04
  3.33171511e-01 1.58572305e+00]]
Iteration 615
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.1922015436617635>
Acquisition function convergence reached at iteration 3811.
tf.Tensor(-58.63825523153654, shape=(), dtype=float64)
[[0.66859206 0.0185387  1.44893537 0.00154586 1.46602944 0.96416018]]
Iteration 616
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.1927653476608>
Acquisition function convergence reached at iteration 6087.
tf.Tensor(-52.80837446197379, shape=(), dtype=float64)
[[8.39478932e-01 3.33993475e-01 1.82219130e+00 1.69769510e-04
  9.42385796e-01 1.00454437e+00]]
Iteration 617
```

```
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.1933281945335645>
Acquisition function convergence reached at iteration 4705.
tf.Tensor(-56.16266300161391, shape=(), dtype=float64)
[[5.60299524e-01 1.63574708e-03 1.51200759e+00 1.41374842e-03
  9.58693107e-01 1.10117470e+00]]
Iteration 618
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.19389008745658>
Acquisition function convergence reached at iteration 5743.
tf.Tensor(-54.159200523698274, shape=(), dtype=float64)
[[8.55249827e-01 9.99766662e-01 1.82120339e+00 1.70797661e-04
  9.41640478e-02 7.12113208e-01]]
Iteration 619
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.194451029590704>
Acquisition function convergence reached at iteration 4486.
tf.Tensor(-55.4033056498323, shape=(), dtype=float64)
[[6.45072514e-01 4.33149164e-04 1.52214527e+00 1.70719377e-03
  7.97916491e-01 1.70209036e+00]]
Iteration 620
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.195011024081231>
Acquisition function convergence reached at iteration 2100.
tf.Tensor(-55.57969290698208, shape=(), dtype=float64)
[[0.60903058 0.08305938 1.32590082 0.00753349 1.38571273 1.66048191]]
Iteration 621
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.1955700740579935>
Acquisition function convergence reached at iteration 4207.
tf.Tensor(-55.98810634493491, shape=(), dtype=float64)
[[5.36273905e-01 9.87788492e-01 1.49550727e+00 1.46812895e-03
  4.23536369e-01 1.44201535e+00]]
Iteration 622
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.1961281826354595>
Acquisition function convergence reached at iteration 6266.
tf.Tensor(-53.861911193870924, shape=(), dtype=float64)
[[9.23383324e-01 9.42821932e-02 1.81957562e+00 1.25156311e-03
  2.44065090e-01 1.25915594e+00]]
Iteration 623
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.196685352912839>
Acquisition function convergence reached at iteration 5335.
tf.Tensor(-55.2559368649092, shape=(), dtype=float64)
[[5.92473862e-01 6.00612748e-01 1.45471278e+00 1.26714751e-03
  1.13707200e+00 1.90520871e+00]]
Iteration 624
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.197241587974178>
Acquisition function convergence reached at iteration 659.
```

```
tf.Tensor(-48.4445123129006, shape=(), dtype=float64)
[[0.60280026 0.14963839 1.43959036 0.31353623 1.16490699 1.36264619]]
Iteration 625
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.1977968908884575>
Acquisition function convergence reached at iteration 5398.
tf.Tensor(-54.67168843493637, shape=(), dtype=float64)
[[8.62225440e-01 7.03785880e-01 1.26985480e+00 1.21932543e-03
  1.56930228e-03 1.62859295e+00]]
Iteration 626
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.198351264709695>
Acquisition function convergence reached at iteration 3637.
tf.Tensor(-57.84167646221853, shape=(), dtype=float64)
[[0.62766289 0.10889295 1.63848127 0.00170867 0.08913527 0.72657514]]
Iteration 627
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.198904712477034>
Acquisition function convergence reached at iteration 3138.
tf.Tensor(-56.77795348814704, shape=(), dtype=float64)
[[0.57694896 0.70772864 1.64374813 0.00285863 0.90772216 0.8151901 ]]
Iteration 628
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.199457237214848>
Acquisition function convergence reached at iteration 7638.
tf.Tensor(-56.676569477270746, shape=(), dtype=float64)
[[5.21308858e-01 2.57350864e-01 1.56165909e+00 2.79756070e-04
  8.28442219e-02 5.95257569e-01]]
Iteration 629
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.200008841932831>
Acquisition function convergence reached at iteration 8500.
tf.Tensor(-54.598524377946696, shape=(), dtype=float64)
[[9.16299898e-01 6.60540114e-01 1.88742159e+00 3.14943432e-04
  6.17063937e-01 5.11135642e-01]]
Iteration 630
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.200559529626092>
Acquisition function convergence reached at iteration 9696.
tf.Tensor(-52.13549122393838, shape=(), dtype=float64)
[[9.80645104e-01 3.01628952e-01 1.64276892e+00 6.29973448e-04
  7.19850796e-01 1.57415978e+00]]
Iteration 631
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.201109303275249>
Acquisition function convergence reached at iteration 4638.
tf.Tensor(-57.48844578847508, shape=(), dtype=float64)
[[5.93491029e-01 4.46567141e-02 1.59504470e+00 1.05141657e-03
  8.18639603e-01 2.24223779e-03]]
Iteration 632
```

```
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.201658165846525>
Acquisition function convergence reached at iteration 4231.
tf.Tensor(-58.37055445985903, shape=(), dtype=float64)
[[6.35996607e-01 9.87874215e-01 1.65153974e+00 1.02551996e-03
  4.56037509e-01 3.00631874e-03]]
Iteration 633
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.202206120291836>
Acquisition function convergence reached at iteration 4570.
tf.Tensor(-56.14697733680739, shape=(), dtype=float64)
[[0.90419681 0.00283537 1.39983902 0.00215694 0.11770662 1.42116677]]
Iteration 634
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.202753169548886>
Acquisition function convergence reached at iteration 507.
tf.Tensor(-57.58883003470357, shape=(), dtype=float64)
[[0.90521177 0.22088911 0.84655731 0.40427074 1.00121675 1.19952464]]
Iteration 635
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.203299316541252>
Acquisition function convergence reached at iteration 4992.
tf.Tensor(-55.38621255351392, shape=(), dtype=float64)
[[0.5754431  0.27279385 1.72797618 0.00238706 0.3078026  0.04515716]]
Iteration 636
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.203844564178483>
Acquisition function convergence reached at iteration 4777.
tf.Tensor(-52.07696111643405, shape=(), dtype=float64)
[[0.97585744 0.00252507 1.74053442 0.38965344 0.52864507 1.1772998 ]]
Iteration 637
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.204388915356181>
Acquisition function convergence reached at iteration 8735.
tf.Tensor(-57.438624484150395, shape=(), dtype=float64)
[[9.99901052e-01 2.10786564e-01 1.45469113e+00 1.62754333e-03
  3.01211214e-04 1.19820006e+00]]
Iteration 638
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.204932372956094>
Acquisition function convergence reached at iteration 3040.
tf.Tensor(-55.03044605917425, shape=(), dtype=float64)
[[0.54703395 0.99819966 1.6082074  0.00337634 0.24375924 0.01741558]]
Iteration 639
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.205474939846203>
Acquisition function convergence reached at iteration 7686.
tf.Tensor(-66.91680958518765, shape=(), dtype=float64)
[[8.57119405e-01 8.51491323e-01 5.63278075e-01 3.86071246e-04
  2.90391071e-01 8.75656095e-01]]
Iteration 640
```

```
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.206016618880809>
Acquisition function convergence reached at iteration 6386.
tf.Tensor(-60.289683513815866, shape=(), dtype=float64)
[[8.96006409e-01 9.99828059e-01 7.24718901e-01 7.76914259e-04
  1.45343177e-01 9.32783130e-01]]
Hyperparameter convergence reached at iteration 9456.
Iteration 641
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.206557412900619>
Acquisition function convergence reached at iteration 5547.
tf.Tensor(-56.36776575783057, shape=(), dtype=float64)
[[0.92861774 0.92891226 0.84221357 0.00227446 0.63848494 0.47477233]]
Iteration 642
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.207097324732833>
Acquisition function convergence reached at iteration 4470.
tf.Tensor(-56.1912769661533, shape=(), dtype=float64)
[[0.89724272 0.99936861 0.8197774  0.46512323 0.00453539 0.59782512]]
Iteration 643
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.207636357191227>
Acquisition function convergence reached at iteration 5545.
tf.Tensor(-53.79436818155405, shape=(), dtype=float64)
[[9.34209952e-01 4.16863483e-01 1.79103767e+00 1.30852031e-03
  1.27416171e+00 1.19561888e+00]]
Iteration 644
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.208174513076242>
Acquisition function convergence reached at iteration 6608.
tf.Tensor(-50.93600998413426, shape=(), dtype=float64)
[[8.94646484e-01 9.99827729e-01 1.84228802e+00 4.75898613e-04
  7.04813774e-01 1.48407658e+00]]
Iteration 645
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.208711795175062>
Acquisition function convergence reached at iteration 658.
tf.Tensor(-49.22434808248685, shape=(), dtype=float64)
[[0.5629767  0.42494798 1.64821119 0.40713772 0.23569115 0.3335124 ]]
Iteration 646
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.209248206261702>
Acquisition function convergence reached at iteration 6278.
tf.Tensor(-57.45121737474705, shape=(), dtype=float64)
[[9.59578064e-01 4.14933933e-01 1.00965350e+00 6.54812579e-04
  6.18458727e-01 1.10912764e+00]]
Iteration 647
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.2097837490970855>
Acquisition function convergence reached at iteration 5892.
tf.Tensor(-56.080946102126575, shape=(), dtype=float64)
```

```
[[7.14235115e-01 7.98696585e-01 1.79116048e+00 1.60293022e-04
  1.27697620e-03 1.51193431e-01]]
Iteration 648
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.210318426429134>
Acquisition function convergence reached at iteration 1619.
tf.Tensor(-50.580522180719534, shape=(), dtype=float64)
[[0.97097512 0.94009361 1.85735549 0.30553577 0.37374167 1.16111173]]
Iteration 649
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.21085224099284>
Acquisition function convergence reached at iteration 4613.
tf.Tensor(-56.081214292536785, shape=(), dtype=float64)
[[0.96078948 0.99992212 0.90882748 0.00349549 0.00181427 1.22213214]]
Iteration 650
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.211385195510354>
Acquisition function convergence reached at iteration 5176.
tf.Tensor(-54.128750286047435, shape=(), dtype=float64)
[[8.46019755e-01 3.24705650e-01 7.99953119e-01 1.23382704e+00
  2.03696310e-03 2.83441897e+00]]
Trained parameters:
amplitude_champ:0 is 12.291

length_scales_champ:0 is [0.079 1.    0.124 0.566 1.    1.   ]

observation_noise_variance_champ:0 is 3.058

amp_f_mean:0 is 0.323

amp_gamma_L_mean:0 is 13.784

amp_lambda_mean:0 is 17.347

amp_r_mean:0 is 0.007

bias_mean:0 is 1.988

f_tp:0 is -2.275

gamma_L_tp:0 is -0.589

lambda_tp:0 is -0.955

r_tp:0 is 1.621
```

```
Iteration 651
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.211917292691058>
Acquisition function convergence reached at iteration 5397.
tf.Tensor(-57.45244752737408, shape=(), dtype=float64)
[[3.01542678e-01 6.01436454e-01 1.29459690e+00 2.62468819e-04
  5.41616635e-01 8.62718130e-01]]
Iteration 652
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.212448535231652>
Acquisition function convergence reached at iteration 3638.
tf.Tensor(-54.70447820850748, shape=(), dtype=float64)
[[0.99569823 0.44426174 0.90212799 0.40747366 0.38019579 0.66656531]]
Iteration 653
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.21297892581623>
Acquisition function convergence reached at iteration 299.
tf.Tensor(-50.77802209774416, shape=(), dtype=float64)
[[0.91613226 0.34584291 1.87951045 0.4409167  0.84303131 1.17970522]]
Iteration 654
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.213508467116353>
Acquisition function convergence reached at iteration 7978.
tf.Tensor(-54.887455723903535, shape=(), dtype=float64)
[[9.81182862e-01 2.56082719e-04 1.32835303e+00 4.17439114e-01
  1.23055341e-03 1.36487967e+00]]
Iteration 655
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.214037161791135>
Acquisition function convergence reached at iteration 5615.
tf.Tensor(-50.11359873249212, shape=(), dtype=float64)
[[9.79237090e-01 8.08670054e-02 1.87315344e+00 2.82042327e-01
  1.68622189e-03 5.18090761e-01]]
Iteration 656
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.214565012487316>
Acquisition function convergence reached at iteration 5337.
tf.Tensor(-51.408475672730845, shape=(), dtype=float64)
[[9.89254259e-01 2.23426122e-01 1.90665013e+00 1.55735040e-03
  6.58678632e-01 1.34204936e+00]]
Iteration 657
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.215092021839337>
Acquisition function convergence reached at iteration 4927.
tf.Tensor(-55.16975252168408, shape=(), dtype=float64)
[[0.99969283 0.99955117 1.14029154 0.15637133 0.42154655 1.13810648]]
Iteration 658
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.215618192469416>
Acquisition function convergence reached at iteration 1484.
tf.Tensor(-54.788285756496194, shape=(), dtype=float64)
```

```
[[0.95843203 0.52926502 1.41536241 0.08599556 0.80069541 1.80423394]]
Iteration 659
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.216143526987626>
Acquisition function convergence reached at iteration 5572.
tf.Tensor(-51.87101506957718, shape=(), dtype=float64)
[[9.31613421e-01 6.99769372e-01 1.95020332e+00 2.84615778e-03
  1.27465014e-03 1.25248004e+00]]
Iteration 660
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.216668027991968>
Acquisition function convergence reached at iteration 9672.
tf.Tensor(-52.01765379372396, shape=(), dtype=float64)
[[9.99853422e-01 9.99946282e-01 1.90837651e+00 1.37415611e-04
  3.28537061e-04 5.52034744e-01]]
Hyperparameter convergence reached at iteration 9548.
Iteration 661
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.217191698068446>
Acquisition function convergence reached at iteration 807.
tf.Tensor(-51.051000884816176, shape=(), dtype=float64)
[[0.98405454 0.70965675 1.99486348 0.27320737 0.58665431 0.72074224]]
Iteration 662
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.217714539791136>
Acquisition function convergence reached at iteration 3692.
tf.Tensor(-51.86871575131943, shape=(), dtype=float64)
[[9.11630622e-01 8.01063162e-04 1.31387838e+00 3.92872693e-01
  8.35251420e-01 1.77653052e+00]]
Iteration 663
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.218236555722265>
Acquisition function convergence reached at iteration 5045.
tf.Tensor(-55.26500733088986, shape=(), dtype=float64)
[[0.70521273 0.99975516 0.69690212 0.41056926 0.51463499 1.29015564]]
Iteration 664
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.21875774841228>
Acquisition function convergence reached at iteration 2541.
tf.Tensor(-54.053506321110426, shape=(), dtype=float64)
[[0.96892701 0.99977952 0.93306235 0.26996431 1.19423012 1.15144235]]
Iteration 665
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.2192781203999195>
Acquisition function convergence reached at iteration 3431.
tf.Tensor(-52.92192145315262, shape=(), dtype=float64)
[[2.69232175e-01 1.20830977e-02 1.13607210e+00 8.28707547e-04
  7.94075354e-04 7.91114582e-01]]
Iteration 666
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.2197976742122885>
```

```
Acquisition function convergence reached at iteration 4545.
tf.Tensor(-50.78579247690834, shape=(), dtype=float64)
[[0.88602898 0.00799247 1.29592959 0.00202259 1.76071021 0.00780804]]
Iteration 667
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.220316412364924>
Acquisition function convergence reached at iteration 1876.
tf.Tensor(-53.6206008589788, shape=(), dtype=float64)
[[0.84719432 0.41020068 1.44121344 0.01624639 0.68279261 2.01491594]]
Iteration 668
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.220834337361867>
Acquisition function convergence reached at iteration 4904.
tf.Tensor(-52.220477279356444, shape=(), dtype=float64)
[[2.75388935e-01 9.99289884e-01 1.20669429e+00 3.06011454e-04
  2.14444338e-03 2.68944579e-01]]
Iteration 669
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.221351451695736>
Acquisition function convergence reached at iteration 4025.
tf.Tensor(-55.159057506662464, shape=(), dtype=float64)
[[0.99879347 0.99931816 1.04292427 0.65402424 0.7030873  0.79844055]]
Iteration 670
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.22186775784779>
Acquisition function convergence reached at iteration 8889.
tf.Tensor(-50.834631773313745, shape=(), dtype=float64)
[[9.61057329e-01 3.60369793e-04 1.99854464e+00 1.25159878e-03
  9.06598440e-02 4.97312428e-01]]
Iteration 671
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.222383258288001>
Acquisition function convergence reached at iteration 1443.
tf.Tensor(-54.00456371348643, shape=(), dtype=float64)
[[0.94393411 0.03839366 1.52507829 0.33458916 0.21303511 1.74108554]]
Iteration 672
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.222897955475122>
Acquisition function convergence reached at iteration 2615.
tf.Tensor(-51.82028440116605, shape=(), dtype=float64)
[[0.9518829  0.99955098 0.91011311 0.93436309 0.88769754 1.1297674 ]]
Iteration 673
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.223411851856752>
Acquisition function convergence reached at iteration 5949.
tf.Tensor(-54.61051552595492, shape=(), dtype=float64)
[[0.9998063  0.29105069 1.13373531 0.44228574 0.00338142 0.36630095]]
Iteration 674
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.2239249498694065>
Acquisition function convergence reached at iteration 5622.
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tf.Tensor(-54.11279040844325, shape=(), dtype=float64)
[[0.99961237 0.00348343 1.0892819  0.42066566 1.22600365 0.89834233]]
Iteration 675
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.224437251938581>
Acquisition function convergence reached at iteration 4940.
tf.Tensor(-55.81119655453987, shape=(), dtype=float64)
[[7.64263696e-01 9.99442691e-01 1.05021044e+00 1.11234073e-03
  7.79223931e-01 2.04614187e+00]]
Iteration 676
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.22494876047882>
Acquisition function convergence reached at iteration 4582.
tf.Tensor(-53.440867506911324, shape=(), dtype=float64)
[[2.66086694e-01 9.99322000e-01 1.15846534e+00 3.76187954e-04
  8.07537431e-01 9.77910595e-01]]
Iteration 677
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.225459477893779>
Acquisition function convergence reached at iteration 4747.
tf.Tensor(-52.819639756575775, shape=(), dtype=float64)
[[9.99570896e-01 5.90526932e-04 1.01104731e+00 9.60835028e-01
  5.73047868e-01 1.08749660e+00]]
Iteration 678
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.225969406576293>
Acquisition function convergence reached at iteration 4390.
tf.Tensor(-52.41787435150917, shape=(), dtype=float64)
[[9.99187028e-01 9.99676359e-01 1.22293336e+00 6.58692349e-01
  8.90593923e-04 1.05365292e+00]]
Iteration 679
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.226478548908439>
Acquisition function convergence reached at iteration 3995.
tf.Tensor(-54.33856683419737, shape=(), dtype=float64)
[[0.87937726 0.55419096 0.99725237 0.00200004 1.54097209 1.21221469]]
Iteration 680
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.226986907261602>
Acquisition function convergence reached at iteration 5295.
tf.Tensor(-53.04021405468358, shape=(), dtype=float64)
[[7.75827062e-01 3.54039583e-01 1.88916718e+00 3.22813361e-04
  2.96381602e-01 4.76096486e-01]]
Hyperparameter convergence reached at iteration 9600.
Iteration 681
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.227494483996537>
Acquisition function convergence reached at iteration 6760.
tf.Tensor(-52.4403710824892, shape=(), dtype=float64)
[[8.62973654e-01 1.16301033e-04 1.92993949e+00 3.95226668e-04
```

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  6.45205594e-04 6.50674844e-01]]
Iteration 682
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.228001281463431>
Acquisition function convergence reached at iteration 8030.
tf.Tensor(-60.55429563799788, shape=(), dtype=float64)
[[7.68245181e-01 8.64686945e-01 5.16830880e-01 6.71691401e-04
  1.02418155e+00 9.35327241e-01]]
Iteration 683
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.228507302001971>
Acquisition function convergence reached at iteration 7076.
tf.Tensor(-52.41549791329744, shape=(), dtype=float64)
[[9.99911980e-01 6.45912948e-04 1.10508587e+00 1.69673088e-01
  3.83116867e-04 1.44625735e+00]]
Iteration 684
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.229012547941398>
Acquisition function convergence reached at iteration 5338.
tf.Tensor(-51.815273226635206, shape=(), dtype=float64)
[[9.99831861e-01 9.86931741e-01 1.02777968e+00 4.01522130e-01
  4.04928948e-04 1.46970843e+00]]
Iteration 685
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.229517021600578>
Acquisition function convergence reached at iteration 3727.
tf.Tensor(-50.23090937220283, shape=(), dtype=float64)
[[0.91436441 0.23317535 1.52256433 0.01973681 1.34617917 1.9761177 ]]
Iteration 686
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.230020725288054>
Acquisition function convergence reached at iteration 6035.
tf.Tensor(-51.73791772699624, shape=(), dtype=float64)
[[9.11369652e-01 8.59329427e-01 1.99287839e+00 2.56819614e-01
  1.12689686e-03 2.32388192e-01]]
Iteration 687
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.230523661302117>
Acquisition function convergence reached at iteration 6111.
tf.Tensor(-48.48883621497514, shape=(), dtype=float64)
[[9.57937776e-01 9.79247026e-01 1.04274559e+00 1.10431449e+00
  4.62468800e-04 1.22582947e+00]]
Iteration 688
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.231025831930857>
Acquisition function convergence reached at iteration 8461.
tf.Tensor(-62.039375864920196, shape=(), dtype=float64)
[[5.72942264e-01 3.80231386e-01 4.98519119e-01 3.60661423e-04
  1.16039673e+00 1.22180514e+00]]
Iteration 689
```

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<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.231527239452229>
Acquisition function convergence reached at iteration 6970.
tf.Tensor(-64.0330165259337, shape=(), dtype=float64)
[[5.19075931e-01 8.54304139e-01 7.03086022e-01 5.02341344e-04
  3.65132000e-01 1.86656628e+00]]
Iteration 690
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.2320278861341105>
Acquisition function convergence reached at iteration 728.
tf.Tensor(-49.99734556281711, shape=(), dtype=float64)
[[0.90338741 0.8298425  1.4676927  0.44426947 1.01946556 1.8788194 ]]
Iteration 691
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.2325277742343586>
Acquisition function convergence reached at iteration 5501.
tf.Tensor(-51.53960298816137, shape=(), dtype=float64)
[[9.51608352e-01 1.65484040e-04 1.00940804e+00 4.52455968e-01
  3.19761347e-04 8.59603270e-01]]
Iteration 692
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.233026906000874>
Acquisition function convergence reached at iteration 5949.
tf.Tensor(-49.177595249415965, shape=(), dtype=float64)
[[0.99934322 0.00122211 1.1409414  0.91162364 0.96864074 0.2624114 ]]
Iteration 693
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.2335252836716535>
Acquisition function convergence reached at iteration 7543.
tf.Tensor(-52.2738824065659, shape=(), dtype=float64)
[[2.60846914e-01 6.69973519e-01 1.12623123e+00 4.64172373e-04
  5.25441498e-04 2.06975041e+00]]
Iteration 694
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.234022909474853>
Acquisition function convergence reached at iteration 5971.
tf.Tensor(-51.576035430347694, shape=(), dtype=float64)
[[2.51385397e-01 9.99887125e-01 1.26408454e+00 4.38049342e-04
  1.76028540e-03 1.44273673e+00]]
Iteration 695
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.23451978562884>
Acquisition function convergence reached at iteration 1560.
tf.Tensor(-52.03020634123748, shape=(), dtype=float64)
[[0.96552438 0.66065718 1.07914304 0.20278407 1.41591044 1.74929241]]
Iteration 696
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.235015914342254>
Acquisition function convergence reached at iteration 5246.
tf.Tensor(-51.739065763416846, shape=(), dtype=float64)
[[0.8959418  0.22563943 2.01236516 0.00209921 0.83099509 0.97786227]]
```

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Iteration 697
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.235511297814061>
Acquisition function convergence reached at iteration 775.
tf.Tensor(-52.16129884753828, shape=(), dtype=float64)
[[0.93488798 0.18346855 1.0064907  0.61461075 1.53963183 1.36923566]]
Iteration 698
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.236005938233613>
Acquisition function convergence reached at iteration 4969.
tf.Tensor(-51.298634291161015, shape=(), dtype=float64)
[[9.27386681e-01 1.32309513e-03 2.00759734e+00 4.36041007e-01
  1.07669023e-01 1.09756768e+00]]
Iteration 699
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.236499837780698>
Acquisition function convergence reached at iteration 5506.
tf.Tensor(-51.280860507892896, shape=(), dtype=float64)
[[0.99985914 0.88341745 1.09302928 0.86639407 0.97625787 1.81532504]]
Iteration 700
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.236992998625603>
Acquisition function convergence reached at iteration 1993.
tf.Tensor(-96.85666592872681, shape=(), dtype=float64)
[[0.92407651 0.72953373 0.12128729 0.94266116 0.6416976  1.1332307 ]]
Hyperparameter convergence reached at iteration 9236.
Trained parameters:
amplitude_champ:0 is 12.048

length_scales_champ:0 is [0.08  1.    0.129 0.575 1.    1.   ]

observation_noise_variance_champ:0 is 3.148

amp_f_mean:0 is 0.276

amp_gamma_L_mean:0 is 12.686

amp_lambda_mean:0 is 16.836

amp_r_mean:0 is 0.007

bias_mean:0 is 1.923

f_tp:0 is -2.253

gamma_L_tp:0 is -0.581
```

```
lambda_tp:0 is -1.008

r_tp:0 is 1.444

Iteration 701
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.237485422929162>
Acquisition function convergence reached at iteration 6137.
tf.Tensor(-76.92184172437871, shape=(), dtype=float64)
[[0.88914711 0.9997127  0.17532608 0.40216656 0.09764995 0.34615681]]
Iteration 702
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.237977112842812>
Acquisition function convergence reached at iteration 3732.
tf.Tensor(-52.28168164282287, shape=(), dtype=float64)
[[0.95578452 0.99943699 1.08133741 0.00932436 1.55649762 0.68172712]]
Iteration 703
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.238468070508653>
Acquisition function convergence reached at iteration 6293.
tf.Tensor(-65.0733015365702, shape=(), dtype=float64)
[[9.43074854e-01 7.86516451e-01 2.49017134e-01 9.48213237e-01
  6.26544489e-04 9.20279859e-01]]
Iteration 704
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.238958298059494>
Acquisition function convergence reached at iteration 5928.
tf.Tensor(-50.51698067783613, shape=(), dtype=float64)
[[1.92979324e-01 6.05369285e-01 1.16670081e+00 3.39878508e-04
  9.32309187e-02 1.09773071e+00]]
Iteration 705
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.239447797618909>
Acquisition function convergence reached at iteration 6304.
tf.Tensor(-50.70020458563447, shape=(), dtype=float64)
[[2.18333253e-01 1.82530402e-01 1.28495420e+00 1.15047729e-03
  2.07138762e-03 6.38724146e-01]]
Iteration 706
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.239936571301293>
Acquisition function convergence reached at iteration 4283.
tf.Tensor(-53.20122531310935, shape=(), dtype=float64)
[[7.50775816e-01 6.03914208e-04 1.51790589e+00 1.18895915e-03
  1.30101749e+00 1.66795031e+00]]
Iteration 707
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.240424621211912>
Acquisition function convergence reached at iteration 2790.
tf.Tensor(-52.16856060664417, shape=(), dtype=float64)
[[0.82295686 0.36621484 1.60296962 0.00887624 0.81154921 1.99959569]]
```

```
Iteration 708
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.2409119494469545>
Acquisition function convergence reached at iteration 5719.
tf.Tensor(-48.28582694785983, shape=(), dtype=float64)
[[9.40929262e-01 7.39650483e-01 2.10112937e+00 1.58047008e-03
  2.20571840e-01 8.71941859e-01]]
Iteration 709
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.241398558093586>
Acquisition function convergence reached at iteration 7498.
tf.Tensor(-58.35772044804441, shape=(), dtype=float64)
[[6.53046951e-01 2.45269837e-02 5.19253636e-01 5.14153779e-04
  6.43117071e-01 2.23804360e-01]]
Iteration 710
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.241884449229997>
Acquisition function convergence reached at iteration 4539.
tf.Tensor(-50.27123304415211, shape=(), dtype=float64)
[[0.99961232 0.99972965 1.1453716  0.48750677 1.71256219 1.02000908]]
Iteration 711
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.242369624925459>
Acquisition function convergence reached at iteration 5392.
tf.Tensor(-52.03653946055569, shape=(), dtype=float64)
[[8.73180594e-01 3.41564324e-04 1.38688618e+00 2.22851455e-03
  1.70469568e+00 1.57288576e+00]]
Iteration 712
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.24285408724037>
Acquisition function convergence reached at iteration 6791.
tf.Tensor(-52.974980379399554, shape=(), dtype=float64)
[[8.33045385e-01 9.98925969e-01 1.97620245e+00 8.98872303e-04
  4.23061569e-01 9.92454694e-01]]
Iteration 713
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.243337838226309>
Acquisition function convergence reached at iteration 5347.
tf.Tensor(-50.00525384835552, shape=(), dtype=float64)
[[9.74216536e-01 3.66520418e-03 8.21241397e-01 5.84757517e-01
  9.65532745e-04 1.67108444e+00]]
Iteration 714
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.2438208799260835>
Acquisition function convergence reached at iteration 2799.
tf.Tensor(-49.692265567815355, shape=(), dtype=float64)
[[8.42781363e-01 1.35910956e-03 1.49819043e+00 3.59560853e-01
  1.33948692e+00 1.94860458e+00]]
Iteration 715
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.24430321437378>
```

```
Acquisition function convergence reached at iteration 2925.
tf.Tensor(-53.05297614352355, shape=(), dtype=float64)
[[0.79506182 0.57484228 1.8463774  0.0061079  0.01531184 1.49705214]]
Iteration 716
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.2447848435948154>
Acquisition function convergence reached at iteration 5081.
tf.Tensor(-51.14497592003078, shape=(), dtype=float64)
[[0.85547045 0.2876761  2.08247026 0.00214064 0.00897861 0.68205066]]
Iteration 717
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.245265769605983>
Acquisition function convergence reached at iteration 5482.
tf.Tensor(-51.851022528035095, shape=(), dtype=float64)
[[8.49047650e-01 5.68335169e-01 1.39242689e+00 9.26681492e-04
  2.11599536e+00 3.27633121e-01]]
Iteration 718
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.245745994415501>
Acquisition function convergence reached at iteration 958.
tf.Tensor(-50.5502636795323, shape=(), dtype=float64)
[[0.90566563 0.63371706 1.69472213 0.19913358 0.65586007 2.14377497]]
Iteration 719
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.246225520023066>
Acquisition function convergence reached at iteration 3401.
tf.Tensor(-53.739589793359706, shape=(), dtype=float64)
[[0.8289322  0.00586954 1.70590254 0.00414383 0.00348929 1.46264467]]
Iteration 720
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.246704348419894>
Acquisition function convergence reached at iteration 3504.
tf.Tensor(-49.69459074849446, shape=(), dtype=float64)
[[0.88726973 0.99780979 2.05926595 0.34005516 0.4495942  1.26309367]]
Hyperparameter convergence reached at iteration 9335.
Iteration 721
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.247182481588772>
Acquisition function convergence reached at iteration 6555.
tf.Tensor(-51.5449463964011, shape=(), dtype=float64)
[[8.51138650e-01 9.99931244e-01 1.66066661e+00 1.04326394e-03
  3.33472046e-04 1.80151314e+00]]
Iteration 722
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.247659921504105>
Acquisition function convergence reached at iteration 4500.
tf.Tensor(-49.54753198814746, shape=(), dtype=float64)
[[9.17105490e-01 7.50179838e-04 9.04626034e-01 9.55799677e-01
  1.09271386e-03 1.37929177e+00]]
Iteration 723
```

```
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.248136670131961>
Acquisition function convergence reached at iteration 6028.
tf.Tensor(-48.05746664944134, shape=(), dtype=float64)
[[0.99934134 0.85298312 1.06561003 1.07133937 1.63374974 0.89696645]]
Iteration 724
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.248612729430124>
Acquisition function convergence reached at iteration 3683.
tf.Tensor(-52.21700266127493, shape=(), dtype=float64)
[[0.89904506 0.05379758 1.61687215 0.00245544 0.01120943 1.95387418]]
Iteration 725
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.24908810134813>
Acquisition function convergence reached at iteration 6077.
tf.Tensor(-50.17629551209757, shape=(), dtype=float64)
[[9.02290792e-01 3.80270415e-01 2.07712051e+00 9.31229496e-04
  7.03354850e-01 7.01768327e-03]]
Iteration 726
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.249562787827322>
Acquisition function convergence reached at iteration 2975.
tf.Tensor(-55.60569662928656, shape=(), dtype=float64)
[[0.58701467 0.99699696 1.28770388 0.00222734 0.74923767 1.98915678]]
Iteration 727
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.250036790800891>
Acquisition function convergence reached at iteration 4141.
tf.Tensor(-49.87961624401758, shape=(), dtype=float64)
[[0.87044493 0.62957824 1.78460315 0.35996145 0.00355977 1.76676139]]
Iteration 728
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.250510112193924>
Acquisition function convergence reached at iteration 7060.
tf.Tensor(-56.326855844059665, shape=(), dtype=float64)
[[0.89086348 0.00134463 0.68194434 0.00474817 0.47618229 1.30554706]]
Iteration 729
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.250982753923446>
Acquisition function convergence reached at iteration 2779.
tf.Tensor(-49.87366649626191, shape=(), dtype=float64)
[[0.85736777 0.69558869 1.54252728 0.3427501  0.01393922 2.01496394]]
Iteration 730
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.2514547178984685>
Acquisition function convergence reached at iteration 4242.
tf.Tensor(-48.58916713666137, shape=(), dtype=float64)
[[0.99906946 0.99979484 1.17502509 1.10049148 0.87852317 0.94212139]]
Iteration 731
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.251926006020029>
Acquisition function convergence reached at iteration 518.
```

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tf.Tensor(-45.56364218902613, shape=(), dtype=float64)
[[0.94030885 0.72808083 1.04907146 1.33964674 1.01513484 1.56532964]]
Iteration 732
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.252396620181242>
tf.Tensor(-51.21622244652145, shape=(), dtype=float64)
[[9.61271587e-01 9.99746508e-01 1.54968605e+00 9.19037130e-03
  4.41530092e-04 1.96306913e+00]]
Iteration 733
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.2528665622673385>
Acquisition function convergence reached at iteration 4829.
tf.Tensor(-54.684824131549995, shape=(), dtype=float64)
[[8.66324819e-01 5.99738332e-01 1.18523040e+00 1.41955554e-03
  2.04851783e+00 9.31811016e-01]]
Iteration 734
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.253335834155705>
Acquisition function convergence reached at iteration 1743.
tf.Tensor(-44.95511176338175, shape=(), dtype=float64)
[[0.95066234 0.5411521  1.03628438 1.28527218 0.7718155  0.40217031]]
Iteration 735
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.253804437715938>
Acquisition function convergence reached at iteration 5316.
tf.Tensor(-51.1588786923895, shape=(), dtype=float64)
[[1.99090811e-01 9.99455700e-01 1.27724155e+00 5.84906389e-04
  6.45064825e-01 5.52730360e-01]]
Iteration 736
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.254272374809878>
Acquisition function convergence reached at iteration 8446.
tf.Tensor(-53.699359115712, shape=(), dtype=float64)
[[2.08724344e-01 3.64158421e-01 1.15455601e+00 2.88267014e-04
  5.59698278e-01 9.53541966e-03]]
Iteration 737
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.254739647291653>
Acquisition function convergence reached at iteration 5411.
tf.Tensor(-52.07172744288195, shape=(), dtype=float64)
[[0.9995518  0.20262709 1.01172632 0.98866856 0.0021204  2.01192411]]
Iteration 738
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.2552062570077265>
Acquisition function convergence reached at iteration 5171.
tf.Tensor(-54.7369705064024, shape=(), dtype=float64)
[[4.84862122e-01 7.17027958e-01 1.56277942e+00 3.45687080e-04
  1.15077673e+00 7.90313605e-01]]
Iteration 739
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.255672205796933>
```

```
Acquisition function convergence reached at iteration 4189.
tf.Tensor(-52.13126785193941, shape=(), dtype=float64)
[[9.99837717e-01 2.59250390e-04 1.17165488e+00 9.78860115e-01
  4.54098150e-03 1.38799171e+00]]
Iteration 740
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.256137495490524>
Acquisition function convergence reached at iteration 5786.
tf.Tensor(-52.126375013789435, shape=(), dtype=float64)
[[8.30810001e-01 4.64852519e-01 1.97425800e+00 6.09026246e-04
  8.60763634e-01 8.33465662e-03]]
Iteration 741
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.256602127912206>
Acquisition function convergence reached at iteration 4337.
tf.Tensor(-52.38849153653309, shape=(), dtype=float64)
[[0.9235431  0.99851577 1.39174079 0.31097615 0.00218315 1.87754006]]
Iteration 742
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.257066104878186>
Acquisition function convergence reached at iteration 7516.
tf.Tensor(-50.13866066013247, shape=(), dtype=float64)
[[1.59701926e-01 8.86527415e-01 1.22142135e+00 7.50696309e-04
  1.97083636e-04 6.78416002e-03]]
Iteration 743
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.257529428197209>
Acquisition function convergence reached at iteration 4027.
tf.Tensor(-53.194620018207495, shape=(), dtype=float64)
[[6.78128061e-01 4.76944259e-01 1.25782191e+00 1.84994927e-03
  9.50156571e-01 2.28140773e+00]]
Iteration 744
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.2579920996706>
Acquisition function convergence reached at iteration 7094.
tf.Tensor(-49.01878522310178, shape=(), dtype=float64)
[[9.25375641e-01 9.99872491e-01 1.19973157e+00 5.54866981e-01
  5.85739369e-04 2.07214038e+00]]
Iteration 745
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.258454121092305>
Acquisition function convergence reached at iteration 2775.
tf.Tensor(-49.16621453443577, shape=(), dtype=float64)
[[0.98455293 0.99508583 1.30008952 0.57557506 0.74358824 2.00007883]]
Iteration 746
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.258915494248927>
Acquisition function convergence reached at iteration 4775.
tf.Tensor(-49.19430090663147, shape=(), dtype=float64)
[[8.51327885e-01 7.81319298e-04 2.02429417e+00 3.79956173e-01
```

```
  5.62598167e-01 3.14547567e-01]]
Iteration 747
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.259376220919773>
Acquisition function convergence reached at iteration 4026.
tf.Tensor(-49.19610073814447, shape=(), dtype=float64)
[[0.99881083 0.99928474 1.53631591 0.34127554 0.84977457 1.8085511 ]]
Iteration 748
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.259836302876887>
tf.Tensor(-50.44154316386395, shape=(), dtype=float64)
[[9.99915964e-01 9.99872115e-01 1.45402771e+00 5.11740357e-01
  1.19642580e-04 1.50098282e+00]]
Iteration 749
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.260295741885095>
Acquisition function convergence reached at iteration 6059.
tf.Tensor(-50.51125176192025, shape=(), dtype=float64)
[[1.35805883e-01 8.26303158e-02 1.23708205e+00 8.09859101e-04
  5.46787210e-01 4.81829210e-01]]
Iteration 750
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.260754539702036>
Acquisition function convergence reached at iteration 5799.
tf.Tensor(-47.08609789286092, shape=(), dtype=float64)
[[9.35336939e-01 5.47877142e-04 2.15640174e+00 1.33538857e-03
  1.49290018e-03 2.22005221e-01]]
Trained parameters:
amplitude_champ:0 is 11.883

length_scales_champ:0 is [0.081 1.    0.132 0.575 1.    1.   ]

observation_noise_variance_champ:0 is 3.213

amp_f_mean:0 is 0.297

amp_gamma_L_mean:0 is 12.225

amp_lambda_mean:0 is 16.643

amp_r_mean:0 is 0.005

bias_mean:0 is 1.343

f_tp:0 is -2.31

gamma_L_tp:0 is -0.603
```

```
lambda_tp:0 is -1.012

r_tp:0 is 1.444

Iteration 751
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.261212698078211>
Acquisition function convergence reached at iteration 7833.
tf.Tensor(-49.39601997817297, shape=(), dtype=float64)
[[8.86716548e-01 9.99306771e-01 2.14782095e+00 4.00666733e-04
  1.20021400e-03 3.51373066e-03]]
Iteration 752
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.261670218757013>
Acquisition function convergence reached at iteration 5504.
tf.Tensor(-49.510396428783956, shape=(), dtype=float64)
[[8.85221069e-01 4.97438529e-01 2.20379373e+00 7.64553757e-04
  6.50175985e-01 5.47613005e-01]]
Iteration 753
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.262127103474769>
Acquisition function convergence reached at iteration 1394.
tf.Tensor(-47.889391272297104, shape=(), dtype=float64)
[[0.94649887 0.65937433 1.34750912 0.97372155 0.09025954 1.65474594]]
Iteration 754
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.262583353960777>
Acquisition function convergence reached at iteration 6967.
tf.Tensor(-53.22550298639187, shape=(), dtype=float64)
[[7.37576629e-01 6.49669770e-01 1.21215660e+00 2.87303582e-04
  1.59546003e+00 2.32858807e-04]]
Iteration 755
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.263038971937347>
Acquisition function convergence reached at iteration 3355.
tf.Tensor(-53.67307550860181, shape=(), dtype=float64)
[[9.59503104e-01 6.07332491e-01 1.28800885e+00 1.52083693e-03
  1.97534807e+00 7.71818591e-01]]
Iteration 756
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.263493959119833>
Acquisition function convergence reached at iteration 1377.
tf.Tensor(-50.44293391413315, shape=(), dtype=float64)
[[0.16476729 0.51856111 1.24946429 0.46087626 0.18571337 0.51756204]]
Iteration 757
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.263948317216672>
Acquisition function convergence reached at iteration 2944.
tf.Tensor(-53.02184133637053, shape=(), dtype=float64)
```

```
[[0.91251476 0.89561146 1.25576774 0.0079258  1.64448888 1.81130418]]
Iteration 758
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.264402047929424>
Acquisition function convergence reached at iteration 6335.
tf.Tensor(-50.46206930014545, shape=(), dtype=float64)
[[0.9686474  0.87670663 2.16823086 0.0037041  0.58302021 0.00417287]]
Iteration 759
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.264855152952806>
Acquisition function convergence reached at iteration 5975.
tf.Tensor(-53.09766024808664, shape=(), dtype=float64)
[[2.99829480e-01 6.34238589e-05 1.26611513e+00 1.76856503e-04
  8.11745125e-04 1.66374026e+00]]
Iteration 760
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.26530763397473>
Acquisition function convergence reached at iteration 4369.
tf.Tensor(-56.26670130092926, shape=(), dtype=float64)
[[0.79578233 0.39971069 0.77228464 0.00489081 0.43093752 1.8217649 ]]
Iteration 761
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.265759492676336>
Acquisition function convergence reached at iteration 4157.
tf.Tensor(-48.83578596433763, shape=(), dtype=float64)
[[0.92539851 0.9991536  1.04892429 1.07425574 0.21382354 2.28377969]]
Iteration 762
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.266210730732033>
Acquisition function convergence reached at iteration 581.
tf.Tensor(-51.84546378086742, shape=(), dtype=float64)
[[0.94492364 0.16361372 1.21875533 0.40289903 2.01235652 1.46794436]]
Iteration 763
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.26666134980953>
Acquisition function convergence reached at iteration 6033.
tf.Tensor(-51.21331362641, shape=(), dtype=float64)
[[3.28266509e-01 5.69724419e-05 1.37715316e+00 9.92353160e-05
  1.45996845e-04 6.65826343e-01]]
Iteration 764
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.267111351569875>
Acquisition function convergence reached at iteration 7865.
tf.Tensor(-50.70706805750575, shape=(), dtype=float64)
[[2.83019858e-01 5.68687192e-01 1.41611463e+00 1.63354854e-04
  1.97111627e-03 1.40655755e+00]]
Iteration 765
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.2675607376674884>
Acquisition function convergence reached at iteration 778.
tf.Tensor(-50.7209775037798, shape=(), dtype=float64)
```

```
[[0.9366278  0.63128193 2.17202804 0.4503149  0.26409175 0.2531169 ]]
Iteration 766
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.2680095097501995>
Acquisition function convergence reached at iteration 5553.
tf.Tensor(-51.5134023314828, shape=(), dtype=float64)
[[7.79721349e-01 5.95626938e-01 1.18128964e+00 1.67867936e-03
  2.56568577e-01 2.46514820e+00]]
Iteration 767
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.268457669459279>
Acquisition function convergence reached at iteration 3627.
tf.Tensor(-48.80043692224145, shape=(), dtype=float64)
[[0.99908225 0.17894043 1.16147915 0.87966839 1.5668171  1.47209089]]
Iteration 768
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.2689052184294765>
Acquisition function convergence reached at iteration 4347.
tf.Tensor(-50.39198233612067, shape=(), dtype=float64)
[[0.97981332 0.00917213 2.11980469 0.00246098 0.96194295 0.61857241]]
Iteration 769
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.269352158289053>
Acquisition function convergence reached at iteration 8383.
tf.Tensor(-52.98780506734908, shape=(), dtype=float64)
[[2.20440856e-01 7.53143987e-05 1.22704026e+00 5.97829628e-05
  9.09385094e-01 1.19500579e+00]]
Iteration 770
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.269798490659813>
Acquisition function convergence reached at iteration 5658.
tf.Tensor(-52.46025975693494, shape=(), dtype=float64)
[[8.42686780e-01 2.82421775e-01 1.25539966e+00 1.03851253e-03
  1.11204104e+00 2.33186941e+00]]
Iteration 771
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.270244217157147>
Acquisition function convergence reached at iteration 5234.
tf.Tensor(-47.7785209864983, shape=(), dtype=float64)
[[0.999641   0.96582381 1.09506852 1.46143736 0.441297   1.90748795]]
Iteration 772
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.270689339390053>
Acquisition function convergence reached at iteration 3386.
tf.Tensor(-49.916919456907316, shape=(), dtype=float64)
[[0.88162821 0.99912861 1.30638324 0.18594384 0.68440307 2.48134854]]
Iteration 773
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.271133858961179>
Acquisition function convergence reached at iteration 1558.
tf.Tensor(-46.21138889855328, shape=(), dtype=float64)
```

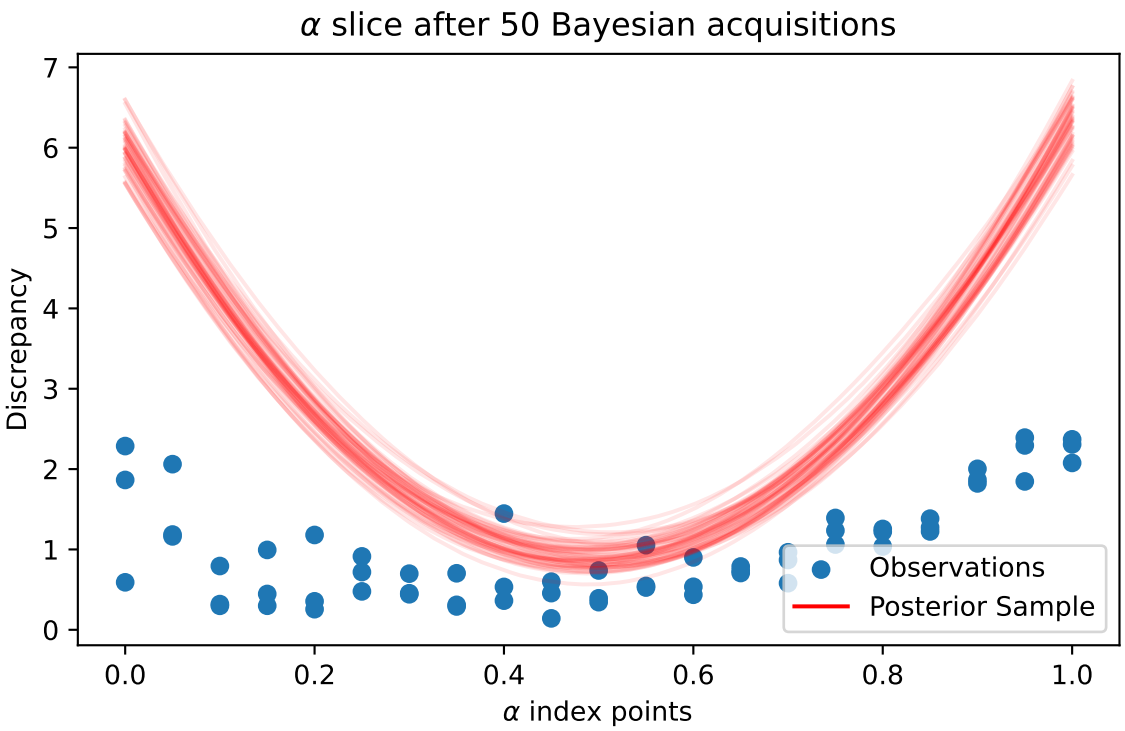
```
[[0.94473687 0.96323098 1.19747238 1.21777421 1.07696051 2.00009778]]
Iteration 774
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.271577777466853>
Acquisition function convergence reached at iteration 4370.
tf.Tensor(-49.50642521691998, shape=(), dtype=float64)
[[0.81166949 0.59566779 1.75975225 0.00332541 0.73881556 2.06037805]]
Iteration 775
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.272021096497118>
Acquisition function convergence reached at iteration 4133.
tf.Tensor(-51.14146621172007, shape=(), dtype=float64)
[[9.31378277e-01 8.22330214e-04 1.42818153e+00 2.64281559e-03
  2.12981760e+00 6.62432136e-01]]
Iteration 776
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.27246381763576>
Acquisition function convergence reached at iteration 4195.
tf.Tensor(-49.99603918737509, shape=(), dtype=float64)
[[0.95228163 0.99761085 1.63278602 0.00591768 1.68241325 1.27752286]]
Iteration 777
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.272905942460346>
Acquisition function convergence reached at iteration 5766.
tf.Tensor(-46.68407460243357, shape=(), dtype=float64)
[[9.23320378e-01 8.66464401e-05 2.15194095e+00 8.82111159e-04
  4.65123910e-01 1.34991144e+00]]
Iteration 778
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.273347472542254>
Acquisition function convergence reached at iteration 3967.
tf.Tensor(-48.049595175757915, shape=(), dtype=float64)
[[9.79900814e-01 2.81873868e-01 2.25200018e+00 1.11592199e-03
  4.64362080e-01 7.89881785e-01]]
Iteration 779
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.2737884094467065>
Acquisition function convergence reached at iteration 5530.
tf.Tensor(-49.576118176762215, shape=(), dtype=float64)
[[9.49900779e-01 8.98492901e-01 2.16147523e+00 4.09558933e-04
  1.26029957e+00 8.98121726e-01]]
Iteration 780
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.274228754732799>
Acquisition function convergence reached at iteration 6442.
tf.Tensor(-44.270573564316436, shape=(), dtype=float64)
[[9.99912076e-01 9.99950523e-01 1.13738838e+00 8.94482363e-01
  2.61475800e-04 1.89921921e+00]]
Hyperparameter convergence reached at iteration 9293.
Iteration 781
```

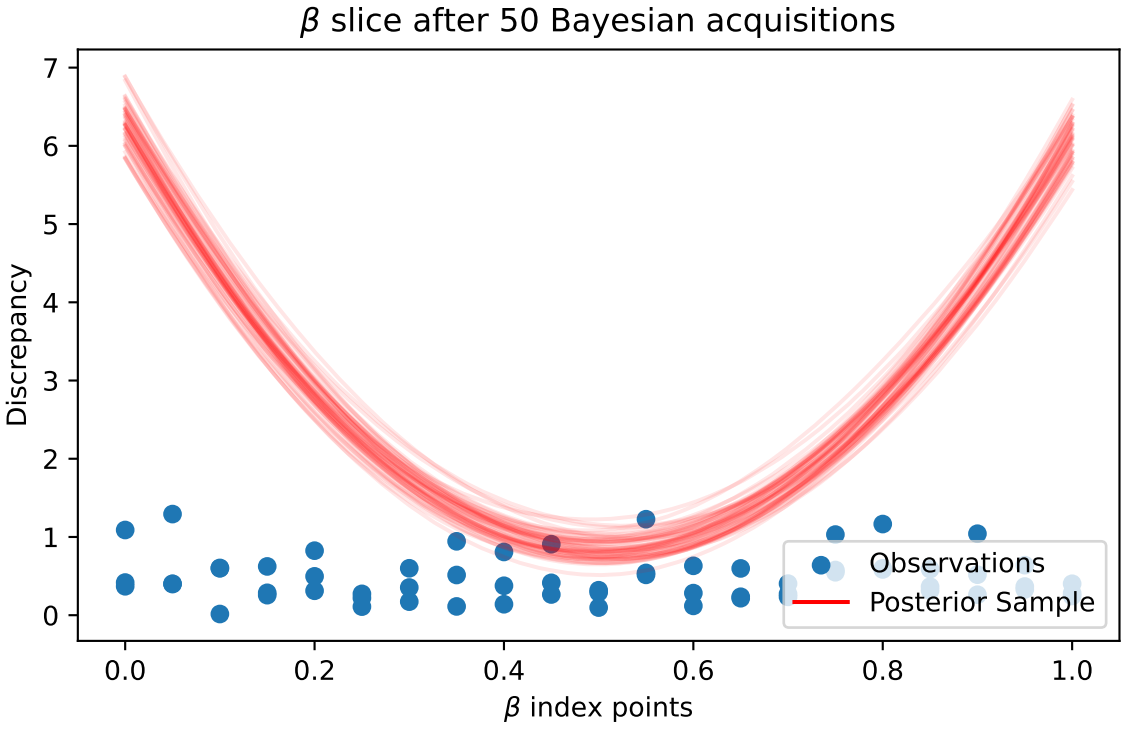
```
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.274668509953536>
Acquisition function convergence reached at iteration 5658.
tf.Tensor(-52.372637762892374, shape=(), dtype=float64)
[[7.94056733e-01 3.05662369e-01 1.06648135e+00 7.74377458e-04
  1.66733343e+00 1.56004525e+00]]
Iteration 782
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.275107676655863>
Acquisition function convergence reached at iteration 6965.
tf.Tensor(-50.772290947946814, shape=(), dtype=float64)
[[9.99744410e-01 5.28890988e-01 1.47655355e+00 1.16965330e-03
  1.79928237e+00 1.28659897e+00]]
Iteration 783
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.275546256380691>
Acquisition function convergence reached at iteration 5343.
tf.Tensor(-50.447172146624794, shape=(), dtype=float64)
[[0.99968552 0.42357238 0.88488349 0.8985528  0.90159109 1.91379624]]
Iteration 784
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.275984250662937>
Acquisition function convergence reached at iteration 4342.
tf.Tensor(-51.31448434454273, shape=(), dtype=float64)
[[0.85127656 0.98712389 1.12317007 0.00454084 1.62913279 2.00195429]]
Iteration 785
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.276421661031546>
Acquisition function convergence reached at iteration 4523.
tf.Tensor(-50.22983496922588, shape=(), dtype=float64)
[[0.8412778  0.07665452 1.31910841 0.23685083 0.00635133 2.38883409]]
Iteration 786
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.276858489009531>
Acquisition function convergence reached at iteration 935.
tf.Tensor(-50.26963731768079, shape=(), dtype=float64)
[[0.93755446 0.64385364 1.40142384 0.29726423 2.11435511 1.56583789]]
Iteration 787
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.277294736113994>
Acquisition function convergence reached at iteration 3427.
tf.Tensor(-49.092707859279365, shape=(), dtype=float64)
[[9.90744364e-01 4.86213280e-04 1.43129884e+00 4.66085459e-01
  1.47598323e+00 1.48659488e+00]]
Iteration 788
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.277730403856165>
Acquisition function convergence reached at iteration 4672.
tf.Tensor(-48.37324426204761, shape=(), dtype=float64)
[[0.9473278  0.13586571 2.23989244 0.00229658 1.20379148 0.1415124 ]]
Iteration 789
```

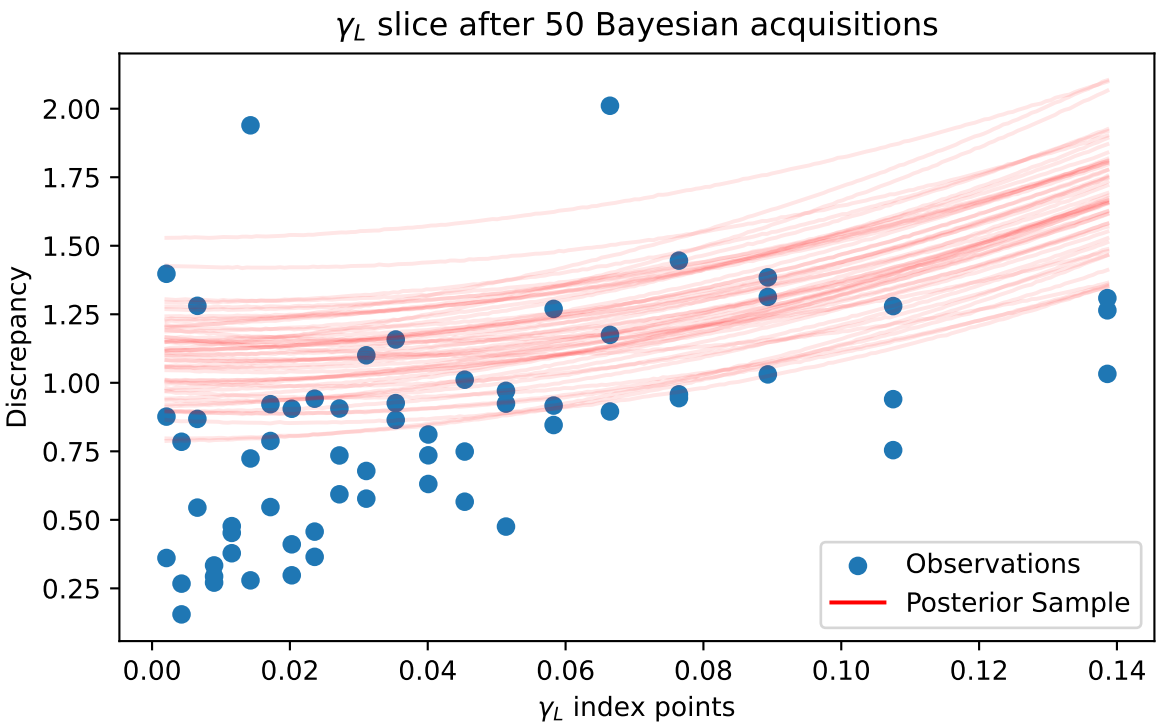
```
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.278165493741427>
Acquisition function convergence reached at iteration 4070.
tf.Tensor(-42.37009186727845, shape=(), dtype=float64)
[[9.44357831e-01 9.99813586e-01 1.18409718e+00 1.23878548e+00
  1.07879035e-03 1.59794369e+00]]
Iteration 790
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.278600007269346>
Acquisition function convergence reached at iteration 5681.
tf.Tensor(-53.08673161060457, shape=(), dtype=float64)
[[0.99967029 0.33374851 1.19952606 0.00890414 1.28555877 0.00137224]]
Iteration 791
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.279033945933704>
Acquisition function convergence reached at iteration 3460.
tf.Tensor(-51.67150533179776, shape=(), dtype=float64)
[[8.76024787e-01 1.49278661e-03 1.14058815e+00 1.03995338e-01
  3.01856000e-02 2.26904150e+00]]
Iteration 792
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.279467311222525>
Acquisition function convergence reached at iteration 5125.
tf.Tensor(-47.33279127332287, shape=(), dtype=float64)
[[9.36173772e-01 7.34914950e-04 2.23601421e+00 1.69347273e-03
  1.31511144e+00 1.14697578e+00]]
Iteration 793
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.2799001046181075>
Acquisition function convergence reached at iteration 3916.
tf.Tensor(-47.35410305028796, shape=(), dtype=float64)
[[9.42939744e-01 9.96250321e-01 2.30460123e+00 1.04044866e-03
  1.00707349e+00 5.87300066e-01]]
Iteration 794
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.280332327597052>
Acquisition function convergence reached at iteration 6065.
tf.Tensor(-51.141678267802405, shape=(), dtype=float64)
[[9.28730677e-01 2.07136713e-01 1.32784501e+00 1.02674261e-02
  1.97331533e-03 2.54347221e+00]]
Iteration 795
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.280763981630291>
Acquisition function convergence reached at iteration 4293.
tf.Tensor(-51.294538399759695, shape=(), dtype=float64)
[[8.87480292e-01 4.57135954e-01 1.54135655e+00 8.46501786e-04
  2.28051609e+00 1.18288473e+00]]
Iteration 796
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.281195068183116>
Acquisition function convergence reached at iteration 5110.
```

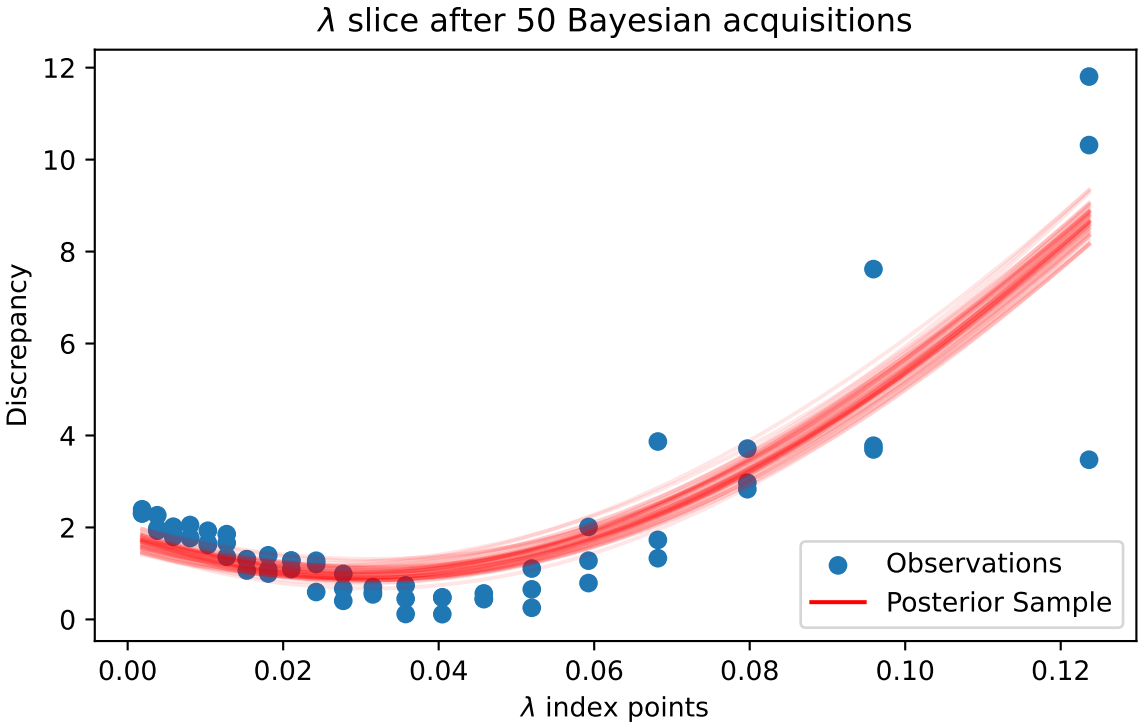
```
tf.Tensor(-52.93645550020637, shape=(), dtype=float64)
[[3.60580011e-01 1.50313064e-01 1.41535431e+00 2.56256214e-04
  8.68699482e-01 1.43503980e+00]]
Iteration 797
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.281625588715208>
Acquisition function convergence reached at iteration 1072.
tf.Tensor(-50.0073965660691, shape=(), dtype=float64)
[[0.95709169 0.28367839 1.17225652 0.33725815 2.07310157 0.21621683]]
Iteration 798
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.282055544680666>
Acquisition function convergence reached at iteration 4902.
tf.Tensor(-49.43873454949587, shape=(), dtype=float64)
[[9.59102949e-01 5.19894787e-01 1.57781240e+00 4.00877699e-04
  2.14188053e+00 3.55954089e-01]]
Iteration 799
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.282484937528034>
Acquisition function convergence reached at iteration 3447.
tf.Tensor(-50.15316503117961, shape=(), dtype=float64)
[[0.97166033 0.00722745 1.59967119 0.13308616 1.94814129 1.35097389]]
Iteration 800
<tf.Variable 'eta_t:0' shape=() dtype=float64, numpy=7.282913768700331>
Acquisition function convergence reached at iteration 755.
tf.Tensor(-50.935430919463606, shape=(), dtype=float64)
[[0.91863974 0.2721278  1.18879843 0.27592681 0.88164338 2.64335805]]
Hyperparameter convergence reached at iteration 9191.
Trained parameters:
amplitude_champ:0 is 11.679

length_scales_champ:0 is [0.083 1.    0.137 0.569 1.    1.   ]

observation_noise_variance_champ:0 is 3.307

amp_f_mean:0 is 0.235

amp_gamma_L_mean:0 is 10.873

amp_lambda_mean:0 is 16.276

amp_r_mean:0 is 0.005

bias_mean:0 is 1.637

f_tp:0 is -2.209
```

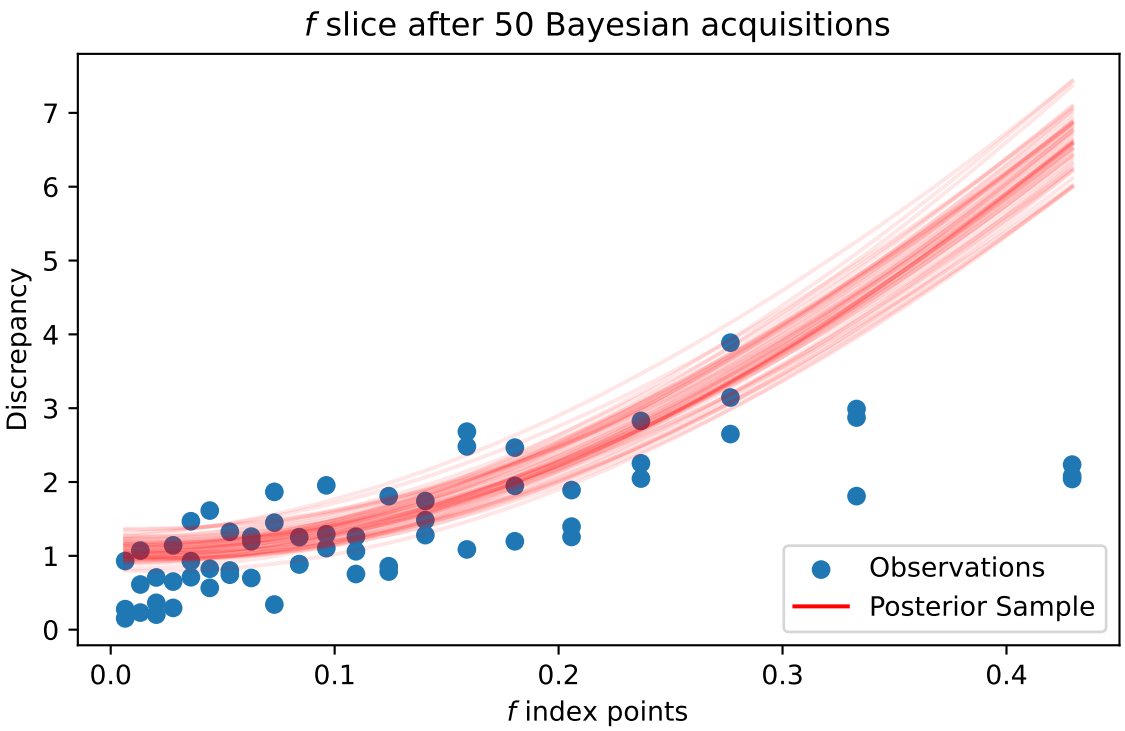
```
gamma_L_tp:0 is -0.608

lambda_tp:0 is -1.067

r_tp:0 is 1.117

[0.9995496  0.99868104 0.09637824 1.08550848 0.05228387 0.04348391]
[0.9462521  0.9977721  0.01805397 1.5942974  0.69616663 2.0845933 ]
[6.89203851e-01 8.72611809e-01 1.41536268e+00 7.78330775e-04
 9.05474795e-01 1.44404137e+00]
[8.51138650e-01 9.99931244e-01 1.66066661e+00 1.04326394e-03
 3.33472046e-04 1.80151314e+00]
[0.92539851 0.9991536  1.04892429 1.07425574 0.21382354 2.28377969]
[7.94056733e-01 3.05662369e-01 1.06648135e+00 7.74377458e-04
 1.66733343e+00 1.56004525e+00]
[9.42939744e-01 9.96250321e-01 2.30460123e+00 1.04044866e-03
 1.00707349e+00 5.87300066e-01]
[0.95709169 0.28367839 1.17225652 0.33725815 2.07310157 0.21621683]
[0.97166033 0.00722745 1.59967119 0.13308616 1.94814129 1.35097389]
[0.91863974 0.2721278  1.18879843 0.27592681 0.88164338 2.64335805]
```

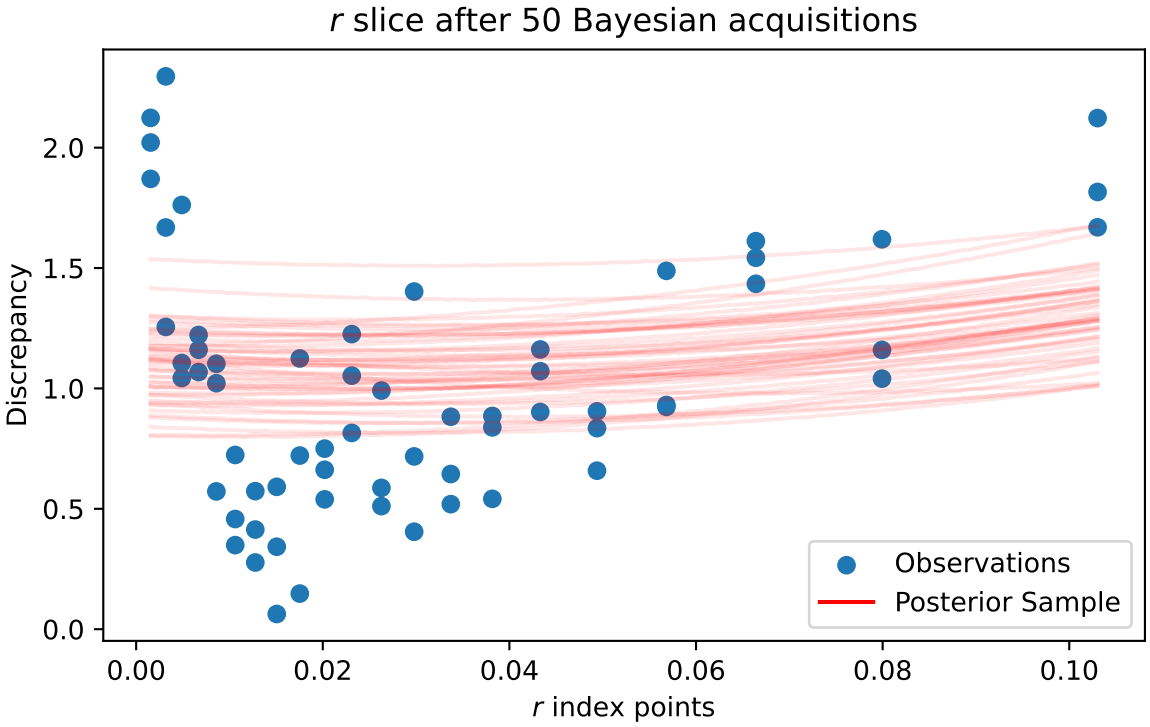

α slice after 50 Bayesian acquisitions
Discrepancy
α index points
Observations
Posterior Sample

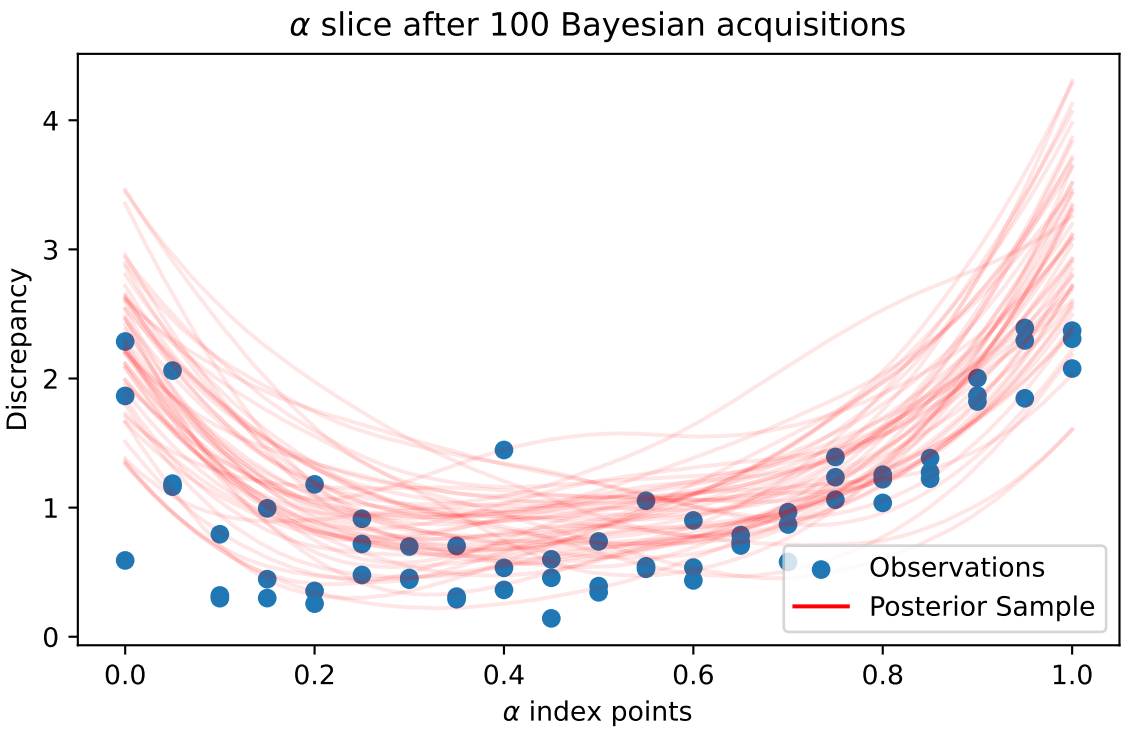

β slice after 50 Bayesian acquisitions
Discrepancy
β index points
Observations
Posterior Sample

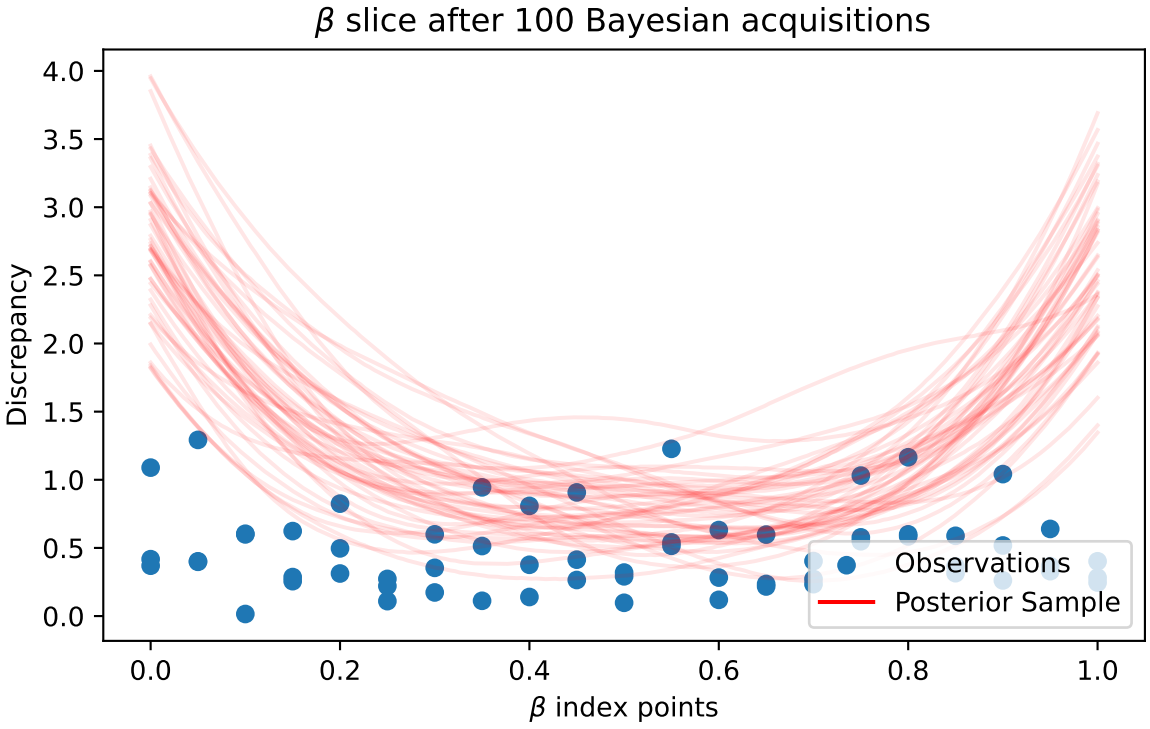

γ_L slice after 50 Bayesian acquisitions
Discrepancy
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.00
0.02
0.04
0.06
0.08
0.10
0.12
0.14
γ_L index points
Observations
Posterior Sample

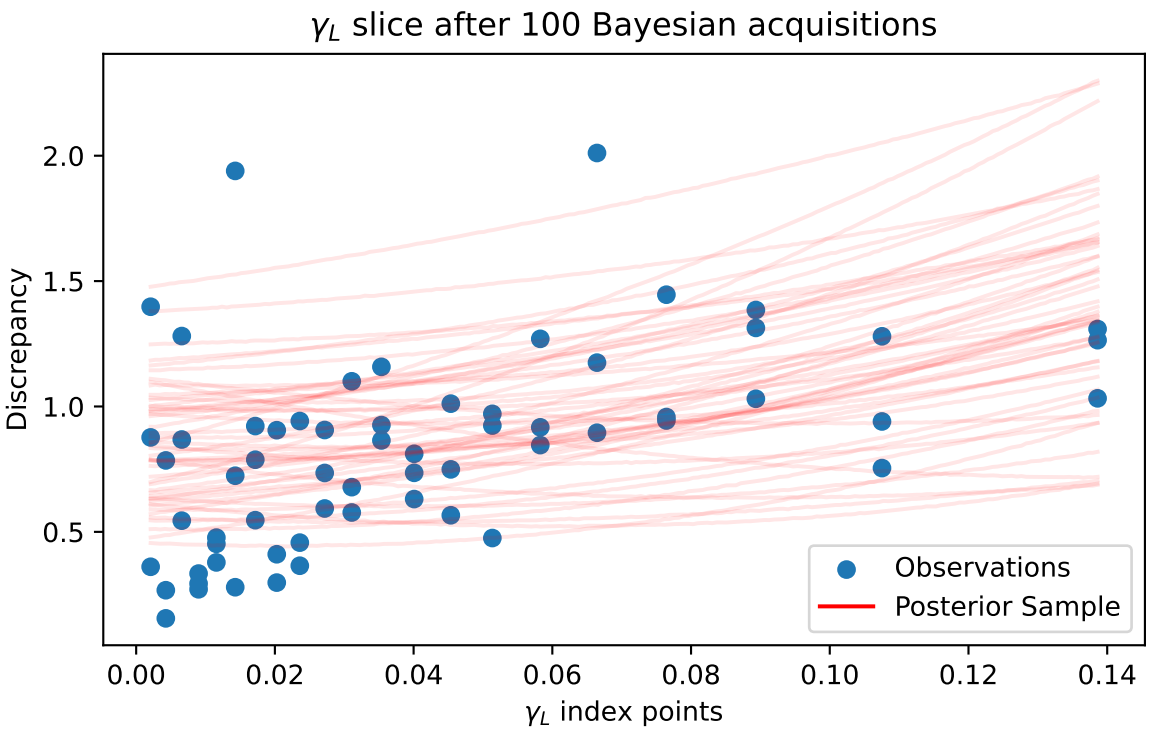

λ slice after 50 Bayesian acquisitions
Discrepancy
12
10
8
6
4
2
0
0.00
0.02
0.04
0.06
0.08
0.10
0.12
λ index points
Observations
Posterior Sample

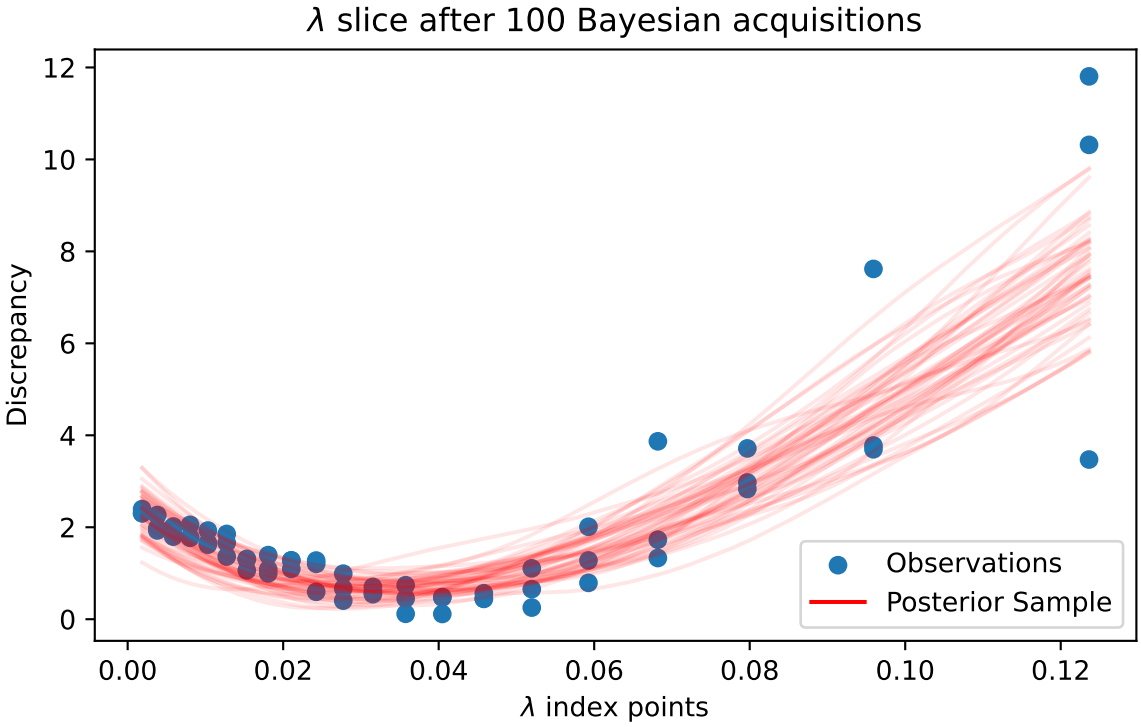

f slice after 50 Bayesian acquisitions
Discrepancy
f index points
Observations
Posterior Sample
0
1
2
3
4
5
6
7
0.0
0.1
0.2
0.3
0.4

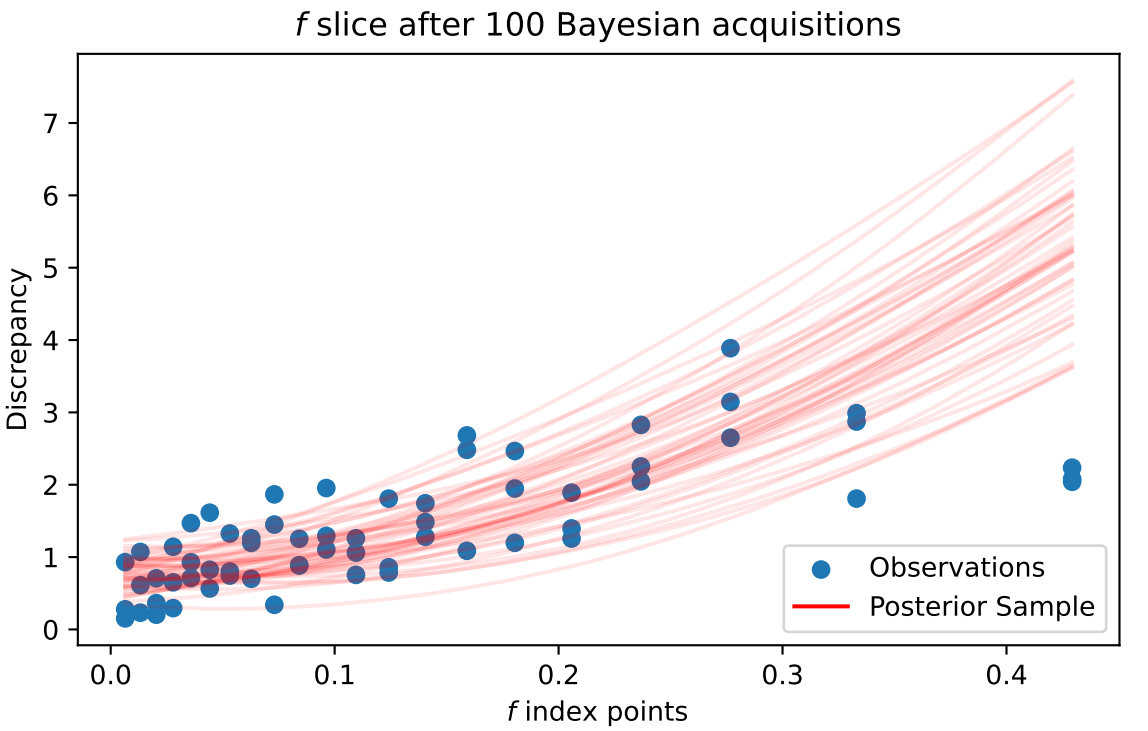

r slice after 50 Bayesian acquisitions
Discrepancy
r index points
Observations
Posterior Sample
0.0
0.5
1.0
1.5
2.0
0.00
0.02
0.04
0.06
0.08
0.10

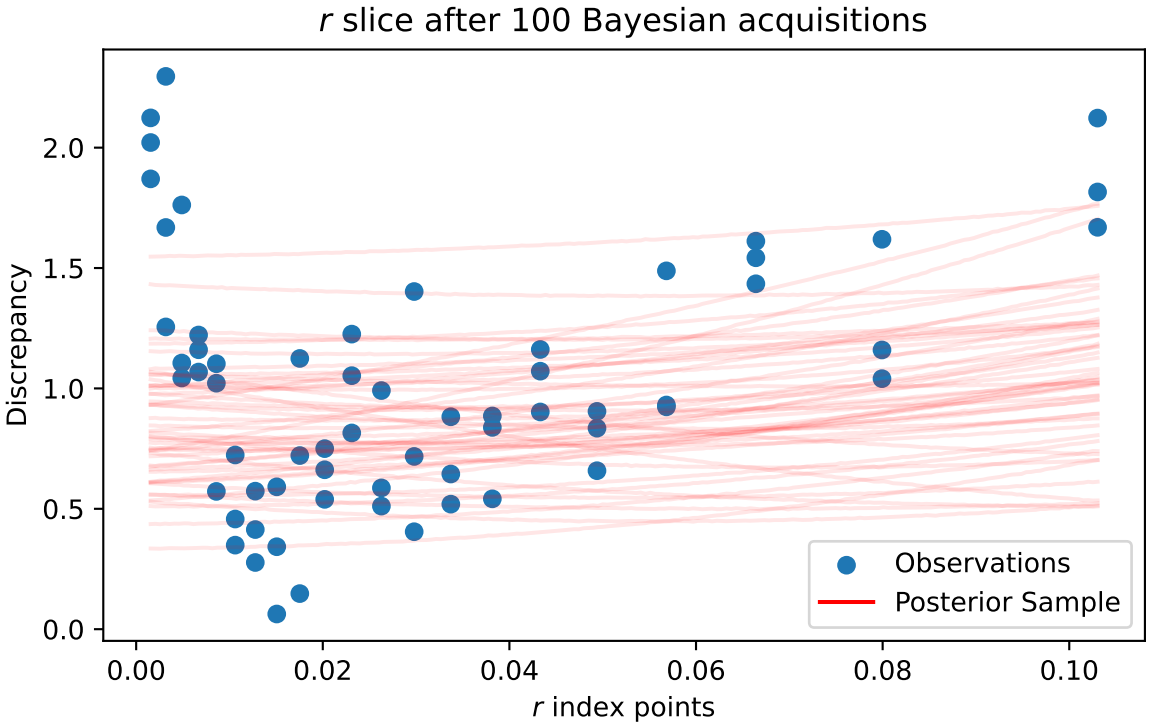

α slice after 100 Bayesian acquisitions
Discrepancy
α index points
Observations
Posterior Sample
0
1
2
3
4
0.0
0.2
0.4
0.6
0.8
1.0

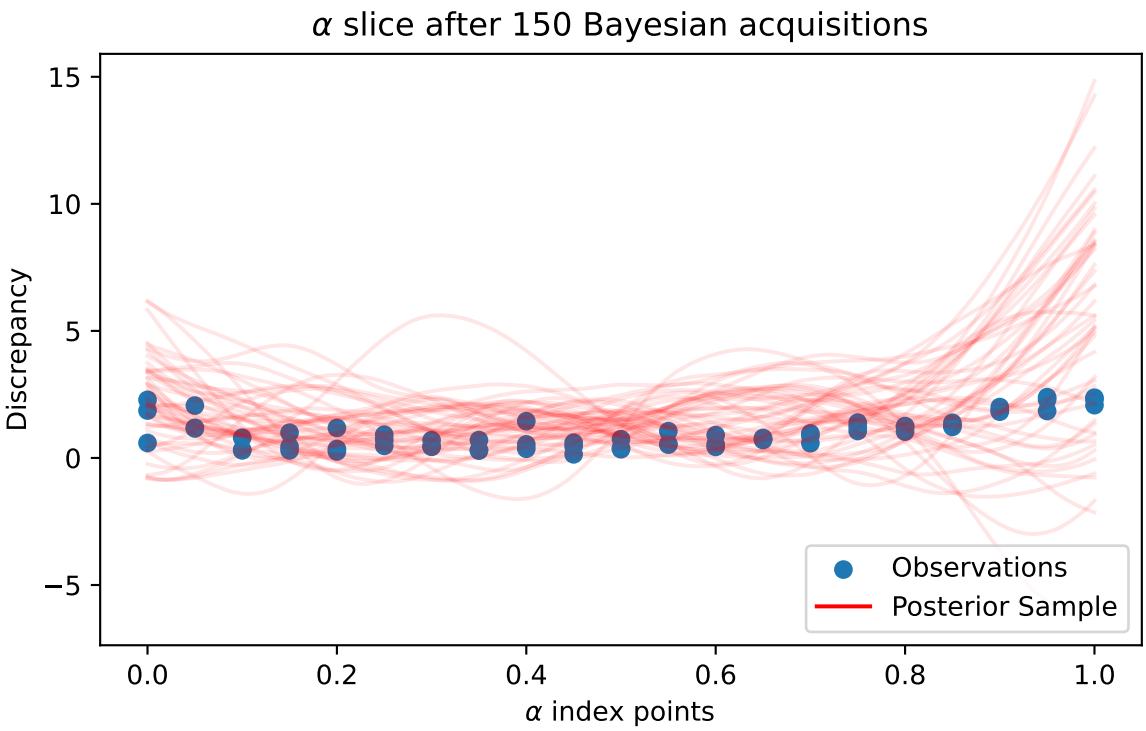

β slice after 100 Bayesian acquisitions
Discrepancy
β index points
Observations
Posterior Sample
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
0.0
0.2
0.4
0.6
0.8
1.0

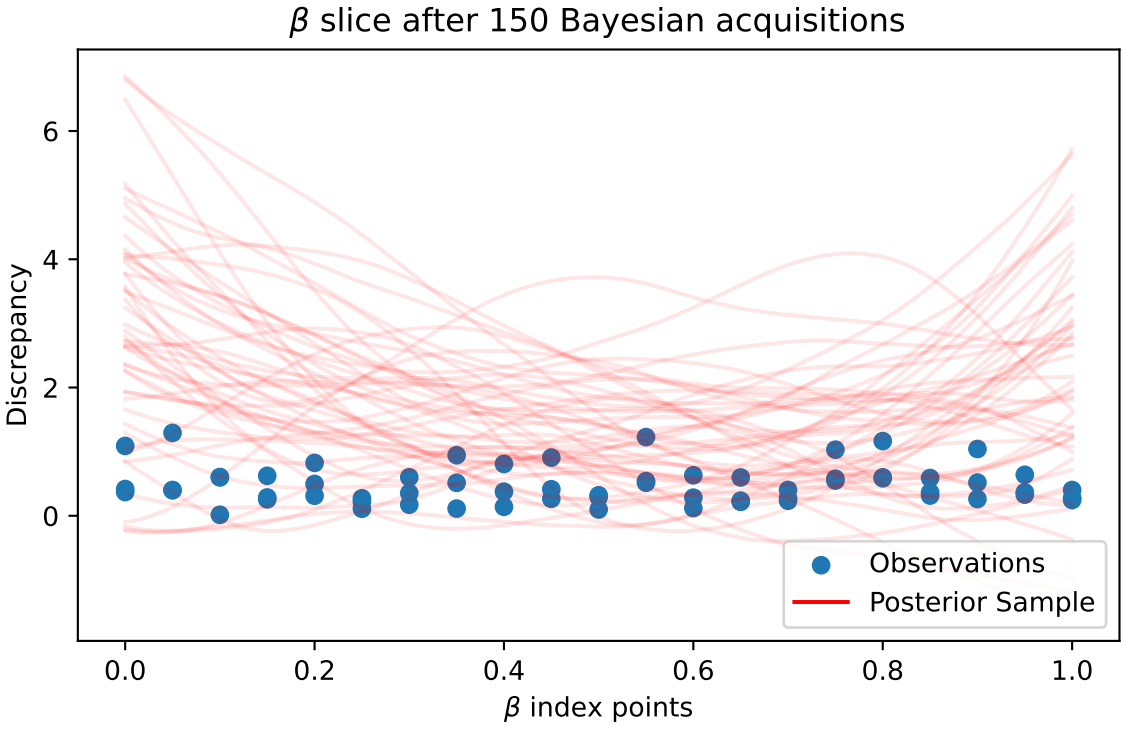

γ_L slice after 100 Bayesian acquisitions
Discrepancy
2.0
1.5
1.0
0.5
0.00
0.02
0.04
0.06
0.08
0.10
0.12
0.14
γ_L index points
Observations
Posterior Sample

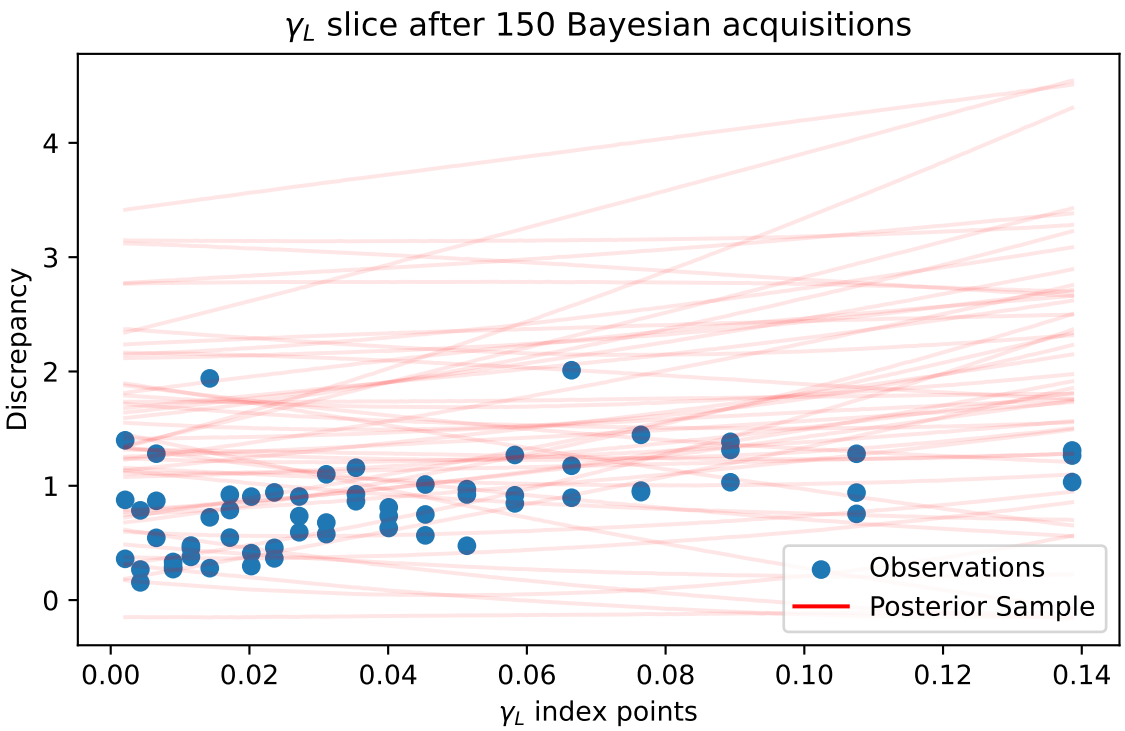

λ slice after 100 Bayesian acquisitions
Discrepancy
12
10
8
6
4
2
0
0.00
0.02
0.04
0.06
0.08
0.10
0.12
λ index points
Observations
Posterior Sample

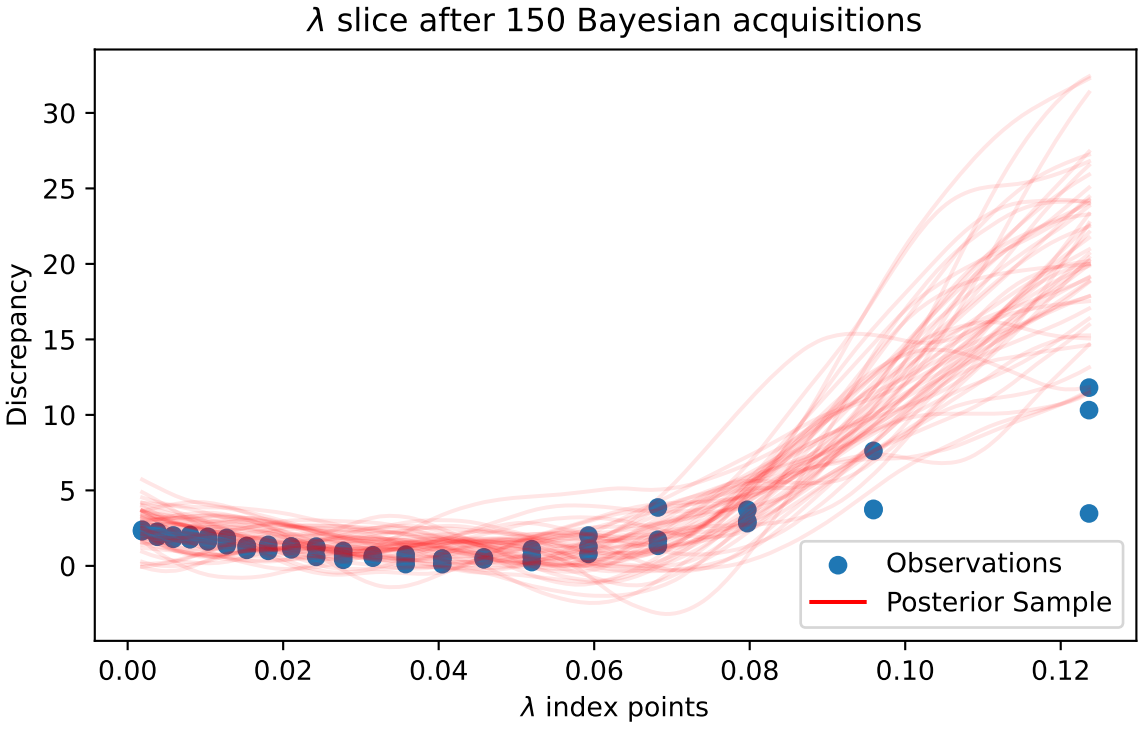

f slice after 100 Bayesian acquisitions
Discrepancy
f index points
Observations
Posterior Sample

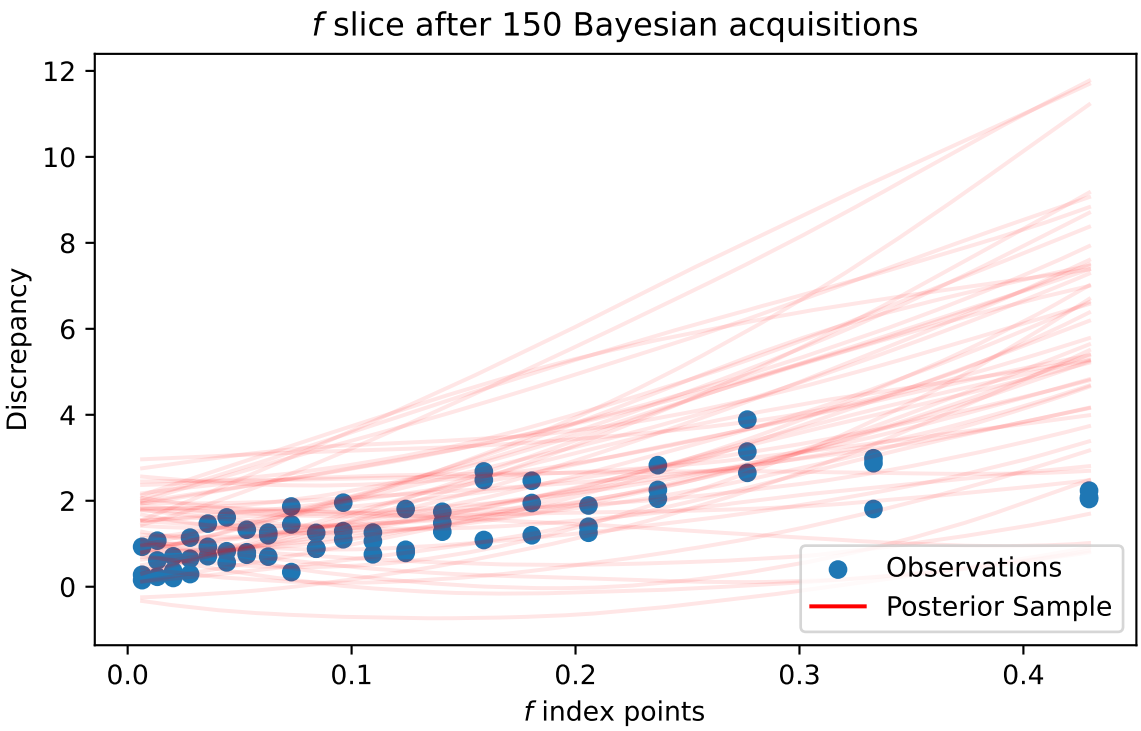

r slice after 100 Bayesian acquisitions
Discrepancy
r index points
Observations
Posterior Sample

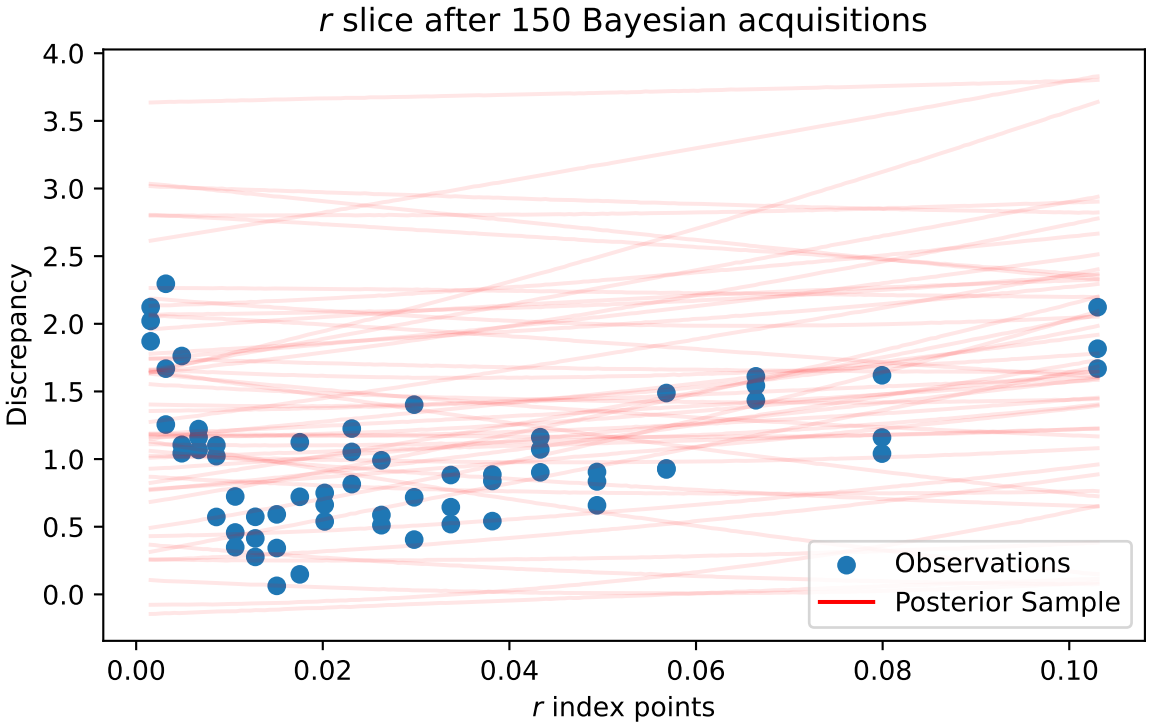

α slice after 150 Bayesian acquisitions
Discrepancy
15
10
5
0
−5
0.0
0.2
0.4
0.6
0.8
1.0
α index points
Observations
Posterior Sample

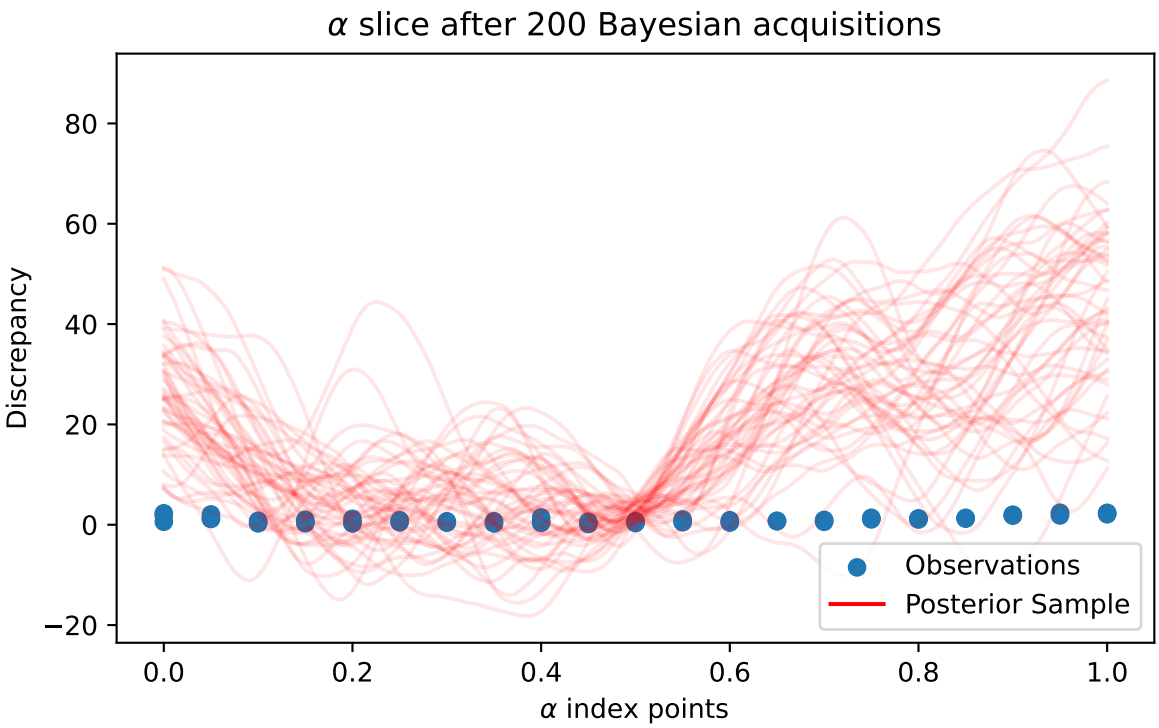

β slice after 150 Bayesian acquisitions
Discrepancy
6
4
2
0
0.0
0.2
0.4
0.6
0.8
1.0
β index points
Observations
Posterior Sample

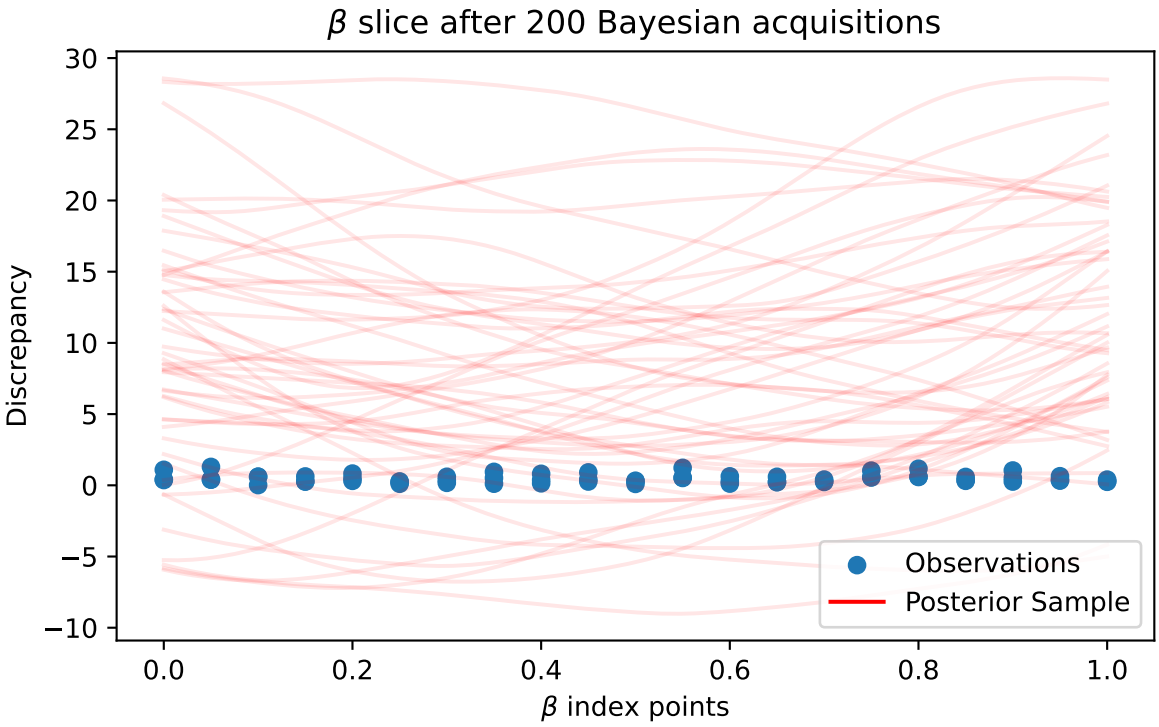

γ_L slice after 150 Bayesian acquisitions
Discrepancy
γ_L index points
Observations
Posterior Sample
0
1
2
3
4
0.00
0.02
0.04
0.06
0.08
0.10
0.12
0.14

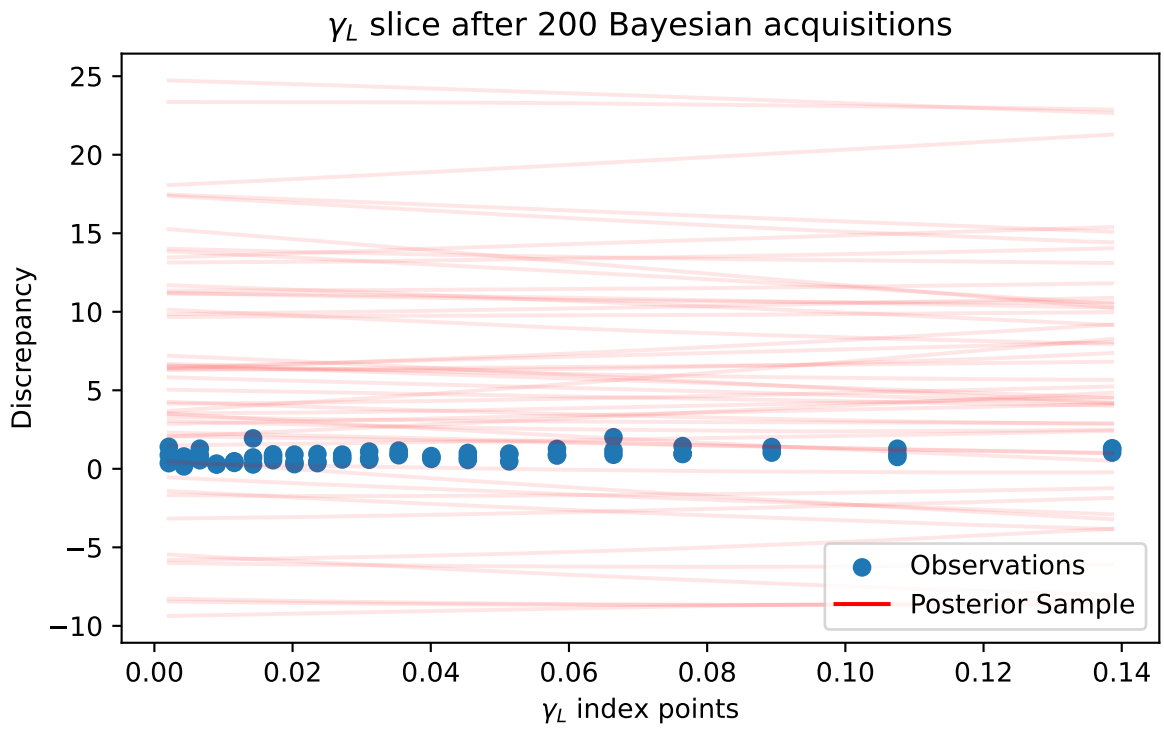

λ slice after 150 Bayesian acquisitions
Discrepancy
λ index points
Observations
Posterior Sample
0
5
10
15
20
25
30
0.00
0.02
0.04
0.06
0.08
0.10
0.12

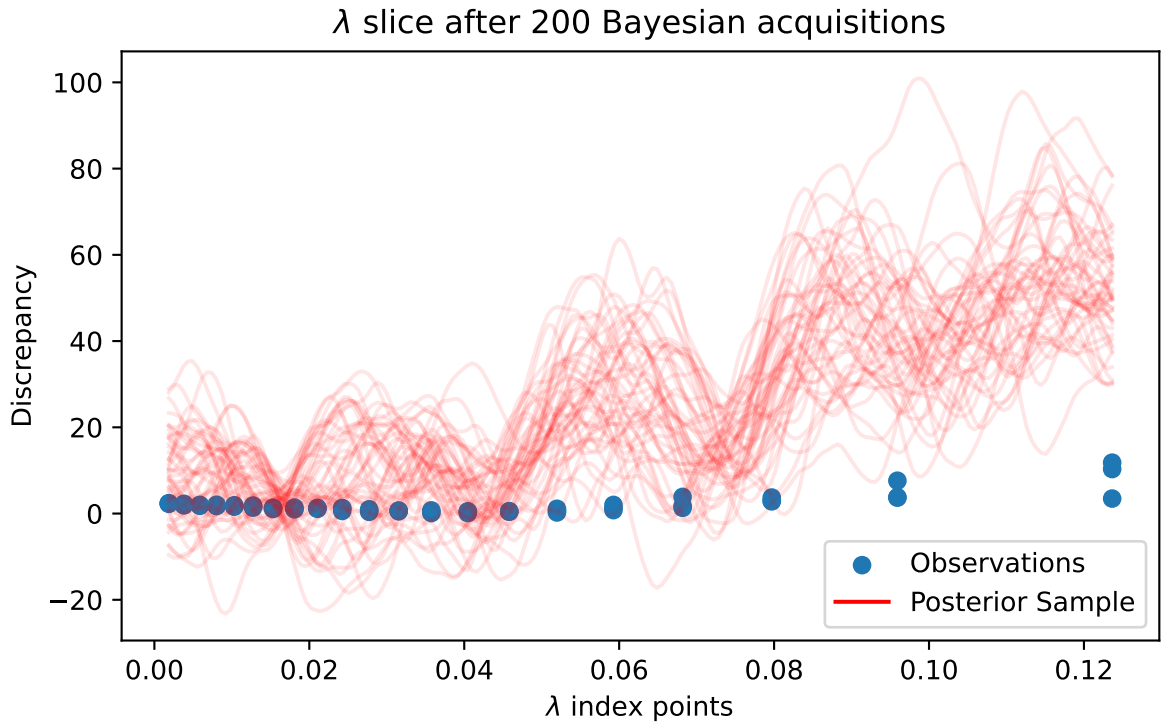

f slice after 150 Bayesian acquisitions
Discrepancy
f index points
Observations
Posterior Sample

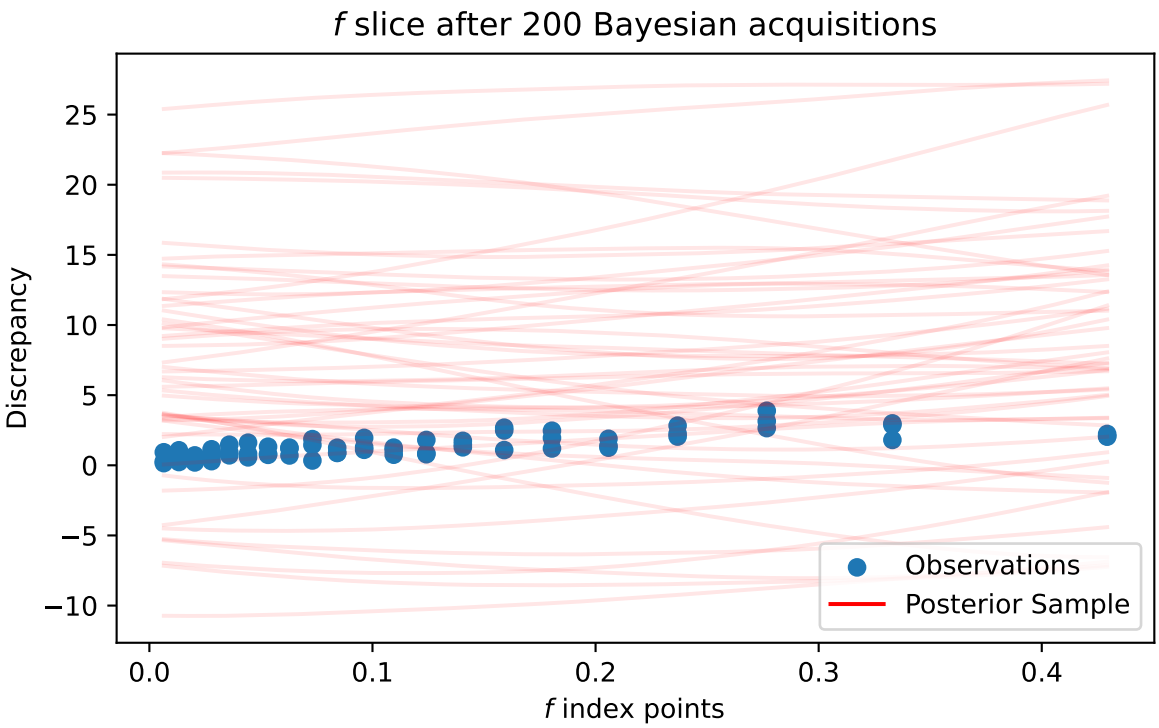

r slice after 150 Bayesian acquisitions
Discrepancy
r index points
Observations
Posterior Sample

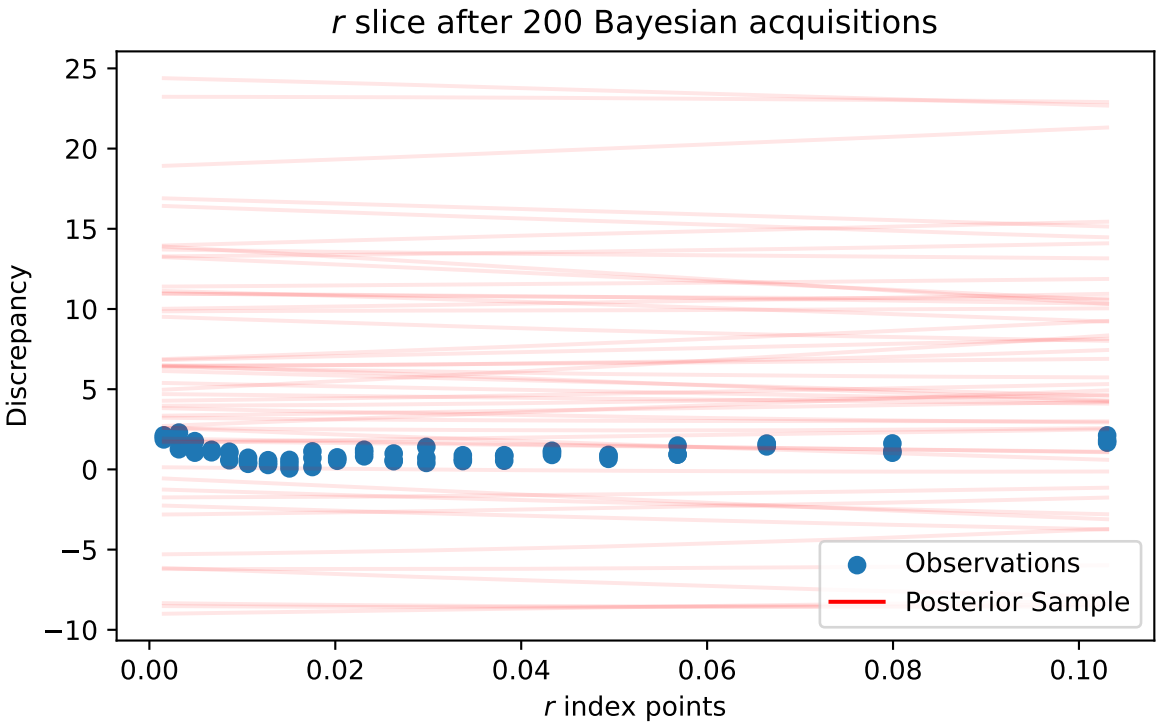

α slice after 200 Bayesian acquisitions
Discrepancy
80
60
40
20
0
−20
0.0
0.2
0.4
0.6
0.8
1.0
α index points
Observations
Posterior Sample

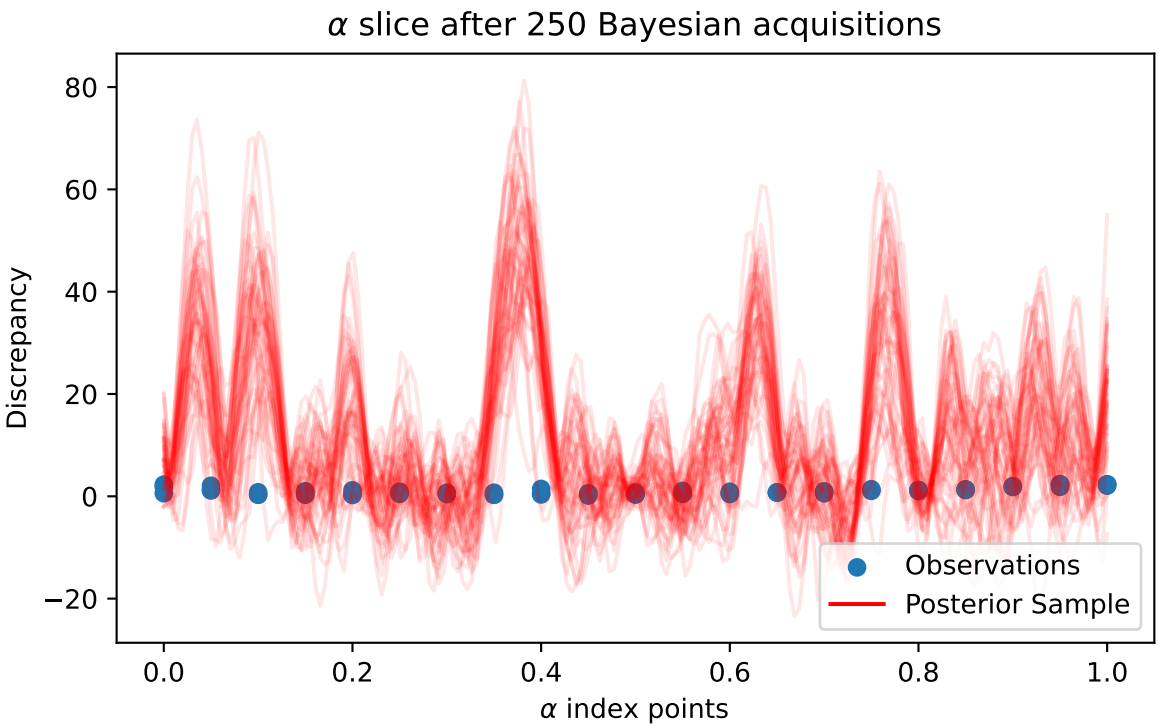

β slice after 200 Bayesian acquisitions
Discrepancy
30
25
20
15
10
5
0
−5
−10
0.0
0.2
0.4
0.6
0.8
1.0
β index points
Observations
Posterior Sample

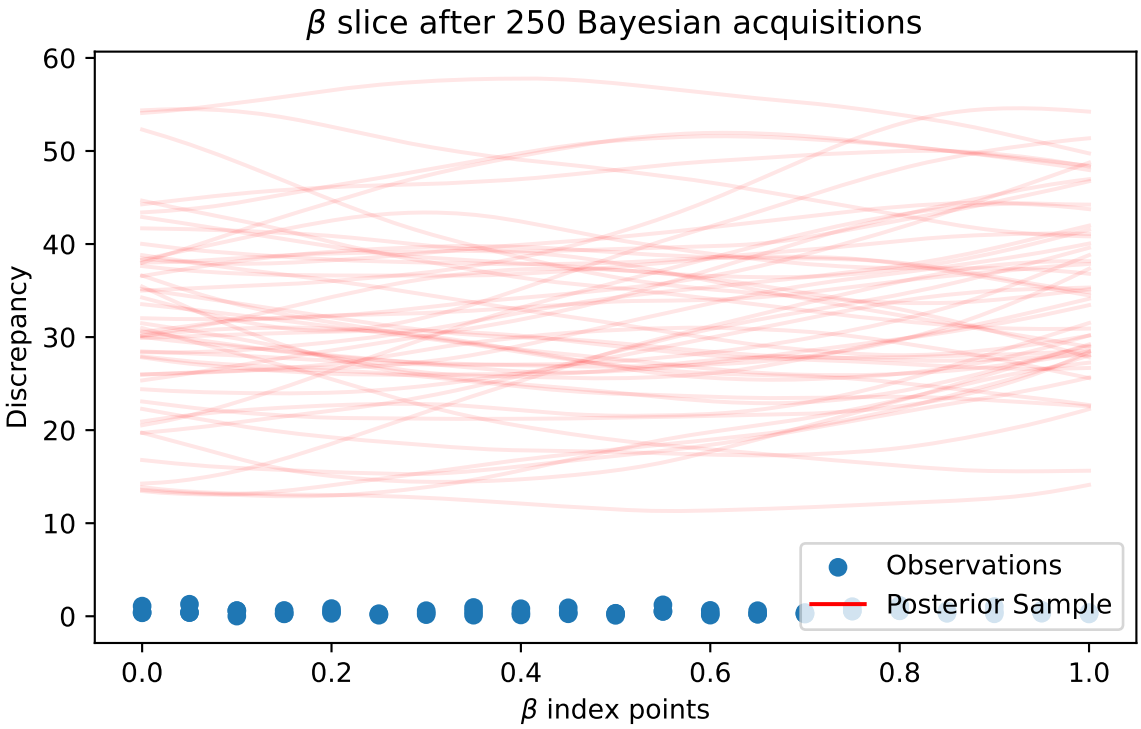

γ_L slice after 200 Bayesian acquisitions
Discrepancy
25
20
15
10
5
0
−5
−10
0.00
0.02
0.04
0.06
0.08
0.10
0.12
0.14
γ_L index points
Observations
Posterior Sample

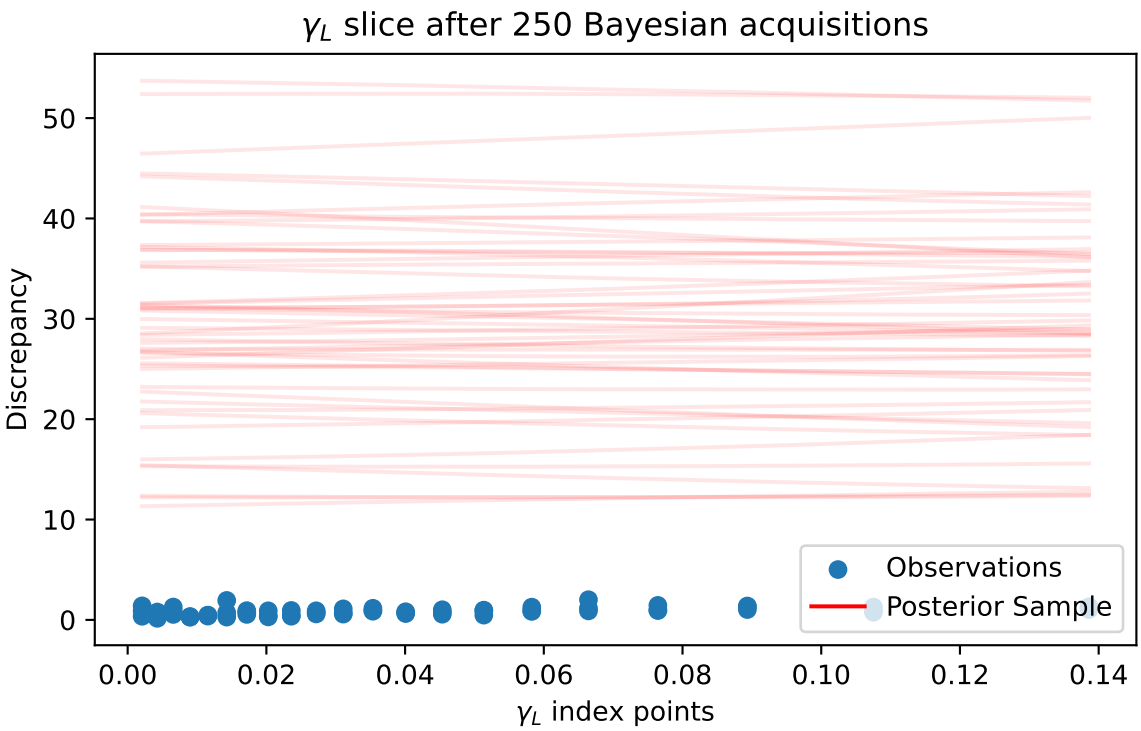

λ slice after 200 Bayesian acquisitions
Discrepancy
100
80
60
40
20
0
−20
0.00
0.02
0.04
0.06
0.08
0.10
0.12
λ index points
Observations
Posterior Sample

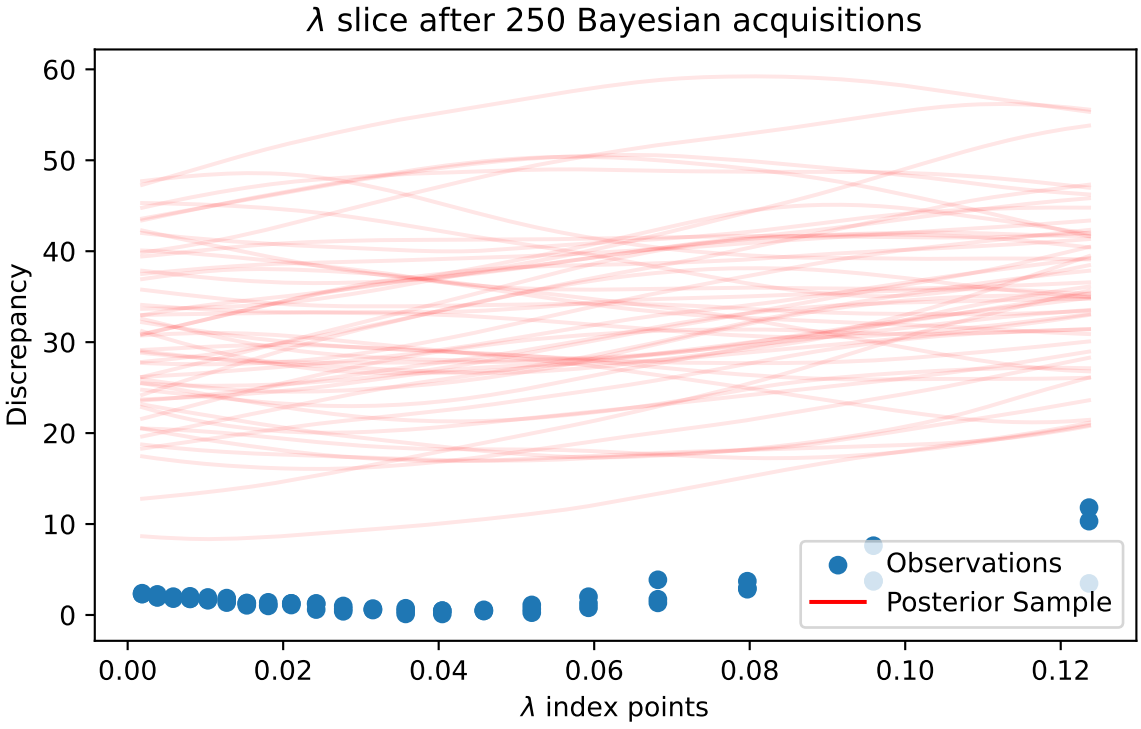

f slice after 200 Bayesian acquisitions
Discrepancy
25
20
15
10
5
0
−5
−10
0.0
0.1
0.2
0.3
0.4
f index points
Observations
Posterior Sample

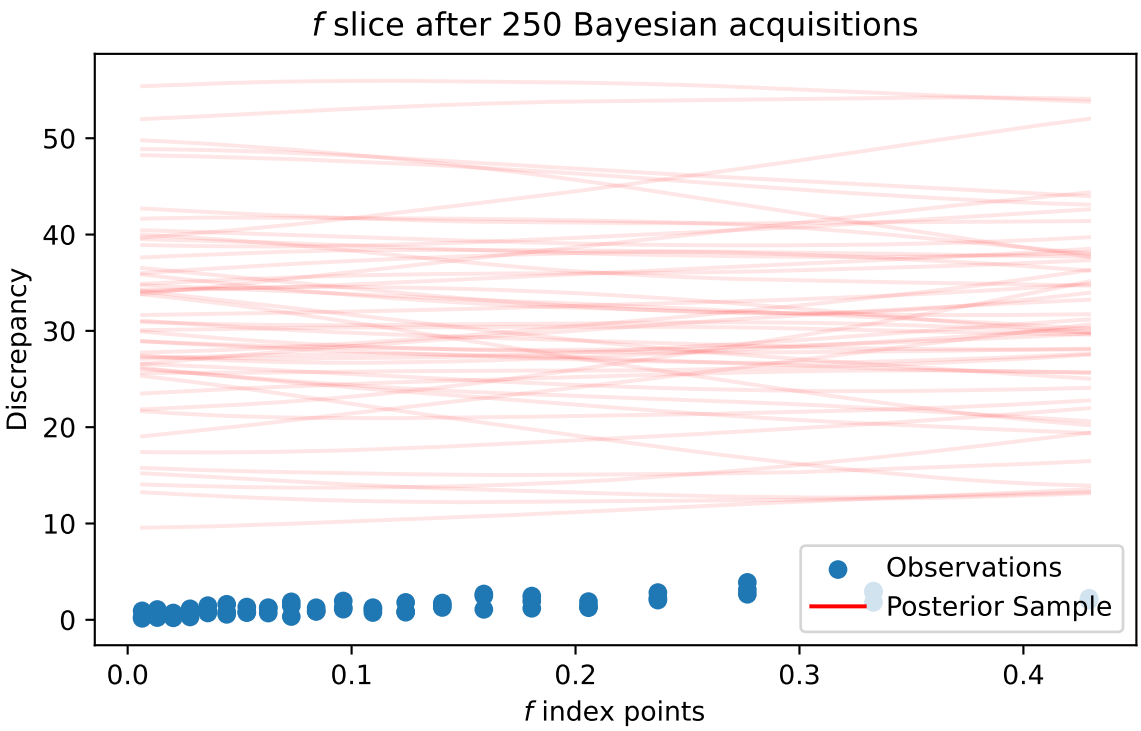

r slice after 200 Bayesian acquisitions
Discrepancy
25
20
15
10
5
0
−5
−10
0.00
0.02
0.04
0.06
0.08
0.10
r index points
Observations
Posterior Sample

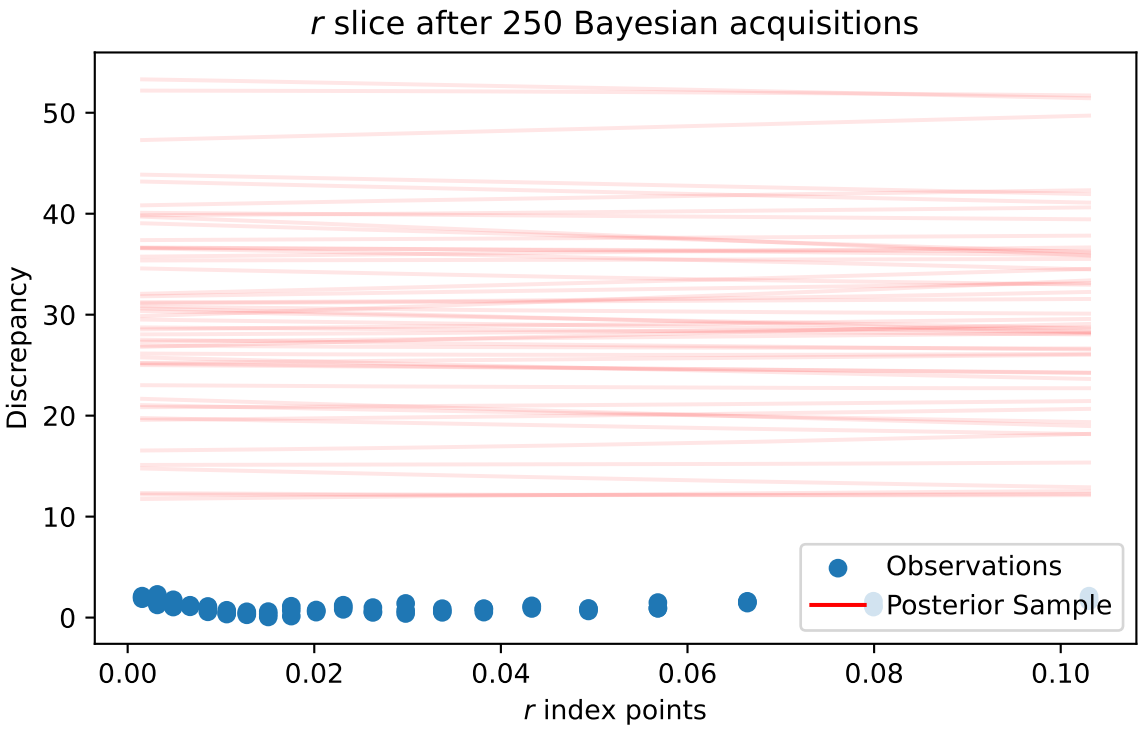

α slice after 250 Bayesian acquisitions
Discrepancy
80
60
40
20
0
−20
0.0
0.2
0.4
0.6
0.8
1.0
α index points
Observations
Posterior Sample

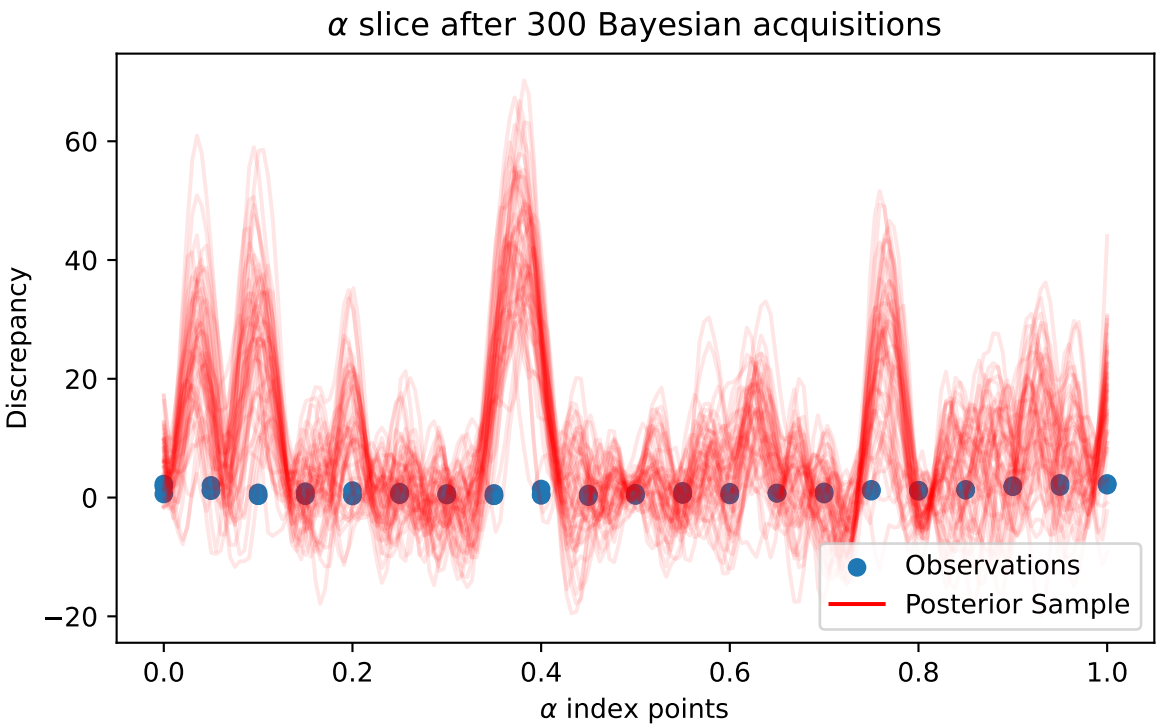

β slice after 250 Bayesian acquisitions
Discrepancy
60
50
40
30
20
10
0
0.0
0.2
0.4
0.6
0.8
1.0
β index points
Observations
Posterior Sample

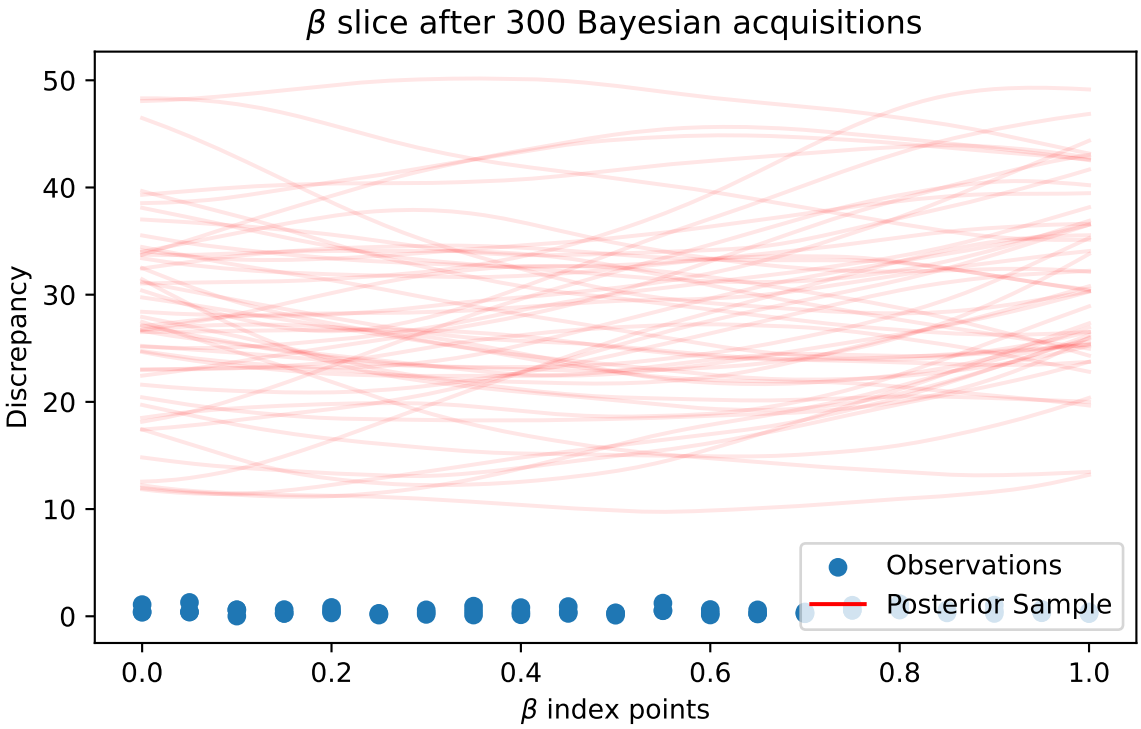

γ_L slice after 250 Bayesian acquisitions
Discrepancy
0
10
20
30
40
50
0.00
0.02
0.04
0.06
0.08
0.10
0.12
0.14
γ_L index points
Observations
Posterior Sample

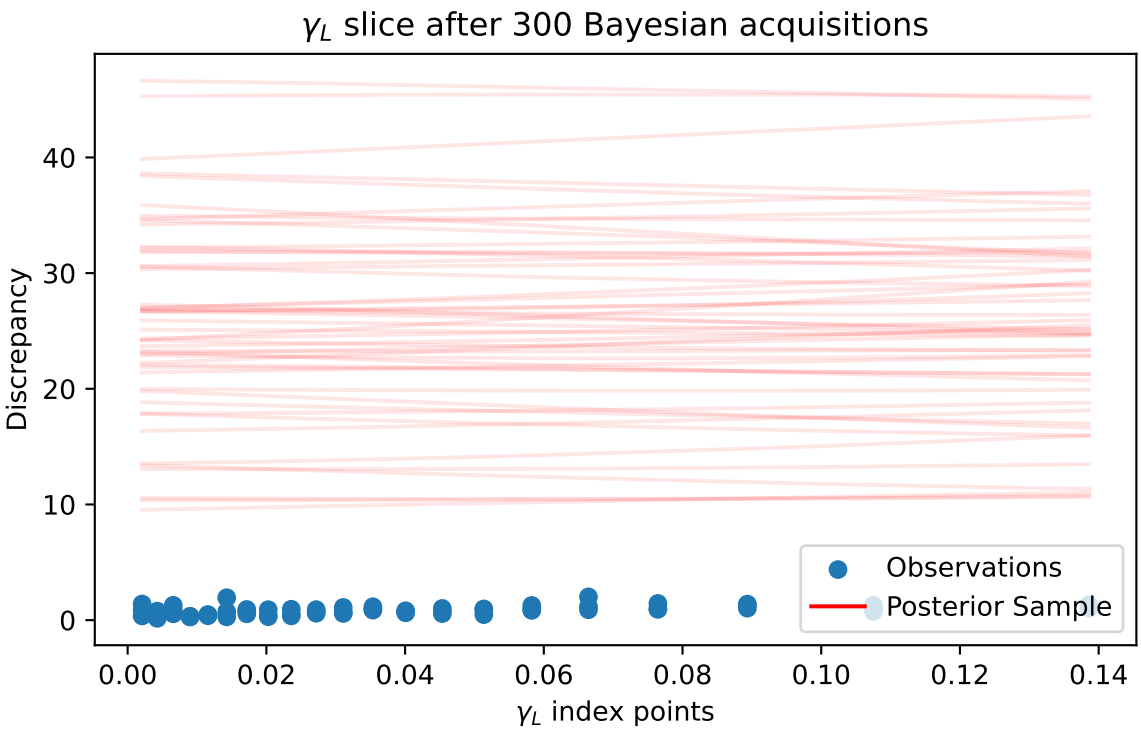

λ slice after 250 Bayesian acquisitions
Discrepancy
0
10
20
30
40
50
60
0.00
0.02
0.04
0.06
0.08
0.10
0.12
λ index points
Observations
Posterior Sample

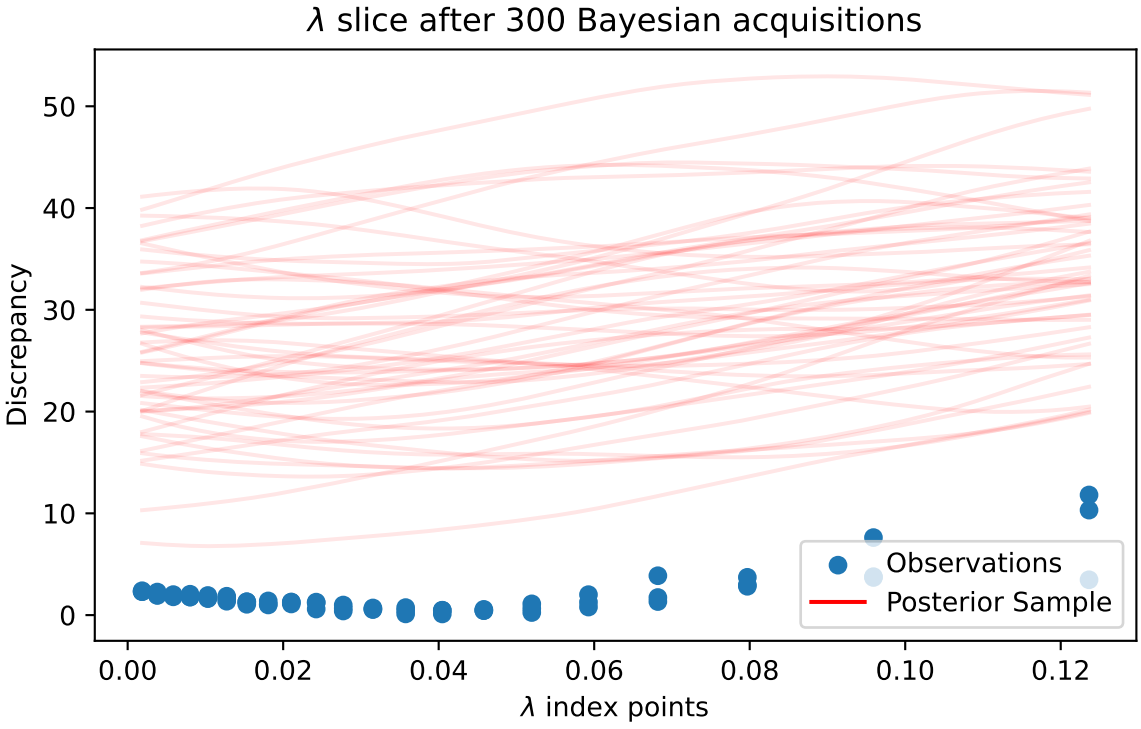

f slice after 250 Bayesian acquisitions
Discrepancy
f index points
Observations
Posterior Sample

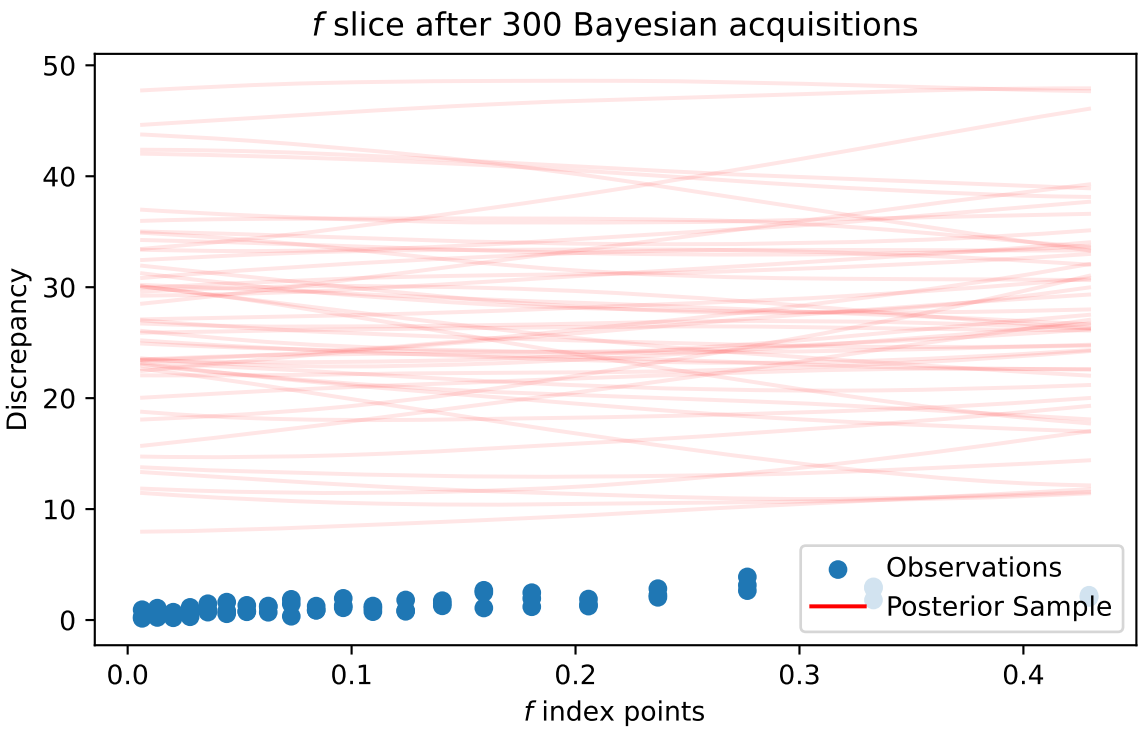

r slice after 250 Bayesian acquisitions
Discrepancy
r index points
Observations
Posterior Sample

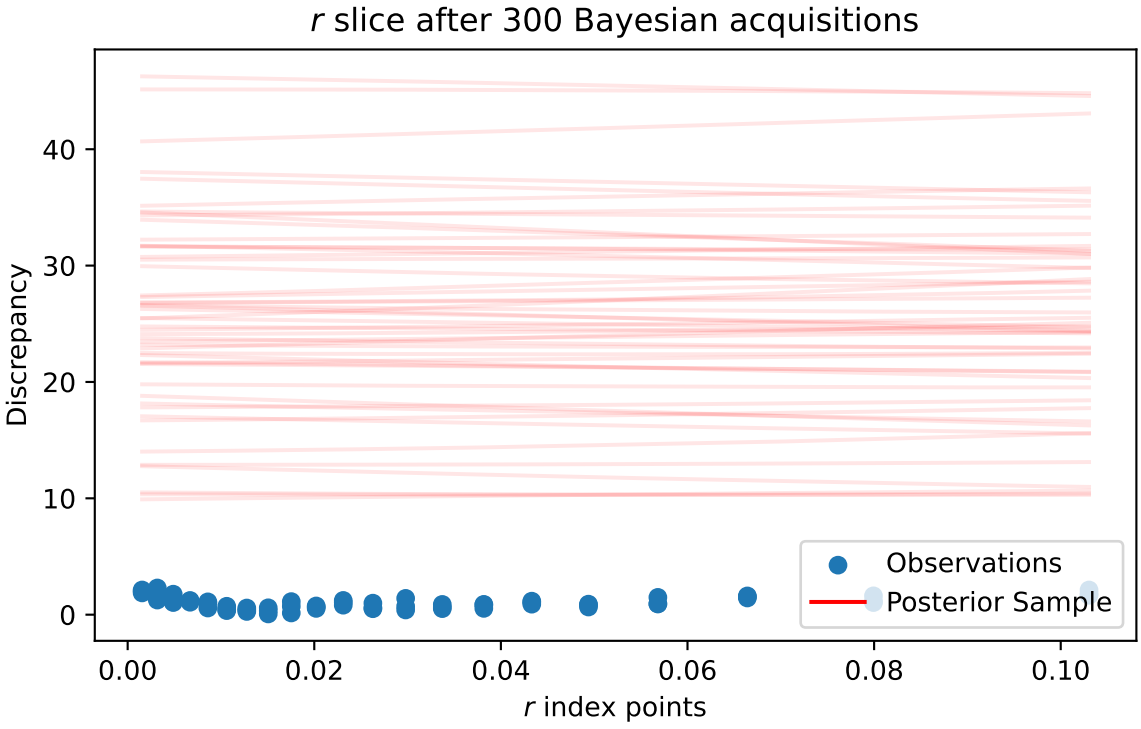

α slice after 300 Bayesian acquisitions
Discrepancy
60
40
20
0
−20
0.0
0.2
0.4
0.6
0.8
1.0
α index points
Observations
Posterior Sample

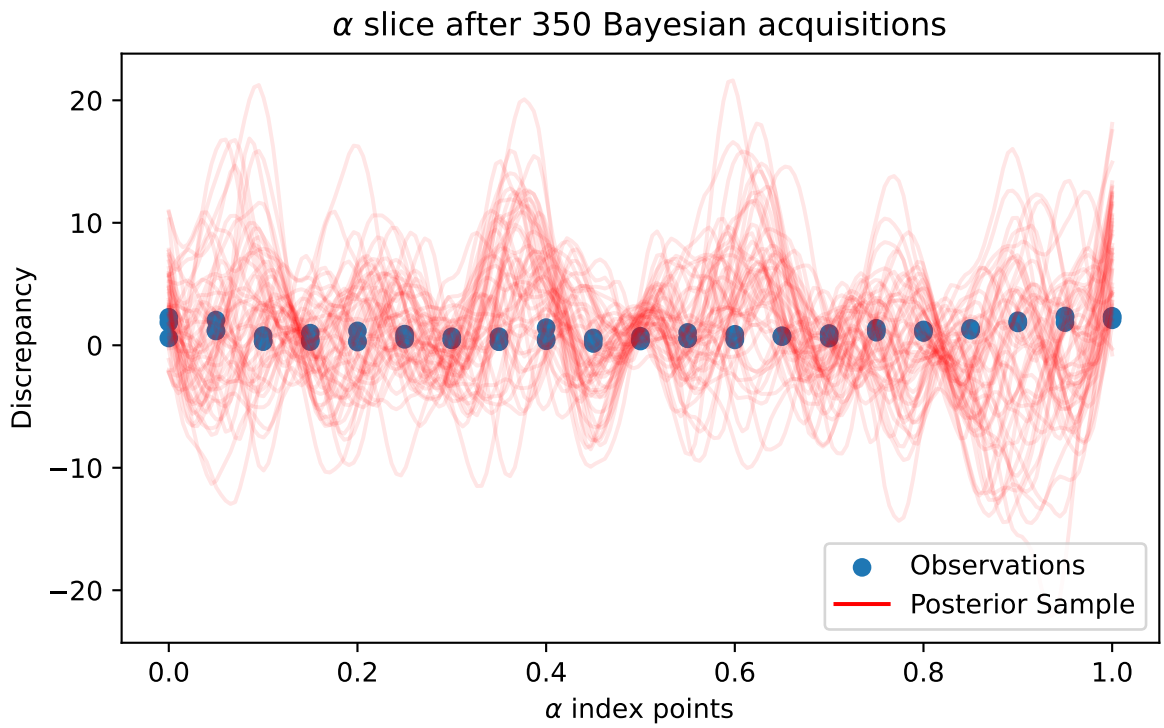

β slice after 300 Bayesian acquisitions
Discrepancy
50
40
30
20
10
0
0.0
0.2
0.4
0.6
0.8
1.0
β index points
Observations
Posterior Sample

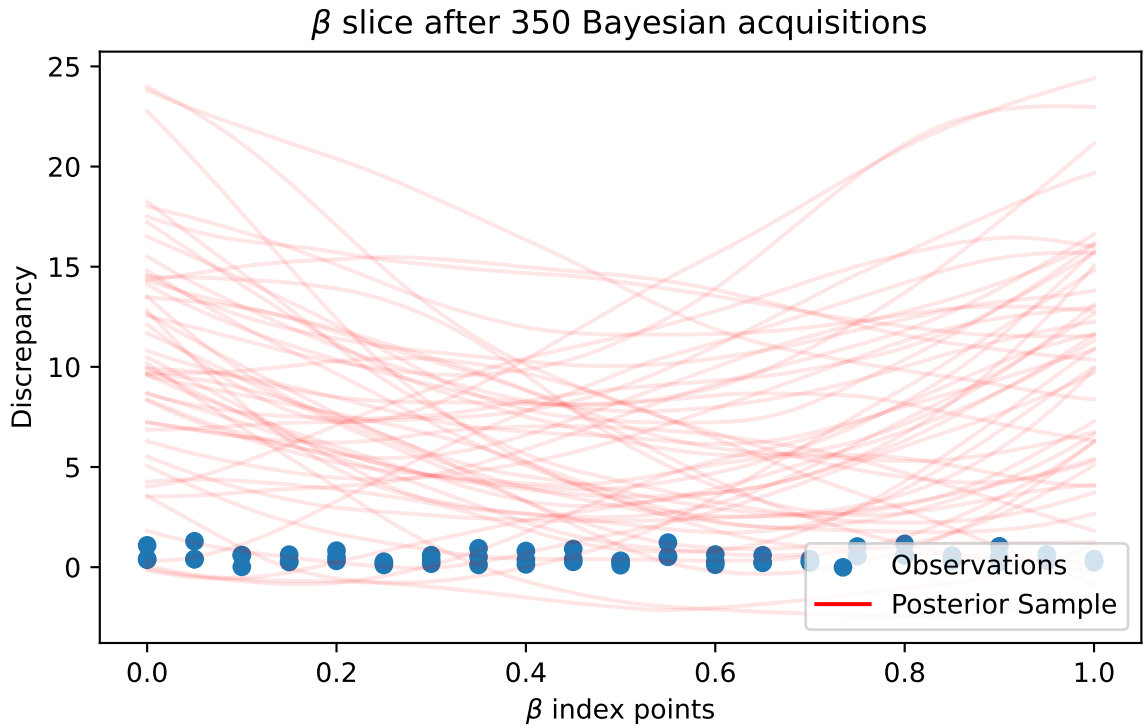

γ_L slice after 300 Bayesian acquisitions
Discrepancy
0
10
20
30
40
0.00
0.02
0.04
0.06
0.08
0.10
0.12
0.14
γ_L index points
Observations
Posterior Sample

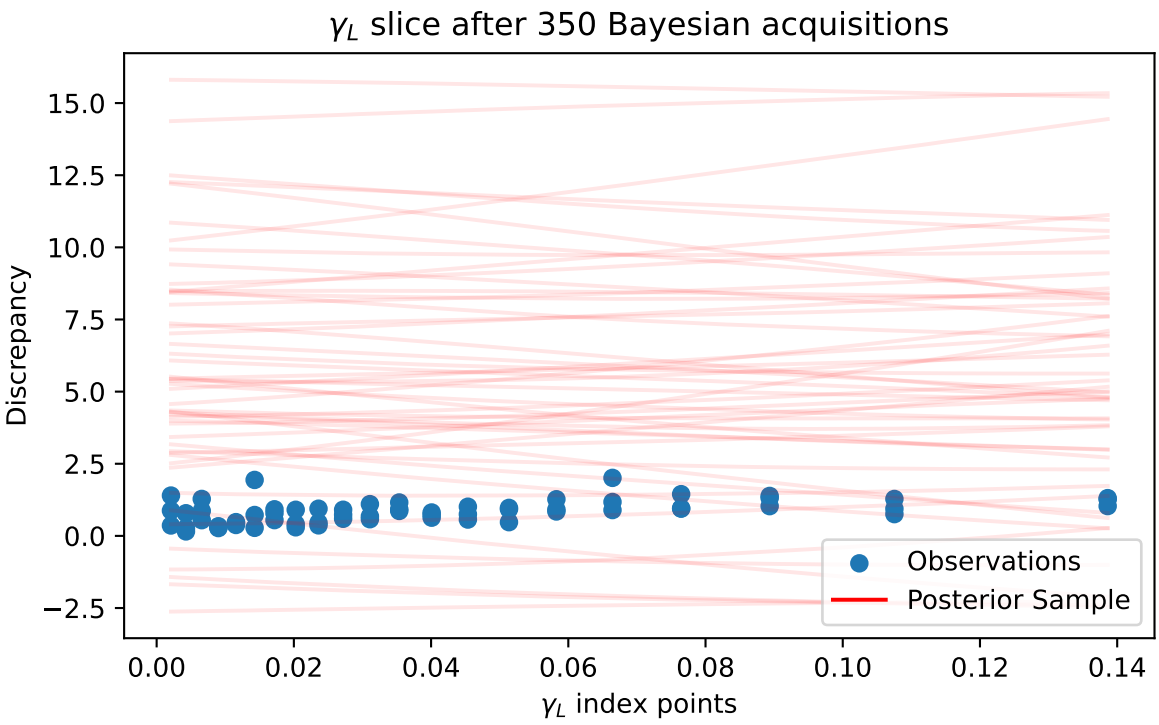

λ slice after 300 Bayesian acquisitions
Discrepancy
0
10
20
30
40
50
0.00
0.02
0.04
0.06
0.08
0.10
0.12
λ index points
Observations
Posterior Sample

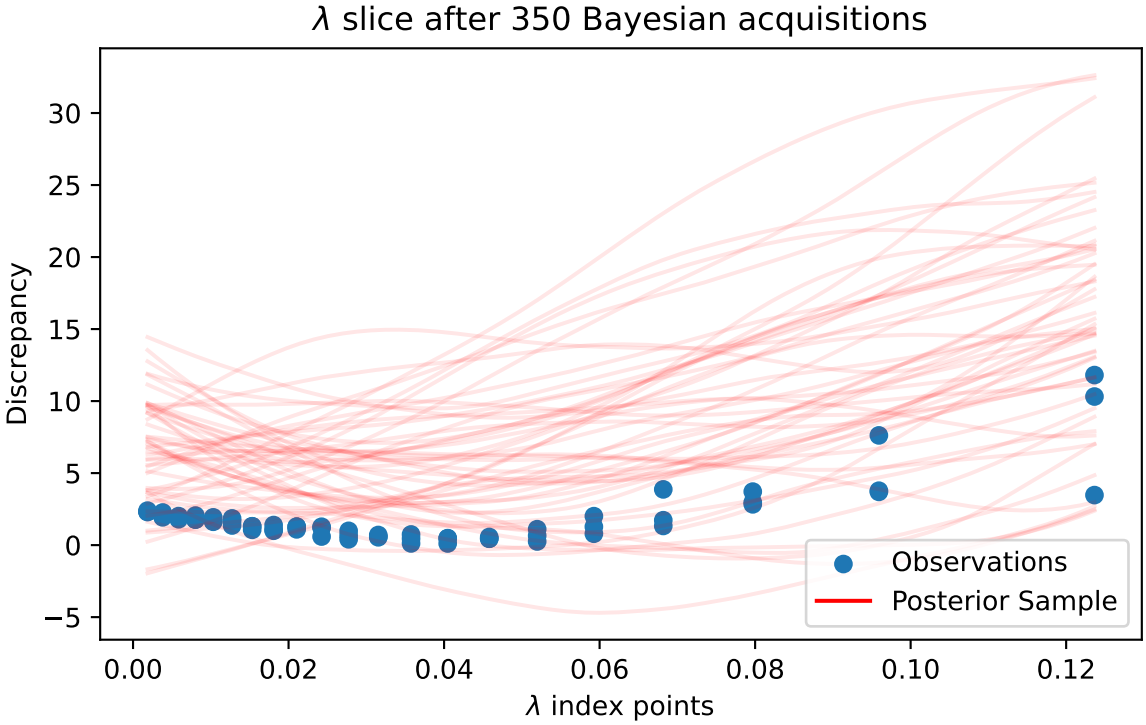

f slice after 300 Bayesian acquisitions
Discrepancy
f index points
Observations
Posterior Sample

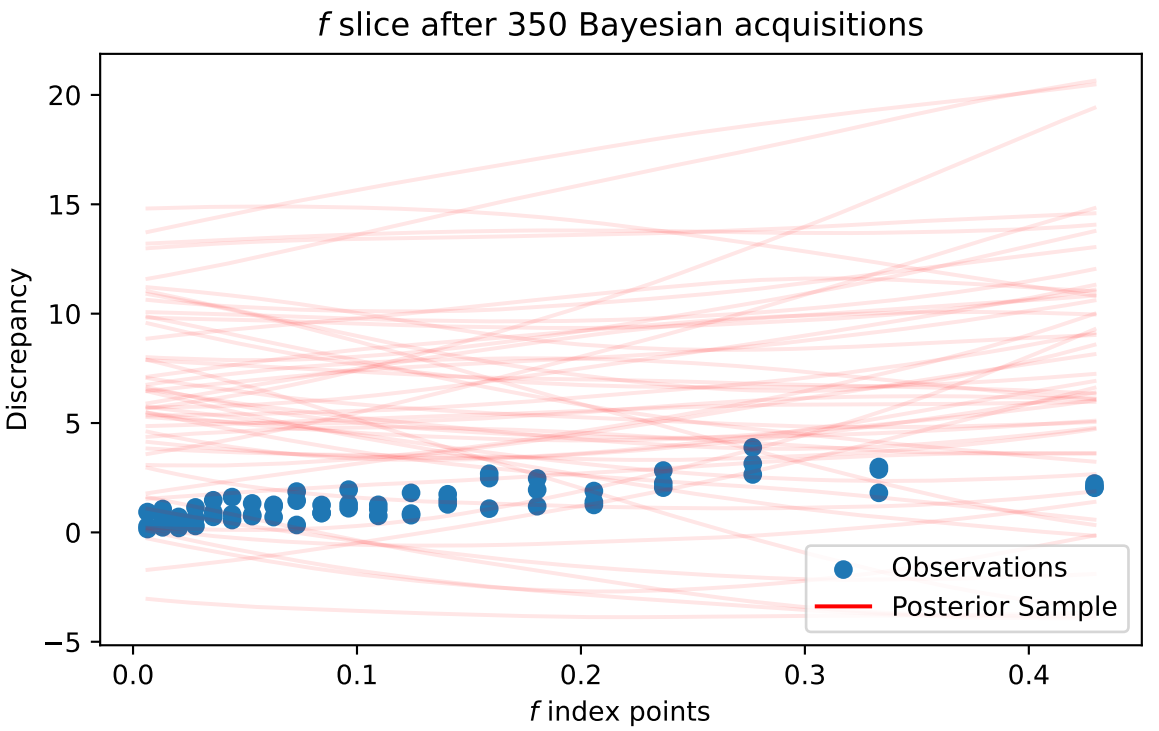

r slice after 300 Bayesian acquisitions
Discrepancy
r index points
Observations
Posterior Sample

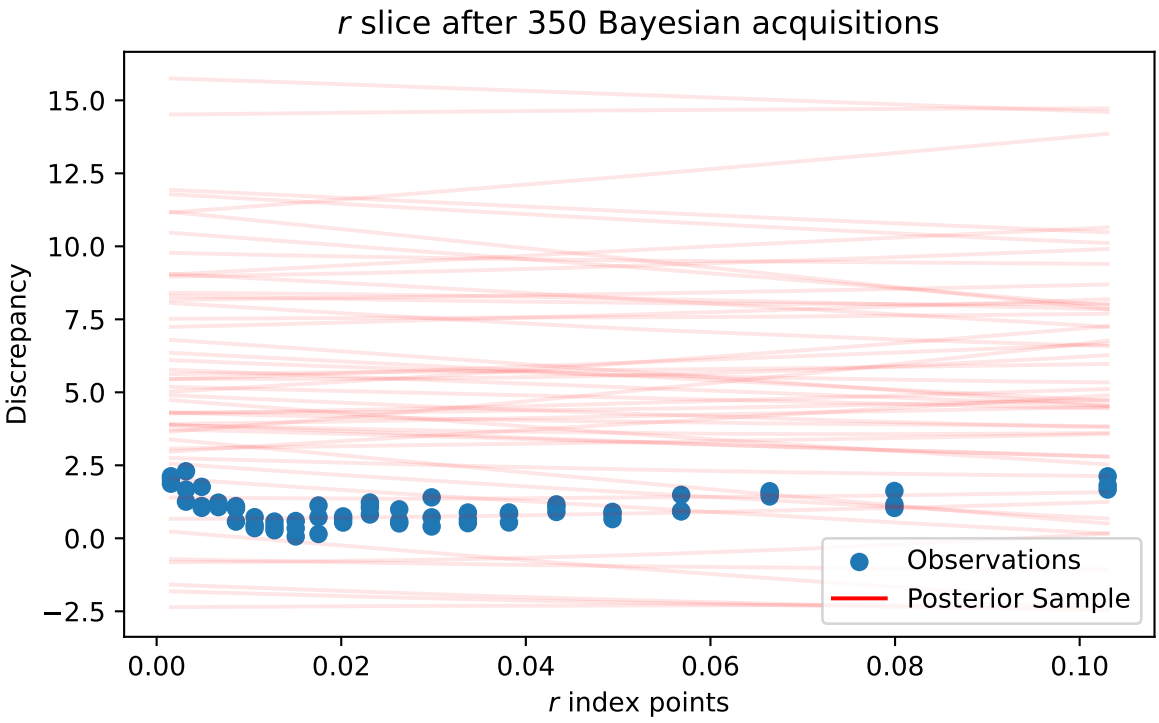

α slice after 350 Bayesian acquisitions
Discrepancy
20
10
0
−10
−20
0.0
0.2
0.4
0.6
0.8
1.0
α index points
Observations
Posterior Sample

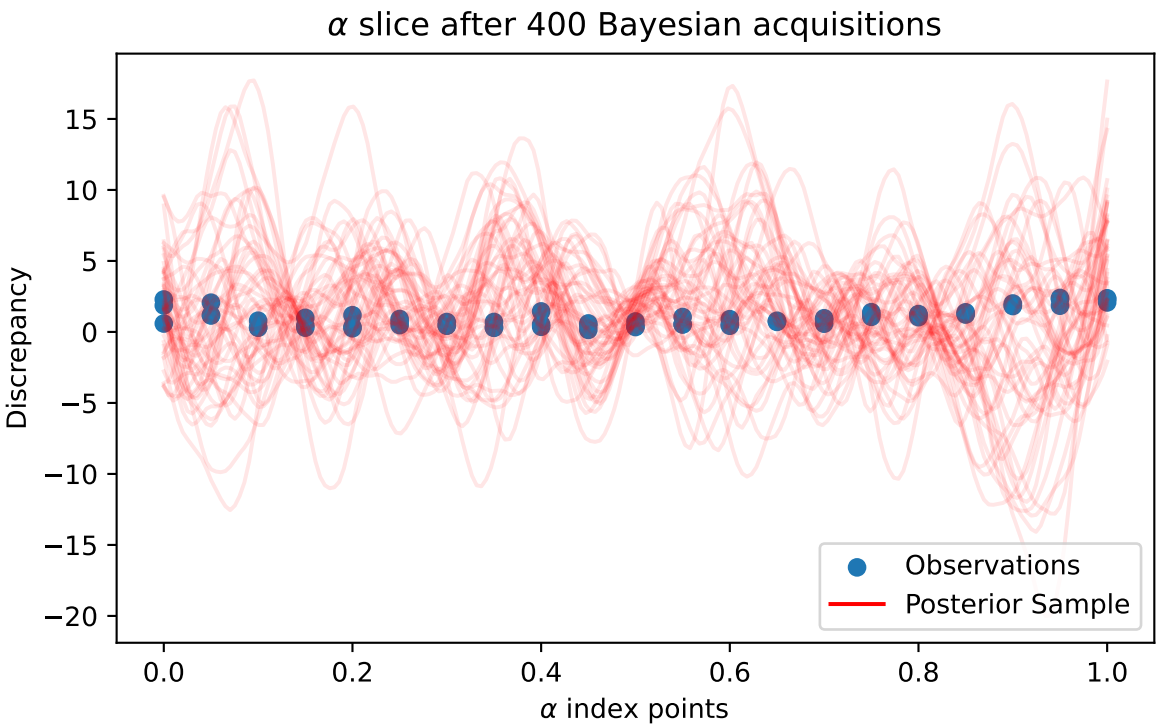

β slice after 350 Bayesian acquisitions
Discrepancy
25
20
15
10
5
0
0.0
0.2
0.4
0.6
0.8
1.0
β index points
Observations
Posterior Sample

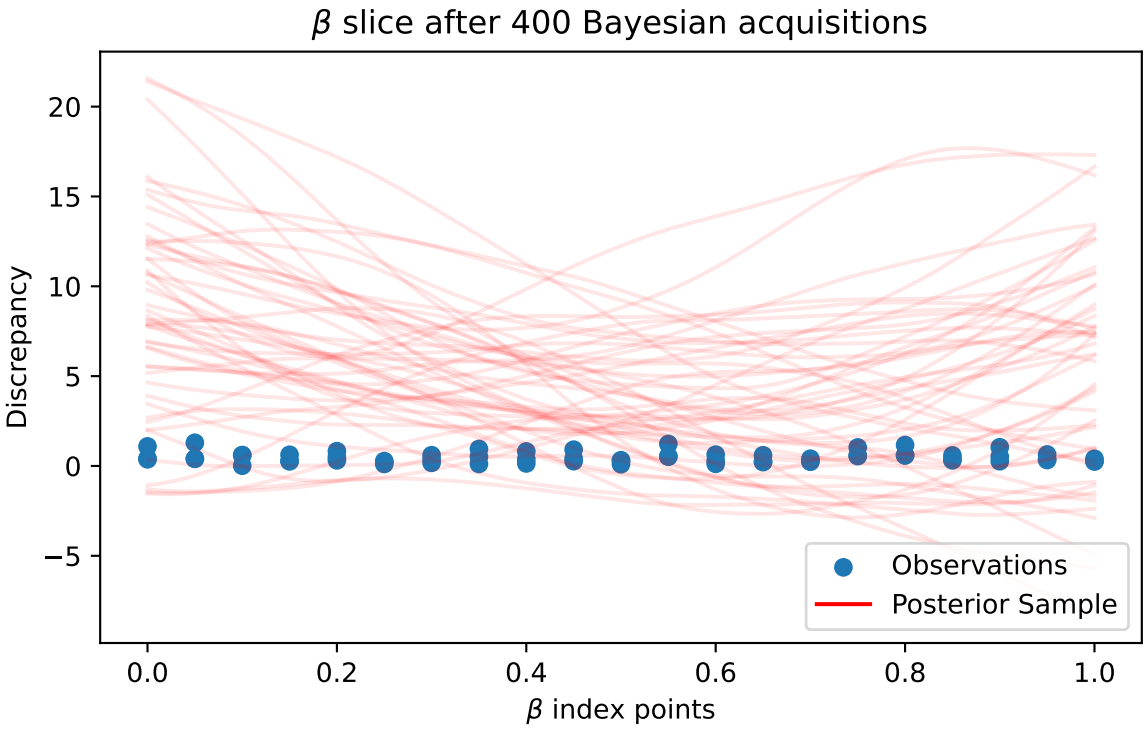

γ_L slice after 350 Bayesian acquisitions
Discrepancy
15.0
12.5
10.0
7.5
5.0
2.5
0.0
−2.5
0.00
0.02
0.04
0.06
0.08
0.10
0.12
0.14
γ_L index points
Observations
Posterior Sample

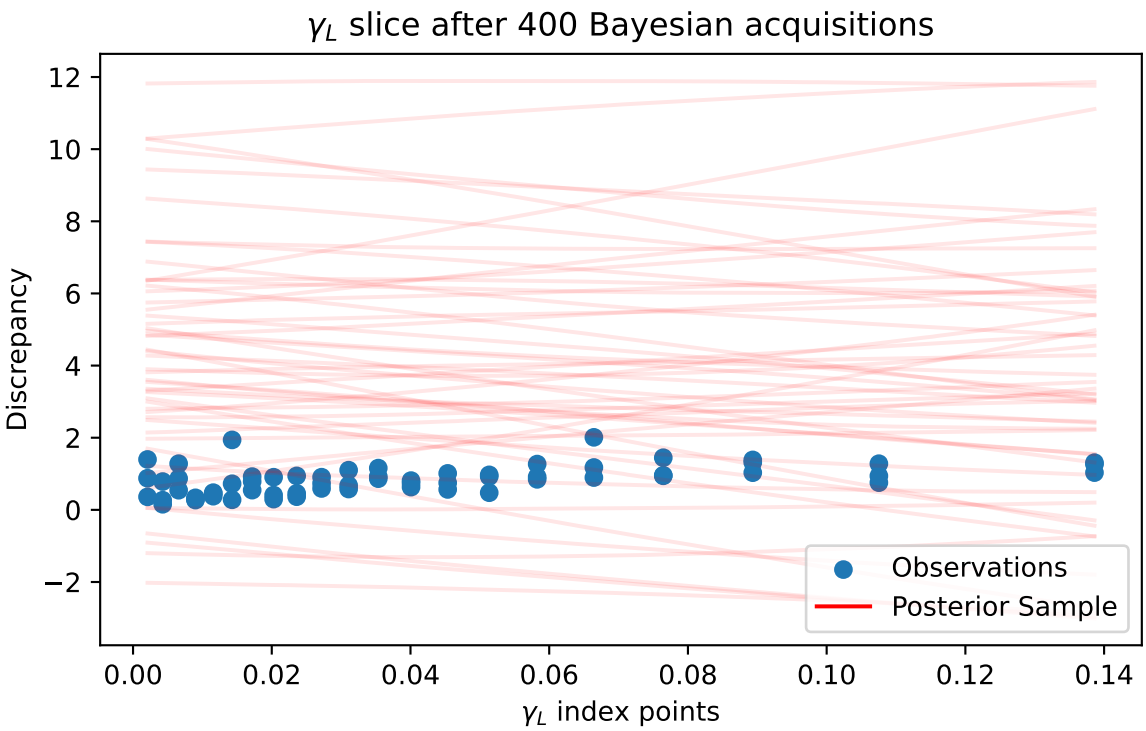

λ slice after 350 Bayesian acquisitions
Discrepancy
30
25
20
15
10
5
0
−5
0.00
0.02
0.04
0.06
0.08
0.10
0.12
λ index points
Observations
Posterior Sample

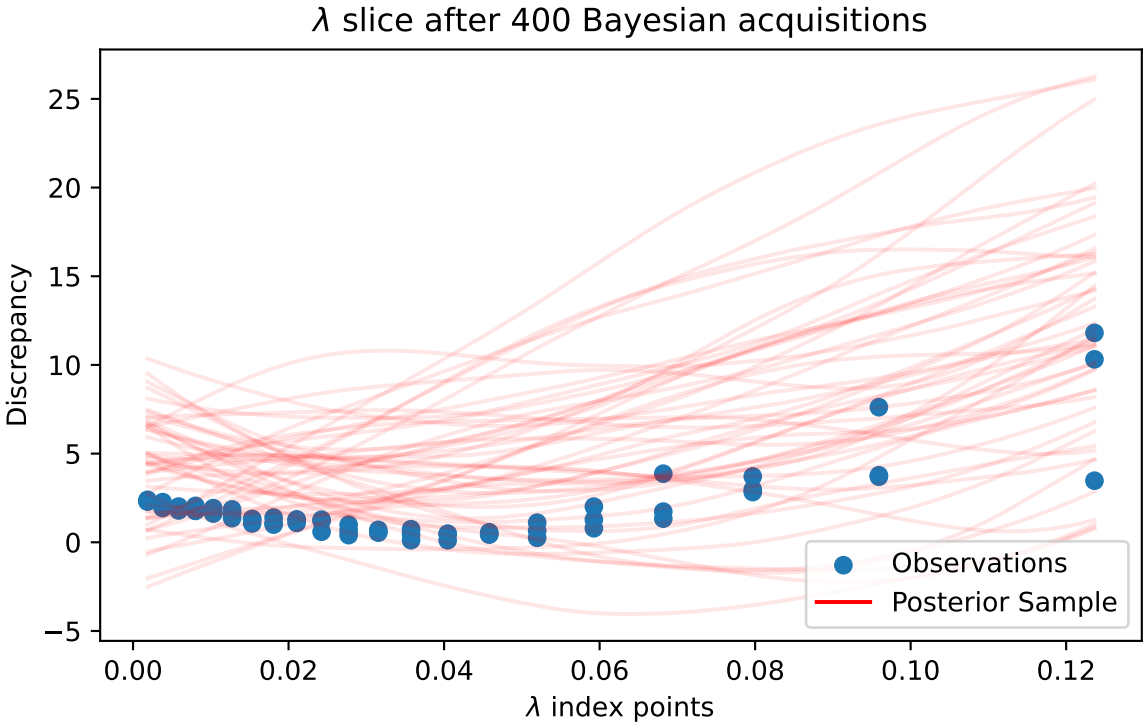

f slice after 350 Bayesian acquisitions
Discrepancy
20
15
10
5
0
−5
0.0
0.1
0.2
0.3
0.4
f index points
Observations
Posterior Sample

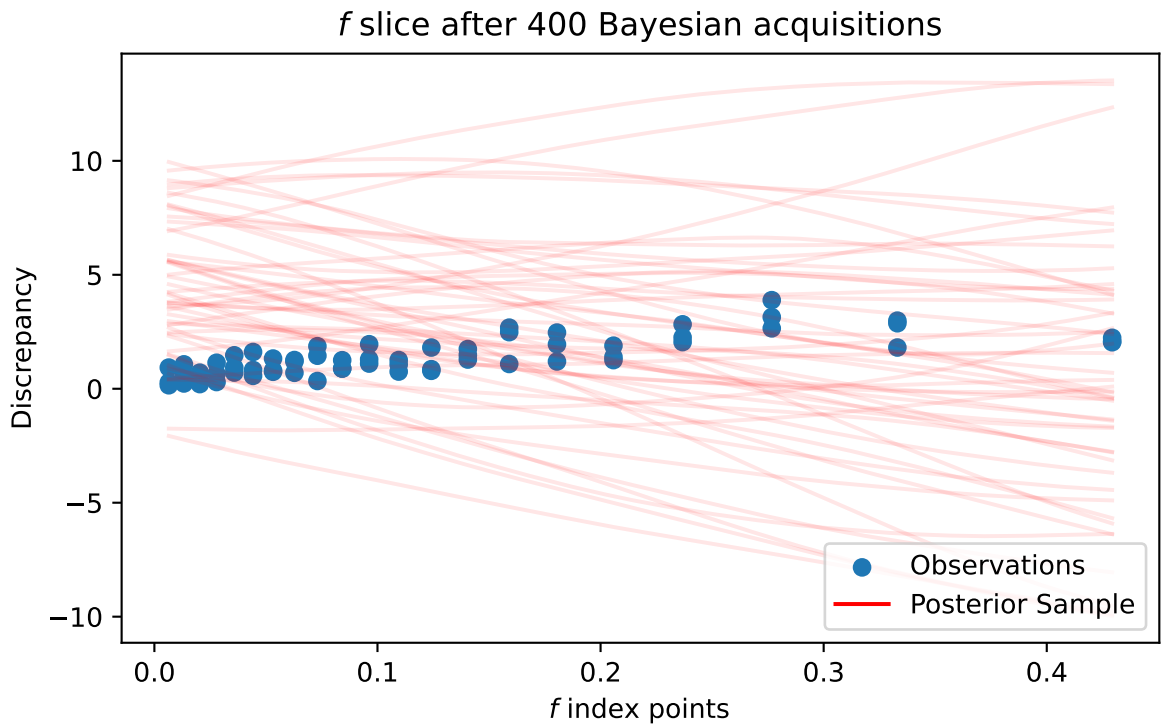

r slice after 350 Bayesian acquisitions
Discrepancy
15.0
12.5
10.0
7.5
5.0
2.5
0.0
−2.5
0.00
0.02
0.04
0.06
0.08
0.10
r index points
Observations
Posterior Sample

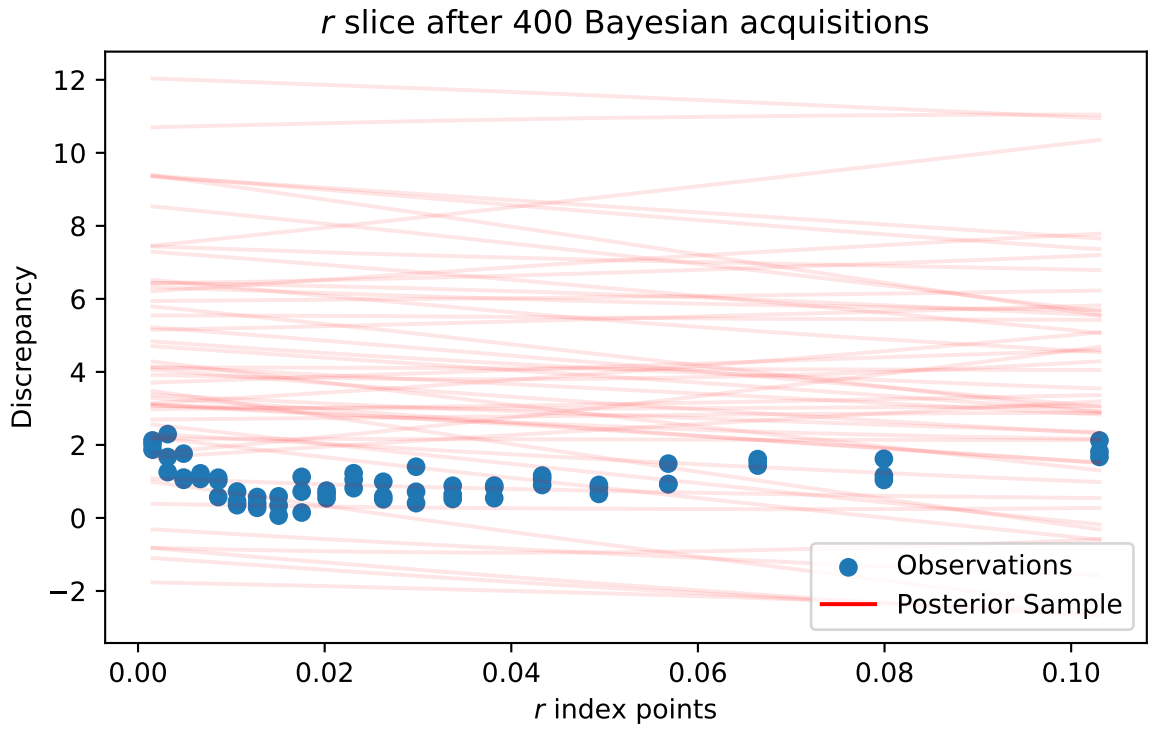

α slice after 400 Bayesian acquisitions
Discrepancy
15
10
5
0
−5
−10
−15
−20
0.0
0.2
0.4
0.6
0.8
1.0
α index points
Observations
Posterior Sample

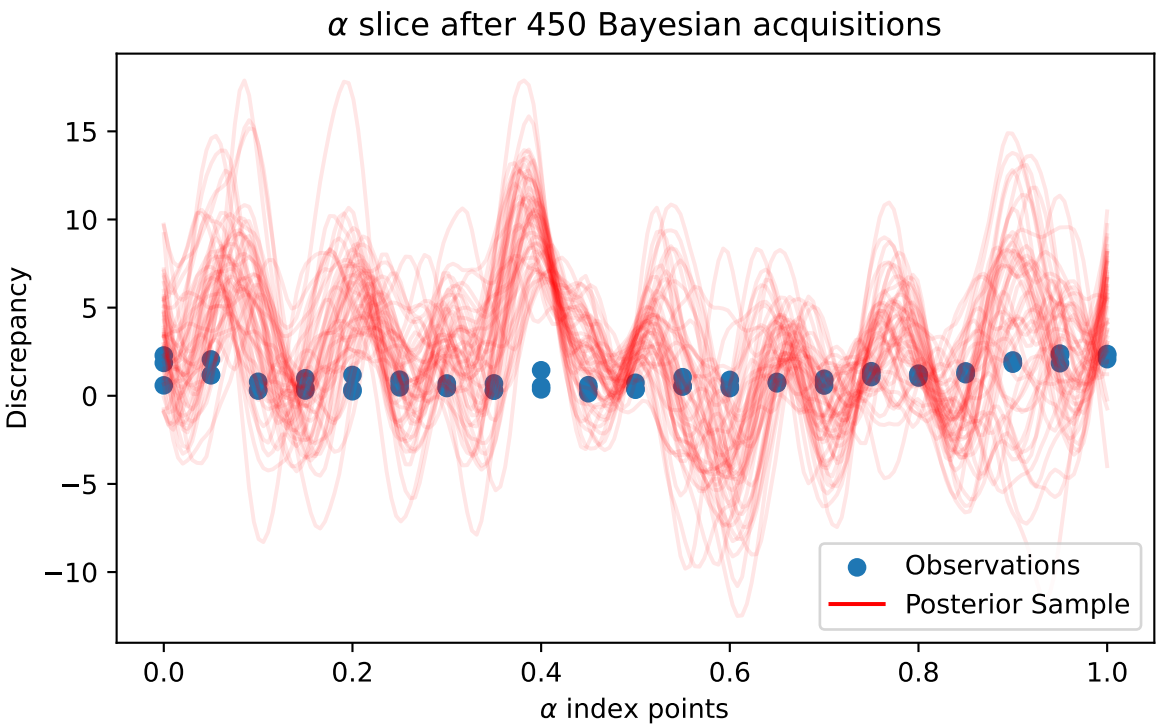

β slice after 400 Bayesian acquisitions
Discrepancy
20
15
10
5
0
−5
0.0
0.2
0.4
0.6
0.8
1.0
β index points
Observations
Posterior Sample

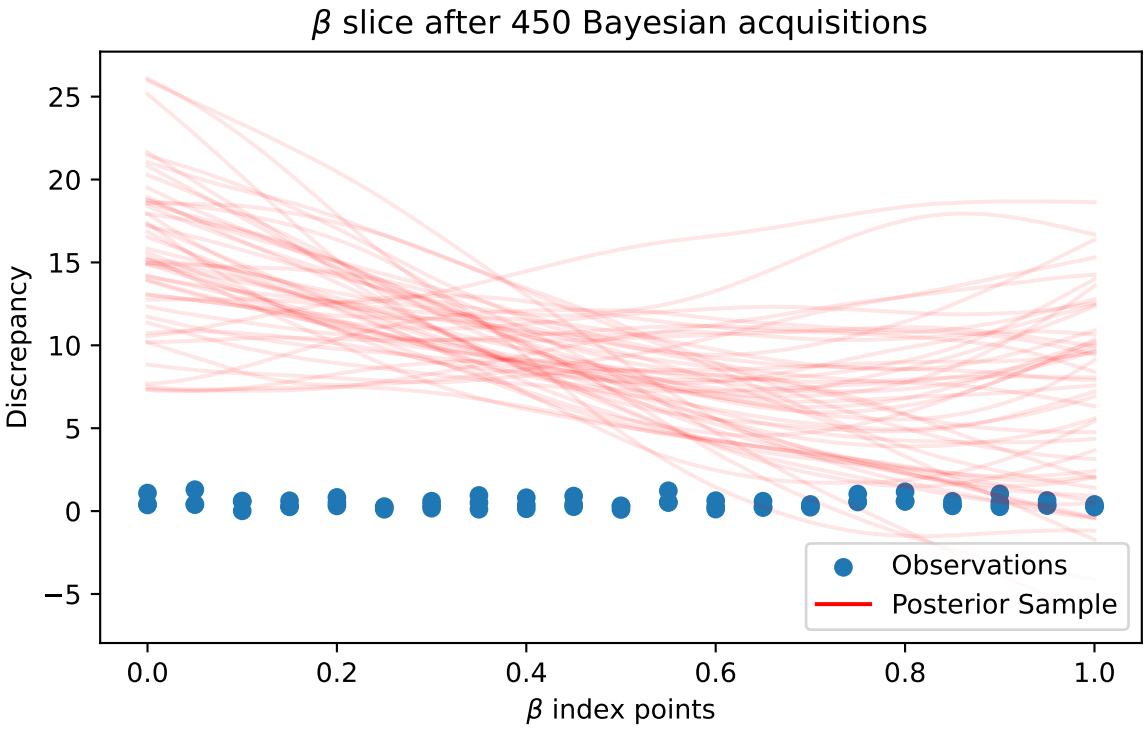

γ_L slice after 400 Bayesian acquisitions
Discrepancy
12
10
8
6
4
2
0
−2
0.00
0.02
0.04
0.06
0.08
0.10
0.12
0.14
γ_L index points
Observations
Posterior Sample

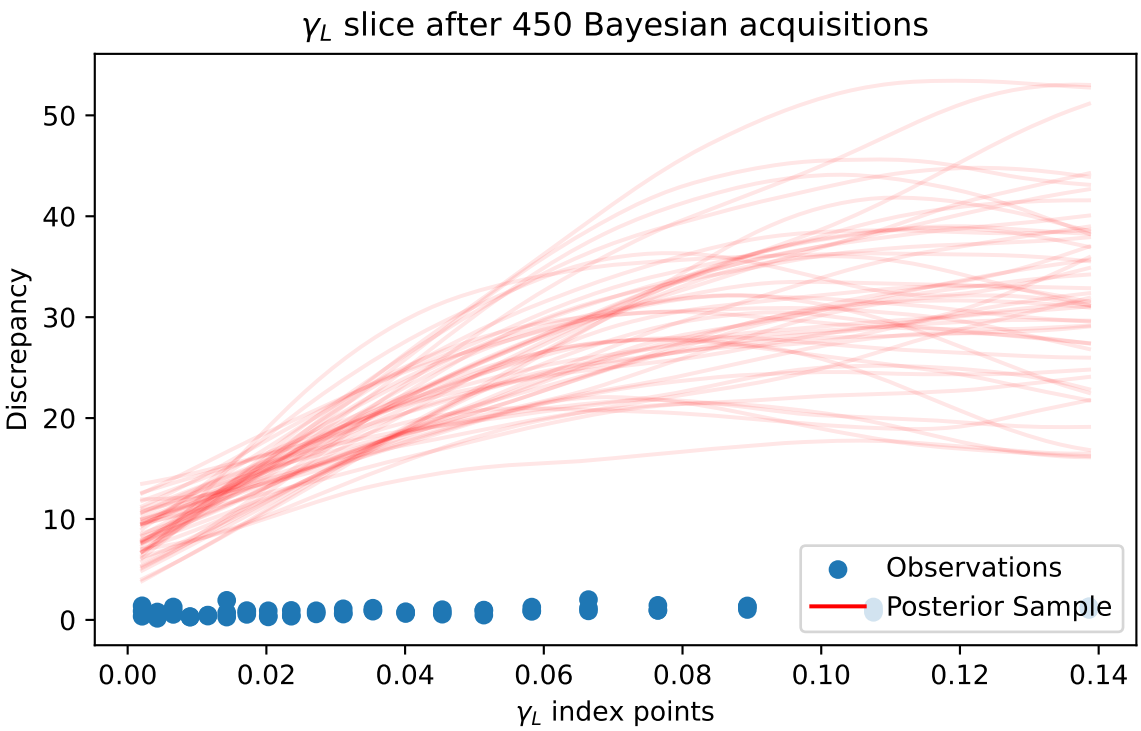

λ slice after 400 Bayesian acquisitions
Discrepancy
25
20
15
10
5
0
−5
0.00
0.02
0.04
0.06
0.08
0.10
0.12
λ index points
Observations
Posterior Sample

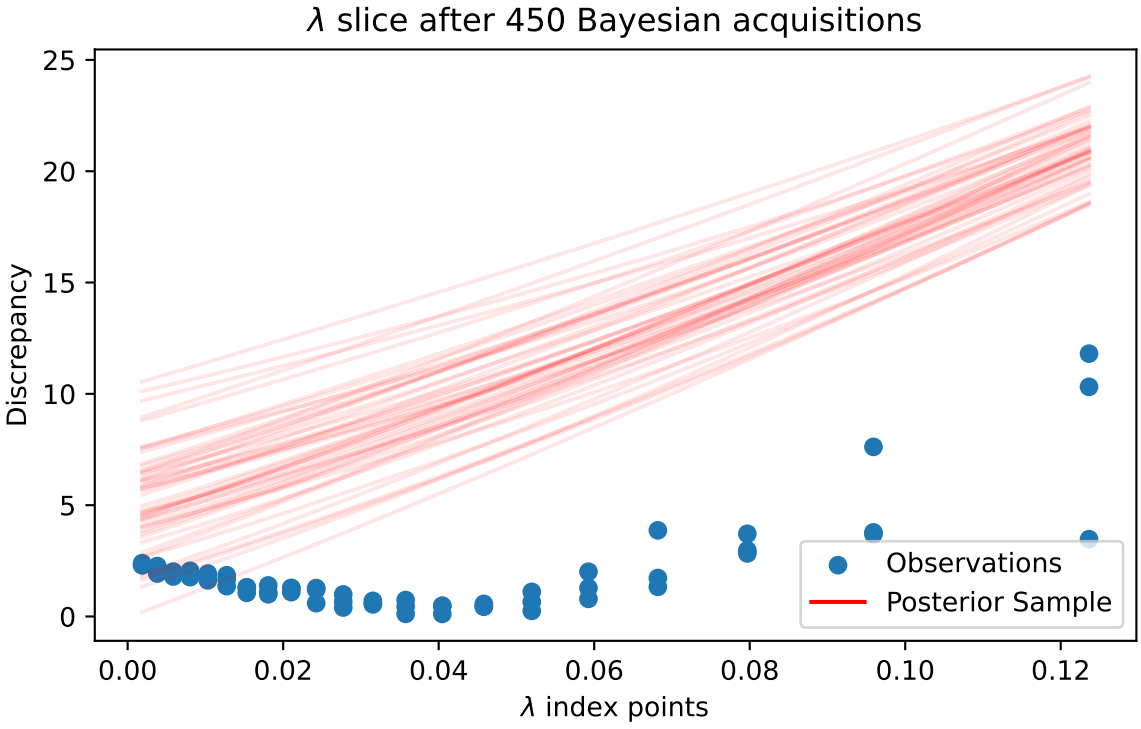

f slice after 400 Bayesian acquisitions
Discrepancy
10
5
0
−5
−10
0.0
0.1
0.2
0.3
0.4
f index points
Observations
Posterior Sample

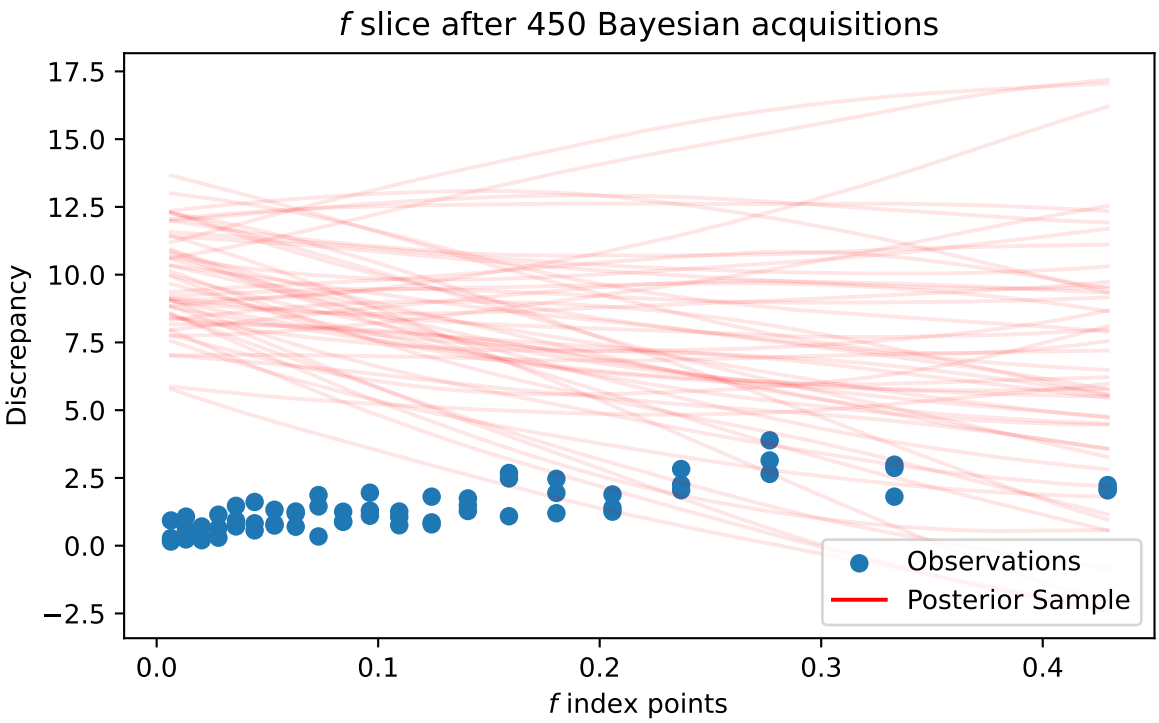

r slice after 400 Bayesian acquisitions
Discrepancy
12
10
8
6
4
2
0
−2
0.00
0.02
0.04
0.06
0.08
0.10
r index points
Observations
Posterior Sample

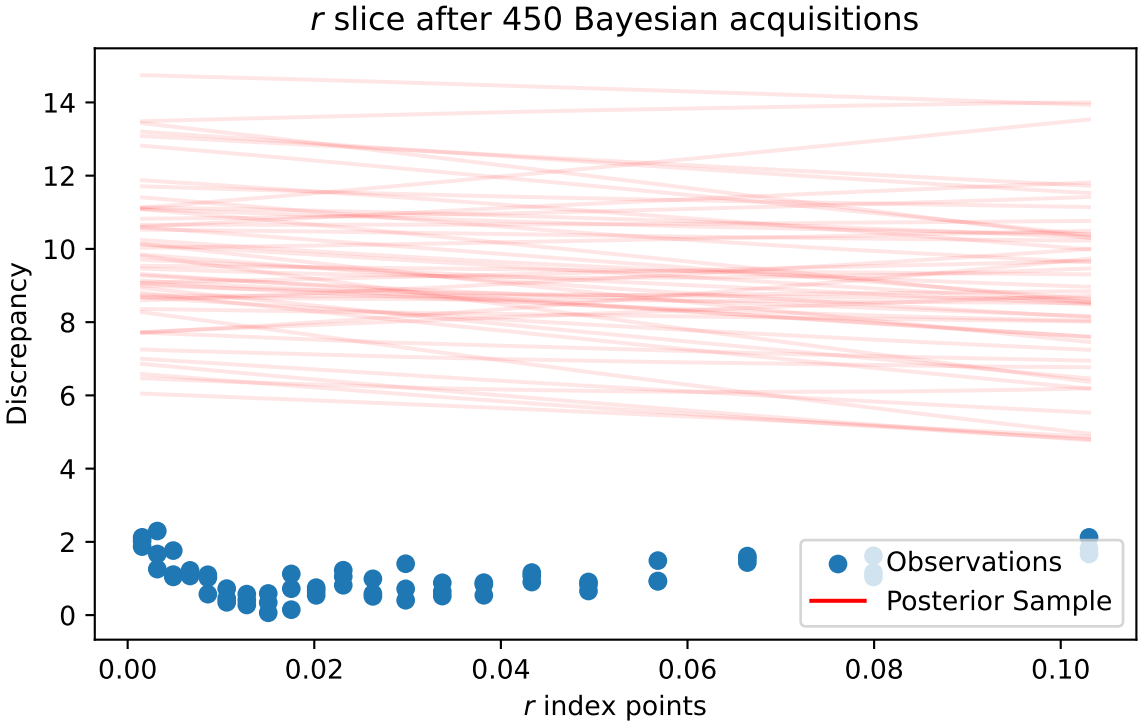

α slice after 450 Bayesian acquisitions
Discrepancy
15
10
5
0
−5
−10
0.0
0.2
0.4
0.6
0.8
1.0
α index points
Observations
Posterior Sample

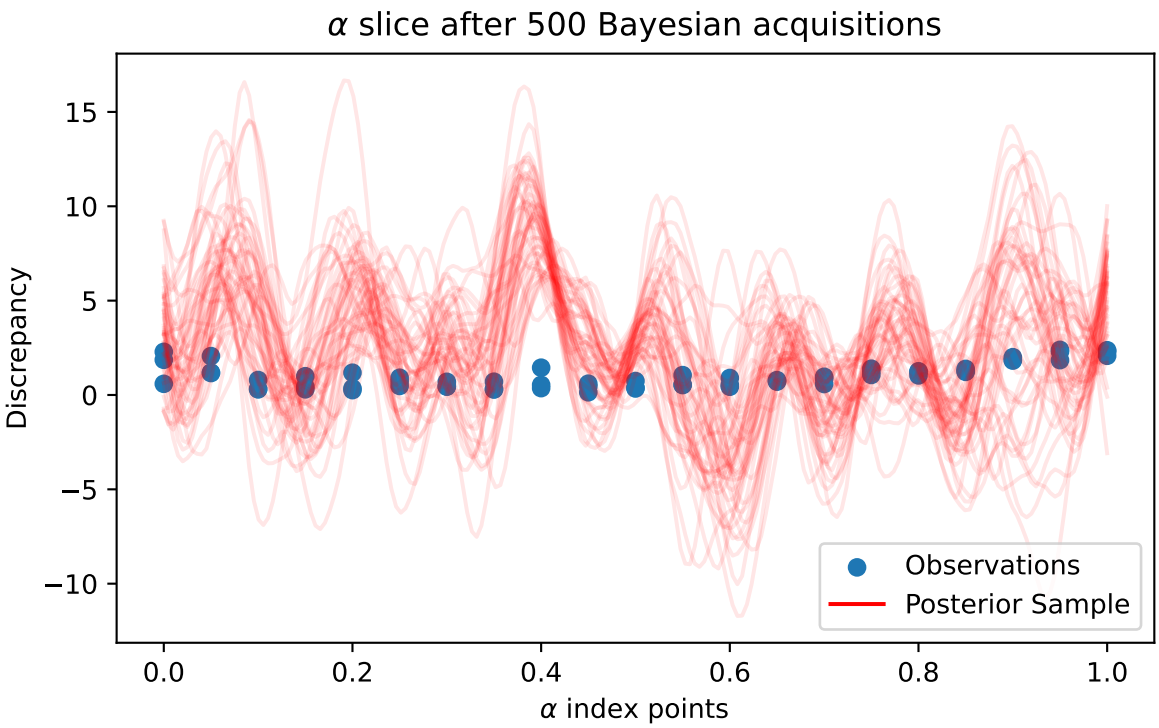

β slice after 450 Bayesian acquisitions
Discrepancy
25
20
15
10
5
0
−5
0.0
0.2
0.4
0.6
0.8
1.0
β index points
Observations
Posterior Sample

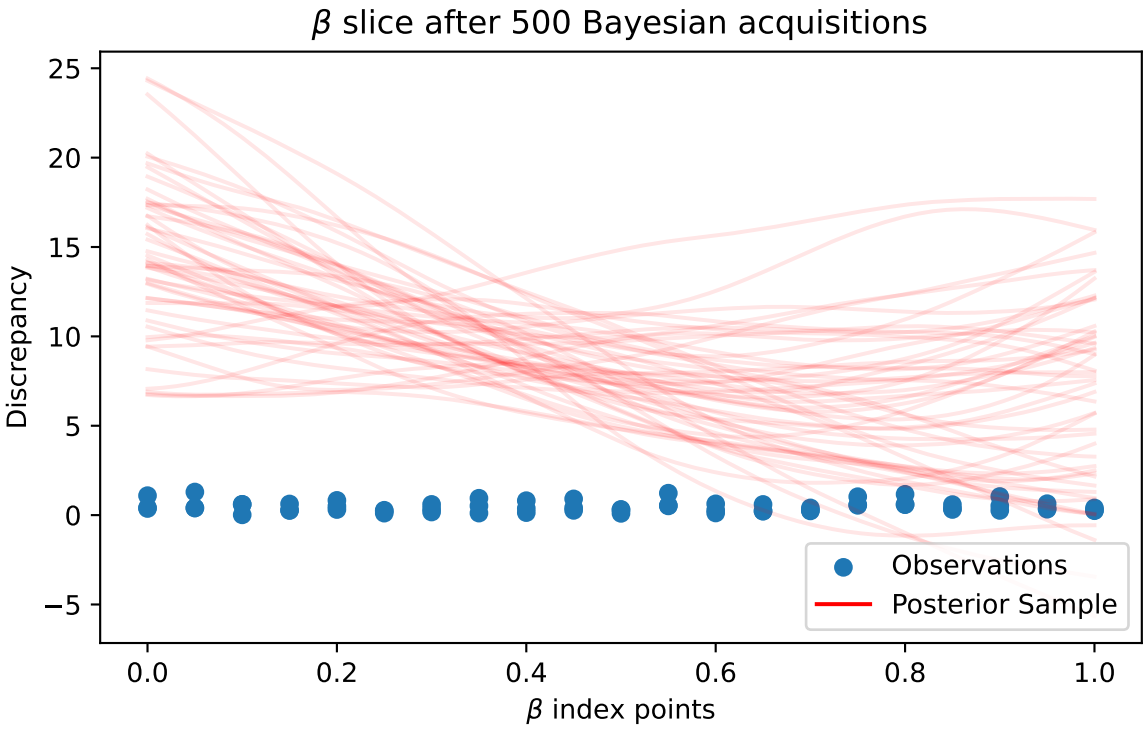

γ_L slice after 450 Bayesian acquisitions
Discrepancy
50
40
30
20
10
0
0.00
0.02
0.04
0.06
0.08
0.10
0.12
0.14
γ_L index points
Observations
Posterior Sample

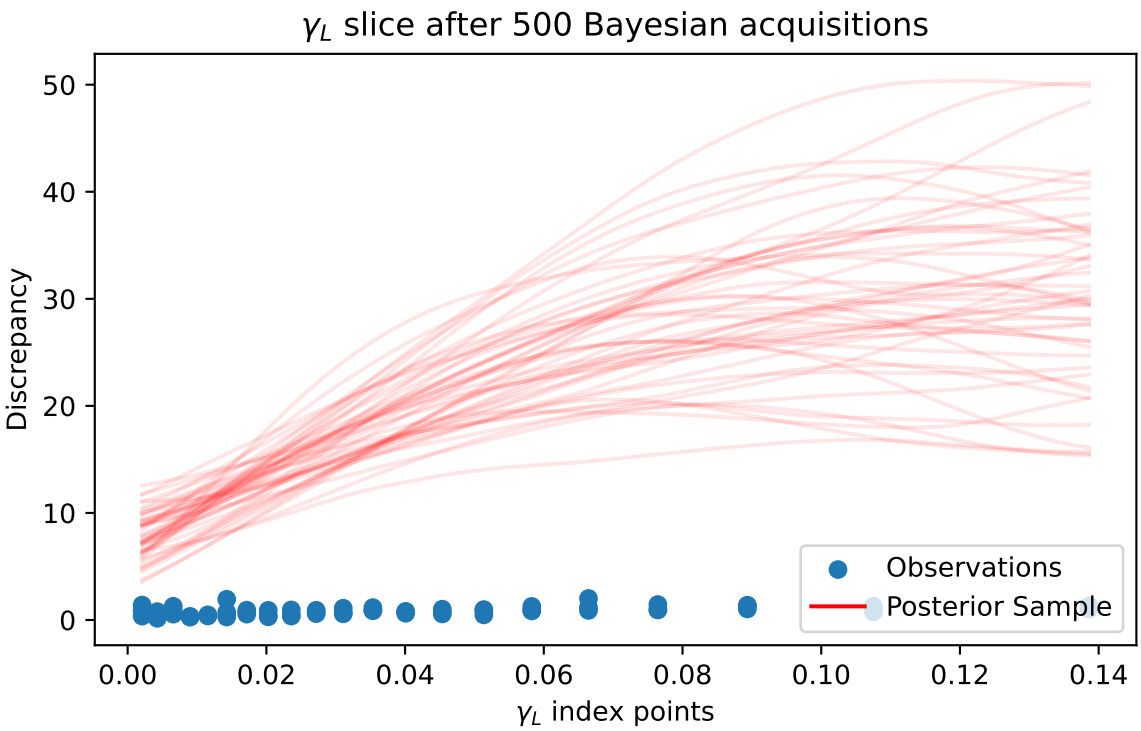

λ slice after 450 Bayesian acquisitions
Discrepancy
25
20
15
10
5
0
0.00
0.02
0.04
0.06
0.08
0.10
0.12
λ index points
Observations
Posterior Sample

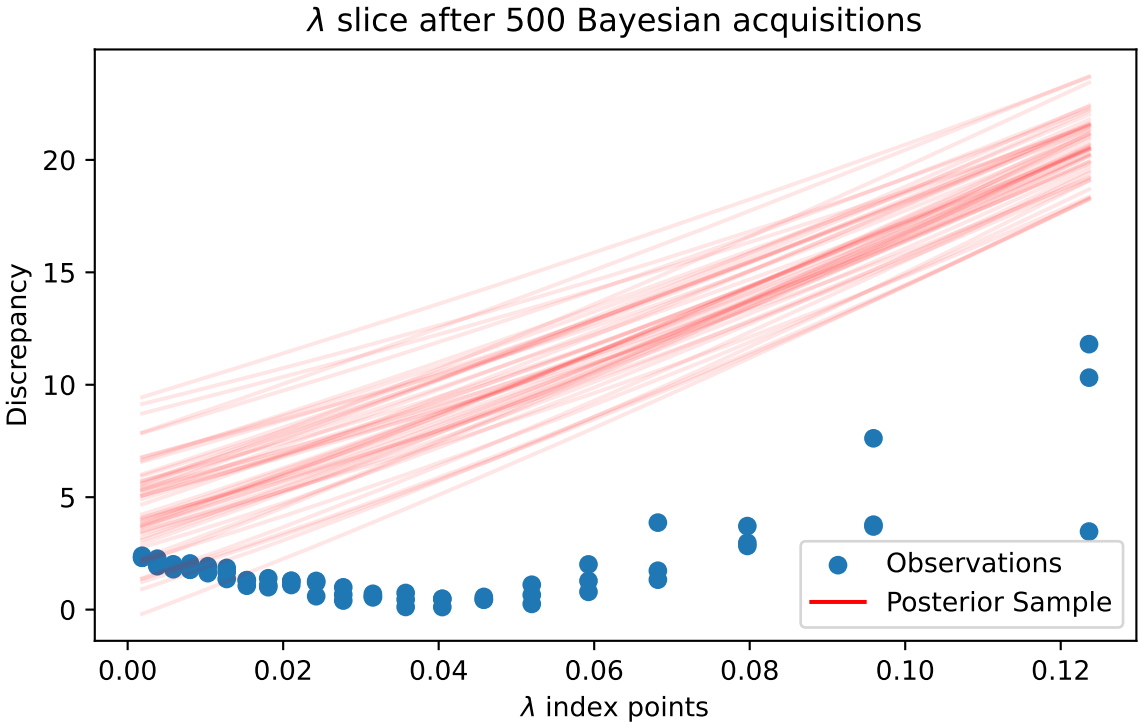

f slice after 450 Bayesian acquisitions
Discrepancy
f index points
Observations
Posterior Sample

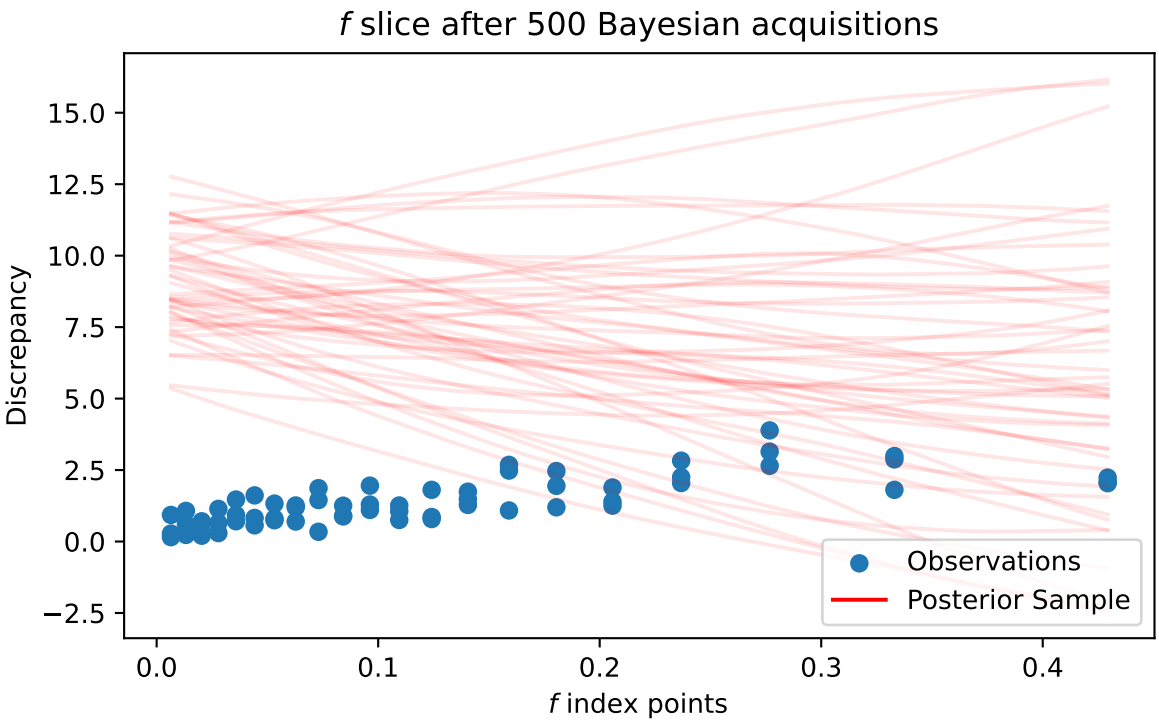

r slice after 450 Bayesian acquisitions
Discrepancy
r index points
Observations
Posterior Sample

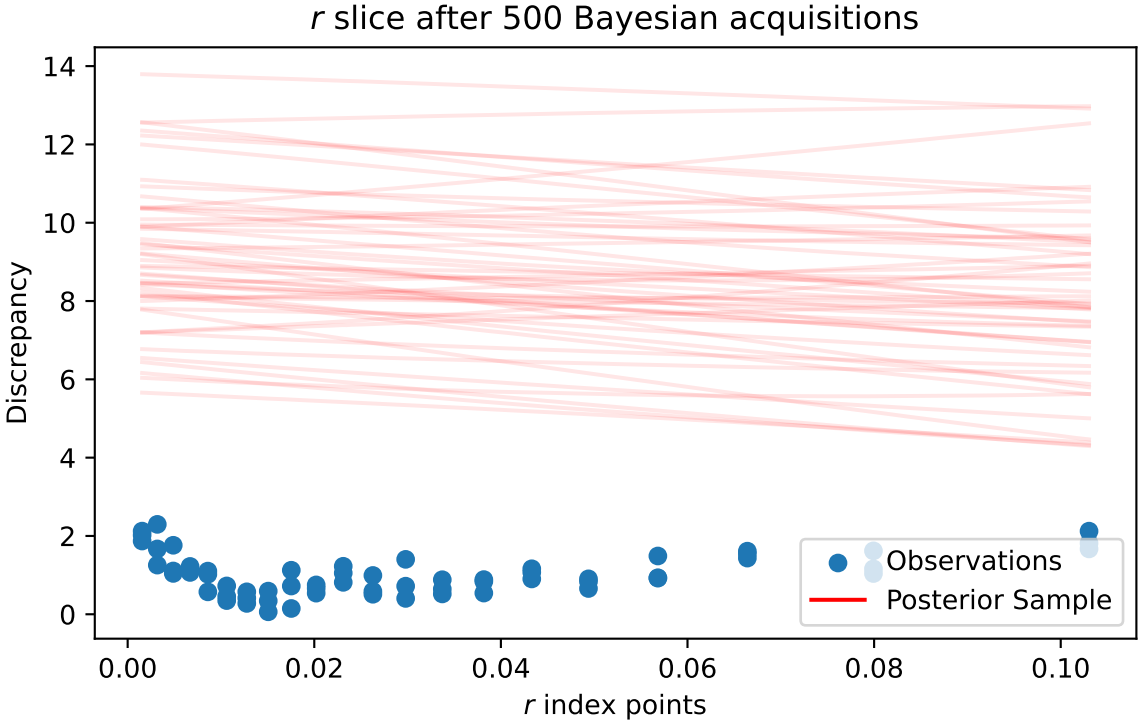

α slice after 500 Bayesian acquisitions
Discrepancy
15
10
5
0
−5
−10
0.0
0.2
0.4
0.6
0.8
1.0
α index points
Observations
Posterior Sample

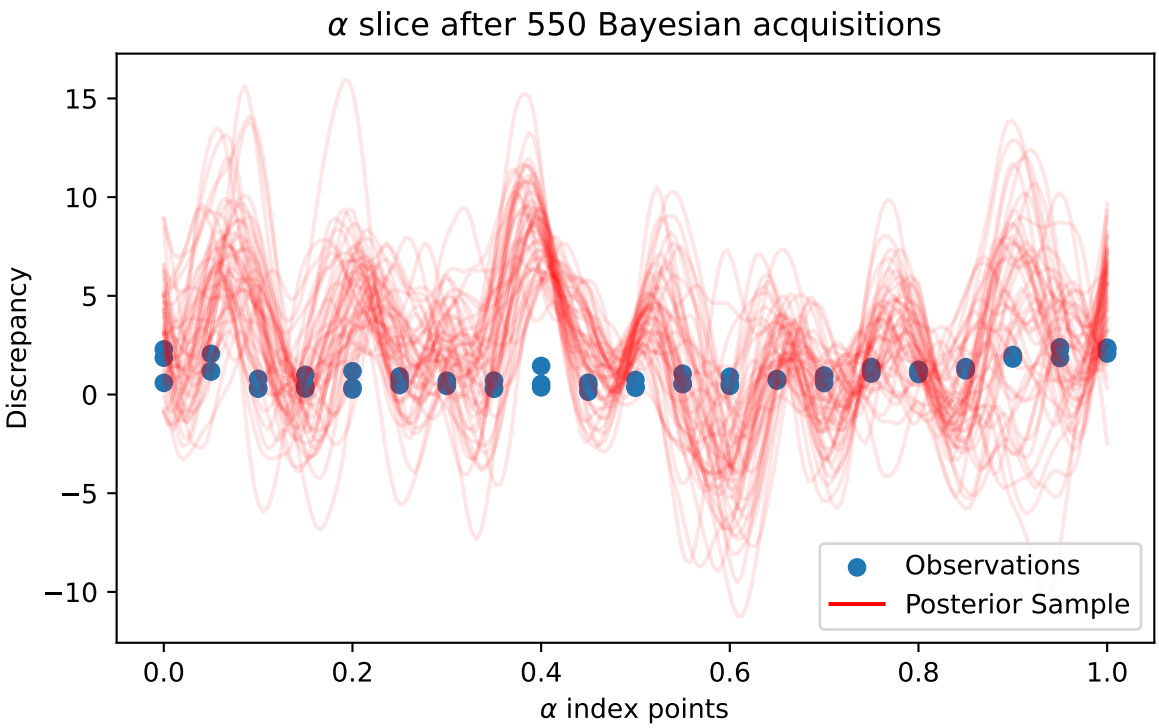

β slice after 500 Bayesian acquisitions
Discrepancy
25
20
15
10
5
0
−5
0.0
0.2
0.4
0.6
0.8
1.0
β index points
Observations
Posterior Sample

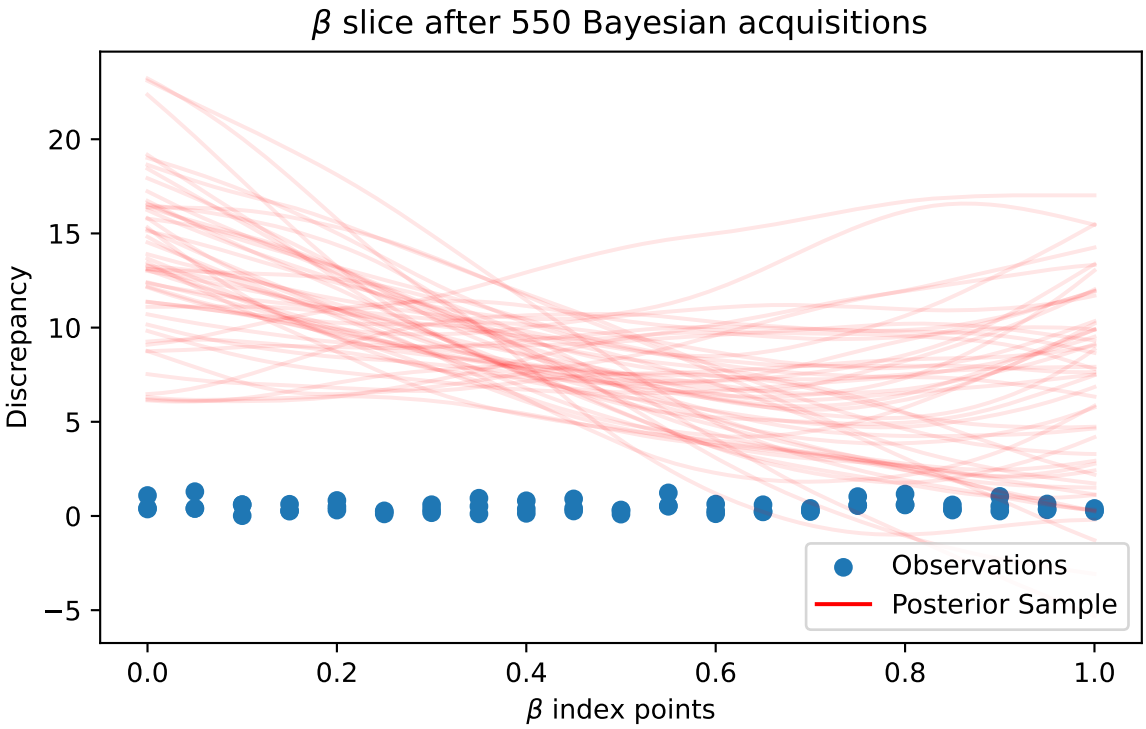

γ_L slice after 500 Bayesian acquisitions
Discrepancy
50
40
30
20
10
0
0.00
0.02
0.04
0.06
0.08
0.10
0.12
0.14
γ_L index points
Observations
Posterior Sample

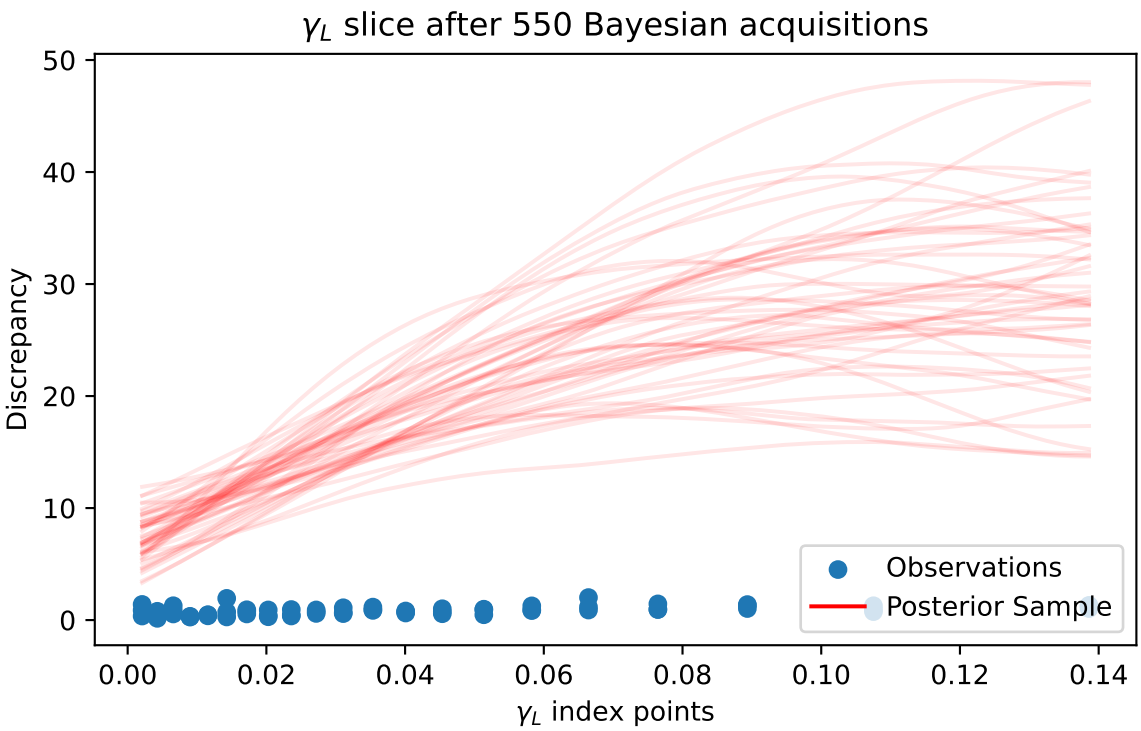

λ slice after 500 Bayesian acquisitions
Discrepancy
20
15
10
5
0
0.00
0.02
0.04
0.06
0.08
0.10
0.12
λ index points
Observations
Posterior Sample

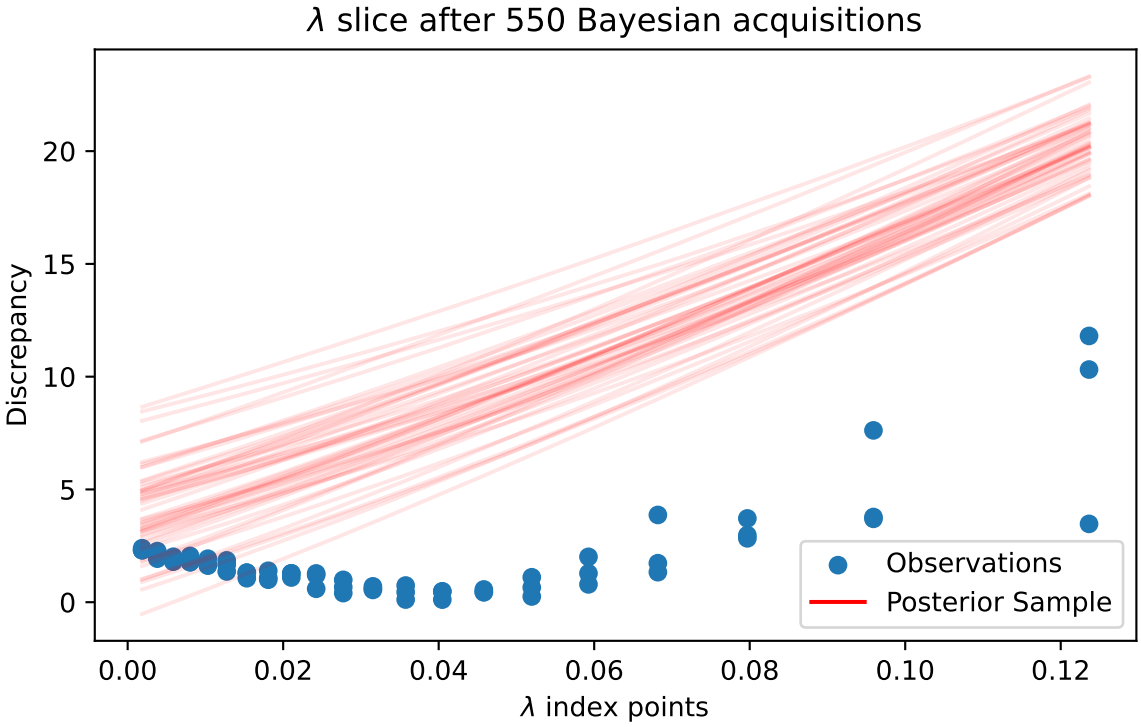

f slice after 500 Bayesian acquisitions
Discrepancy
15.0
12.5
10.0
7.5
5.0
2.5
0.0
−2.5
0.0
0.1
0.2
0.3
0.4
f index points
Observations
Posterior Sample

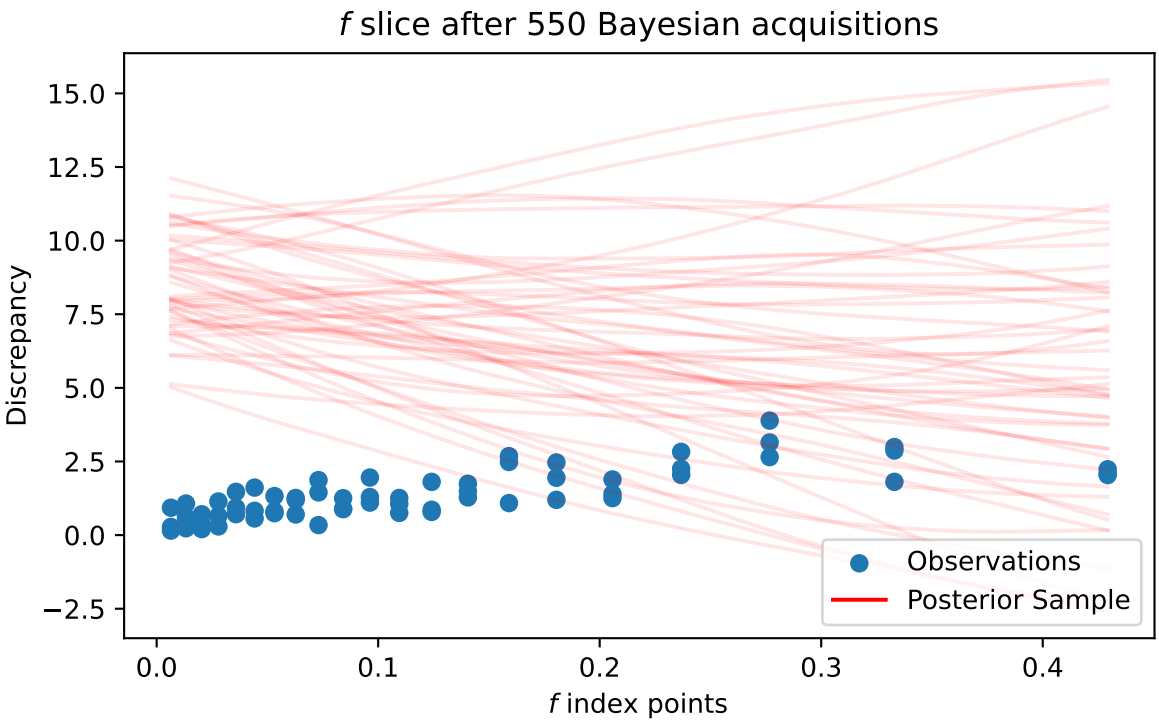

r slice after 500 Bayesian acquisitions
Discrepancy
14
12
10
8
6
4
2
0
0.00
0.02
0.04
0.06
0.08
0.10
r index points
Observations
Posterior Sample

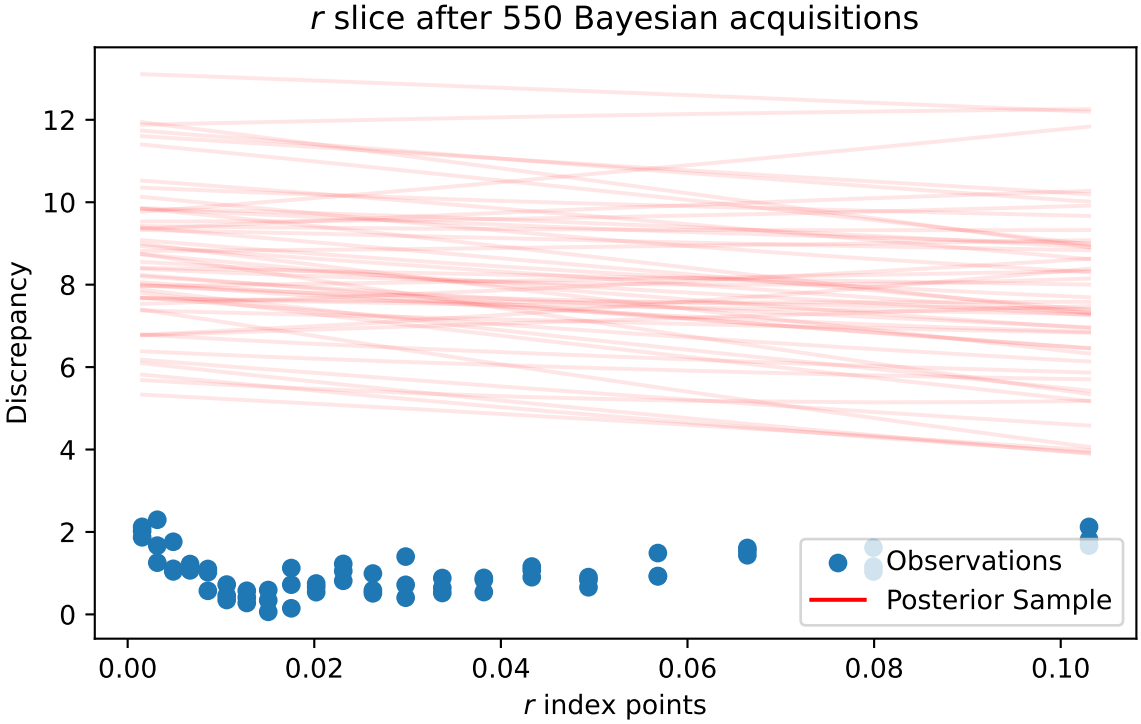

α slice after 550 Bayesian acquisitions
Discrepancy
15
10
5
0
−5
−10
0.0
0.2
0.4
0.6
0.8
1.0
α index points
Observations
Posterior Sample

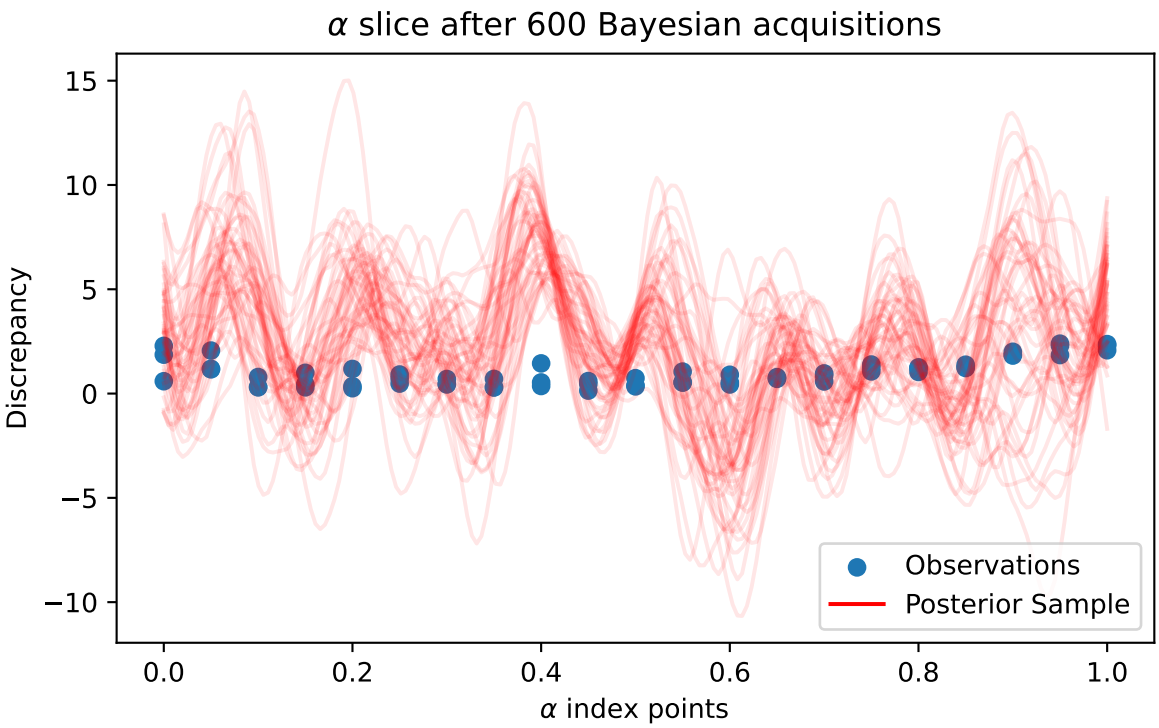

β slice after 550 Bayesian acquisitions
Discrepancy
20
15
10
5
0
−5
0.0
0.2
0.4
0.6
0.8
1.0
β index points
Observations
Posterior Sample

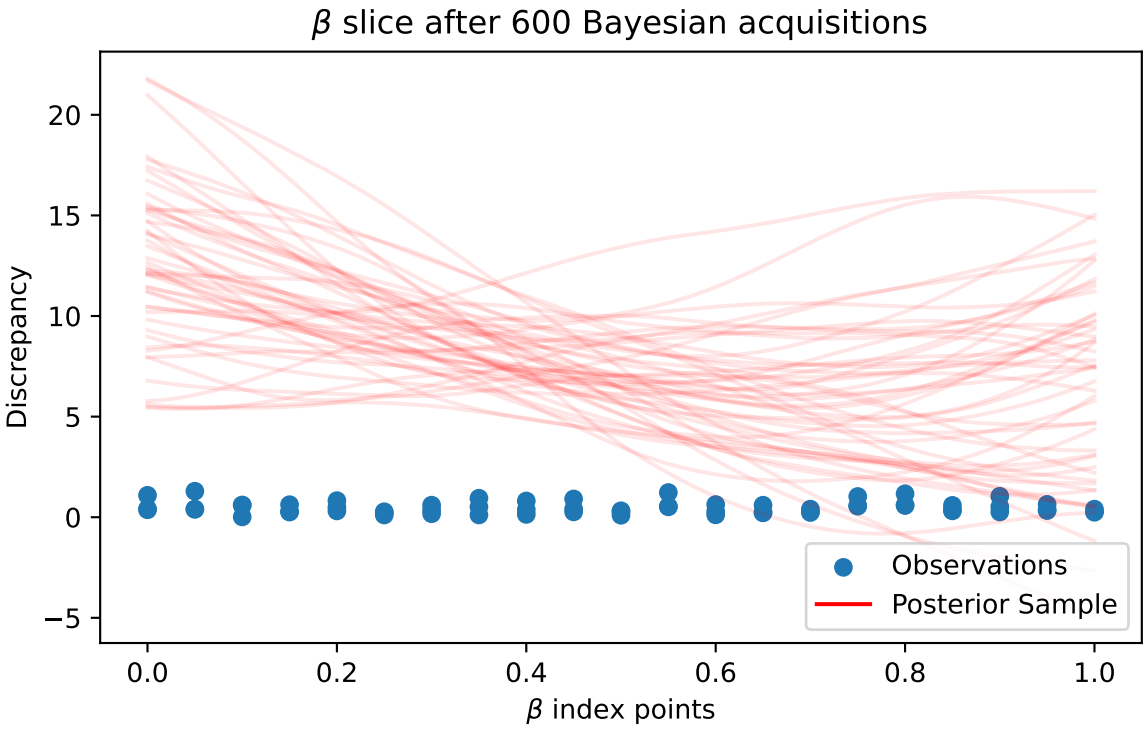

γ_L slice after 550 Bayesian acquisitions
Discrepancy
γ_L index points
Observations
Posterior Sample

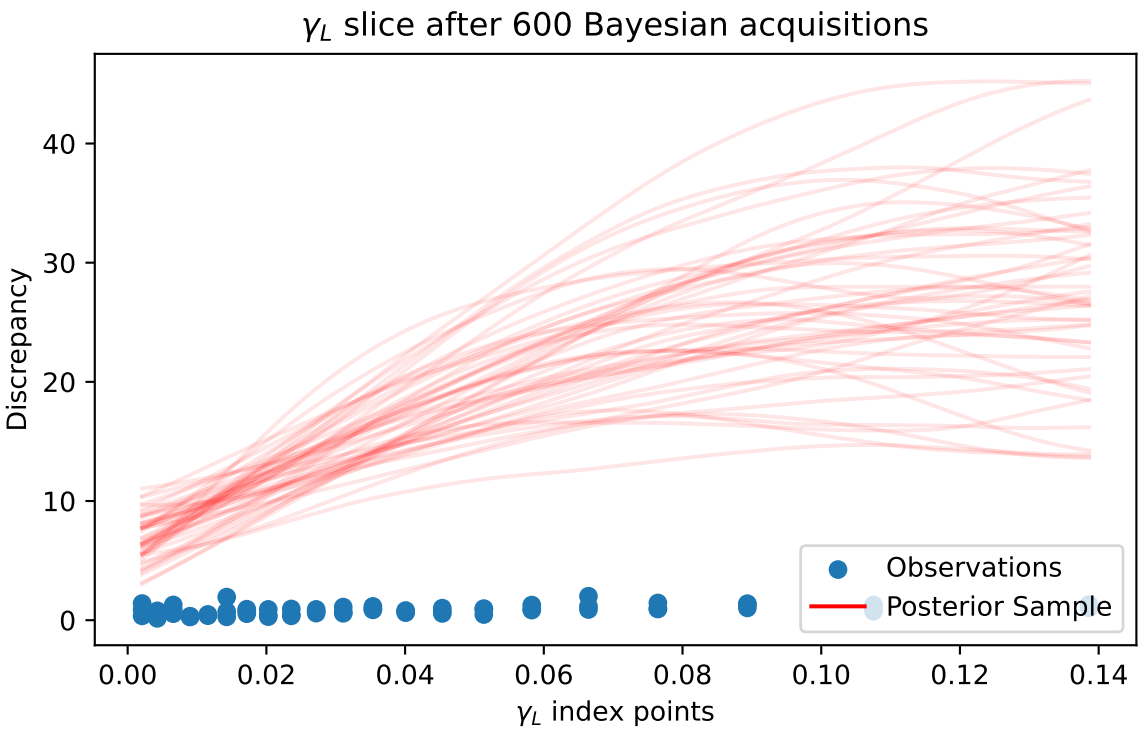

λ slice after 550 Bayesian acquisitions
Discrepancy
λ index points
Observations
Posterior Sample

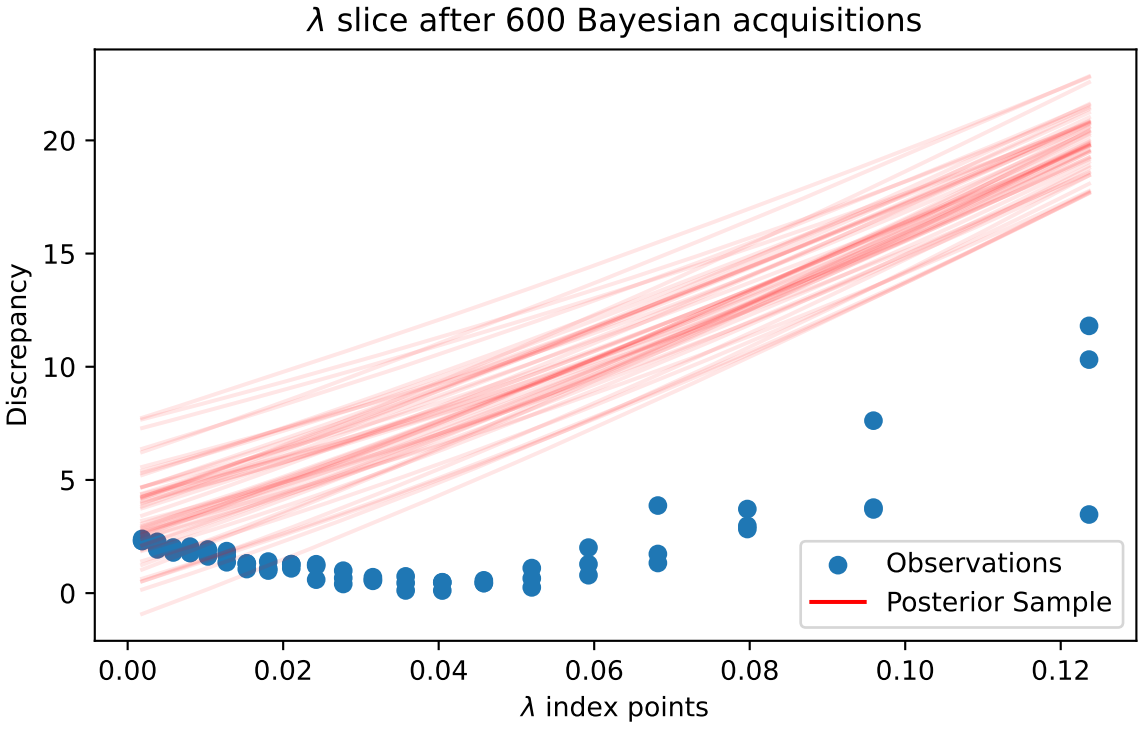

f slice after 550 Bayesian acquisitions
Discrepancy
15.0
12.5
10.0
7.5
5.0
2.5
0.0
−2.5
0.0
0.1
0.2
0.3
0.4
f index points
Observations
Posterior Sample

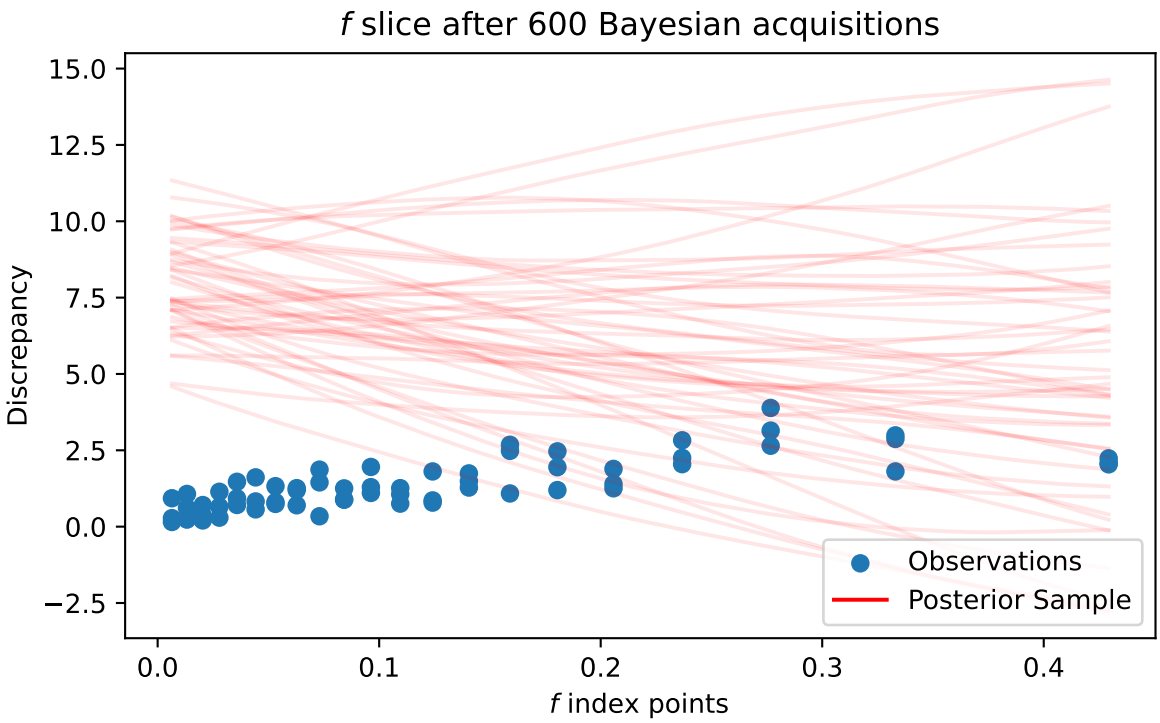

r slice after 550 Bayesian acquisitions
Discrepancy
12
10
8
6
4
2
0
0.00
0.02
0.04
0.06
0.08
0.10
r index points
Observations
Posterior Sample

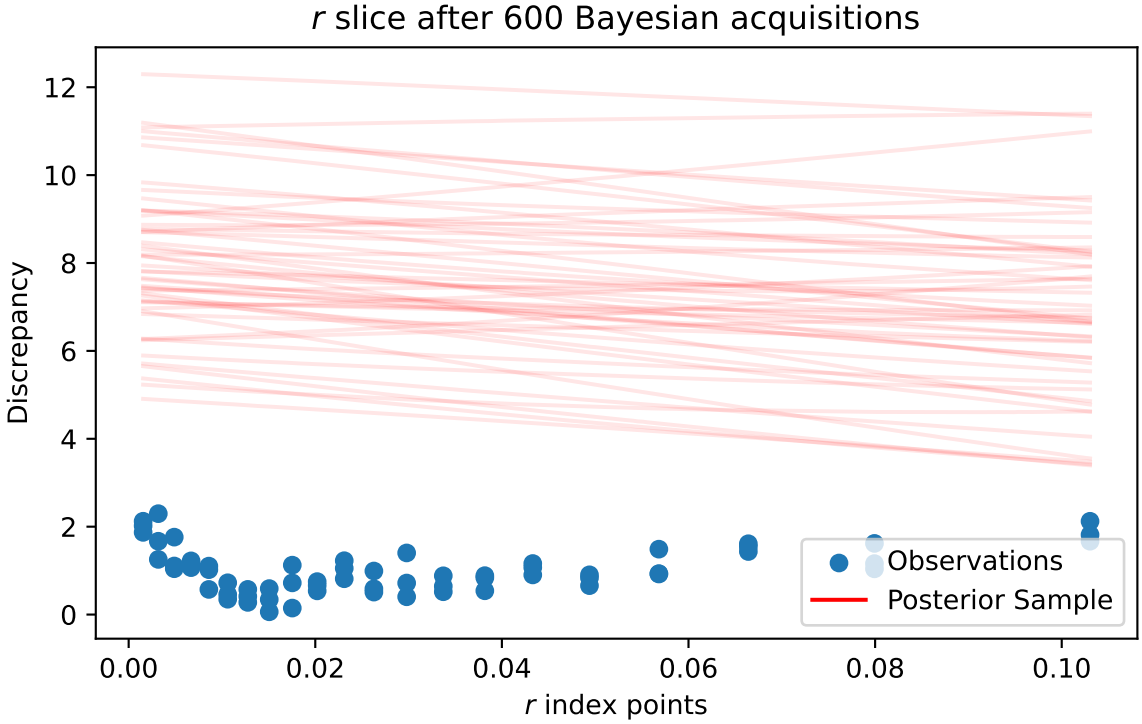

α slice after 600 Bayesian acquisitions
Discrepancy
15
10
5
0
−5
−10
0.0
0.2
0.4
0.6
0.8
1.0
α index points
Observations
Posterior Sample

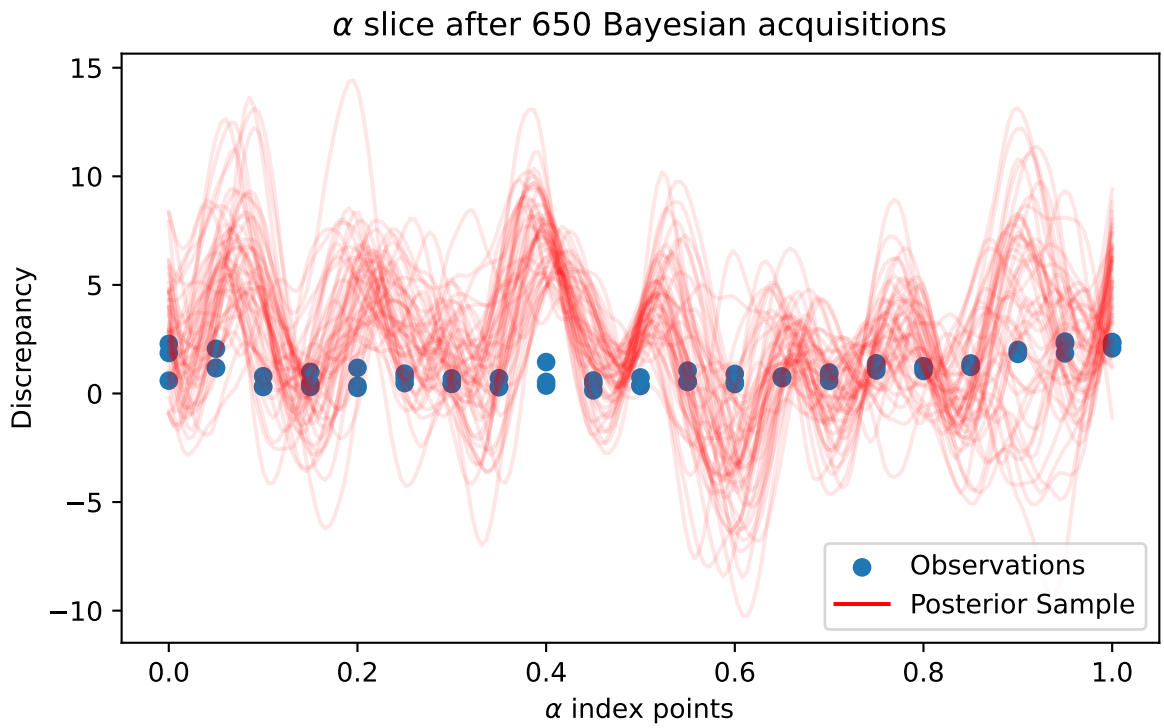

β slice after 600 Bayesian acquisitions
Discrepancy
20
15
10
5
0
−5
0.0
0.2
0.4
0.6
0.8
1.0
β index points
Observations
Posterior Sample

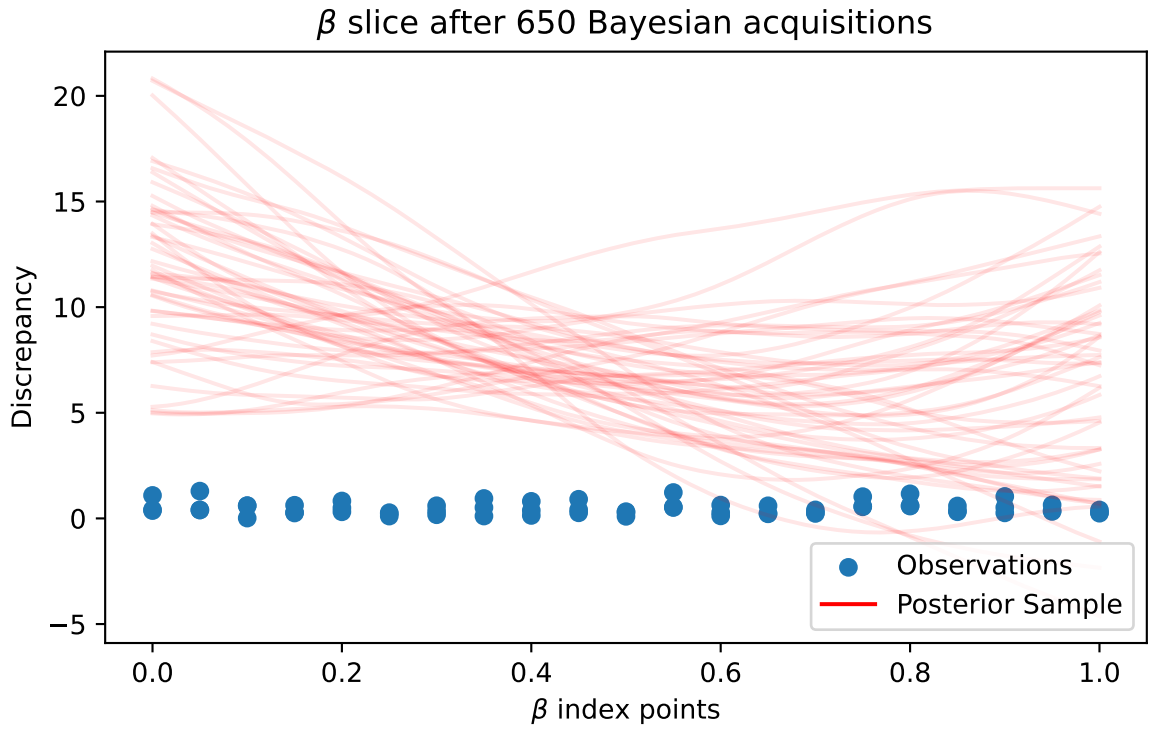

γ_L slice after 600 Bayesian acquisitions
Discrepancy
0
10
20
30
40
0.00
0.02
0.04
0.06
0.08
0.10
0.12
0.14
γ_L index points
Observations
Posterior Sample

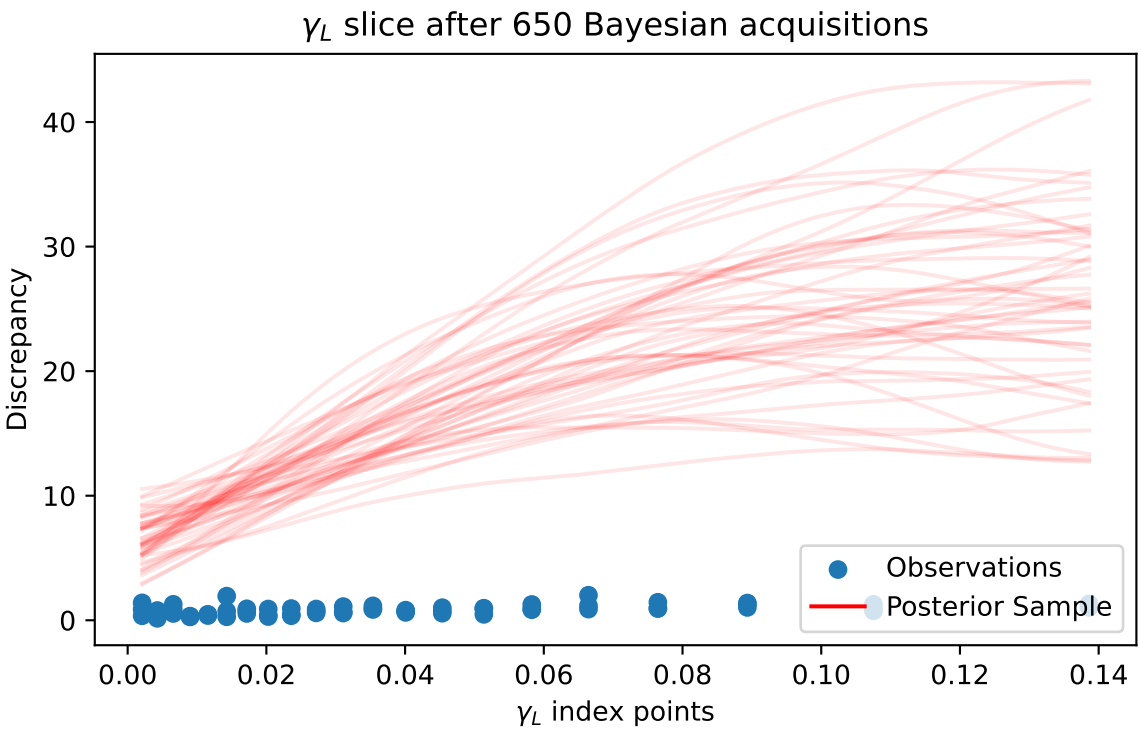

λ slice after 600 Bayesian acquisitions
Discrepancy
0
5
10
15
20
0.00
0.02
0.04
0.06
0.08
0.10
0.12
λ index points
Observations
Posterior Sample

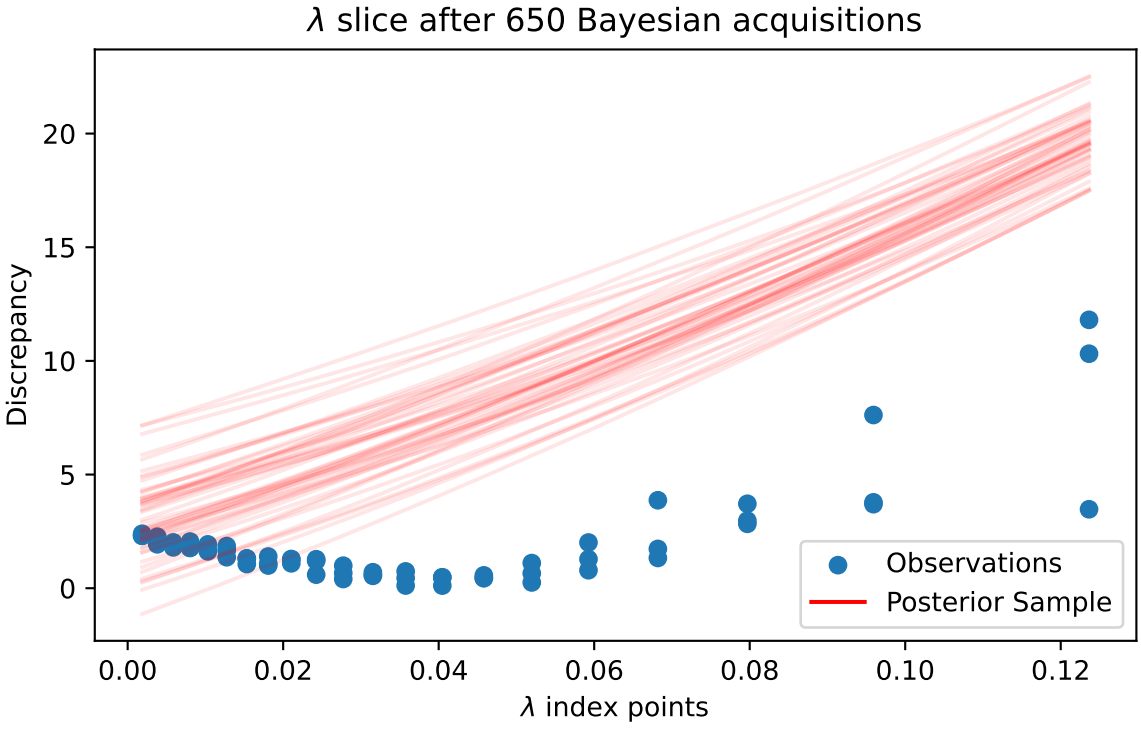

f slice after 600 Bayesian acquisitions
Discrepancy
15.0
12.5
10.0
7.5
5.0
2.5
0.0
−2.5
0.0
0.1
0.2
0.3
0.4
f index points
Observations
Posterior Sample

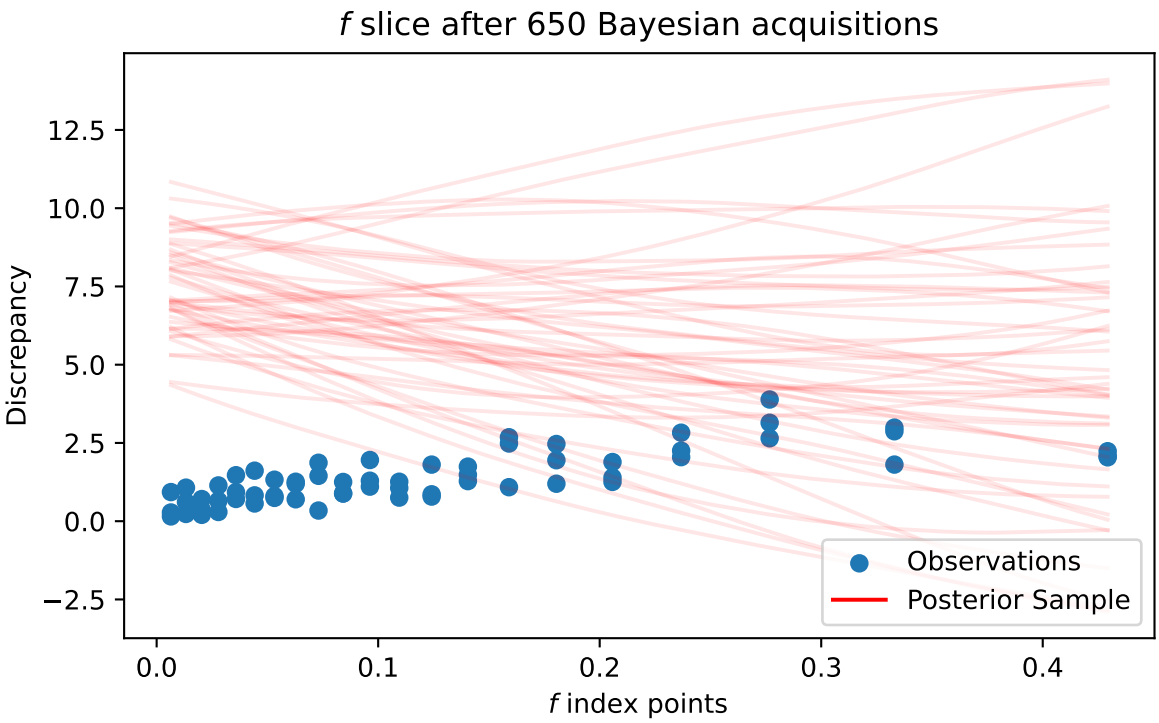

r slice after 600 Bayesian acquisitions
Discrepancy
12
10
8
6
4
2
0
0.00
0.02
0.04
0.06
0.08
0.10
r index points
Observations
Posterior Sample

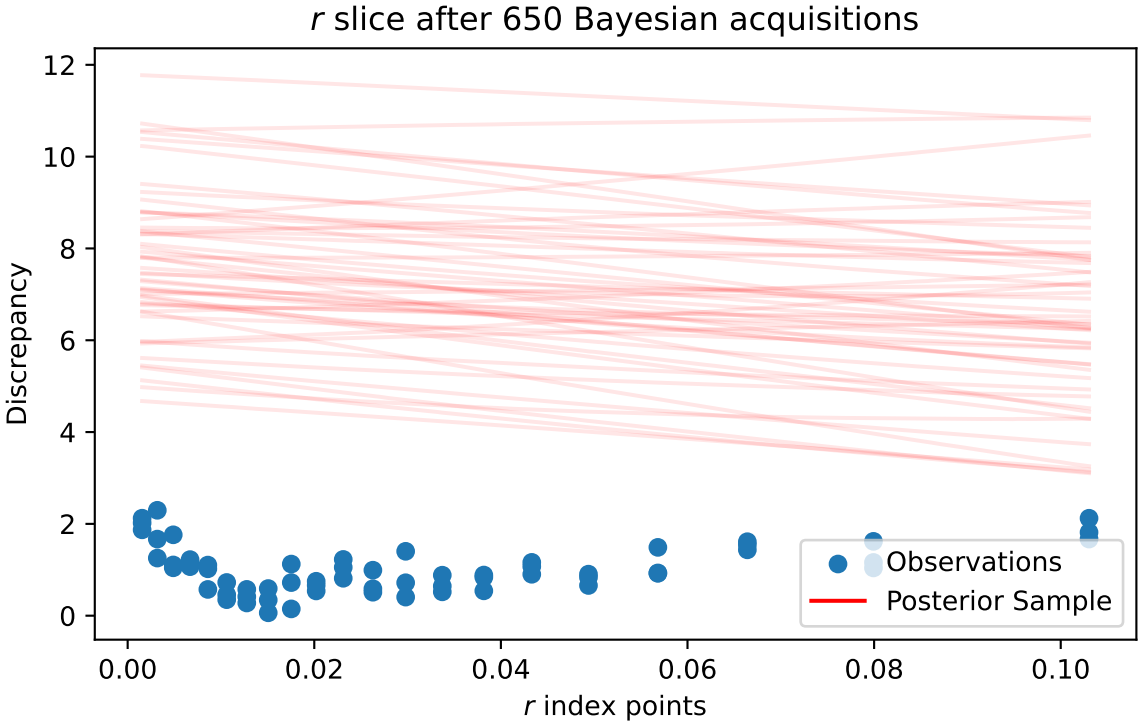

α slice after 650 Bayesian acquisitions
Discrepancy
15
10
5
0
−5
−10
0.0
0.2
0.4
0.6
0.8
1.0
α index points
Observations
Posterior Sample

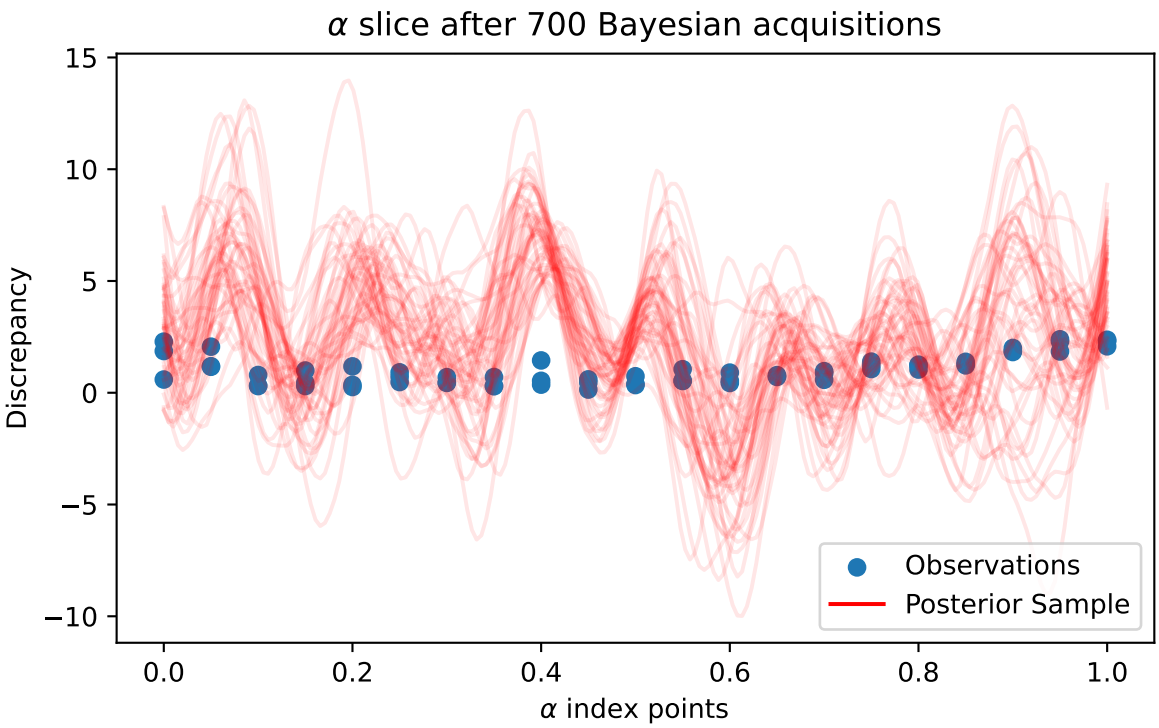

β slice after 650 Bayesian acquisitions
Discrepancy
20
15
10
5
0
−5
0.0
0.2
0.4
0.6
0.8
1.0
β index points
Observations
Posterior Sample

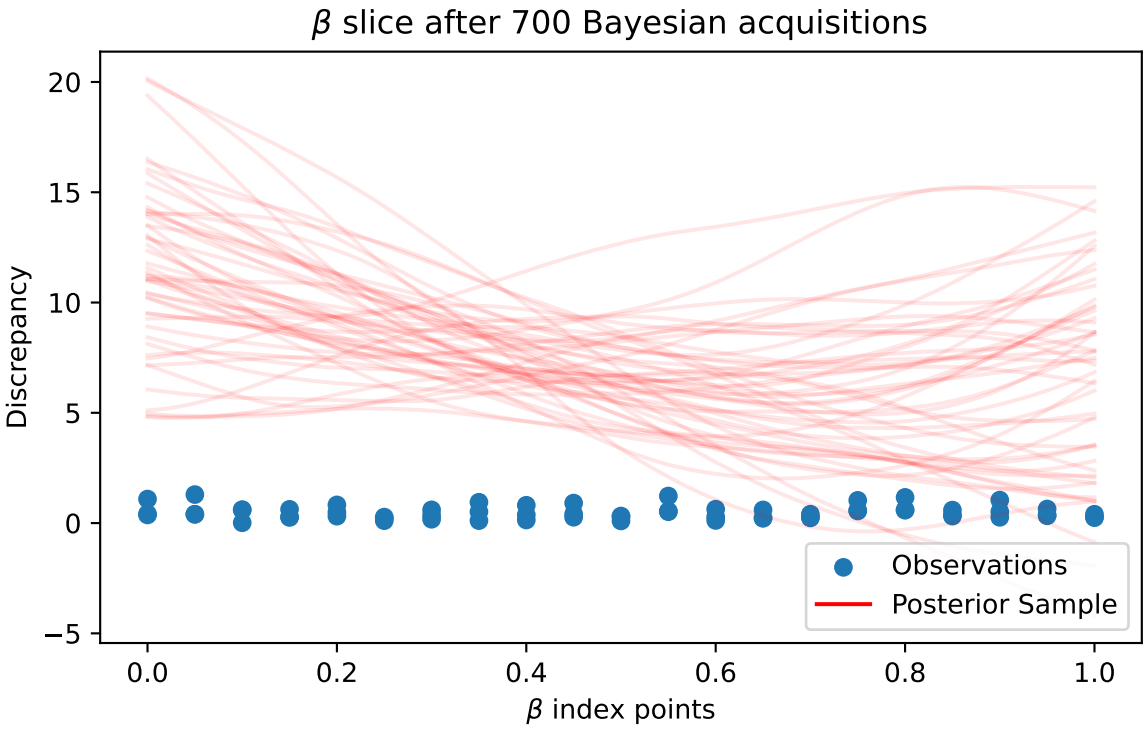

γ_L slice after 650 Bayesian acquisitions
Discrepancy
0
10
20
30
40
0.00
0.02
0.04
0.06
0.08
0.10
0.12
0.14
γ_L index points
Observations
Posterior Sample

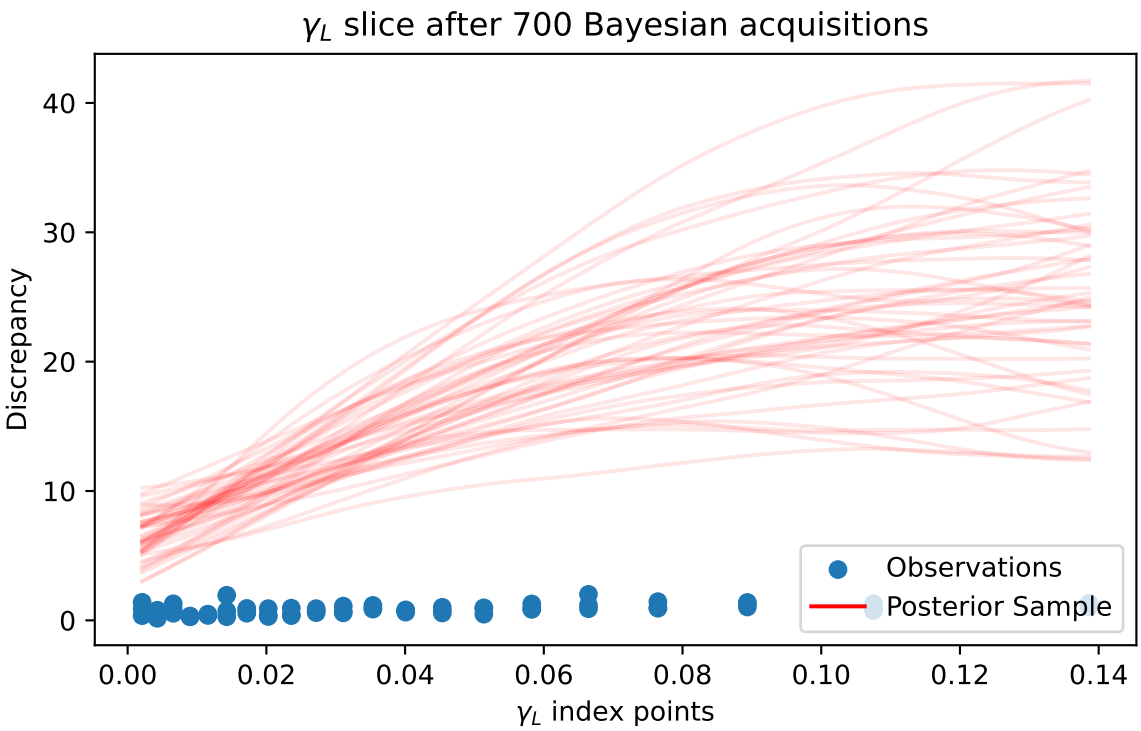

λ slice after 650 Bayesian acquisitions
Discrepancy
0
5
10
15
20
0.00
0.02
0.04
0.06
0.08
0.10
0.12
λ index points
Observations
Posterior Sample

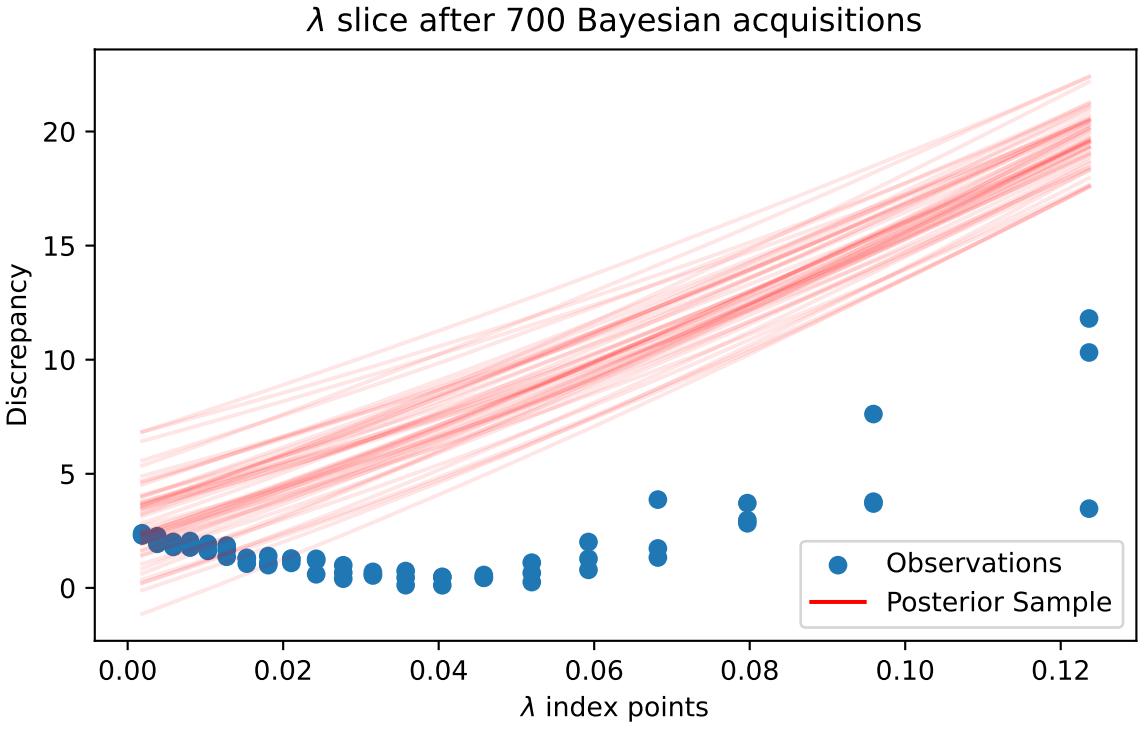

f slice after 650 Bayesian acquisitions
Discrepancy
12.5
10.0
7.5
5.0
2.5
0.0
−2.5
0.0
0.1
0.2
0.3
0.4
f index points
Observations
Posterior Sample

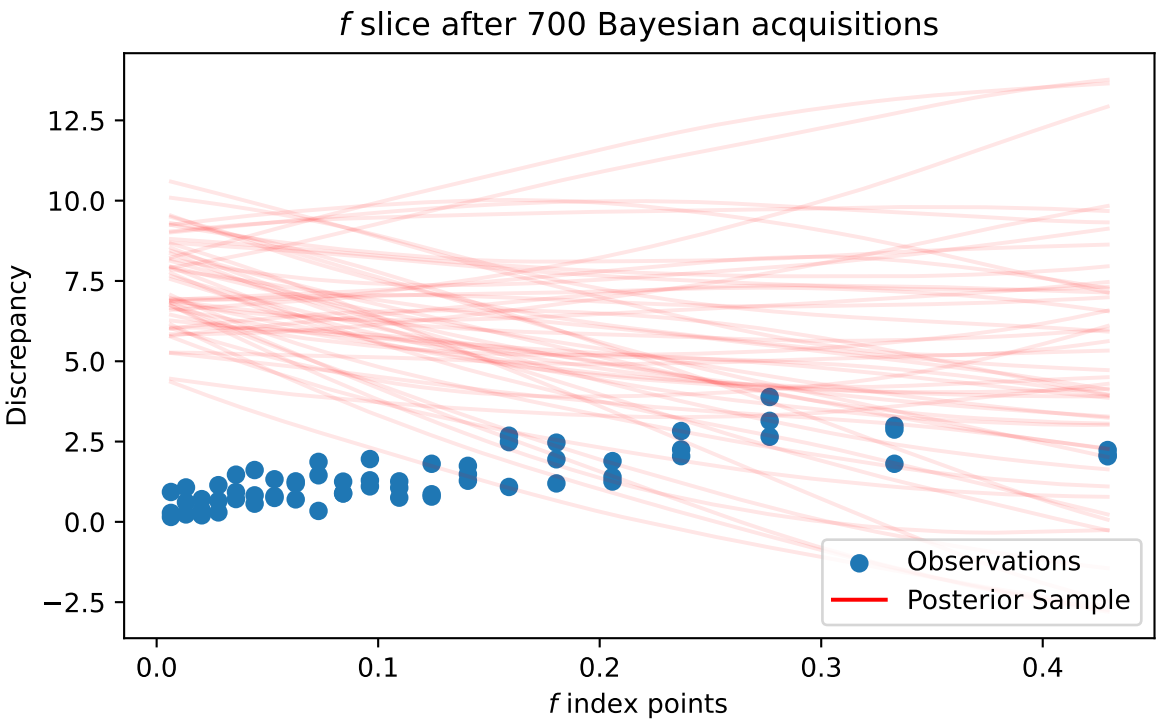

r slice after 650 Bayesian acquisitions
Discrepancy
12
10
8
6
4
2
0
0.00
0.02
0.04
0.06
0.08
0.10
r index points
Observations
Posterior Sample

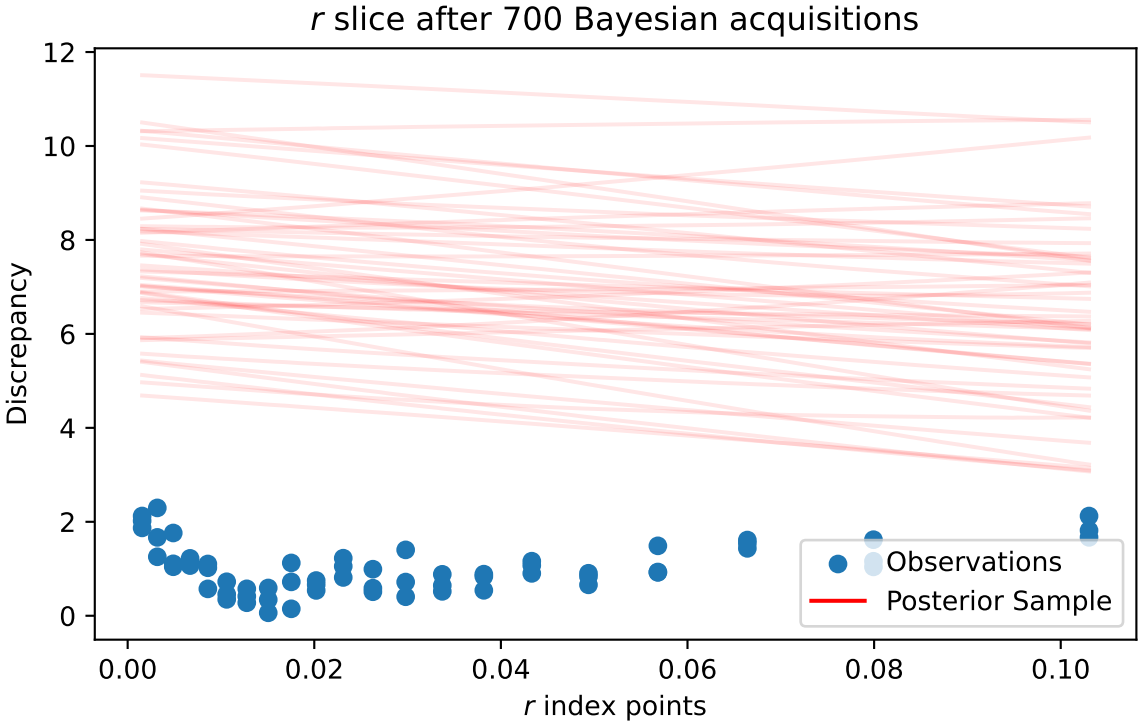

α slice after 700 Bayesian acquisitions
Discrepancy
α index points
Observations
Posterior Sample

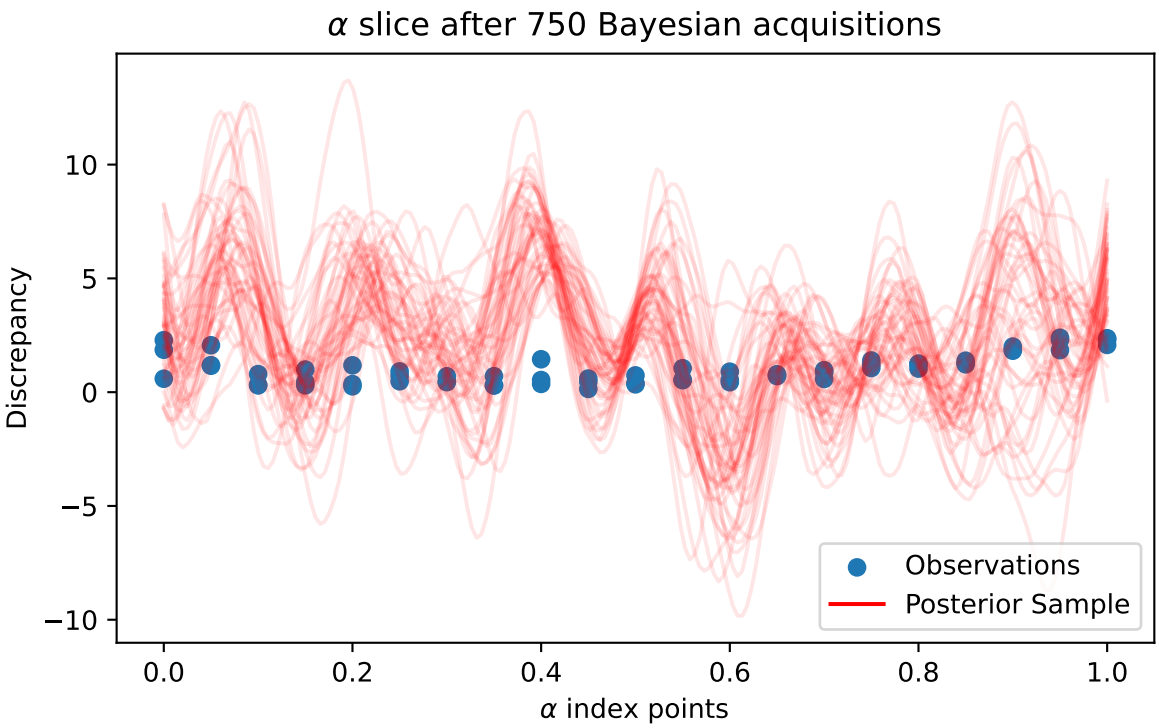

β slice after 700 Bayesian acquisitions
Discrepancy
β index points
Observations
Posterior Sample

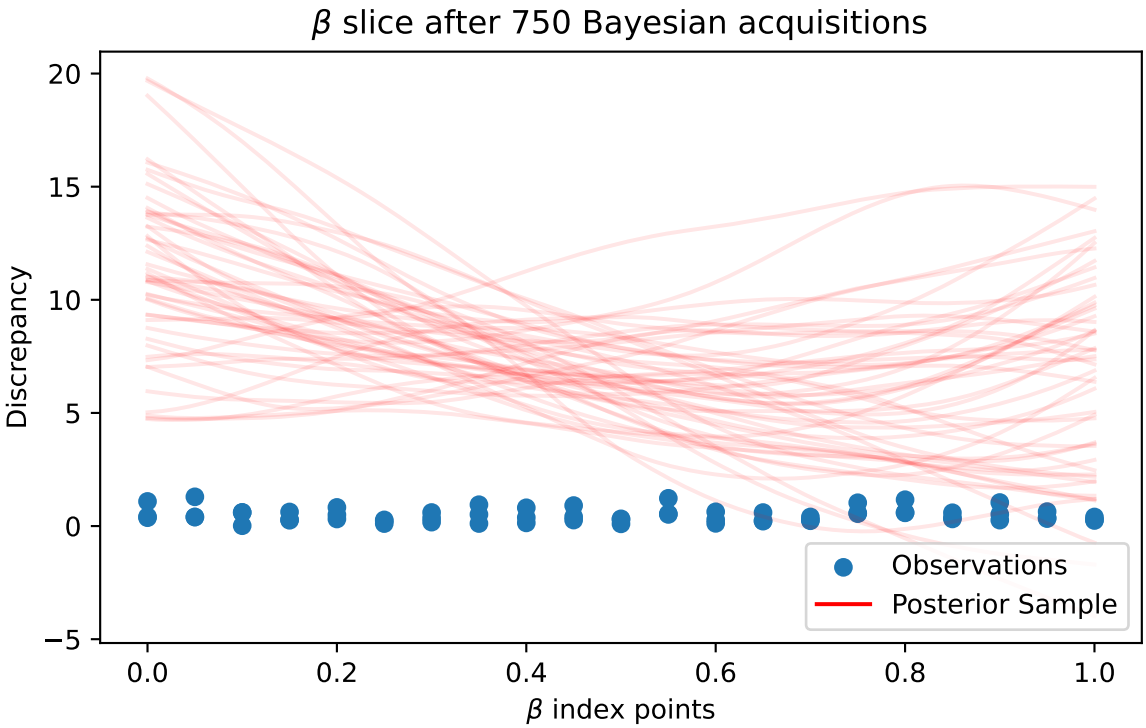

γ_L slice after 700 Bayesian acquisitions
Discrepancy
40
30
20
10
0
0.00
0.02
0.04
0.06
0.08
0.10
0.12
0.14
γ_L index points
Observations
Posterior Sample

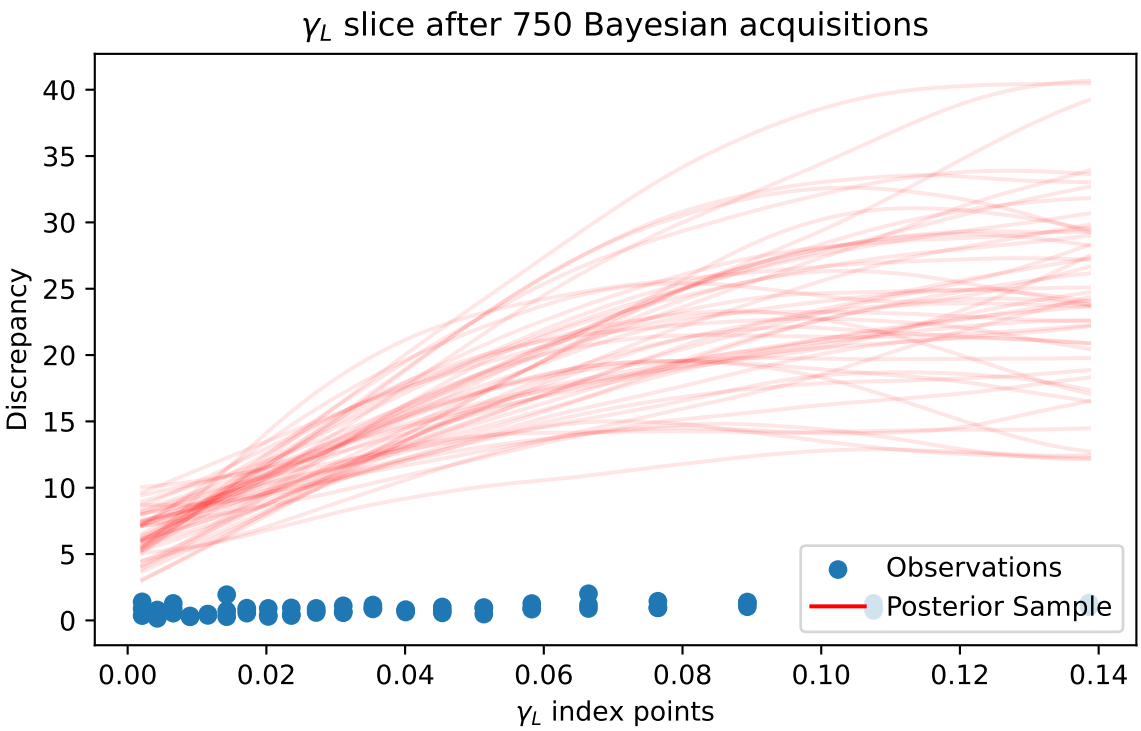

λ slice after 700 Bayesian acquisitions
Discrepancy
20
15
10
5
0
0.00
0.02
0.04
0.06
0.08
0.10
0.12
λ index points
Observations
Posterior Sample

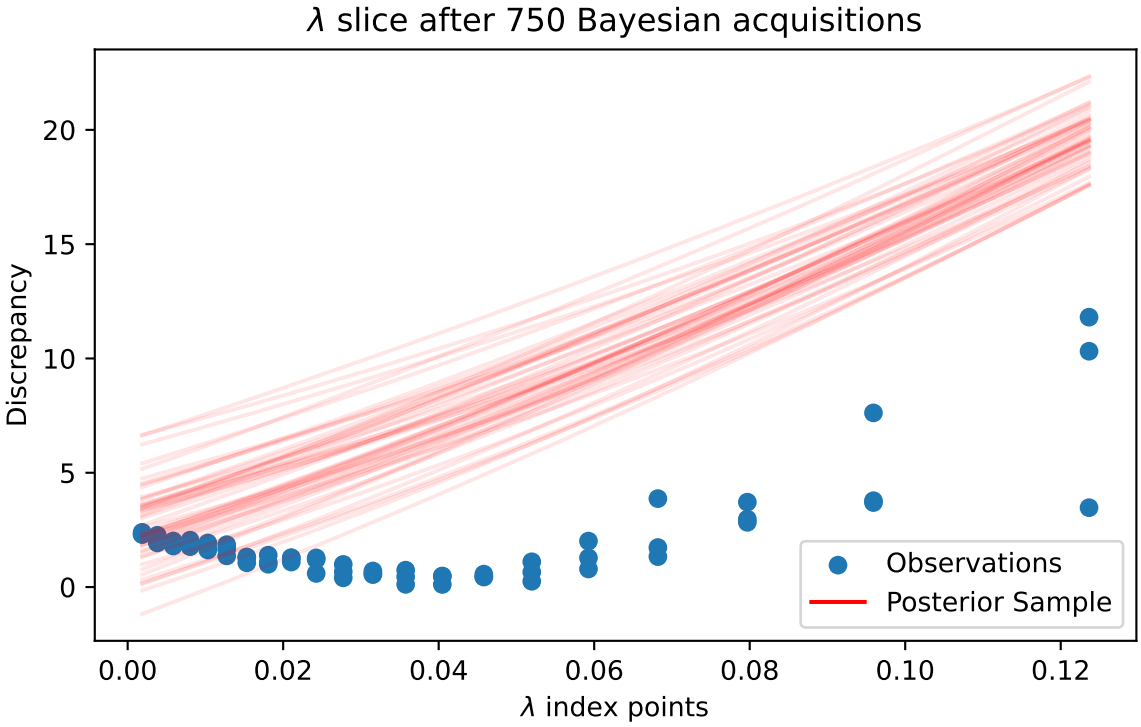

f slice after 700 Bayesian acquisitions
Discrepancy
12.5
10.0
7.5
5.0
2.5
0.0
−2.5
0.0
0.1
0.2
0.3
0.4
f index points
Observations
Posterior Sample

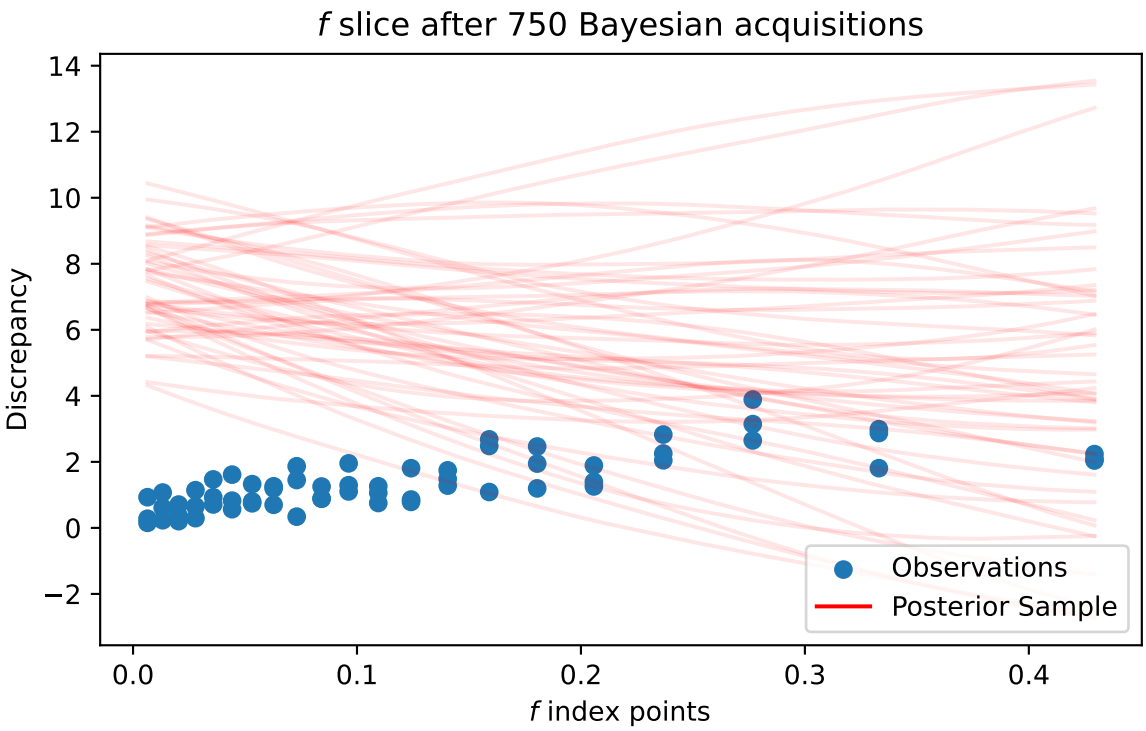

r slice after 700 Bayesian acquisitions
Discrepancy
12
10
8
6
4
2
0
0.00
0.02
0.04
0.06
0.08
0.10
r index points
Observations
Posterior Sample

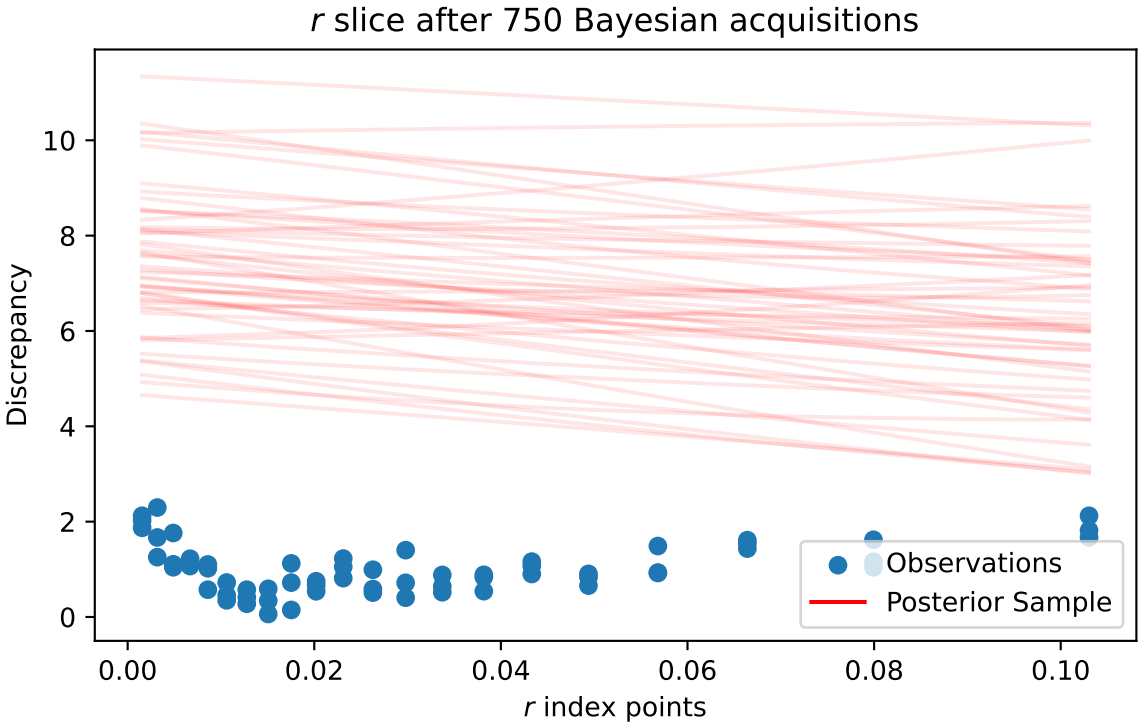

α slice after 750 Bayesian acquisitions
Discrepancy
10
5
0
−5
−10
0.0
0.2
0.4
0.6
0.8
1.0
α index points
Observations
Posterior Sample

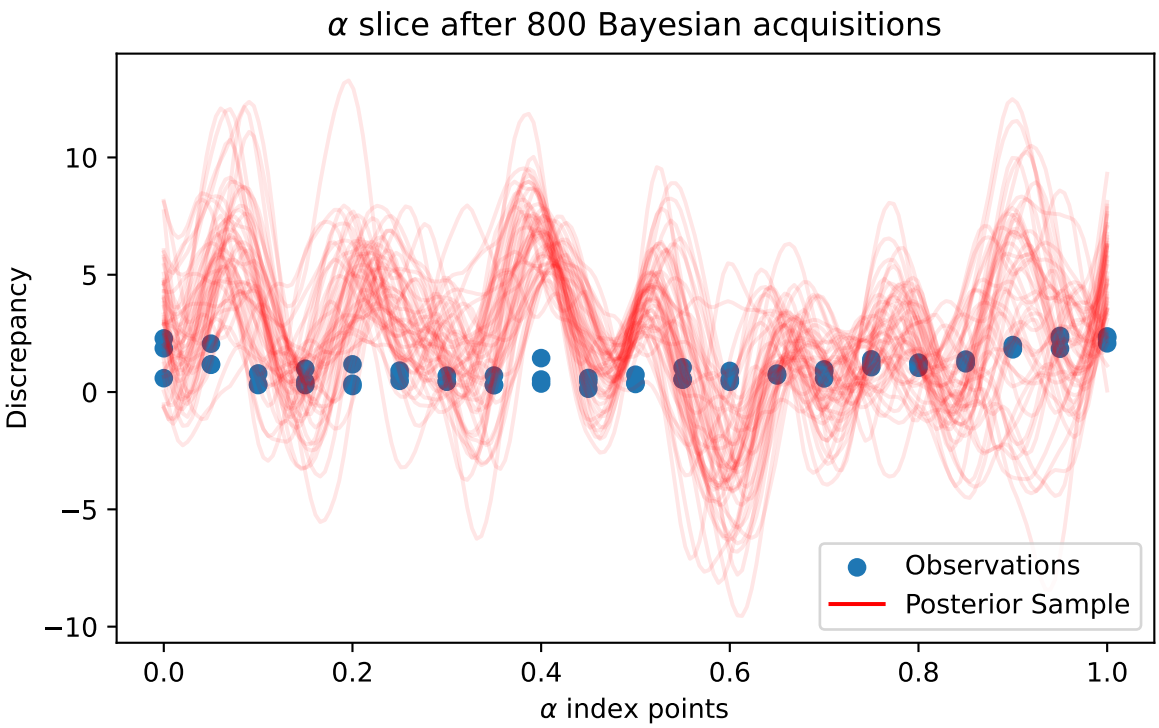

β slice after 750 Bayesian acquisitions
Discrepancy
20
15
10
5
0
−5
0.0
0.2
0.4
0.6
0.8
1.0
β index points
Observations
Posterior Sample

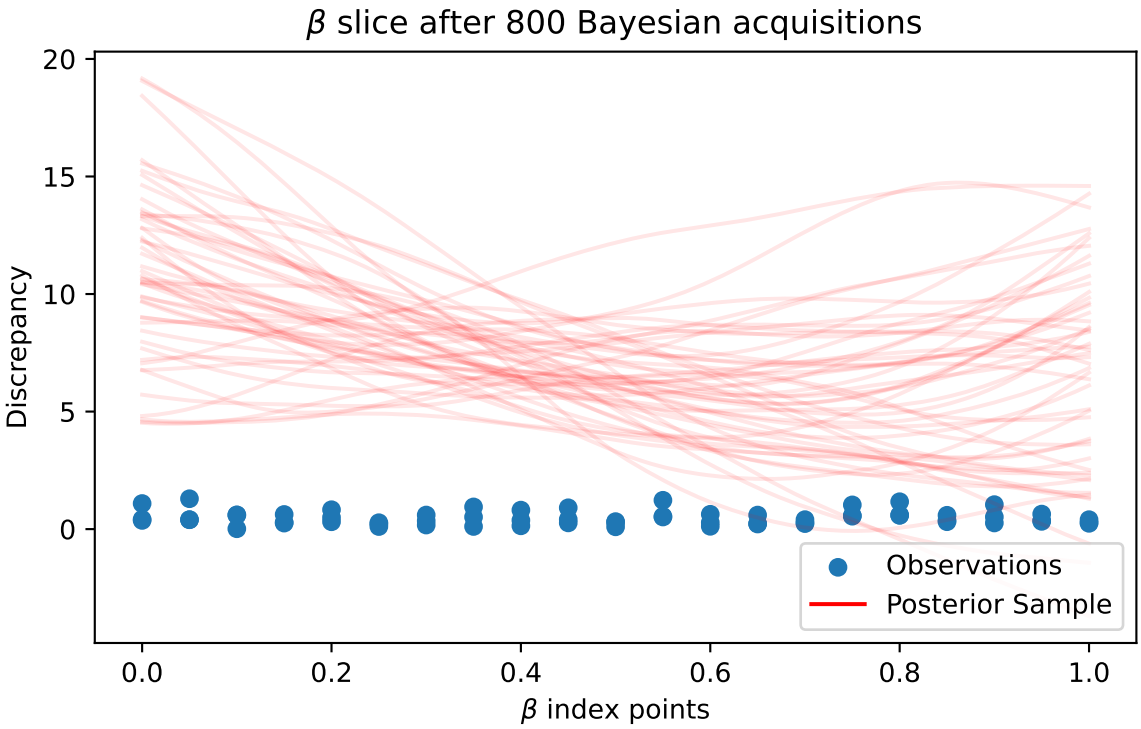

γ_L slice after 750 Bayesian acquisitions
Discrepancy
γ_L index points
Observations
Posterior Sample

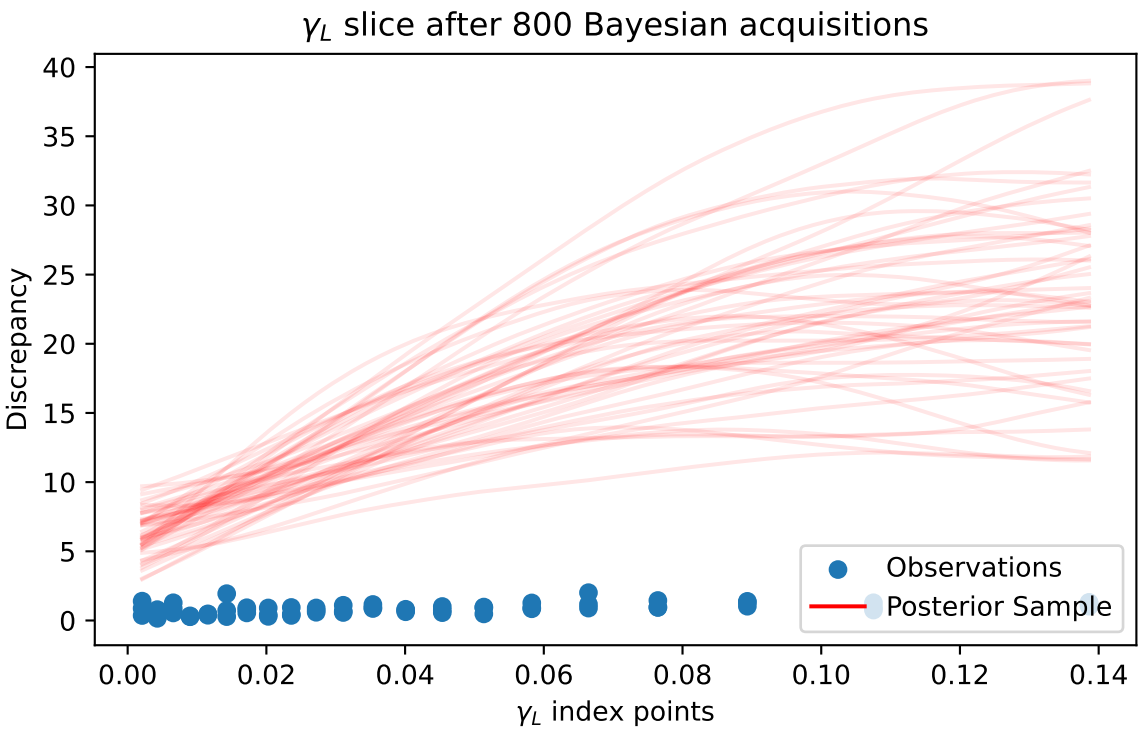

λ slice after 750 Bayesian acquisitions
Discrepancy
λ index points
Observations
Posterior Sample

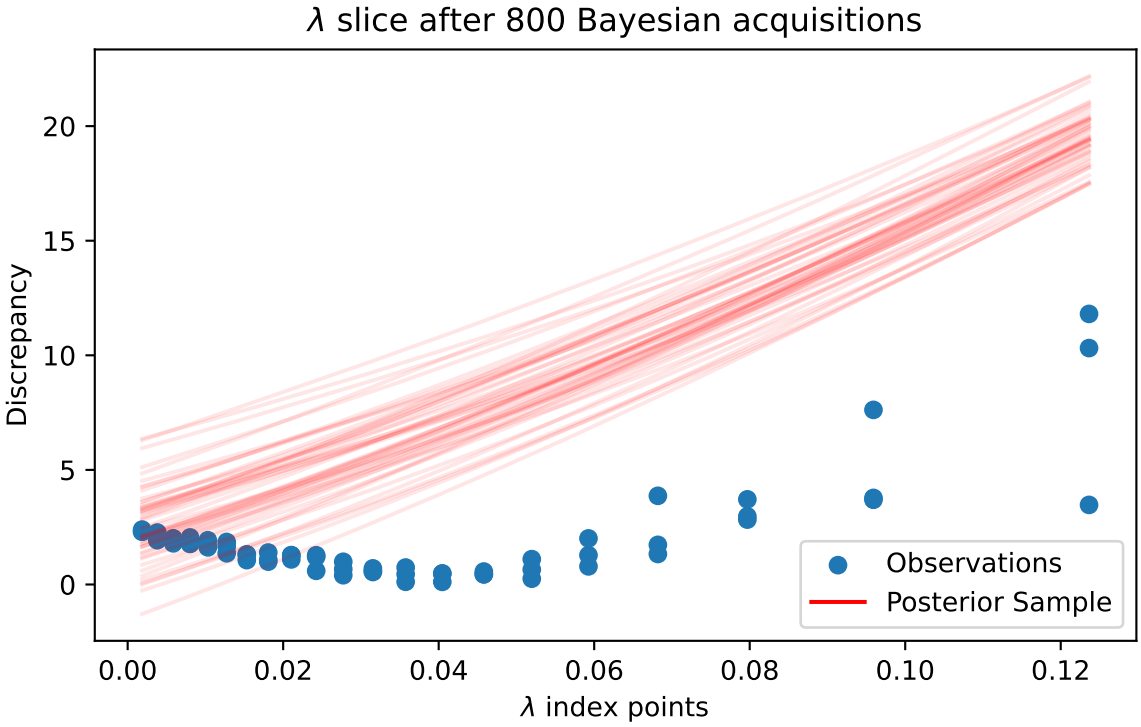

f slice after 750 Bayesian acquisitions
Discrepancy
f index points
Observations
Posterior Sample

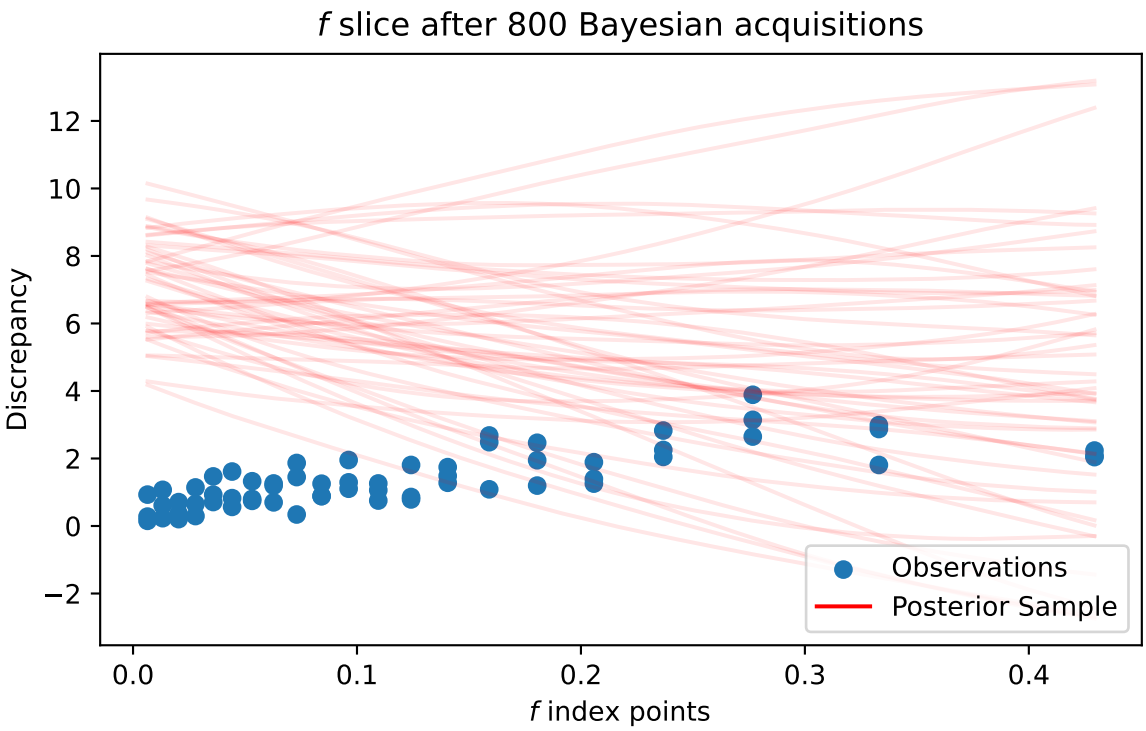

r slice after 750 Bayesian acquisitions
Discrepancy
r index points
Observations
Posterior Sample

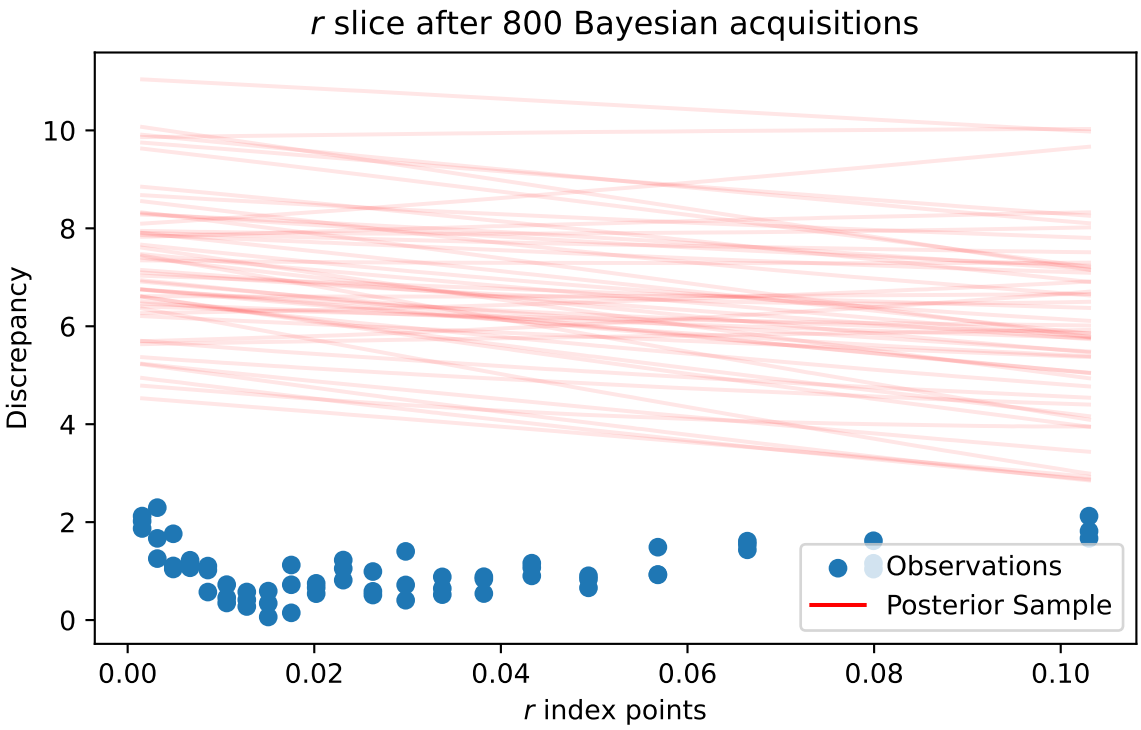

α slice after 800 Bayesian acquisitions
Discrepancy
10
5
0
−5
−10
0.0
0.2
0.4
0.6
0.8
1.0
α index points
Observations
Posterior Sample


β slice after 800 Bayesian acquisitions
Discrepancy
20
15
10
5
0
0.0
0.2
0.4
0.6
0.8
1.0
β index points
Observations
Posterior Sample


γ_L slice after 800 Bayesian acquisitions
Discrepancy
γ_L index points
Observations
Posterior Sample


λ slice after 800 Bayesian acquisitions
Discrepancy
λ index points
Observations
Posterior Sample


f slice after 800 Bayesian acquisitions
Discrepancy
12
10
8
6
4
2
0
−2
0.0
0.1
0.2
0.3
0.4
f index points
Observations
Posterior Sample


r slice after 800 Bayesian acquisitions
Discrepancy
10
8
6
4
2
0
0.00
0.02
0.04
0.06
0.08
0.10
r index points
Observations
Posterior Sample