

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
import multiprocessing as mp
import pickle
import random

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

import tensorflow as tf
import tensorflow_probability as tfp
from tensorflow_probability.python.distributions import normal

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

```

gpu_devices = tf.config.experimental.list_physical_devices("GPU")
for device in gpu_devices:
    tf.config.experimental.set_memory_growth(device, True)

```

```

2024-06-07 11:31:57.506397: I tensorflow/core/util/port.cc:113] oneDNN custom operations are
2024-06-07 11:31:58.026668: I tensorflow/core/platform/cpu_feature_guard.cc:210] This Tensor
To enable the following instructions: AVX2 AVX512F AVX512_VNNI FMA, in other operations, rebu
2024-06-07 11:31:59.861302: W tensorflow/compiler/tf2tensorrt/utils/py_utils.cc:38] TF-TRT W
2024-06-07 11:32:03.473568: W tensorflow/core/common_runtime/gpu/gpu_device.cc:2251] Cannot o
Skipping registering GPU devices...

```

Model itself

```

np.random.seed(590154)

population = 10000
initial_infecteds = 100
epidemic_length = 1000 # not used
number_of_events = 200000

pv_champ_alpha = 0.95 * 0.13 # prop of effective care
pv_champ_beta = 0.429 # prop of radical cure
pv_champ_gamma_L = 1 / 383 # liver stage clearance rate
pv_champ_delta = 0.05 # prop of imported cases
pv_champ_lambda = 0.01 # transmission rate
pv_champ_f = 1 / 69 # relapse frequency
pv_champ_r = 1 / 60 # blood stage clearance rate

gamma_L_max = 1 / 30
lambda_max = 0.05
f_max = 1 / 20
r_max = 1 / 15

upper_bounds = np.array([1, 1, gamma_L_max, lambda_max, f_max, r_max])

num_lhc_samples = 50
initial_repeats = 1
dis_mean_n = 30

```

```

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,
    seed=12,
):
    np.random.seed(seed)
    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
        + delta_t * alpha_ * (1 - beta_) * (f + lambda_ * (I_L + I_0) / N) * S_L
    )

```

```

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,
)

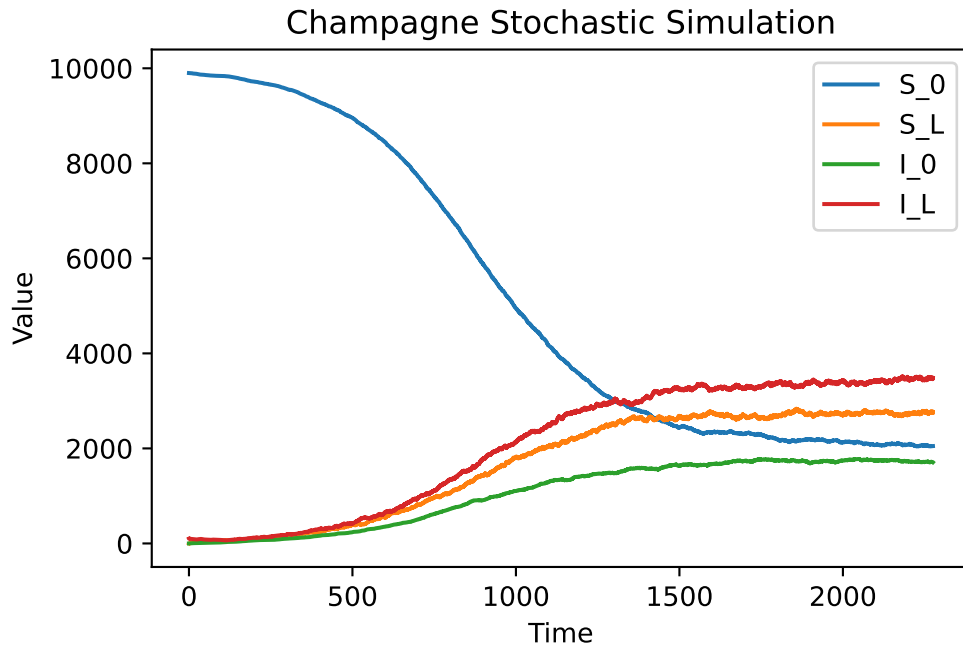
```

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, seed=12301923):
    champ_df_ = champagne_stochastic(alpha_, beta_, gamma_L, lambda_, f, r, seed=seed)
    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)

    first_month_ind = champ_df_[champ_df_["t"].le(30)].index[-1]
    first_month_prev = (
        champ_df_.iloc[first_month_ind]["I_0"]
        + champ_df_.iloc[first_month_ind]["I_L"]
    )
    fin_prev = champ_df_.iloc[-1]["I_0"] + champ_df_.iloc[-1]["I_L"]
```



```

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

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,
)

print(observed_sum_stats)

def single_discrepancy(alpha_, beta_, gamma_L, lambda_, f, r, seed=12301923):
    x = champ_sum_stats(alpha_, beta_, gamma_L, lambda_, f, r, seed=seed)
    return np.log(np.linalg.norm((x - observed_sum_stats) / observed_sum_stats))

def discrepancy_fn(alpha_, beta_, gamma_L, lambda_, f, r, mean_of=dis_mean_n):
    seed = int(np.random.uniform() * 1000000)
    with mp.Pool(processes=mp.cpu_count()) as pool:
        args = [
            (alpha_, beta_, gamma_L, lambda_, f, r, seed * i) for i in range(mean_of)
        ]
        results = pool.starmap(single_discrepancy, args)
    mean_obs = np.mean(results)
    return mean_obs

```

```
[ 461.  5205.   42.   87.]
```

Gaussian Process Regression on Final Prevalence Discrepancy

```

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

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

LHC_sampler = qmc.LatinHypercube(d=6, seed=my_seed)

```

```

LHC_samples = LHC_sampler.random(n=num_lhc_samples)

# Using Champagne Initialisation table 2
LHC_samples[:, 2] = gamma_L_max * LHC_samples[:, 2]
LHC_samples[:, 3] = lambda_max * LHC_samples[:, 3]
LHC_samples[:, 4] = f_max * LHC_samples[:, 4]
LHC_samples[:, 5] = r_max * LHC_samples[:, 5]

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

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

print(LHC_indices_df.head())

```

	alpha	beta	gamma_L	lambda	f	r
0	0.100008	0.122349	0.009668	0.015376	0.016920	0.015954
1	0.659225	0.590955	0.001070	0.038947	0.007433	0.003318
2	0.503558	0.005003	0.031832	0.027053	0.002028	0.019736
3	0.011840	0.630562	0.023631	0.033488	0.035622	0.035127
4	0.271011	0.942434	0.014052	0.030138	0.031133	0.051736

Generate Discrepancies

```

LHC_samples_reps = np.repeat(LHC_samples, dis_mean_n, axis=0)

with mp.Pool(processes=mp.cpu_count()) as pool:
    args = [
        (a, b, c, d, e, f, int(g * np.random.uniform()))
        for (a, b, c, d, e, f), g in zip(
            list(map(tuple, LHC_samples_reps)), range(LHC_samples_reps.shape[0])
        )
    ]
    results = pool.starmap(single_discrepancy, args)

random_discrepancies = np.mean(np.array(results).reshape(-1, dis_mean_n), axis=1)

print(random_discrepancies)

```

```

[-0.72112073  0.85173495 -0.10445358  1.04268897  0.56652755  0.46286618

```

```

0.36628974  0.78458654  0.64547033 -0.43466706  0.72250049 -0.10120307
-0.0321187  -0.16726528  1.26145031  0.92538462 -0.26121501  0.3277712
-0.70371735  0.2155892   0.81173955  0.59710669  0.51707793  1.33971327
1.0812211   0.8602283    1.38585448 -0.09602358  0.61782169  0.42402107
0.31068428 -0.04423537 -0.96457358  0.38741823  0.24964537  0.14481727
0.22145299  0.33272269 -0.67052626  1.12934722  1.21789051  0.20304941
0.39821991  0.35048571  0.18218027  1.24579385 -0.49153258  0.34009135
1.04344262 -0.03480152]

```

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())
```

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 = tfp.util.TransformedVariable(
        #     bijector=constrain_positive,
        #     initial_value=1.0,
        #     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 = tfp.util.TransformedVariable(
    #     bijector=constrain_positive,
    #     initial_value=1.0,
    #     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 = tfp.util.TransformedVariable(
    #     bijector=constrain_positive,
    #     initial_value=1.0,
    #     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 = tfp.util.TransformedVariable(
    #     bijector=constrain_positive,
    #     initial_value=1.0,
    #     dtype=np.float64,
    #     name="r_tp",
    # )
    # self.bias_mean = tfp.util.TransformedVariable(
    #     bijector=constrain_positive,
    #     initial_value=1.0,
    #     dtype=np.float64,
    #     name="bias_mean",
    # )
    self.bias_mean = tf.Variable(-1.5, 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
+ self.amp_gamma_L_mean * (x[..., 2]) ** 2
+ self.amp_lambda_mean * (x[..., 3]) ** 2
+ self.amp_f_mean * (x[..., 4]) ** 2
+ self.amp_r_mean * (x[..., 5]) ** 2
)

```

```
quad_mean_fn().__call__(x=np.array([[1.0, 1.0, 1.0, 1.0, 1.0, 1.0]])) # should return 1
```

```
<tf.Tensor: shape=(1,), dtype=float64, numpy=array([2.5])>
```

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])
    )

class const_mean_fn(tf.Module):
    def __init__(self):
        super(const_mean_fn, self).__init__()

```

```

        self.bias_lin = tf.Variable(0.0, dtype=np.float64, name="bias_mean")

    def __call__(self, x):
        return self.bias_lin

```

Making the ARD Kernel

```

index_vals = LHC_indices_df.values
obs_vals = random_discrepancies

amplitude_champ = tfp.util.TransformedVariable(
    bijector=constrain_positive,
    initial_value=4.0,
    dtype=np.float64,
    name="amplitude_champ",
)

observation_noise_variance_champ = tfp.util.TransformedVariable(
    bijector=constrain_positive,
    initial_value=1.,
    dtype=np.float64,
    name="observation_noise_variance_champ",
)

length_scales_champ = tfp.util.TransformedVariable(
    bijector=tfb.Sigmoid(
        np.float64(0.0),
        [1.0 / 2, 1.0 / 2, gamma_L_max / 2, lambda_max / 2, f_max / 2, r_max / 2],
    ),
    initial_value=[1 / 8, 1 / 8, gamma_L_max / 8, lambda_max / 8, f_max / 8, r_max / 8],
    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=const_mean_fn(),
)

print(champ_GP.trainable_variables)

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

(<tf.Variable 'amplitude_champ:0' shape=() dtype=float64, numpy=1.3862943611198906>, <tf.Variable 'observation_noise_variance_champ:0' shape=() dtype=float64, numpy=1.09861229>, <tf.Variable 'index_points:0' shape=(5) dtype=float64, numpy=array([-1.09861229, -1.09861229, -1.09861229, -1.09861229, -1.09861229, -1.09861229])>), <tf.Variable 'observation_noise_variance_champ:0' shape=() dtype=float64, numpy=1.09861229>)
```

Train the Hyperparameters

Leave One Out Predictive Log-likelihood

```
# 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 3920.

```

print("Trained parameters:")
for var in champ_GP.trainable_variables:
    if "bias" in var.name:
        print("{} is {}\n".format(var.name, var.numpy().round(3)))
    else:
        if "length" in var.name:
            print(
                "{} is {}\n".format(
                    var.name,
                    tfb.Sigmoid(
                        np.float64(0.0),
                        [
                            1.0 / 2,
                            1.0 / 2,
                            gamma_L_max / 2,
                            lambda_max / 2,
                            f_max / 2,
                            r_max / 2,

```

```

        ],
    )
    .forward(var)
    .numpy()
    .round(3),
    )
    )
else:
    print(
        "{} is {}".format(
            var.name, constrain_positive.forward(var).numpy().round(3)
        )
    )

initial_losses_LOOCV = lls_

```

Trained parameters:

amplitude_champ:0 is 0.729

length_scales_champ:0 is [0.499 0.5 0.017 0.008 0.025 0.033]

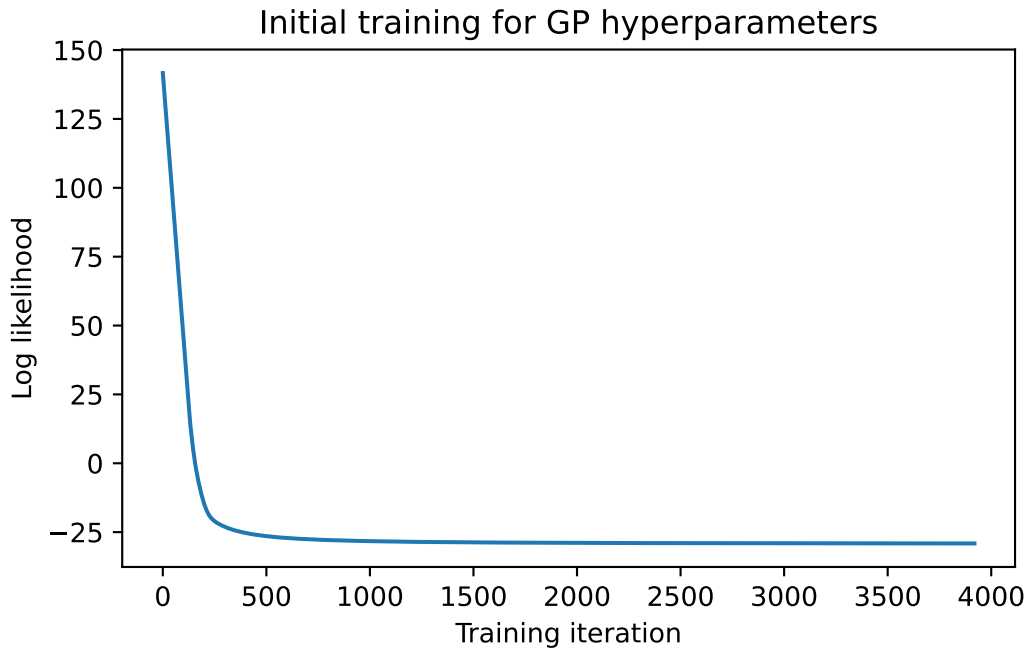
observation_noise_variance_champ:0 is 0.001

bias_mean:0 is 0.595

```

plt.figure(figsize=(6, 3.5))
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_log_discrep.pdf")
plt.show()

```



Creating slices across one variable dimension

```

plot_samp_no = 21
plot_samp_times = 10
plot_gp_no = 100
gp_samp_no = 30

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,
    ), plot_samp_times, 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,
), plot_samp_times, 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
    np.linspace(0, gamma_L_max, plot_samp_no, dtype=np.float64).reshape(-1, 1), #
    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,
    ), plot_samp_times, 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(0, gamma_L_max, plot_gp_no, dtype=np.float64).reshape(-1, 1), # g
            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
            np.linspace(0, lambda_max, plot_samp_no, dtype=np.float64).reshape(-1, 1), # l
            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,
    ), plot_samp_times, 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(0, lambda_max, plot_gp_no, dtype=np.float64).reshape(-1, 1), # lam
            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

```

```

        np.linspace(0, f_max, plot_samp_no, dtype=np.float64).reshape(-1, 1), # f
        np.repeat(pv_champ_r, plot_samp_no).reshape(-1, 1), # r
    ),
    axis=1,
), plot_samp_times, 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(0, f_max, plot_gp_no, dtype=np.float64).reshape(-1, 1), # 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
        np.linspace(0, r_max, plot_samp_no, dtype=np.float64).reshape(-1, 1), # r
    ),
    axis=1,
), plot_samp_times, 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(0, r_max, plot_gp_no, dtype=np.float64).reshape(-1, 1), # 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_discrepancies_dict = {}
gp_samples_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

    df_temp = val_df.assign(seed=range(val_df.shape[0]))
    seed = int(np.random.uniform() * 1000000)
    with mp.Pool(processes=mp.cpu_count()) as pool:
        args = list(df_temp.itertuples(index=False, name=None))
        results = pool.starmap(single_discrepancy, args)

    discreps = results
    slice_discrepancies_dict[var + "_slice_discrepancies"] = 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_plot = 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=const_mean_fn(),
    )
    GP_samples = champ_GP_reg_plot.sample(gp_samp_no, seed=GP_seed)
```

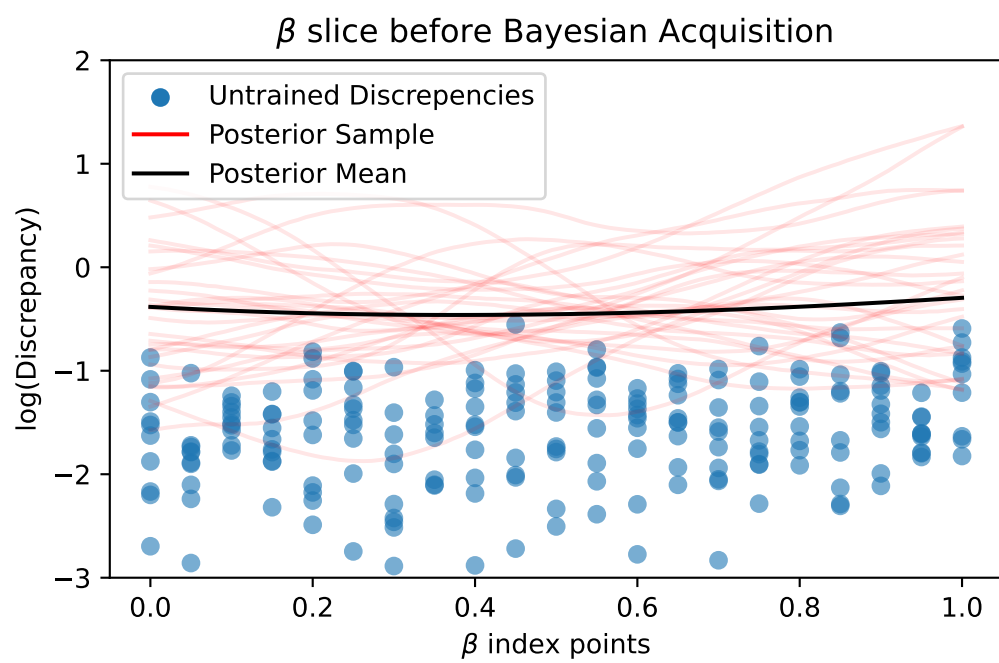
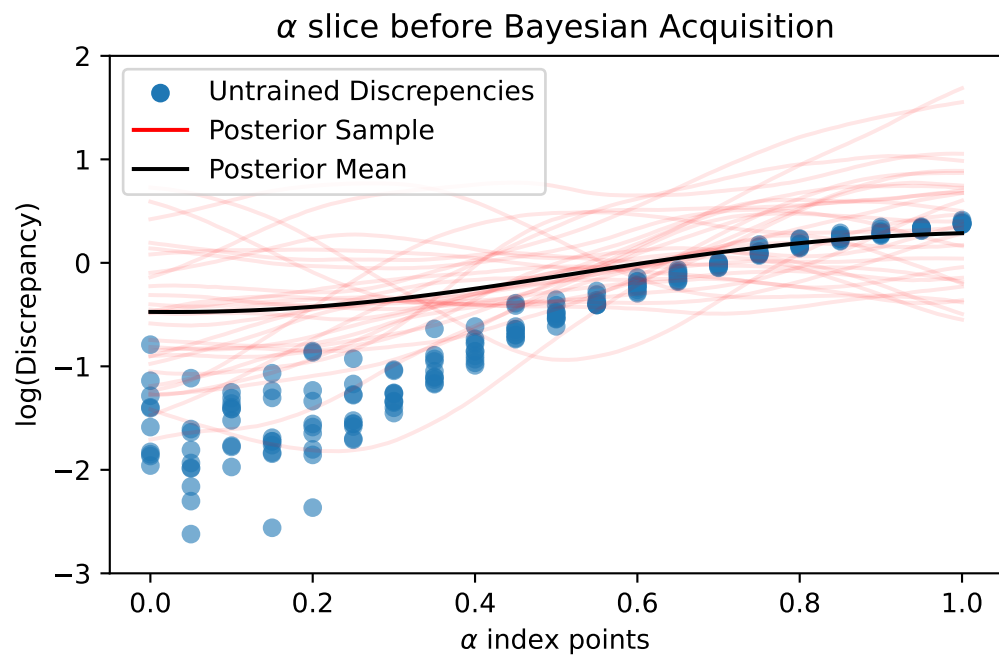


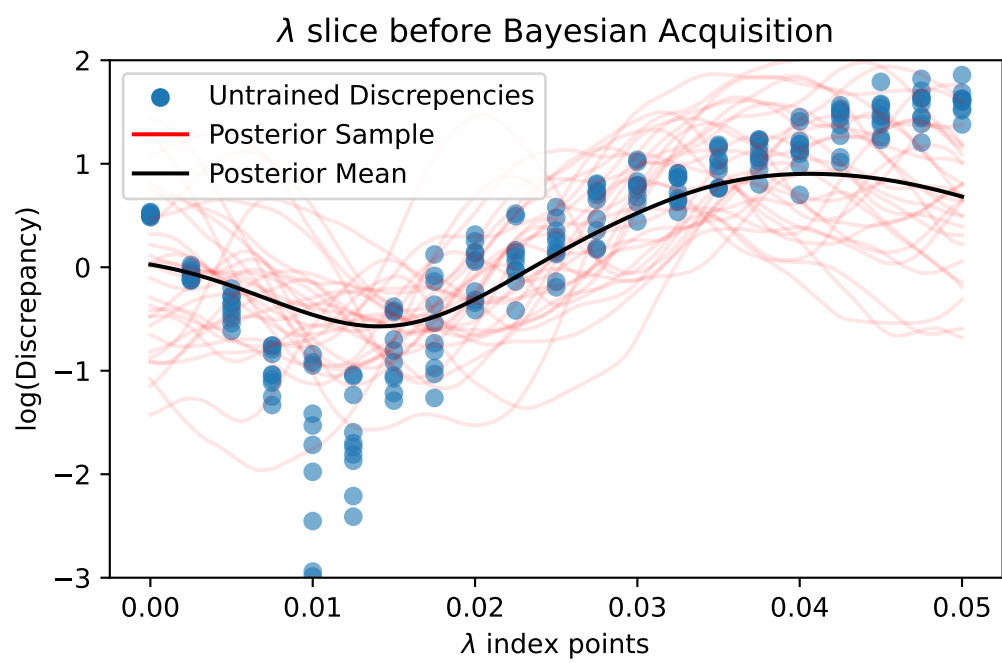
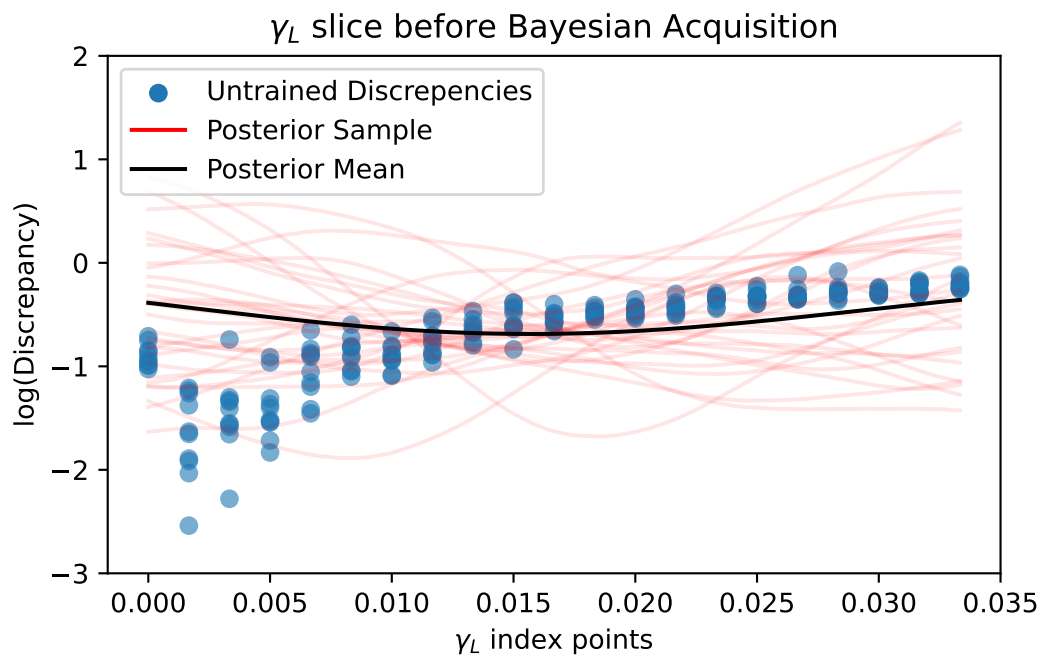
```

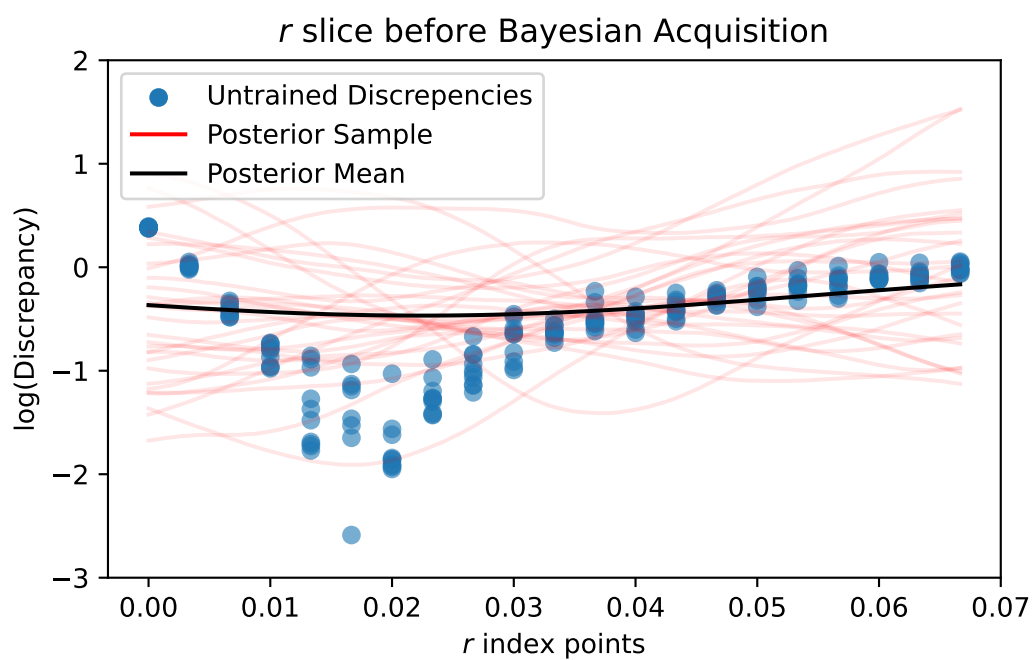
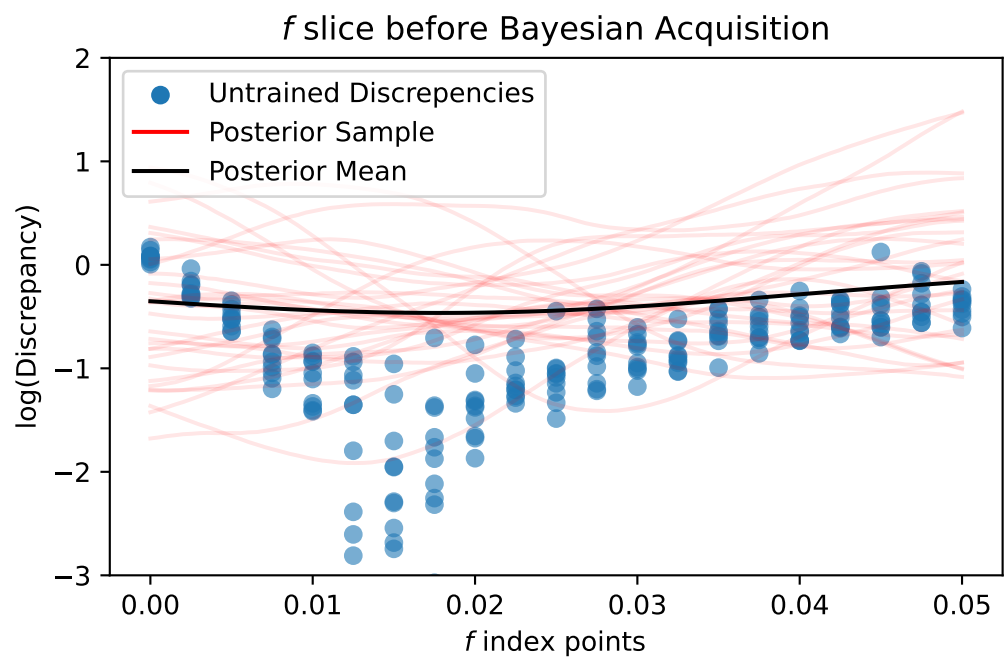
gp_samples_dict[var + "initial_gp_samps"] = GP_samples

plt.figure(figsize=(6, 3.5))
plt.scatter(
    val_df[var].values,
    discreps,
    label="Untrained Discrepancies",
    alpha=0.6,
)
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,
    )
plt.plot(
    slice_indices_dfs_dict[var + "_gp_indices_df"][var].values,
    champ_GP_reg_plot.mean_fn(
        slice_indices_dfs_dict[var + "_gp_indices_df"].values
    ),
    c="black",
    alpha=1,
    label="Posterior Mean",
)
leg = plt.legend(loc="upper left")
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("log(Discrepancy)")
plt.ylim((-3, 2))
plt.savefig("champagne_GP_images/initial_" + var + "_slice_log_discrep.pdf")
plt.show()

```







Acquiring the next datapoint to test

Proof that `.variance` returns what we need in acquisition function

```
champ_GP_reg = tfd.GaussianProcessRegressionModel(
    kernel=kernel_champ,
    observation_index_points=index_vals,
    observations=obs_vals,
    observation_noise_variance=observation_noise_variance_champ,
    mean_fn=const_mean_fn(),
)

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 0.532

```
Others Kernel is [0.      0.      0.      0.001 0.002 0.005 0.      0.001 0.      0.      0.002 0.
0.      0.001 0.004 0.004 0.      0.007 0.      0.001 0.001 0.001 0.006 0.001
0.      0.001 0.003 0.      0.      0.      0.      0.      0.      0.      0.      0.
0.      0.      0.      0.006 0.006 0.      0.      0.      0.      0.003 0.      0.001
0.      0.      ]
[[ 2.43907699e+00  9.04941335e-03 -1.95938089e-02 ... -6.70431227e-02
  1.05179552e-03 -5.63875095e-01]
 [ 9.04941335e-03  2.47534484e+00  1.72781117e-02 ...  1.04767362e-03
 -5.55692566e-01  2.17876770e-03]
 [-1.95938089e-02  1.72781117e-02  2.24292081e+00 ... -3.87518498e-01
```

```

1.19500590e-02 -3.92962545e-01]
...
[-6.70431227e-02  1.04767362e-03 -3.87518498e-01 ...  2.33092109e+00
 -5.42814807e-04  1.22896549e-02]
[ 1.05179552e-03 -5.55692566e-01  1.19500590e-02 ... -5.42814807e-04
 2.15512928e+00  5.89726568e-03]
[-5.63875095e-01  2.17876770e-03 -3.92962545e-01 ...  1.22896549e-02
 5.89726568e-03  2.66090472e+00]]
Variance function is [0.532]
Variance function is 0.532

```

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=gamma_L_max/2,
    bijector=tfb.Sigmoid(np.float64(0.), gamma_L_max),
    dtype=np.float64,
    name="next_gamma_L",
)

next_lambda = tfp.util.TransformedVariable(
    initial_value=lambda_max/2,
    bijector=tfb.Sigmoid(np.float64(0.), lambda_max),
    dtype=np.float64,
    name="next_lambda",
)

```

```

next_f = tfp.util.TransformedVariable(
    initial_value=f_max/2,
    bijector=tfb.Sigmoid(np.float64(0.), f_max),
    dtype=np.float64,
    name="next_f",
)

```

```

)

```

```

next_r = tfp.util.TransformedVariable(
    initial_value=r_max/2,
    bijector=tfb.Sigmoid(np.float64(0.), r_max),
    dtype=np.float64,
    name="next_r",
)

```

```

)

```

```

next_vars = (
    (next_alpha.trainable_variables[0],
    next_beta.trainable_variables[0],
    next_gamma_L.trainable_variables[0],
    next_lambda.trainable_variables[0],
    next_f.trainable_variables[0],
    next_r.trainable_variables[0],)
)

```

```

)

```

```

next_vars

```

```

(<tf.Variable 'next_alpha:0' shape=() dtype=float64, numpy=0.0>,
<tf.Variable 'next_beta:0' shape=() dtype=float64, numpy=0.0>,
<tf.Variable 'next_gamma_L:0' shape=() dtype=float64, numpy=0.0>,
<tf.Variable 'next_lambda:0' shape=() dtype=float64, numpy=0.0>,
<tf.Variable 'next_f:0' shape=() dtype=float64, numpy=0.0>,
<tf.Variable 'next_r:0' shape=() dtype=float64, numpy=0.0>)

```

```

eta_t = tf.constant(1.0, dtype=np.float64)

```

```

def UCB_loss(champ_GP_reg):
    next_guess = tf.reshape(
        tf.stack([next_alpha, next_beta, next_gamma_L, next_lambda, next_f, next_r]),
        [1, 6],
    )
    mean_t = champ_GP_reg.mean_fn(next_guess)
    std_t = tf.math.sqrt(

```

```

        champ_GP_reg.variance(index_points=next_guess)
        - observation_noise_variance_champ
    )
    return tf.squeeze(mean_t - std_t)

optimizer_fast = tf.keras.optimizers.Adam(learning_rate=0.1)

@tf.function(autograph=False, jit_compile=False)
def opt_var():
    with tf.GradientTape() as tape:
        loss = UCB_loss(champ_GP_reg)
        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("Trained parameters:")
for var in [next_alpha, next_beta, next_gamma_L, next_lambda, next_f, next_r]:
    print("{} is {}".format(var.name, (var.bijector.forward(var).numpy().round(3))))

```

Acquisition function convergence reached at iteration 76.

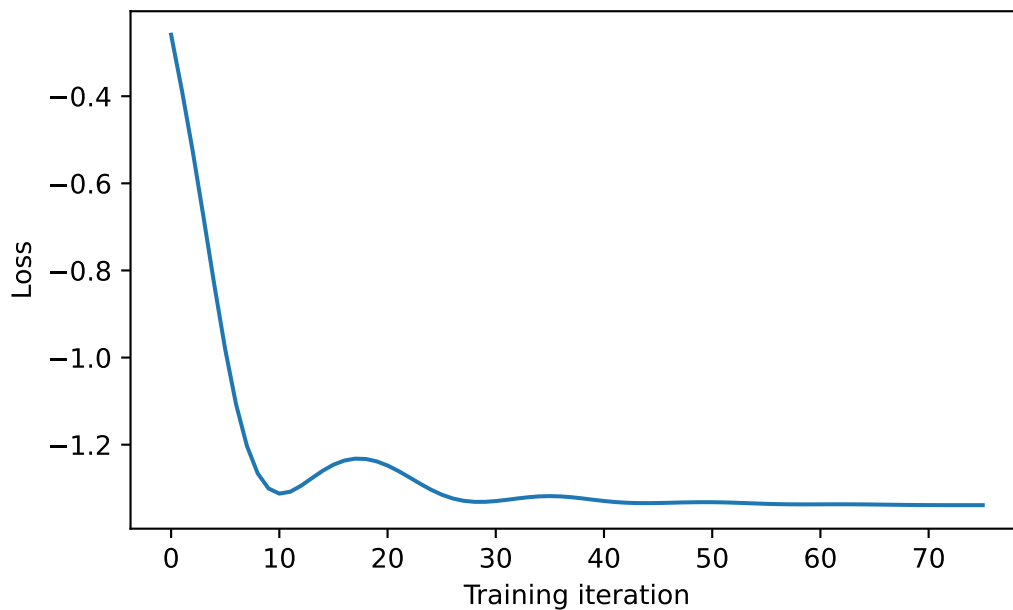
Trained parameters:

next_alpha is 0.541

next_beta is 0.632


```
next_gamma_L is 0.017
next_lambda is 0.025
next_f is 0.025
next_r is 0.034
```

```
plt.figure(figsize=(6, 3.5))
plt.plot(lls_)
plt.xlabel("Training iteration")
plt.ylabel("Loss")
plt.savefig("champagne_GP_images/bolfi_optim_loss_log_discrep.pdf")
plt.show()
```



```
def update_GP_L00(champ_GP, index_vals, obs_vals, observation_noise_variance_champ):

    def L00_loss(champ_GP, index_vals, obs_vals, observation_noise_variance_champ):
        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
return -tf.math.reduce_sum(log_var - log_mu)

@tf.function(autograph=False, jit_compile=False)
def opt_GP():
    with tf.GradientTape() as tape:
        loss = L00_loss(
            champ_GP, index_vals, obs_vals, observation_noise_variance_champ
        )
    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()

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

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

def update_GP_MLE(champ_GP):
    @tf.function(autograph=False, jit_compile=False)
    def train_model():
        with tf.GradientTape() as tape:
            loss = -champ_GP.log_prob(obs_vals)
            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 = train_model()

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

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

# def UCB_loss(eta_t, champ_GP_reg):
#     next_guess = tf.reshape(
#         tf.stack([next_alpha, next_beta, next_gamma_L, next_lambda, next_f, next_r]),
#         [1, 6],
#     )
#     mean_t = champ_GP_reg.mean_fn(next_guess)
#     std_t = champ_GP_reg.stddev(index_points=next_guess)
#     return tf.squeeze(mean_t - eta_t * std_t)

def update_var_UCB(eta_t, champ_GP_reg, next_vars):
    optimizer_fast = tf.keras.optimizers.Adam(learning_rate=0.1)

    @tf.function(autograph=False, jit_compile=False)
    def opt_var():
        with tf.GradientTape() as tape:
            loss = UCB_loss(eta_t, champ_GP_reg)
            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-3 # 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}.")
        break

    previous_loss = loss

next_guess = tf.reshape(
    tf.stack([next_alpha, next_beta, next_gamma_L, next_lambda, next_f, next_r]),
    [1, 6],
)
print(
    "The final UCB loss was {}".format(loss.numpy().round(3))
    + " with predicted mean of {}".format(
        champ_GP_reg.mean_fn(next_guess).numpy().round(3)
    )
)
for var in optimizer_fast.variables:
    var.assign(tf.zeros_like(var))

def update_var_EI(GP_reg, alpha, beta, gamma_L, lambda_, f, r, min_obs):
    def EI_loss(alpha, beta, gamma_L, lambda_, f, r, min_obs):
        next_guess = tf.reshape(
            tf.stack([alpha, beta, gamma_L, lambda_, f, r]),
            [1, 6],
        )
        mean_t = GP_reg.mean_fn(next_guess)
        std_t = GP_reg.stddev(index_points=next_guess)

```

```

    delt = min_obs - mean_t
    return -tf.squeeze(
        delt * tfd.Normal(0, np.float64(1)).cdf(delt / std_t)
        + std_t * tfd.Normal(0, np.float64(1)).prob(delt / std_t)
    )

optimizer_fast = tf.keras.optimizers.Adam(learning_rate=0.1)

@tf.function(autograph=False, jit_compile=False)
def opt_var():
    with tf.GradientTape() as tape:
        loss = EI_loss(alpha, beta, gamma_L, lambda_, f, r, min_obs)
    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 = np.float64("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

next_guess = tf.reshape(
    tf.stack([next_alpha, next_beta, next_gamma_L, next_lambda, next_f, next_r]),
    [1, 6],
)
print(
    "The final EI loss was {}".format(loss.numpy().round(3))
    + " with predicted mean of {}".format(

```

```

        champ_GP_reg.mean_fn(next_guess).numpy().round(3)
    )
)

def new_eta_t(t, d, exploration_rate):
    # return np.log((t + 1) ** (d * 2 + 2) * np.pi**2 / (3 * exploration_rate))
    return np.sqrt(np.log((t + 1) ** (d * 2 + 2) * np.pi**2 / (3 * exploration_rate)))

# optimizer_fast = tf.keras.optimizers.Adam(learning_rate=1.)
# update_var_EI()
# plt.figure(figsize=(6, 3.5))
# plt.plot(lls_)
# plt.xlabel("Training iteration")
# plt.ylabel("Loss")
# plt.show()

num_slice_updates = 15

all_slices = [
    np.linspace(0, 1, num_slice_updates + 2, dtype=np.float64)[1:-1], # alpha
    np.linspace(0, 1, num_slice_updates + 2, dtype=np.float64)[1:-1], # beta
    np.linspace(0, gamma_L_max, num_slice_updates + 2, dtype=np.float64)[
        1:-1
    ], # gamma_L
    np.linspace(0, lambda_max, num_slice_updates + 2, dtype=np.float64)[1:-1], # lambda
    np.linspace(0, f_max, num_slice_updates + 2, dtype=np.float64)[1:-1], # f
    np.linspace(0, r_max, num_slice_updates + 2, dtype=np.float64)[1:-1], # r
]

exploration_rate = 1
d = 6
update_GP_hp_freq = 20 # how many iterations before updating GP hyperparams
eta_t = tf.Variable(0, dtype=np.float64, name="eta_t")
min_obs = tf.Variable(100, dtype=np.float64, name="min_obs", shape=())
min_index = index_vals[
    champ_GP_reg.mean_fn(index_vals) == min(champ_GP_reg.mean_fn(index_vals))
][0]
simulation_reps = 20

```

```

for t in range(501):
    min_index = index_vals[
        champ_GP_reg.mean_fn(index_vals) == min(champ_GP_reg.mean_fn(index_vals))
    ][
        0,
    ]
    optimizer_slow = tf.keras.optimizers.Adam()
    # eta_t.assign(new_eta_t(t, d, exploration_rate))
    min_obs.assign(min(champ_GP_reg.mean_fn(index_vals)))
    print("Iteration " + str(t))
    # print(eta_t)

#####

# for var in [next_alpha, next_beta, next_gamma_L, next_lambda, next_f, next_r]:
#     var.assign(
#         var.bijector.forward(np.float64(100000000.0))
#         * np.float64(np.random.uniform())
#     )

index_update = 0
for var in [next_alpha, next_beta, next_gamma_L, next_lambda, next_f, next_r]:
    if np.random.uniform() > 0.5:
        var.assign(min_index[index_update])
    else:
        var.assign(
            var.bijector.forward(np.float64(100000000.0))
            * np.float64(np.random.uniform())
        )
    index_update += 1

# update_var_UCB(eta_t, champ_GP_reg)
update_var_EI(
    champ_GP_reg,
    next_alpha,
    next_beta,
    next_gamma_L,
    next_lambda,
    next_f,
    next_r,
    min_obs,

```

```

)

bayes_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("The next parameters to simulate from are {}".format(bayes_params.round(3)))

if t < 6:
    new_params = np.repeat(
        np.array(
            [
                [
                    next_alpha.numpy(),
                    next_beta.numpy(),
                    next_gamma_L.numpy(),
                    next_lambda.numpy(),
                    next_f.numpy(),
                    next_r.numpy(),
                ]
            ]
        ),
        num_slice_updates,
        axis=0,
    )
    new_params[:, t % 6] = all_slices[t % 6]
else:
    new_params = np.repeat(
        np.array(
            [
                [
                    next_alpha.numpy(),
                    next_beta.numpy(),
                    next_gamma_L.numpy(),
                    next_lambda.numpy(),

```



```

        next_f.numpy(),
        next_r.numpy(),
    ]
],
),
4,
axis=0,
)
new_params[:, t % 6] = np.random.uniform(0, upper_bounds[t % 6], 4)

new_params = np.append(
    new_params,
    np.array(
        [
            [
                next_alpha.numpy(),
                next_beta.numpy(),
                next_gamma_L.numpy(),
                next_lambda.numpy(),
                next_f.numpy(),
                next_r.numpy(),
            ]
        ]
    ),
    axis=0,
)

new_params_reps = np.repeat(new_params, dis_mean_n, axis=0)
index_vals = np.append(index_vals, new_params, axis=0)

with mp.Pool(processes=mp.cpu_count()) as pool:
    args = [
        (a, b, c, d, e, f, int(g * np.random.uniform()))
        for (a, b, c, d, e, f), g in zip(
            list(map(tuple, new_params_reps)), range(new_params_reps.shape[0])
        )
    ]
    results = pool.starmap(single_discrepancy, args)

new_discrepancies = np.mean(np.array(results).reshape(-1, dis_mean_n), axis=1)

```

```

print("The mean of the samples was {}".format(new_discrepancies[-1].round(3)))
obs_vals = np.append(obs_vals, new_discrepancies)

#####

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=const_mean_fn(),
)

if t % update_GP_hp_freq == 0:
    champ_GP = tfd.GaussianProcess(
        kernel=kernel_champ,
        observation_noise_variance=observation_noise_variance_champ,
        index_points=index_vals,
        mean_fn=const_mean_fn(),
    )
    update_GP_LOO(champ_GP, index_vals, obs_vals, observation_noise_variance_champ)
    # update_GP_MLE(champ_GP)
    min_value = min(champ_GP_reg.mean_fn(index_vals))
    min_index = index_vals[champ_GP_reg.mean_fn(index_vals) == min_value][0,]
    print(
        "The minimum predicted mean of the observed indices is {}".format(
            min_value.numpy().round(3)
        )
        + " at the point \n{}".format(min_index.round(3))
    )

if (t > 0) & (t % 50 == 0):
    print("Trained parameters:")
    for train_var in champ_GP.trainable_variables:
        if "bias" in train_var.name:
            print("{} is {}".format(train_var.name, train_var.numpy().round(3)))
        else:
            if "length" in train_var.name:
                print(
                    "{} is {}".format(

```

```

        train_var.name,
        tfb.Sigmoid(
            np.float64(0.0),
            [
                1.0 / 2,
                1.0 / 2,
                gamma_L_max / 2,
                lambda_max / 2,
                f_max / 2,
                r_max / 2,
            ],
        )
        .forward(train_var)
        .numpy()
        .round(3),
    )
)
else:
    print(
        "{} is {}\n".format(
            train_var.name,
            constrain_positive.forward(train_var).numpy().round(3),
        )
    )

for var in vars:
    champ_GP_reg_plot = 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=const_mean_fn(),
    )
    GP_samples = champ_GP_reg_plot.sample(gp_samp_no, seed=GP_seed)
    gp_samples_dict[var + "_gp_samps" + str(t) + "iters"] = GP_samples

plt.figure(figsize=(6, 3.5))
plt.scatter(
    slice_indices_dfs_dict[var + "_slice_indices_df"][var].values,

```

```

        slice_discrepancies_dict[var + "_slice_discrepancies"],
        label="Untrained Discrepancies",
        alpha=0.6,
    )
    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,
        )
    plt.plot(
        slice_indices_dfs_dict[var + "_gp_indices_df"][var].values,
        champ_GP_reg_plot.mean_fn(
            slice_indices_dfs_dict[var + "_gp_indices_df"].values
        ),
        c="black",
        alpha=1,
        label="Posterior Mean",
    )
    leg = plt.legend(loc="upper left")
    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("log(Discrepancy)")
    plt.ylim((-3, 2))
    plt.savefig(
        "champagne_GP_images/"
        + var
        + "_slice_"
        + str(t)

```

```

        + "_bolfi_updates_log_discrep.pdf"
    )
    plt.show()

```

Iteration 0

Acquisition function convergence reached at iteration 169.

The final EI loss was -0.014 with predicted mean of [0.246]

The next parameters to simulate from are [[0.001 1. 0. 0.05 0.05 0.]]

The mean of the samples was 2.031

The minimum predicted mean of the observed indices is -0.958 at the point
[0.169 0.759 0.018 0.012 0.026 0.04]

Iteration 1

Acquisition function convergence reached at iteration 113.

The final EI loss was -0.151 with predicted mean of [-0.81]

The next parameters to simulate from are [[0.126 0.559 0.012 0.011 0.018 0.038]]

The mean of the samples was -0.831

Iteration 2

Acquisition function convergence reached at iteration 50.

The final EI loss was -0.093 with predicted mean of [-0.471]

The next parameters to simulate from are [[0.736 0.102 0.033 0.012 0.022 0.005]]

The mean of the samples was -0.348

Iteration 3

Acquisition function convergence reached at iteration 79.

The final EI loss was -0.094 with predicted mean of [-0.686]

The next parameters to simulate from are [[0.144 0.042 0.001 0.009 0.014 0.031]]

The mean of the samples was -0.373

Iteration 4

Acquisition function convergence reached at iteration 79.

The final EI loss was -0.116 with predicted mean of [-0.886]

The next parameters to simulate from are [[0.694 0.002 0.007 0.011 0.031 0.]]

The mean of the samples was 0.329

Iteration 5

Acquisition function convergence reached at iteration 150.

The final EI loss was -0.427 with predicted mean of [-1.481]

The next parameters to simulate from are [[0.776 0.183 0.007 0.014 0.023 0.007]]

The mean of the samples was -1.266

Iteration 6

Acquisition function convergence reached at iteration 96.

The final EI loss was -0.107 with predicted mean of [-1.212]

The next parameters to simulate from are [[0.762 0.208 0.007 0.012 0.022 0.002]]

The mean of the samples was -0.33

Iteration 7

Acquisition function convergence reached at iteration 78.
 The final EI loss was -0.11 with predicted mean of [-0.858]
 The next parameters to simulate from are [[0.049 0.061 0.015 0.012 0.01 0.035]]
 The mean of the samples was -0.811
 Iteration 8
 Acquisition function convergence reached at iteration 117.
 The final EI loss was -0.101 with predicted mean of [-0.79]
 The next parameters to simulate from are [[0.154 0.671 0.022 0.01 0.011 0.049]]
 The mean of the samples was -0.276
 Iteration 9
 Acquisition function convergence reached at iteration 122.
 The final EI loss was -0.009 with predicted mean of [0.443]
 The next parameters to simulate from are [[0.638 0.001 0. 0.05 0.05 0.]]
 The mean of the samples was 1.825
 Iteration 10
 Acquisition function convergence reached at iteration 193.
 The final EI loss was -0.02 with predicted mean of [0.191]
 The next parameters to simulate from are [[0.396 0.999 0.033 0.05 0. 0.]]
 The mean of the samples was 1.691
 Iteration 11
 Acquisition function convergence reached at iteration 192.
 The final EI loss was -0.104 with predicted mean of [-0.888]
 The next parameters to simulate from are [[0.096 0.747 0.016 0.01 0.033 0.033]]
 The mean of the samples was -1.158
 Iteration 12
 Acquisition function convergence reached at iteration 75.
 The final EI loss was -0.09 with predicted mean of [-1.03]
 The next parameters to simulate from are [[0.083 0.422 0.015 0.011 0.031 0.036]]
 The mean of the samples was -1.261
 Iteration 13
 Acquisition function convergence reached at iteration 123.
 The final EI loss was -0.11 with predicted mean of [-1.239]
 The next parameters to simulate from are [[0.145 0.489 0.015 0.012 0.037 0.037]]
 The mean of the samples was -0.969
 Iteration 14
 Acquisition function convergence reached at iteration 72.
 The final EI loss was -0.108 with predicted mean of [-1.285]
 The next parameters to simulate from are [[0.074 0.609 0.018 0.011 0.027 0.035]]
 The mean of the samples was -1.25
 Iteration 15
 Acquisition function convergence reached at iteration 55.
 The final EI loss was -0.072 with predicted mean of [-0.991]
 The next parameters to simulate from are [[0.062 0.055 0.014 0.011 0.03 0.035]]

The mean of the samples was -0.982
 Iteration 16
 Acquisition function convergence reached at iteration 198.
 The final EI loss was -0.022 with predicted mean of [0.02]
 The next parameters to simulate from are [[0.999 0.992 0.033 0. 0.05 0.066]]
 The mean of the samples was 0.4
 Iteration 17
 Acquisition function convergence reached at iteration 37.
 The final EI loss was -0.092 with predicted mean of [-1.26]
 The next parameters to simulate from are [[0.086 0.312 0.017 0.009 0.027 0.034]]
 The mean of the samples was -1.061
 Iteration 18
 Acquisition function convergence reached at iteration 88.
 The final EI loss was -0.067 with predicted mean of [-1.07]
 The next parameters to simulate from are [[0.029 0.642 0.017 0.01 0.035 0.037]]
 The mean of the samples was -1.165
 Iteration 19
 Acquisition function convergence reached at iteration 56.
 The final EI loss was -0.027 with predicted mean of [-0.204]
 The next parameters to simulate from are [[0.002 0.999 0.025 0.002 0.003 0.037]]
 The mean of the samples was 0.256
 Iteration 20
 Acquisition function convergence reached at iteration 65.
 The final EI loss was -0.071 with predicted mean of [-0.887]
 The next parameters to simulate from are [[0.272 0.378 0.024 0.013 0.031 0.04]]
 The mean of the samples was -0.993
 The minimum predicted mean of the observed indices is -1.189 at the point
 [0.776 0.183 0.007 0.014 0.023 0.007]
 Iteration 21
 Acquisition function convergence reached at iteration 110.
 The final EI loss was -0.096 with predicted mean of [-0.981]
 The next parameters to simulate from are [[0.937 0.05 0.007 0.014 0.021 0.007]]
 The mean of the samples was -0.369
 Iteration 22
 Acquisition function convergence reached at iteration 75.
 The final EI loss was -0.124 with predicted mean of [-1.07]
 The next parameters to simulate from are [[0.003 0.575 0.019 0.012 0.035 0.028]]
 The mean of the samples was -0.68
 Iteration 23
 Acquisition function convergence reached at iteration 79.
 The final EI loss was -0.11 with predicted mean of [-1.019]
 The next parameters to simulate from are [[0.042 0.988 0.018 0.011 0.028 0.031]]
 The mean of the samples was -1.101

Iteration 24

Acquisition function convergence reached at iteration 95.

The final EI loss was -0.157 with predicted mean of [-1.216]

The next parameters to simulate from are [[0.075 0.284 0.02 0.01 0.029 0.038]]

The mean of the samples was -1.061

Iteration 25

Acquisition function convergence reached at iteration 68.

The final EI loss was -0.083 with predicted mean of [-0.684]

The next parameters to simulate from are [[0.314 0.337 0.022 0.014 0.019 0.022]]

The mean of the samples was -1.156

Iteration 26

Acquisition function convergence reached at iteration 55.

The final EI loss was -0.115 with predicted mean of [-1.008]

The next parameters to simulate from are [[0.251 0.824 0.022 0.013 0.024 0.028]]

The mean of the samples was -1.086

Iteration 27

Acquisition function convergence reached at iteration 83.

The final EI loss was -0.102 with predicted mean of [-0.907]

The next parameters to simulate from are [[0.435 0.226 0.021 0.015 0.019 0.016]]

The mean of the samples was -0.865

Iteration 28

Acquisition function convergence reached at iteration 83.

The final EI loss was -0.104 with predicted mean of [-1.081]

The next parameters to simulate from are [[0.116 0.966 0.023 0.01 0.033 0.037]]

The mean of the samples was -0.886

Iteration 29

Acquisition function convergence reached at iteration 22.

The final EI loss was -0.116 with predicted mean of [-1.142]

The next parameters to simulate from are [[0.256 0.651 0.014 0.013 0.02 0.025]]

The mean of the samples was -1.23

Iteration 30

Acquisition function convergence reached at iteration 90.

The final EI loss was -0.108 with predicted mean of [-1.174]

The next parameters to simulate from are [[0.16 0.871 0.015 0.013 0.018 0.027]]

The mean of the samples was -1.208

Iteration 31

Acquisition function convergence reached at iteration 90.

The final EI loss was -0.1 with predicted mean of [-1.185]

The next parameters to simulate from are [[0.175 0.768 0.015 0.014 0.025 0.025]]

The mean of the samples was -1.203

Iteration 32

Acquisition function convergence reached at iteration 30.

The final EI loss was -0.054 with predicted mean of [-0.556]

The next parameters to simulate from are [[0.032 0.013 0.025 0.012 0.037 0.044]]
 The mean of the samples was -0.83
 Iteration 33
 Acquisition function convergence reached at iteration 77.
 The final EI loss was -0.089 with predicted mean of [-0.989]
 The next parameters to simulate from are [[0.147 0.608 0.015 0.013 0.009 0.022]]
 The mean of the samples was -0.938
 Iteration 34
 Acquisition function convergence reached at iteration 56.
 The final EI loss was -0.077 with predicted mean of [-1.041]
 The next parameters to simulate from are [[0.236 0.612 0.021 0.015 0.012 0.026]]
 The mean of the samples was -0.98
 Iteration 35
 Acquisition function convergence reached at iteration 157.
 The final EI loss was -0.013 with predicted mean of [0.237]
 The next parameters to simulate from are [[0.001 0.998 0.033 0.05 0.05 0.024]]
 The mean of the samples was 1.888
 Iteration 36
 Acquisition function convergence reached at iteration 65.
 The final EI loss was -0.102 with predicted mean of [-1.294]
 The next parameters to simulate from are [[0.134 0.836 0.014 0.012 0.024 0.029]]
 The mean of the samples was -1.344
 Iteration 37
 Acquisition function convergence reached at iteration 59.
 The final EI loss was -0.08 with predicted mean of [-0.833]
 The next parameters to simulate from are [[0.01 0.639 0.025 0.011 0.039 0.045]]
 The mean of the samples was -0.801
 Iteration 38
 Acquisition function convergence reached at iteration 170.
 The final EI loss was -0.066 with predicted mean of [-0.868]
 The next parameters to simulate from are [[0.005 0.998 0.014 0.008 0.037 0.043]]
 The mean of the samples was -1.048
 Iteration 39
 Acquisition function convergence reached at iteration 128.
 The final EI loss was -0.067 with predicted mean of [-1.073]
 The next parameters to simulate from are [[0.123 0.999 0.016 0.014 0.025 0.03]]
 The mean of the samples was -1.053
 Iteration 40
 Acquisition function convergence reached at iteration 112.
 The final EI loss was -0.063 with predicted mean of [-0.785]
 The next parameters to simulate from are [[0.26 0.197 0.033 0.014 0.026 0.021]]
 The mean of the samples was -0.456
 Hyperparameter convergence reached at iteration 6306.

The minimum predicted mean of the observed indices is -1.297 at the point
[0.134 0.836 0.014 0.012 0.024 0.029]

Iteration 41
Acquisition function convergence reached at iteration 74.
The final EI loss was -0.067 with predicted mean of [-0.933]
The next parameters to simulate from are [[0.217 0.009 0.023 0.011 0.029 0.034]]
The mean of the samples was -1.086

Iteration 42
Acquisition function convergence reached at iteration 74.
The final EI loss was -0.068 with predicted mean of [-1.292]
The next parameters to simulate from are [[0.152 0.758 0.016 0.012 0.023 0.03]]
The mean of the samples was -1.272

Iteration 43
Acquisition function convergence reached at iteration 150.
The final EI loss was -0.014 with predicted mean of [0.053]
The next parameters to simulate from are [[0.998 0.011 0. 0.05 0. 0.066]]
The mean of the samples was 0.577

Iteration 44
Acquisition function convergence reached at iteration 77.
The final EI loss was -0.055 with predicted mean of [-1.296]
The next parameters to simulate from are [[0.156 0.793 0.016 0.012 0.023 0.028]]
The mean of the samples was -1.247

Iteration 45
Acquisition function convergence reached at iteration 135.
The final EI loss was -0.074 with predicted mean of [-1.26]
The next parameters to simulate from are [[0.146 0.825 0.009 0.012 0.024 0.025]]
The mean of the samples was -1.472

Iteration 46
Acquisition function convergence reached at iteration 78.
The final EI loss was -0.065 with predicted mean of [-1.33]
The next parameters to simulate from are [[0.133 0.908 0.008 0.013 0.022 0.026]]
The mean of the samples was -1.484

Iteration 47
Acquisition function convergence reached at iteration 166.
The final EI loss was -0.085 with predicted mean of [-1.401]
The next parameters to simulate from are [[0.134 0.789 0.008 0.012 0.017 0.026]]
The mean of the samples was -1.453

Iteration 48
Acquisition function convergence reached at iteration 109.
The final EI loss was -0.005 with predicted mean of [0.177]
The next parameters to simulate from are [[0.994 0.997 0. 0.05 0.05 0.03]]
The mean of the samples was 0.912

Iteration 49

Acquisition function convergence reached at iteration 136.
 The final EI loss was -0.031 with predicted mean of [-0.776]
 The next parameters to simulate from are [[0.204 0.008 0.028 0.014 0.016 0.04]]
 The mean of the samples was -1.062
 Iteration 50
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [0.85]
 The next parameters to simulate from are [[0.131 0.012 0.008 0.046 0.016 0.061]]
 The mean of the samples was 1.164
 Trained parameters:
 amplitude_champ:0 is 0.791

 length_scales_champ:0 is [0.322 0.5 0.014 0.006 0.025 0.009]

 observation_noise_variance_champ:0 is 0.051

 bias_mean:0 is 0.65

 Iteration 51
 Acquisition function convergence reached at iteration 108.
 The final EI loss was -0.009 with predicted mean of [0.034]
 The next parameters to simulate from are [[0.986 0.994 0. 0.028 0. 0.066]]
 The mean of the samples was 0.5
 Iteration 52
 Acquisition function convergence reached at iteration 86.
 The final EI loss was -0.064 with predicted mean of [-1.368]
 The next parameters to simulate from are [[0.177 0.849 0.007 0.012 0.017 0.023]]
 The mean of the samples was -1.364
 Iteration 53
 Acquisition function convergence reached at iteration 133.
 The final EI loss was -0.074 with predicted mean of [-1.471]
 The next parameters to simulate from are [[0.159 0.721 0.008 0.012 0.022 0.024]]
 The mean of the samples was -1.549
 Iteration 54
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [0.738]
 The next parameters to simulate from are [[0.014 0.721 0.008 0.031 0.022 0.024]]
 The mean of the samples was 0.883
 Iteration 55
 Acquisition function convergence reached at iteration 177.
 The final EI loss was -0.027 with predicted mean of [-0.77]
 The next parameters to simulate from are [[0.297 0.009 0.029 0.013 0.027 0.047]]
 The mean of the samples was -0.776

Iteration 56

Acquisition function convergence reached at iteration 81.

The final EI loss was -0.021 with predicted mean of [-0.596]

The next parameters to simulate from are [[0.001 0.009 0.031 0.014 0.012 0.047]]

The mean of the samples was -0.953

Iteration 57

Acquisition function convergence reached at iteration 126.

The final EI loss was -0.032 with predicted mean of [-0.881]

The next parameters to simulate from are [[0.006 0.418 0.025 0.016 0.022 0.044]]

The mean of the samples was -0.873

Iteration 58

Acquisition function convergence reached at iteration 75.

The final EI loss was -0.053 with predicted mean of [-1.414]

The next parameters to simulate from are [[0.177 0.698 0.006 0.013 0.021 0.023]]

The mean of the samples was -1.461

Iteration 59

Acquisition function convergence reached at iteration 40.

The final EI loss was -0.01 with predicted mean of [-0.291]

The next parameters to simulate from are [[0.956 0.026 0.025 0.014 0.047 0.012]]

The mean of the samples was -0.063

Iteration 60

Acquisition function convergence reached at iteration 117.

The final EI loss was -0.006 with predicted mean of [0.073]

The next parameters to simulate from are [[0.998 0.976 0. 0. 0.05 0.066]]

The mean of the samples was 0.512

Hyperparameter convergence reached at iteration 7718.

The minimum predicted mean of the observed indices is -1.523 at the point

[0.159 0.721 0.008 0.012 0.022 0.024]

Iteration 61

Acquisition function convergence reached at iteration 146.

The final EI loss was -0.024 with predicted mean of [-0.886]

The next parameters to simulate from are [[0.003 0.998 0.015 0.013 0.031 0.046]]

The mean of the samples was -0.602

Iteration 62

Acquisition function convergence reached at iteration 108.

The final EI loss was -0.026 with predicted mean of [-0.863]

The next parameters to simulate from are [[0.417 0.103 0.024 0.015 0.016 0.031]]

The mean of the samples was -1.038

Iteration 63

Acquisition function convergence reached at iteration 66.

The final EI loss was -0.008 with predicted mean of [0.005]

The next parameters to simulate from are [[0.009 0.994 0.033 0.017 0. 0.001]]

The mean of the samples was 0.494

Iteration 64
 Acquisition function convergence reached at iteration 128.
 The final EI loss was -0.061 with predicted mean of [-1.523]
 The next parameters to simulate from are [[0.133 0.795 0.009 0.013 0.021 0.023]]
 The mean of the samples was -1.575

Iteration 65
 Acquisition function convergence reached at iteration 41.
 The final EI loss was -0.05 with predicted mean of [-1.55]
 The next parameters to simulate from are [[0.163 0.789 0.009 0.012 0.021 0.024]]
 The mean of the samples was -1.772

Iteration 66
 Acquisition function convergence reached at iteration 73.
 The final EI loss was -0.015 with predicted mean of [-0.515]
 The next parameters to simulate from are [[0.374 0.998 0.032 0.017 0.012 0.031]]
 The mean of the samples was -0.966

Iteration 67
 Acquisition function convergence reached at iteration 67.
 The final EI loss was -0.006 with predicted mean of [0.044]
 The next parameters to simulate from are [[0.014 0.012 0.033 0.016 0.05 0.]]
 The mean of the samples was 0.541

Iteration 68
 Acquisition function convergence reached at iteration 55.
 The final EI loss was -0.014 with predicted mean of [-0.607]
 The next parameters to simulate from are [[0.014 0.684 0.017 0.005 0.047 0.044]]
 The mean of the samples was -0.738

Iteration 69
 Acquisition function convergence reached at iteration 174.
 The final EI loss was -0.018 with predicted mean of [-0.618]
 The next parameters to simulate from are [[0.002 0.008 0.032 0.015 0.028 0.055]]
 The mean of the samples was -0.874

Iteration 70
 Acquisition function convergence reached at iteration 72.
 The final EI loss was -0.024 with predicted mean of [-0.885]
 The next parameters to simulate from are [[0.378 0.528 0.033 0.016 0.02 0.034]]
 The mean of the samples was -0.945

Iteration 71
 Acquisition function convergence reached at iteration 74.
 The final EI loss was -0.035 with predicted mean of [-1.433]
 The next parameters to simulate from are [[0.119 0.785 0.007 0.011 0.022 0.024]]
 The mean of the samples was -1.907

Iteration 72
 Acquisition function convergence reached at iteration 72.
 The final EI loss was -0.006 with predicted mean of [-0.142]

The next parameters to simulate from are [[0.97 0.987 0. 0.015 0.013 0.005]]
 The mean of the samples was 0.344
 Iteration 73
 Acquisition function convergence reached at iteration 66.
 The final EI loss was -0.071 with predicted mean of [-1.616]
 The next parameters to simulate from are [[0.092 0.786 0.005 0.01 0.022 0.023]]
 The mean of the samples was -1.808
 Iteration 74
 Acquisition function convergence reached at iteration 129.
 The final EI loss was -0.083 with predicted mean of [-1.738]
 The next parameters to simulate from are [[0.074 0.62 0.004 0.01 0.023 0.023]]
 The mean of the samples was -1.596
 Iteration 75
 Acquisition function convergence reached at iteration 42.
 The final EI loss was -0.007 with predicted mean of [-0.602]
 The next parameters to simulate from are [[0.56 0.639 0.033 0.015 0.024 0.02]]
 The mean of the samples was -0.834
 Iteration 76
 Acquisition function convergence reached at iteration 39.
 The final EI loss was -0.009 with predicted mean of [-0.697]
 The next parameters to simulate from are [[0.672 0.181 0.03 0.015 0.014 0.023]]
 The mean of the samples was -0.85
 Iteration 77
 Acquisition function convergence reached at iteration 88.
 The final EI loss was -0.005 with predicted mean of [-0.507]
 The next parameters to simulate from are [[0.002 0.994 0.014 0.003 0.035 0.05]]
 The mean of the samples was -0.352
 Iteration 78
 Acquisition function convergence reached at iteration 60.
 The final EI loss was -0.057 with predicted mean of [-1.735]
 The next parameters to simulate from are [[0.1 0.821 0.004 0.01 0.022 0.023]]
 The mean of the samples was -1.424
 Iteration 79
 Acquisition function convergence reached at iteration 49.
 The final EI loss was -0.009 with predicted mean of [-0.345]
 The next parameters to simulate from are [[0.038 0.963 0.031 0.012 0.048 0.058]]
 The mean of the samples was -0.591
 Iteration 80
 Acquisition function convergence reached at iteration 73.
 The final EI loss was -0.002 with predicted mean of [0.28]
 The next parameters to simulate from are [[0.001 0.996 0. 0.05 0. 0.]]
 The mean of the samples was 2.085
 Hyperparameter convergence reached at iteration 2324.

The minimum predicted mean of the observed indices is -1.761 at the point
[0.119 0.785 0.007 0.011 0.022 0.024]

Iteration 81
Acquisition function convergence reached at iteration 130.
The final EI loss was -0.086 with predicted mean of [-1.788]
The next parameters to simulate from are [[0.083 0.662 0.007 0.01 0.023 0.024]]
The mean of the samples was -1.611

Iteration 82
Acquisition function convergence reached at iteration 143.
The final EI loss was -0.011 with predicted mean of [-0.958]
The next parameters to simulate from are [[0.002 0.001 0.024 0.014 0.018 0.037]]
The mean of the samples was -1.125

Iteration 83
Acquisition function convergence reached at iteration 2.
The final EI loss was -0.0 with predicted mean of [0.578]
The next parameters to simulate from are [[0.119 0.916 0.007 0.03 0.017 0.024]]
The mean of the samples was 0.591

Iteration 84
Acquisition function convergence reached at iteration 79.
The final EI loss was -0.016 with predicted mean of [-1.099]
The next parameters to simulate from are [[0.495 0.488 0.028 0.015 0.023 0.026]]
The mean of the samples was -0.963

Iteration 85
Acquisition function convergence reached at iteration 2.
The final EI loss was -0.0 with predicted mean of [-0.749]
The next parameters to simulate from are [[0.121 0.667 0.024 0.011 0.022 0.024]]
The mean of the samples was -0.709

Iteration 86
Acquisition function convergence reached at iteration 83.
The final EI loss was -0.01 with predicted mean of [-0.771]
The next parameters to simulate from are [[0.461 0.729 0.028 0.015 0.005 0.022]]
The mean of the samples was -0.847

Iteration 87
Acquisition function convergence reached at iteration 107.
The final EI loss was -0.055 with predicted mean of [-1.752]
The next parameters to simulate from are [[0.095 0.76 0.007 0.01 0.022 0.024]]
The mean of the samples was -1.59

Iteration 88
Acquisition function convergence reached at iteration 88.
The final EI loss was -0.054 with predicted mean of [-1.708]
The next parameters to simulate from are [[0.086 0.654 0.006 0.011 0.023 0.023]]
The mean of the samples was -1.556

Iteration 89

Acquisition function convergence reached at iteration 76.
 The final EI loss was -0.002 with predicted mean of [0.151]
 The next parameters to simulate from are [[0.004 0.006 0.033 0.036 0. 0.]]
 The mean of the samples was 1.462
 Iteration 90
 Acquisition function convergence reached at iteration 67.
 The final EI loss was -0.008 with predicted mean of [-0.47]
 The next parameters to simulate from are [[0.003 0.127 0.018 0.008 0.047 0.055]]
 The mean of the samples was -0.727
 Iteration 91
 Acquisition function convergence reached at iteration 143.
 The final EI loss was -0.043 with predicted mean of [-1.474]
 The next parameters to simulate from are [[0.19 0.325 0.007 0.01 0.023 0.022]]
 The mean of the samples was -1.708
 Iteration 92
 Acquisition function convergence reached at iteration 50.
 The final EI loss was -0.003 with predicted mean of [0.007]
 The next parameters to simulate from are [[0.981 0.985 0.032 0.022 0.049 0.063]]
 The mean of the samples was 0.459
 Iteration 93
 Acquisition function convergence reached at iteration 83.
 The final EI loss was -0.063 with predicted mean of [-1.75]
 The next parameters to simulate from are [[0.16 0.451 0.006 0.01 0.023 0.021]]
 The mean of the samples was -1.86
 Iteration 94
 Acquisition function convergence reached at iteration 162.
 The final EI loss was -0.012 with predicted mean of [-0.951]
 The next parameters to simulate from are [[0.002 0.002 0.024 0.011 0.019 0.048]]
 The mean of the samples was -0.805
 Iteration 95
 Acquisition function convergence reached at iteration 30.
 The final EI loss was -0.008 with predicted mean of [-0.868]
 The next parameters to simulate from are [[0.374 0.73 0.025 0.017 0.016 0.034]]
 The mean of the samples was -0.881
 Iteration 96
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [1.279]
 The next parameters to simulate from are [[0.16 0.6 0.014 0.041 0.023 0.022]]
 The mean of the samples was 1.273
 Iteration 97
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [1.381]
 The next parameters to simulate from are [[0.341 0.451 0.006 0.044 0.023 0.021]]

The mean of the samples was 1.285
 Iteration 98
 Acquisition function convergence reached at iteration 184.
 The final EI loss was -0.084 with predicted mean of [-1.791]
 The next parameters to simulate from are [[0.169 0.422 0.007 0.009 0.023 0.023]]
 The mean of the samples was -1.778
 Iteration 99
 Acquisition function convergence reached at iteration 43.
 The final EI loss was -0.003 with predicted mean of [-0.191]
 The next parameters to simulate from are [[0.14 0.998 0.001 0.007 0.046 0.014]]
 The mean of the samples was -1.349
 Iteration 100
 Acquisition function convergence reached at iteration 127.
 The final EI loss was -0.003 with predicted mean of [0.047]
 The next parameters to simulate from are [[0.998 0.005 0.002 0. 0. 0.067]]
 The mean of the samples was 0.646
 Hyperparameter convergence reached at iteration 2485.
 The minimum predicted mean of the observed indices is -1.77 at the point
 [0.16 0.451 0.006 0.01 0.023 0.021]
 Trained parameters:
 amplitude_champ:0 is 0.782

 length_scales_champ:0 is [0.309 0.5 0.011 0.006 0.02 0.012]

 observation_noise_variance_champ:0 is 0.064

 bias_mean:0 is 0.707

 Iteration 101
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [1.218]
 The next parameters to simulate from are [[0.161 0.45 0.026 0.041 0.04 0.042]]
 The mean of the samples was 1.248
 Iteration 102
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [0.841]
 The next parameters to simulate from are [[0.16 0.66 0.006 0.031 0.024 0.021]]
 The mean of the samples was 0.804
 Iteration 103
 Acquisition function convergence reached at iteration 58.
 The final EI loss was -0.061 with predicted mean of [-1.757]
 The next parameters to simulate from are [[0.171 0.41 0.006 0.009 0.024 0.021]]
 The mean of the samples was -1.933

Iteration 104
Acquisition function convergence reached at iteration 43.
The final EI loss was -0.006 with predicted mean of [-0.611]
The next parameters to simulate from are [[0.329 0.014 0.014 0.012 0. 0.021]]
The mean of the samples was -0.392

Iteration 105
Acquisition function convergence reached at iteration 2.
The final EI loss was -0.0 with predicted mean of [0.617]
The next parameters to simulate from are [[0.459 0.761 0.005 0.036 0.007 0.021]]
The mean of the samples was 0.627

Iteration 106
Acquisition function convergence reached at iteration 117.
The final EI loss was -0.055 with predicted mean of [-1.786]
The next parameters to simulate from are [[0.18 0.351 0.005 0.009 0.027 0.021]]
The mean of the samples was -1.69

Iteration 107
Acquisition function convergence reached at iteration 40.
The final EI loss was -0.006 with predicted mean of [-0.662]
The next parameters to simulate from are [[0.176 0.037 0.023 0.017 0.003 0.037]]
The mean of the samples was -0.758

Iteration 108
Acquisition function convergence reached at iteration 86.
The final EI loss was -0.06 with predicted mean of [-1.835]
The next parameters to simulate from are [[0.169 0.409 0.006 0.01 0.026 0.023]]
The mean of the samples was -1.593

Iteration 109
Acquisition function convergence reached at iteration 37.
The final EI loss was -0.048 with predicted mean of [-1.807]
The next parameters to simulate from are [[0.163 0.432 0.006 0.01 0.025 0.021]]
The mean of the samples was -1.714

Iteration 110
Acquisition function convergence reached at iteration 123.
The final EI loss was -0.04 with predicted mean of [-1.804]
The next parameters to simulate from are [[0.161 0.487 0.006 0.01 0.024 0.022]]
The mean of the samples was -1.793

Iteration 111
Acquisition function convergence reached at iteration 120.
The final EI loss was -0.035 with predicted mean of [-1.721]
The next parameters to simulate from are [[0.183 0.296 0.007 0.009 0.026 0.023]]
The mean of the samples was -1.707

Iteration 112
Acquisition function convergence reached at iteration 12.
The final EI loss was -0.003 with predicted mean of [-0.572]

The next parameters to simulate from are [[0.091 0.267 0.013 0.005 0.036 0.049]]
 The mean of the samples was -0.545
 Iteration 113
 Acquisition function convergence reached at iteration 95.
 The final EI loss was -0.006 with predicted mean of [-0.612]
 The next parameters to simulate from are [[0.507 0.004 0.033 0.018 0.026 0.031]]
 The mean of the samples was -0.577
 Iteration 114
 Acquisition function convergence reached at iteration 68.
 The final EI loss was -0.005 with predicted mean of [-0.647]
 The next parameters to simulate from are [[0.47 0.985 0.033 0.012 0.021 0.035]]
 The mean of the samples was -0.572
 Iteration 115
 Acquisition function convergence reached at iteration 58.
 The final EI loss was -0.005 with predicted mean of [-0.684]
 The next parameters to simulate from are [[0.468 0.256 0.023 0.019 0.003 0.026]]
 The mean of the samples was -0.807
 Iteration 116
 Acquisition function convergence reached at iteration 85.
 The final EI loss was -0.002 with predicted mean of [0.123]
 The next parameters to simulate from are [[0.987 0.002 0. 0. 0. 0.035]]
 The mean of the samples was 0.599
 Iteration 117
 Acquisition function convergence reached at iteration 73.
 The final EI loss was -0.002 with predicted mean of [0.093]
 The next parameters to simulate from are [[0.003 0.01 0. 0.022 0.001 0.]]
 The mean of the samples was 0.774
 Iteration 118
 Acquisition function convergence reached at iteration 145.
 The final EI loss was -0.037 with predicted mean of [-1.768]
 The next parameters to simulate from are [[0.145 0.417 0.006 0.009 0.025 0.021]]
 The mean of the samples was -1.813
 Iteration 119
 Acquisition function convergence reached at iteration 112.
 The final EI loss was -0.037 with predicted mean of [-1.796]
 The next parameters to simulate from are [[0.148 0.424 0.006 0.009 0.025 0.021]]
 The mean of the samples was -1.763
 Iteration 120
 Acquisition function convergence reached at iteration 285.
 The final EI loss was -0.031 with predicted mean of [-1.783]
 The next parameters to simulate from are [[0.175 0.415 0.006 0.009 0.025 0.02]]
 The mean of the samples was -1.738
 Hyperparameter convergence reached at iteration 1824.

The minimum predicted mean of the observed indices is -1.799 at the point
[0.148 0.424 0.006 0.009 0.025 0.021]

Iteration 121
Acquisition function convergence reached at iteration 54.
The final EI loss was -0.004 with predicted mean of [-0.476]
The next parameters to simulate from are [[0.005 0.481 0.028 0.012 0.029 0.066]]
The mean of the samples was -0.812

Iteration 122
Acquisition function convergence reached at iteration 72.
The final EI loss was -0.034 with predicted mean of [-1.798]
The next parameters to simulate from are [[0.142 0.489 0.006 0.009 0.024 0.022]]
The mean of the samples was -1.736

Iteration 123
Acquisition function convergence reached at iteration 35.
The final EI loss was -0.004 with predicted mean of [-0.48]
The next parameters to simulate from are [[0.267 0.304 0.033 0.015 0.036 0.066]]
The mean of the samples was -0.443

Iteration 124
Acquisition function convergence reached at iteration 50.
The final EI loss was -0.035 with predicted mean of [-1.79]
The next parameters to simulate from are [[0.167 0.355 0.007 0.009 0.024 0.021]]
The mean of the samples was -1.473

Iteration 125
Acquisition function convergence reached at iteration 2.
The final EI loss was -0.0 with predicted mean of [-0.823]
The next parameters to simulate from are [[0.162 0.439 0.001 0.01 0.025 0.022]]
The mean of the samples was -0.364

Iteration 126
Acquisition function convergence reached at iteration 2.
The final EI loss was -0.0 with predicted mean of [1.027]
The next parameters to simulate from are [[0.666 0.469 0.007 0.048 0.039 0.023]]
The mean of the samples was 1.364

Iteration 127
Acquisition function convergence reached at iteration 58.
The final EI loss was -0.005 with predicted mean of [-0.479]
The next parameters to simulate from are [[0.008 0.584 0.02 0.012 0.048 0.067]]
The mean of the samples was -0.221

Iteration 128
Acquisition function convergence reached at iteration 37.
The final EI loss was -0.001 with predicted mean of [0.243]
The next parameters to simulate from are [[0.991 0.826 0.001 0.012 0.048 0.066]]
The mean of the samples was 0.578

Iteration 129

Acquisition function convergence reached at iteration 44.
 The final EI loss was -0.035 with predicted mean of [-1.788]
 The next parameters to simulate from are [[0.147 0.552 0.007 0.01 0.023 0.022]]
 The mean of the samples was -1.63
 Iteration 130
 Acquisition function convergence reached at iteration 76.
 The final EI loss was -0.011 with predicted mean of [-0.927]
 The next parameters to simulate from are [[0.046 0.893 0.005 0.005 0.05 0.016]]
 The mean of the samples was -0.68
 Iteration 131
 Acquisition function convergence reached at iteration 115.
 The final EI loss was -0.001 with predicted mean of [0.113]
 The next parameters to simulate from are [[0.001 0.003 0.033 0. 0. 0.001]]
 The mean of the samples was 0.499
 Iteration 132
 Acquisition function convergence reached at iteration 103.
 The final EI loss was -0.005 with predicted mean of [-0.654]
 The next parameters to simulate from are [[0.013 0.01 0.033 0.017 0.01 0.035]]
 The mean of the samples was -0.801
 Iteration 133
 Acquisition function convergence reached at iteration 75.
 The final EI loss was -0.025 with predicted mean of [-1.688]
 The next parameters to simulate from are [[0.163 0.264 0.007 0.009 0.024 0.023]]
 The mean of the samples was -1.61
 Iteration 134
 Acquisition function convergence reached at iteration 81.
 The final EI loss was -0.002 with predicted mean of [-0.135]
 The next parameters to simulate from are [[0.019 0.007 0.012 0.017 0. 0.066]]
 The mean of the samples was 0.083
 Iteration 135
 Acquisition function convergence reached at iteration 34.
 The final EI loss was -0.014 with predicted mean of [-1.298]
 The next parameters to simulate from are [[0.253 0.002 0.01 0.009 0.025 0.025]]
 The mean of the samples was -1.557
 Iteration 136
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [1.273]
 The next parameters to simulate from are [[0.146 0.488 0.007 0.043 0.022 0.01]]
 The mean of the samples was 1.491
 Iteration 137
 Acquisition function convergence reached at iteration 55.
 The final EI loss was -0.033 with predicted mean of [-1.786]
 The next parameters to simulate from are [[0.147 0.544 0.007 0.01 0.023 0.022]]

The mean of the samples was -1.823
 Iteration 138
 Acquisition function convergence reached at iteration 68.
 The final EI loss was -0.032 with predicted mean of [-1.789]
 The next parameters to simulate from are [[0.152 0.511 0.007 0.01 0.023 0.022]]
 The mean of the samples was -1.919
 Iteration 139
 Acquisition function convergence reached at iteration 33.
 The final EI loss was -0.004 with predicted mean of [-0.631]
 The next parameters to simulate from are [[0.21 0.987 0.013 0.009 0.049 0.045]]
 The mean of the samples was -0.65
 Iteration 140
 Acquisition function convergence reached at iteration 58.
 The final EI loss was -0.001 with predicted mean of [0.18]
 The next parameters to simulate from are [[0.99 0.989 0. 0.05 0. 0.038]]
 The mean of the samples was 0.643
 Hyperparameter convergence reached at iteration 1792.
 The minimum predicted mean of the observed indices is -1.802 at the point
 [0.152 0.511 0.007 0.01 0.023 0.022]
 Iteration 141
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [-0.636]
 The next parameters to simulate from are [[0.152 0.514 0.007 0.009 0.023 0.042]]
 The mean of the samples was -0.679
 Iteration 142
 Acquisition function convergence reached at iteration 150.
 The final EI loss was -0.007 with predicted mean of [-0.791]
 The next parameters to simulate from are [[0.005 0.617 0.033 0.015 0.03 0.045]]
 The mean of the samples was -0.942
 Iteration 143
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [0.768]
 The next parameters to simulate from are [[0.152 0.511 0.007 0.03 0.023 0.022]]
 The mean of the samples was 0.738
 Iteration 144
 Acquisition function convergence reached at iteration 11.
 The final EI loss was -0.004 with predicted mean of [-0.957]
 The next parameters to simulate from are [[0.119 0.26 0.01 0.008 0.037 0.032]]
 The mean of the samples was -1.374
 Iteration 145
 Acquisition function convergence reached at iteration 81.
 The final EI loss was -0.018 with predicted mean of [-1.552]
 The next parameters to simulate from are [[0.134 0.18 0.008 0.009 0.026 0.027]]

The mean of the samples was -1.61
 Iteration 146
 Acquisition function convergence reached at iteration 82.
 The final EI loss was -0.036 with predicted mean of [-1.806]
 The next parameters to simulate from are [[0.121 0.505 0.006 0.01 0.024 0.023]]
 The mean of the samples was -1.886
 Iteration 147
 Acquisition function convergence reached at iteration 29.
 The final EI loss was -0.006 with predicted mean of [-0.673]
 The next parameters to simulate from are [[0.401 0.938 0. 0.007 0.048 0.009]]
 The mean of the samples was -0.459
 Iteration 148
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [-0.02]
 The next parameters to simulate from are [[0.824 0.182 0.006 0.01 0.024 0.023]]
 The mean of the samples was -0.047
 Iteration 149
 Acquisition function convergence reached at iteration 78.
 The final EI loss was -0.033 with predicted mean of [-1.815]
 The next parameters to simulate from are [[0.131 0.512 0.006 0.01 0.024 0.023]]
 The mean of the samples was -1.816
 Iteration 150
 Acquisition function convergence reached at iteration 14.
 The final EI loss was -0.001 with predicted mean of [-0.283]
 The next parameters to simulate from are [[0.041 0.025 0.005 0.012 0.001 0.044]]
 The mean of the samples was 0.203
 Trained parameters:
 amplitude_champ:0 is 0.738

 length_scales_champ:0 is [0.347 0.5 0.008 0.006 0.02 0.012]

 observation_noise_variance_champ:0 is 0.073

 bias_mean:0 is 0.709

 Iteration 151
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [1.516]
 The next parameters to simulate from are [[0.131 0.512 0.006 0.045 0.049 0.011]]
 The mean of the samples was 1.652
 Iteration 152
 Acquisition function convergence reached at iteration 76.
 The final EI loss was -0.002 with predicted mean of [-0.34]

The next parameters to simulate from are [[0.007 0.004 0.019 0.007 0.031 0.067]]
 The mean of the samples was -0.464
 Iteration 153
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [1.415]
 The next parameters to simulate from are [[0.43 0.512 0.004 0.046 0.024 0.015]]
 The mean of the samples was 1.336
 Iteration 154
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [-0.194]
 The next parameters to simulate from are [[0.131 0.858 0.006 0.009 0.024 0.064]]
 The mean of the samples was -0.195
 Iteration 155
 Acquisition function convergence reached at iteration 80.
 The final EI loss was -0.004 with predicted mean of [-0.703]
 The next parameters to simulate from are [[0.011 0.33 0.007 0.004 0.049 0.032]]
 The mean of the samples was -1.086
 Iteration 156
 Acquisition function convergence reached at iteration 38.
 The final EI loss was -0.005 with predicted mean of [-0.672]
 The next parameters to simulate from are [[0.065 0.949 0.033 0.019 0.015 0.038]]
 The mean of the samples was -0.681
 Iteration 157
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [0.787]
 The next parameters to simulate from are [[0.039 0.071 0.006 0.032 0.016 0.023]]
 The mean of the samples was 0.933
 Iteration 158
 Acquisition function convergence reached at iteration 66.
 The final EI loss was -0.008 with predicted mean of [-0.93]
 The next parameters to simulate from are [[0.506 0.993 0.001 0.013 0.038 0.006]]
 The mean of the samples was -1.035
 Iteration 159
 Acquisition function convergence reached at iteration 99.
 The final EI loss was -0.012 with predicted mean of [-1.373]
 The next parameters to simulate from are [[0.254 0.005 0.007 0.009 0.031 0.026]]
 The mean of the samples was -1.068
 Iteration 160
 Acquisition function convergence reached at iteration 46.
 The final EI loss was -0.001 with predicted mean of [0.08]
 The next parameters to simulate from are [[0.988 0.023 0.033 0.03 0.05 0.052]]
 The mean of the samples was 0.893
 Hyperparameter convergence reached at iteration 1863.

The minimum predicted mean of the observed indices is -1.816 at the point
[0.131 0.512 0.006 0.01 0.024 0.023]

Iteration 161
Acquisition function convergence reached at iteration 62.
The final EI loss was -0.032 with predicted mean of [-1.817]
The next parameters to simulate from are [[0.133 0.492 0.006 0.01 0.023 0.023]]
The mean of the samples was -1.715

Iteration 162
Acquisition function convergence reached at iteration 2.
The final EI loss was -0.0 with predicted mean of [0.46]
The next parameters to simulate from are [[0.885 0.511 0.006 0.031 0.024 0.023]]
The mean of the samples was 0.542

Iteration 163
Acquisition function convergence reached at iteration 105.
The final EI loss was -0.003 with predicted mean of [-0.338]
The next parameters to simulate from are [[0.418 0.991 0.033 0.013 0.049 0.029]]
The mean of the samples was -0.857

Iteration 164
Acquisition function convergence reached at iteration 21.
The final EI loss was -0.001 with predicted mean of [-0.244]
The next parameters to simulate from are [[0.58 0.758 0.001 0.019 0.012 0.001]]
The mean of the samples was 0.293

Iteration 165
Acquisition function convergence reached at iteration 52.
The final EI loss was -0.004 with predicted mean of [-0.501]
The next parameters to simulate from are [[0.346 0.673 0.033 0.009 0.049 0.038]]
The mean of the samples was -0.706

Iteration 166
Acquisition function convergence reached at iteration 50.
The final EI loss was -0.001 with predicted mean of [0.165]
The next parameters to simulate from are [[0.004 0.983 0. 0.039 0. 0.066]]
The mean of the samples was 0.565

Iteration 167
Acquisition function convergence reached at iteration 2.
The final EI loss was -0.0 with predicted mean of [0.663]
The next parameters to simulate from are [[0.727 0.508 0.008 0.037 0.024 0.024]]
The mean of the samples was 0.723

Iteration 168
Acquisition function convergence reached at iteration 2.
The final EI loss was -0.0 with predicted mean of [1.004]
The next parameters to simulate from are [[0.127 0.811 0.007 0.047 0.036 0.058]]
The mean of the samples was 1.461

Iteration 169

Acquisition function convergence reached at iteration 68.
 The final EI loss was -0.003 with predicted mean of [-0.764]
 The next parameters to simulate from are [[0.024 0.378 0.017 0.017 0.01 0.034]]
 The mean of the samples was -1.142
 Iteration 170
 Acquisition function convergence reached at iteration 41.
 The final EI loss was -0.005 with predicted mean of [-0.71]
 The next parameters to simulate from are [[0.006 0.939 0.025 0.017 0.002 0.034]]
 The mean of the samples was -0.9
 Iteration 171
 Acquisition function convergence reached at iteration 26.
 The final EI loss was -0.005 with predicted mean of [-0.761]
 The next parameters to simulate from are [[0.455 0.697 0.026 0.011 0.042 0.026]]
 The mean of the samples was -0.825
 Iteration 172
 Acquisition function convergence reached at iteration 118.
 The final EI loss was -0.03 with predicted mean of [-1.811]
 The next parameters to simulate from are [[0.131 0.494 0.006 0.01 0.023 0.023]]
 The mean of the samples was -1.82
 Iteration 173
 Acquisition function convergence reached at iteration 40.
 The final EI loss was -0.004 with predicted mean of [-1.073]
 The next parameters to simulate from are [[0.13 0. 0.02 0.015 0.013 0.029]]
 The mean of the samples was -0.992
 Iteration 174
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [-0.54]
 The next parameters to simulate from are [[0.132 0.495 0.023 0.01 0.016 0.023]]
 The mean of the samples was -0.537
 Iteration 175
 Acquisition function convergence reached at iteration 51.
 The final EI loss was -0.012 with predicted mean of [-1.342]
 The next parameters to simulate from are [[0.028 0.023 0.01 0.01 0.023 0.024]]
 The mean of the samples was -1.227
 Iteration 176
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [0.012]
 The next parameters to simulate from are [[0.728 0.446 0.018 0.01 0.024 0.035]]
 The mean of the samples was -0.019
 Iteration 177
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [1.163]
 The next parameters to simulate from are [[0.658 0.488 0.006 0.05 0.024 0.006]]

The mean of the samples was 1.39
 Iteration 178
 Acquisition function convergence reached at iteration 57.
 The final EI loss was -0.003 with predicted mean of [-0.844]
 The next parameters to simulate from are [[0.004 0. 0.011 0.014 0.014 0.027]]
 The mean of the samples was -1.395
 Iteration 179
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [0.238]
 The next parameters to simulate from are [[0.733 0.429 0.006 0.009 0.026 0.05]]
 The mean of the samples was 0.294
 Iteration 180
 Acquisition function convergence reached at iteration 57.
 The final EI loss was -0.001 with predicted mean of [0.191]
 The next parameters to simulate from are [[0.004 0.01 0.033 0.029 0.05 0.]]
 The mean of the samples was 1.165
 Hyperparameter convergence reached at iteration 1968.
 The minimum predicted mean of the observed indices is -1.8 at the point
 [0.161 0.487 0.006 0.01 0.024 0.022]
 Iteration 181
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [-0.664]
 The next parameters to simulate from are [[0.161 0.313 0.022 0.01 0.024 0.022]]
 The mean of the samples was -0.642
 Iteration 182
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [0.094]
 The next parameters to simulate from are [[0.667 0.145 0.006 0.009 0.025 0.044]]
 The mean of the samples was 0.0
 Iteration 183
 Acquisition function convergence reached at iteration 74.
 The final EI loss was -0.005 with predicted mean of [-0.812]
 The next parameters to simulate from are [[0.007 0.042 0.014 0.017 0.001 0.027]]
 The mean of the samples was -0.806
 Iteration 184
 Acquisition function convergence reached at iteration 77.
 The final EI loss was -0.027 with predicted mean of [-1.805]
 The next parameters to simulate from are [[0.142 0.517 0.006 0.01 0.024 0.022]]
 The mean of the samples was -1.706
 Iteration 185
 Acquisition function convergence reached at iteration 48.
 The final EI loss was -0.003 with predicted mean of [-0.853]
 The next parameters to simulate from are [[0.273 0.46 0.015 0.018 0.009 0.033]]

The mean of the samples was -0.804
 Iteration 186
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [-0.747]
 The next parameters to simulate from are [[0.142 0.517 0.006 0.01 0.045 0.022]]
 The mean of the samples was -0.787
 Iteration 187
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [0.973]
 The next parameters to simulate from are [[0.96 0.46 0.009 0.047 0.024 0.006]]
 The mean of the samples was 1.035
 Iteration 188
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [-0.074]
 The next parameters to simulate from are [[0.142 0.299 0.006 0.01 0. 0.022]]
 The mean of the samples was -0.026
 Iteration 189
 WARNING:tensorflow:5 out of the last 55 calls to <function update_var_EI.<locals>.opt_var at
 Acquisition function convergence reached at iteration 65.
 The final EI loss was -0.001 with predicted mean of [0.071]
 The next parameters to simulate from are [[0.011 0.987 0. 0. 0.001 0.067]]
 The mean of the samples was 0.65
 Iteration 190
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [1.489]
 The next parameters to simulate from are [[0.101 0.413 0.006 0.046 0.014 0.022]]
 The mean of the samples was 1.534
 Iteration 191
 Acquisition function convergence reached at iteration 57.
 The final EI loss was -0.001 with predicted mean of [0.011]
 The next parameters to simulate from are [[0.009 0.987 0.002 0.015 0.049 0.066]]
 The mean of the samples was 0.97
 Iteration 192
 Acquisition function convergence reached at iteration 91.
 The final EI loss was -0.007 with predicted mean of [-1.133]
 The next parameters to simulate from are [[0.366 0.077 0.012 0.011 0.023 0.02]]
 The mean of the samples was -1.632
 Iteration 193
 Acquisition function convergence reached at iteration 24.
 The final EI loss was -0.013 with predicted mean of [-1.311]
 The next parameters to simulate from are [[0.403 0.196 0.011 0.011 0.031 0.017]]
 The mean of the samples was -1.409
 Iteration 194

Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [-0.602]
 The next parameters to simulate from are [[0.142 0.344 0.023 0.01 0.018 0.022]]
 The mean of the samples was -0.592
 Iteration 195
 Acquisition function convergence reached at iteration 66.
 The final EI loss was -0.017 with predicted mean of [-1.332]
 The next parameters to simulate from are [[0.485 0.272 0.013 0.013 0.025 0.016]]
 The mean of the samples was -1.626
 Iteration 196
 Acquisition function convergence reached at iteration 72.
 The final EI loss was -0.019 with predicted mean of [-1.42]
 The next parameters to simulate from are [[0.45 0.229 0.015 0.012 0.029 0.021]]
 The mean of the samples was -1.389
 Iteration 197
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [0.242]
 The next parameters to simulate from are [[0.142 0.517 0.006 0.022 0.024 0.022]]
 The mean of the samples was 0.152
 Iteration 198
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [-0.849]
 The next parameters to simulate from are [[0.142 0.518 0.015 0.01 0.019 0.022]]
 The mean of the samples was -0.827
 Iteration 199
 Acquisition function convergence reached at iteration 46.
 The final EI loss was -0.001 with predicted mean of [0.079]
 The next parameters to simulate from are [[0.46 0.985 0. 0.023 0.001 0.041]]
 The mean of the samples was 0.41
 Iteration 200
 Acquisition function convergence reached at iteration 52.
 The final EI loss was -0.015 with predicted mean of [-1.401]
 The next parameters to simulate from are [[0.495 0.044 0.012 0.013 0.026 0.015]]
 The mean of the samples was -1.245
 Hyperparameter convergence reached at iteration 1909.
 The minimum predicted mean of the observed indices is -1.801 at the point
 [0.142 0.517 0.006 0.01 0.024 0.022]
 Trained parameters:
 amplitude_champ:0 is 0.71

 length_scales_champ:0 is [0.305 0.5 0.008 0.005 0.018 0.013]

 observation_noise_variance_champ:0 is 0.07

bias_mean:0 is 0.751

Iteration 201

Acquisition function convergence reached at iteration 57.

The final EI loss was -0.026 with predicted mean of [-1.799]

The next parameters to simulate from are [[0.147 0.437 0.006 0.01 0.023 0.023]]

The mean of the samples was -1.895

Iteration 202

Acquisition function convergence reached at iteration 114.

The final EI loss was -0.025 with predicted mean of [-1.805]

The next parameters to simulate from are [[0.147 0.435 0.006 0.01 0.023 0.023]]

The mean of the samples was -1.752

Iteration 203

Acquisition function convergence reached at iteration 57.

The final EI loss was -0.008 with predicted mean of [-1.093]

The next parameters to simulate from are [[0.171 0.631 0.009 0.007 0.041 0.031]]

The mean of the samples was -1.09

Iteration 204

Acquisition function convergence reached at iteration 38.

The final EI loss was -0.001 with predicted mean of [-0.073]

The next parameters to simulate from are [[0.999 0.905 0.006 0.016 0.046 0.001]]

The mean of the samples was 0.336

Iteration 205

Acquisition function convergence reached at iteration 41.

The final EI loss was -0.003 with predicted mean of [-0.561]

The next parameters to simulate from are [[0.059 0.018 0.03 0.009 0.049 0.053]]

The mean of the samples was -0.762

Iteration 206

Acquisition function convergence reached at iteration 77.

The final EI loss was -0.023 with predicted mean of [-1.798]

The next parameters to simulate from are [[0.145 0.527 0.006 0.01 0.024 0.022]]

The mean of the samples was -1.679

Iteration 207

Acquisition function convergence reached at iteration 96.

The final EI loss was -0.014 with predicted mean of [-1.533]

The next parameters to simulate from are [[0.31 0.221 0.011 0.01 0.027 0.024]]

The mean of the samples was -1.421

Iteration 208

Acquisition function convergence reached at iteration 56.

The final EI loss was -0.024 with predicted mean of [-1.796]

The next parameters to simulate from are [[0.143 0.438 0.006 0.01 0.024 0.023]]

The mean of the samples was -1.55

Iteration 209

Acquisition function convergence reached at iteration 2.

The final EI loss was -0.0 with predicted mean of [0.608]

The next parameters to simulate from are [[0.143 0.438 0.006 0.027 0.024 0.023]]

The mean of the samples was 0.585

Iteration 210

Acquisition function convergence reached at iteration 72.

The final EI loss was -0.003 with predicted mean of [-0.611]

The next parameters to simulate from are [[0.008 0.692 0.002 0.003 0.05 0.033]]

The mean of the samples was -1.178

Iteration 211

Acquisition function convergence reached at iteration 51.

The final EI loss was -0.015 with predicted mean of [-1.244]

The next parameters to simulate from are [[0.302 0.997 0.003 0.01 0.042 0.015]]

The mean of the samples was -1.602

Iteration 212

Acquisition function convergence reached at iteration 35.

The final EI loss was -0.016 with predicted mean of [-1.402]

The next parameters to simulate from are [[0.31 0.981 0.005 0.01 0.046 0.015]]

The mean of the samples was -1.618

Iteration 213

Acquisition function convergence reached at iteration 2.

The final EI loss was -0.0 with predicted mean of [-0.056]

The next parameters to simulate from are [[0.143 0.524 0.006 0.01 0.001 0.015]]

The mean of the samples was -0.291

Iteration 214

Acquisition function convergence reached at iteration 67.

The final EI loss was -0.013 with predicted mean of [-1.327]

The next parameters to simulate from are [[0.506 0.444 0.011 0.012 0.031 0.014]]

The mean of the samples was -1.489

Iteration 215

Acquisition function convergence reached at iteration 2.

The final EI loss was -0.0 with predicted mean of [0.326]

The next parameters to simulate from are [[0.844 0.413 0.006 0.01 0.024 0.048]]

The mean of the samples was 0.355

Iteration 216

Acquisition function convergence reached at iteration 44.

The final EI loss was -0.002 with predicted mean of [-0.147]

The next parameters to simulate from are [[0.013 0.008 0.015 0.001 0.05 0.066]]

The mean of the samples was 0.011

Iteration 217

Acquisition function convergence reached at iteration 74.

The final EI loss was -0.022 with predicted mean of [-1.769]

The next parameters to simulate from are [[0.141 0.611 0.006 0.01 0.023 0.022]]
 The mean of the samples was -1.781
 Iteration 218
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [0.456]
 The next parameters to simulate from are [[0.034 0.98 0.006 0.029 0.013 0.023]]
 The mean of the samples was 0.598
 Iteration 219
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [-0.573]
 The next parameters to simulate from are [[0.145 0.196 0.017 0.01 0.023 0.016]]
 The mean of the samples was -0.51
 Iteration 220
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [-0.858]
 The next parameters to simulate from are [[0.148 0.772 0.017 0.01 0.024 0.023]]
 The mean of the samples was -0.841
 Hyperparameter convergence reached at iteration 1915.
 The minimum predicted mean of the observed indices is -1.79 at the point
 [0.143 0.438 0.006 0.01 0.024 0.023]
 Iteration 221
 WARNING:tensorflow:5 out of the last 81 calls to <function update_var_EI.<locals>.opt_var at
 Acquisition function convergence reached at iteration 88.
 The final EI loss was -0.004 with predicted mean of [-0.579]
 The next parameters to simulate from are [[0.001 0.985 0.033 0.016 0.02 0.056]]
 The mean of the samples was -1.009
 Iteration 222
 Acquisition function convergence reached at iteration 58.
 The final EI loss was -0.001 with predicted mean of [0.093]
 The next parameters to simulate from are [[0.998 0.016 0. 0.033 0.049 0.066]]
 The mean of the samples was 1.171
 Iteration 223
 Acquisition function convergence reached at iteration 44.
 The final EI loss was -0.006 with predicted mean of [-0.92]
 The next parameters to simulate from are [[0.23 0.26 0.016 0.008 0.045 0.029]]
 The mean of the samples was -1.084
 Iteration 224
 Acquisition function convergence reached at iteration 56.
 The final EI loss was -0.001 with predicted mean of [0.14]
 The next parameters to simulate from are [[0.181 0.008 0. 0. 0.001 0.066]]
 The mean of the samples was 0.647
 Iteration 225
 Acquisition function convergence reached at iteration 2.

The final EI loss was -0.0 with predicted mean of [1.612]
 The next parameters to simulate from are [[0.143 0.868 0.006 0.049 0.023 0.008]]
 The mean of the samples was 1.769
 Iteration 226
 Acquisition function convergence reached at iteration 74.
 The final EI loss was -0.023 with predicted mean of [-1.766]
 The next parameters to simulate from are [[0.134 0.669 0.007 0.01 0.023 0.022]]
 The mean of the samples was -1.732
 Iteration 227
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [-0.322]
 The next parameters to simulate from are [[0.143 0.548 0.004 0.01 0.024 0.052]]
 The mean of the samples was -0.356
 Iteration 228
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [1.224]
 The next parameters to simulate from are [[0.196 0.993 0.015 0.046 0.031 0.023]]
 The mean of the samples was 1.488
 Iteration 229
 Acquisition function convergence reached at iteration 67.
 The final EI loss was -0.021 with predicted mean of [-1.793]
 The next parameters to simulate from are [[0.159 0.445 0.006 0.01 0.024 0.022]]
 The mean of the samples was -1.673
 Iteration 230
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [0.148]
 The next parameters to simulate from are [[0.879 0.038 0.006 0.009 0.019 0.034]]
 The mean of the samples was 0.182
 Iteration 231
 Acquisition function convergence reached at iteration 58.
 The final EI loss was -0.009 with predicted mean of [-1.327]
 The next parameters to simulate from are [[0.61 0.336 0.014 0.013 0.027 0.012]]
 The mean of the samples was -1.31
 Iteration 232
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [0.007]
 The next parameters to simulate from are [[0.176 0.129 0.006 0.019 0.023 0.022]]
 The mean of the samples was 0.011
 Iteration 233
 Acquisition function convergence reached at iteration 17.
 The final EI loss was -0.002 with predicted mean of [-0.434]
 The next parameters to simulate from are [[0.029 0.035 0.016 0.021 0.002 0.039]]
 The mean of the samples was -0.636

Iteration 234
Acquisition function convergence reached at iteration 2.
The final EI loss was -0.0 with predicted mean of [-0.485]
The next parameters to simulate from are [[0.142 0.517 0.006 0.01 0.007 0.022]]
The mean of the samples was -0.488

Iteration 235
Acquisition function convergence reached at iteration 2.
The final EI loss was -0.0 with predicted mean of [1.274]
The next parameters to simulate from are [[0.224 0.409 0.015 0.041 0.024 0.015]]
The mean of the samples was 1.321

Iteration 236
Acquisition function convergence reached at iteration 49.
The final EI loss was -0.002 with predicted mean of [-0.509]
The next parameters to simulate from are [[0.022 0.007 0.026 0.014 0.05 0.058]]
The mean of the samples was -0.149

Iteration 237
Acquisition function convergence reached at iteration 57.
The final EI loss was -0.016 with predicted mean of [-1.444]
The next parameters to simulate from are [[0.289 0.985 0.002 0.01 0.047 0.017]]
The mean of the samples was -1.176

Iteration 238
Acquisition function convergence reached at iteration 56.
The final EI loss was -0.004 with predicted mean of [-0.553]
The next parameters to simulate from are [[0.081 0.878 0.033 0.019 0.003 0.054]]
The mean of the samples was -0.868

Iteration 239
Acquisition function convergence reached at iteration 108.
The final EI loss was -0.01 with predicted mean of [-1.53]
The next parameters to simulate from are [[0.398 0.32 0.011 0.012 0.025 0.019]]
The mean of the samples was -1.431

Iteration 240
Acquisition function convergence reached at iteration 40.
The final EI loss was -0.005 with predicted mean of [-1.459]
The next parameters to simulate from are [[0.531 0.249 0.013 0.011 0.028 0.015]]
The mean of the samples was -1.455

Hyperparameter convergence reached at iteration 1899.
The minimum predicted mean of the observed indices is -1.796 at the point
[0.142 0.517 0.006 0.01 0.024 0.022]

Iteration 241
Acquisition function convergence reached at iteration 2.
The final EI loss was -0.0 with predicted mean of [0.247]
The next parameters to simulate from are [[0.77 0.519 0.006 0.006 0.024 0.022]]
The mean of the samples was 0.191

Iteration 242

Acquisition function convergence reached at iteration 61.

The final EI loss was -0.001 with predicted mean of [0.155]

The next parameters to simulate from are [[0.997 0.994 0.012 0. 0. 0.065]]

The mean of the samples was 0.597

Iteration 243

Acquisition function convergence reached at iteration 2.

The final EI loss was -0.0 with predicted mean of [1.421]

The next parameters to simulate from are [[0.142 0.816 0.016 0.045 0.008 0.008]]

The mean of the samples was 1.566

Iteration 244

Acquisition function convergence reached at iteration 2.

The final EI loss was -0.0 with predicted mean of [1.426]

The next parameters to simulate from are [[0.142 0.726 0.006 0.049 0.024 0.026]]

The mean of the samples was 1.577

Iteration 245

Acquisition function convergence reached at iteration 30.

The final EI loss was -0.001 with predicted mean of [-0.329]

The next parameters to simulate from are [[0.334 0.019 0.019 0.011 0.035 0.067]]

The mean of the samples was -0.344

Iteration 246

Acquisition function convergence reached at iteration 49.

The final EI loss was -0.019 with predicted mean of [-1.525]

The next parameters to simulate from are [[0.345 0.824 0.006 0.01 0.04 0.015]]

The mean of the samples was -1.448

Iteration 247

Acquisition function convergence reached at iteration 91.

The final EI loss was -0.011 with predicted mean of [-1.346]

The next parameters to simulate from are [[0.394 0.003 0.014 0.011 0.028 0.025]]

The mean of the samples was -1.373

Iteration 248

Acquisition function convergence reached at iteration 2.

The final EI loss was -0.0 with predicted mean of [0.142]

The next parameters to simulate from are [[0.142 0.517 0.006 0.021 0.024 0.033]]

The mean of the samples was 0.225

Iteration 249

Acquisition function convergence reached at iteration 16.

The final EI loss was -0.005 with predicted mean of [-0.961]

The next parameters to simulate from are [[0.489 0.075 0.022 0.012 0.036 0.026]]

The mean of the samples was -0.998

Iteration 250

Acquisition function convergence reached at iteration 59.

The final EI loss was -0.006 with predicted mean of [-0.897]

The next parameters to simulate from are [[0.002 0.495 0.033 0.015 0.016 0.057]]
The mean of the samples was -1.018
Trained parameters:
amplitude_champ:0 is 0.703

length_scales_champ:0 is [0.292 0.5 0.009 0.005 0.018 0.013]

observation_noise_variance_champ:0 is 0.072

bias_mean:0 is 0.742

Iteration 251

Acquisition function convergence reached at iteration 2.

The final EI loss was -0.0 with predicted mean of [0.357]

The next parameters to simulate from are [[0.996 0.517 0.013 0.01 0.024 0.022]]

The mean of the samples was 0.374

Iteration 252

Acquisition function convergence reached at iteration 2.

The final EI loss was -0.0 with predicted mean of [0.39]

The next parameters to simulate from are [[0.967 0.605 0.006 0.032 0.009 0.022]]

The mean of the samples was 0.501

Iteration 253

Acquisition function convergence reached at iteration 89.

The final EI loss was -0.015 with predicted mean of [-1.442]

The next parameters to simulate from are [[0.252 0.99 0.003 0.01 0.04 0.012]]

The mean of the samples was -1.418

Iteration 254

Acquisition function convergence reached at iteration 23.

The final EI loss was -0.004 with predicted mean of [-0.805]

The next parameters to simulate from are [[0.432 0.965 0.029 0.016 0.034 0.029]]

The mean of the samples was -0.916

Iteration 255

Acquisition function convergence reached at iteration 2.

The final EI loss was -0.0 with predicted mean of [0.61]

The next parameters to simulate from are [[0.686 0.517 0.006 0.037 0.024 0.034]]

The mean of the samples was 0.657

Iteration 256

Acquisition function convergence reached at iteration 81.

The final EI loss was -0.022 with predicted mean of [-1.789]

The next parameters to simulate from are [[0.15 0.575 0.006 0.01 0.024 0.023]]

The mean of the samples was -1.845

Iteration 257

Acquisition function convergence reached at iteration 2.

The final EI loss was -0.0 with predicted mean of [0.673]
 The next parameters to simulate from are [[0.142 0.231 0.006 0.028 0.024 0.022]]
 The mean of the samples was 0.681
 Iteration 258
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [0.32]
 The next parameters to simulate from are [[0.869 0.517 0.015 0.01 0.024 0.041]]
 The mean of the samples was 0.274
 Iteration 259
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [-0.546]
 The next parameters to simulate from are [[0.142 0.186 0.026 0.01 0.024 0.022]]
 The mean of the samples was -0.551
 Iteration 260
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [0.242]
 The next parameters to simulate from are [[0.142 0.06 0.006 0.022 0.024 0.022]]
 The mean of the samples was 0.23
 Hyperparameter convergence reached at iteration 1911.
 The minimum predicted mean of the observed indices is -1.795 at the point
 [0.142 0.517 0.006 0.01 0.024 0.022]
 Iteration 261
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [0.325]
 The next parameters to simulate from are [[0.724 0.506 0.006 0.03 0.004 0.023]]
 The mean of the samples was 0.207
 Iteration 262
 Acquisition function convergence reached at iteration 75.
 The final EI loss was -0.02 with predicted mean of [-1.795]
 The next parameters to simulate from are [[0.156 0.515 0.006 0.01 0.024 0.023]]
 The mean of the samples was -1.746
 Iteration 263
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [0.812]
 The next parameters to simulate from are [[0.86 0.515 0.006 0.042 0.024 0.023]]
 The mean of the samples was 0.839
 Iteration 264
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [-0.248]
 The next parameters to simulate from are [[0.157 0.274 0.006 0.01 0.024 0.061]]
 The mean of the samples was -0.321
 Iteration 265
 Acquisition function convergence reached at iteration 126.

The final EI loss was -0.02 with predicted mean of [-1.794]
 The next parameters to simulate from are [[0.156 0.515 0.006 0.01 0.024 0.022]]
 The mean of the samples was -1.734
 Iteration 266
 Acquisition function convergence reached at iteration 85.
 The final EI loss was -0.02 with predicted mean of [-1.786]
 The next parameters to simulate from are [[0.145 0.604 0.007 0.01 0.024 0.023]]
 The mean of the samples was -1.873
 Iteration 267
 Acquisition function convergence reached at iteration 62.
 The final EI loss was -0.02 with predicted mean of [-1.789]
 The next parameters to simulate from are [[0.148 0.607 0.007 0.01 0.024 0.023]]
 The mean of the samples was -1.959
 Iteration 268
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [-0.323]
 The next parameters to simulate from are [[0.146 0.515 0.006 0.01 0.024 0.06]]
 The mean of the samples was -0.305
 Iteration 269
 Acquisition function convergence reached at iteration 55.
 The final EI loss was -0.021 with predicted mean of [-1.797]
 The next parameters to simulate from are [[0.147 0.617 0.007 0.01 0.024 0.023]]
 The mean of the samples was -1.92
 Iteration 270
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [-0.072]
 The next parameters to simulate from are [[0.338 0.577 0.001 0.01 0.024 0.031]]
 The mean of the samples was -0.104
 Iteration 271
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [-0.644]
 The next parameters to simulate from are [[0.15 0.575 0.006 0.01 0.024 0.044]]
 The mean of the samples was -0.641
 Iteration 272
 Acquisition function convergence reached at iteration 30.
 The final EI loss was -0.003 with predicted mean of [-0.56]
 The next parameters to simulate from are [[0.013 0.917 0.03 0.014 0.004 0.065]]
 The mean of the samples was -0.377
 Iteration 273
 Acquisition function convergence reached at iteration 57.
 The final EI loss was -0.022 with predicted mean of [-1.802]
 The next parameters to simulate from are [[0.145 0.62 0.007 0.01 0.024 0.023]]
 The mean of the samples was -1.725

Iteration 274
Acquisition function convergence reached at iteration 2.
The final EI loss was -0.0 with predicted mean of [0.317]
The next parameters to simulate from are [[0.691 0.536 0.001 0.01 0.024 0.059]]
The mean of the samples was 0.426

Iteration 275
Acquisition function convergence reached at iteration 70.
The final EI loss was -0.021 with predicted mean of [-1.798]
The next parameters to simulate from are [[0.144 0.621 0.007 0.01 0.024 0.023]]
The mean of the samples was -1.74

Iteration 276
Acquisition function convergence reached at iteration 44.
The final EI loss was -0.004 with predicted mean of [-0.975]
The next parameters to simulate from are [[0.514 0.52 0.02 0.014 0.032 0.018]]
The mean of the samples was -1.07

Iteration 277
Acquisition function convergence reached at iteration 2.
The final EI loss was -0.0 with predicted mean of [-0.343]
The next parameters to simulate from are [[0.702 0.207 0.006 0.01 0.024 0.022]]
The mean of the samples was -0.366

Iteration 278
Acquisition function convergence reached at iteration 2.
The final EI loss was -0.0 with predicted mean of [0.289]
The next parameters to simulate from are [[0.894 0.387 0.006 0.01 0.011 0.022]]
The mean of the samples was 0.28

Iteration 279
Acquisition function convergence reached at iteration 63.
The final EI loss was -0.019 with predicted mean of [-1.799]
The next parameters to simulate from are [[0.149 0.595 0.007 0.01 0.024 0.023]]
The mean of the samples was -1.765

Iteration 280
Acquisition function convergence reached at iteration 77.
The final EI loss was -0.006 with predicted mean of [-1.363]
The next parameters to simulate from are [[0.385 0.919 0.002 0.011 0.038 0.013]]
The mean of the samples was -1.154

Hyperparameter convergence reached at iteration 1948.
The minimum predicted mean of the observed indices is -1.803 at the point
[0.156 0.515 0.006 0.01 0.024 0.022]

Iteration 281
Acquisition function convergence reached at iteration 54.
The final EI loss was -0.0 with predicted mean of [0.106]
The next parameters to simulate from are [[0.005 0.013 0. 0. 0.04 0.001]]
The mean of the samples was 0.348

Iteration 282

Acquisition function convergence reached at iteration 70.

The final EI loss was -0.004 with predicted mean of [-0.841]

The next parameters to simulate from are [[0.19 0.288 0.033 0.018 0.012 0.047]]

The mean of the samples was -0.873

Iteration 283

Acquisition function convergence reached at iteration 2.

The final EI loss was -0.0 with predicted mean of [-1.389]

The next parameters to simulate from are [[0.159 0.521 0.007 0.009 0.034 0.023]]

The mean of the samples was -1.495

Iteration 284

Acquisition function convergence reached at iteration 58.

The final EI loss was -0.003 with predicted mean of [-0.801]

The next parameters to simulate from are [[0.028 0.975 0.033 0.011 0.028 0.055]]

The mean of the samples was -0.816

Iteration 285

Acquisition function convergence reached at iteration 2.

The final EI loss was -0.0 with predicted mean of [-0.027]

The next parameters to simulate from are [[0.167 0.533 0.01 0.009 0.003 0.037]]

The mean of the samples was 0.048

Iteration 286

Acquisition function convergence reached at iteration 67.

The final EI loss was -0.002 with predicted mean of [-0.379]

The next parameters to simulate from are [[0.006 0.971 0.033 0.006 0.037 0.067]]

The mean of the samples was -0.474

Iteration 287

Acquisition function convergence reached at iteration 49.

The final EI loss was -0.009 with predicted mean of [-1.556]

The next parameters to simulate from are [[0.177 0.132 0.009 0.011 0.02 0.025]]

The mean of the samples was -1.788

Iteration 288

Acquisition function convergence reached at iteration 38.

The final EI loss was -0.011 with predicted mean of [-1.433]

The next parameters to simulate from are [[0.223 0.958 0.005 0.009 0.039 0.018]]

The mean of the samples was -1.675

Iteration 289

Acquisition function convergence reached at iteration 67.

The final EI loss was -0.003 with predicted mean of [-1.173]

The next parameters to simulate from are [[0.529 0.525 0.006 0.013 0.029 0.012]]

The mean of the samples was -1.571

Iteration 290

Acquisition function convergence reached at iteration 42.

The final EI loss was -0.0 with predicted mean of [0.343]

The next parameters to simulate from are [[0.007 0.992 0.019 0.025 0.049 0.]]
 The mean of the samples was 0.902
 Iteration 291
 Acquisition function convergence reached at iteration 61.
 The final EI loss was -0.001 with predicted mean of [-0.076]
 The next parameters to simulate from are [[0.971 0.969 0.032 0.013 0. 0.002]]
 The mean of the samples was -0.303
 Iteration 292
 Acquisition function convergence reached at iteration 88.
 The final EI loss was -0.004 with predicted mean of [-0.722]
 The next parameters to simulate from are [[0.013 0.619 0.024 0.019 0. 0.044]]
 The mean of the samples was -0.777
 Iteration 293
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [-0.52]
 The next parameters to simulate from are [[0.143 0.55 0.027 0.01 0.024 0.022]]
 The mean of the samples was -0.505
 Iteration 294
 Acquisition function convergence reached at iteration 89.
 The final EI loss was -0.01 with predicted mean of [-1.45]
 The next parameters to simulate from are [[0.198 0.999 0.006 0.009 0.044 0.015]]
 The mean of the samples was -1.134
 Iteration 295
 Acquisition function convergence reached at iteration 55.
 The final EI loss was -0.02 with predicted mean of [-1.795]
 The next parameters to simulate from are [[0.147 0.591 0.007 0.01 0.024 0.023]]
 The mean of the samples was -1.701
 Iteration 296
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [-0.792]
 The next parameters to simulate from are [[0.488 0.364 0.006 0.01 0.023 0.023]]
 The mean of the samples was -0.775
 Iteration 297
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [1.099]
 The next parameters to simulate from are [[0.15 0.244 0.006 0.04 0.034 0.039]]
 The mean of the samples was 1.397
 Iteration 298
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [0.909]
 The next parameters to simulate from are [[0.771 0.575 0.003 0.042 0.029 0.023]]
 The mean of the samples was 0.943
 Iteration 299

Acquisition function convergence reached at iteration 46.
 The final EI loss was -0.002 with predicted mean of [-0.947]
 The next parameters to simulate from are [[0.318 0.989 0.011 0.015 0.021 0.019]]
 The mean of the samples was -1.317
 Iteration 300
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [-0.05]
 The next parameters to simulate from are [[0.724 0.575 0.009 0.01 0.05 0.023]]
 The mean of the samples was -0.13
 Hyperparameter convergence reached at iteration 1978.
 The minimum predicted mean of the observed indices is -1.809 at the point
 [0.15 0.575 0.006 0.01 0.024 0.023]
 Trained parameters:
 amplitude_champ:0 is 0.694

 length_scales_champ:0 is [0.279 0.5 0.009 0.006 0.019 0.013]

 observation_noise_variance_champ:0 is 0.073

 bias_mean:0 is 0.755

 Iteration 301
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [0.13]
 The next parameters to simulate from are [[0.995 0.151 0.006 0.01 0.024 0.018]]
 The mean of the samples was 0.358
 Iteration 302
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [0.777]
 The next parameters to simulate from are [[0.363 0.575 0.006 0.035 0.018 0.027]]
 The mean of the samples was 0.765
 Iteration 303
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [-0.617]
 The next parameters to simulate from are [[0.15 0.553 0.024 0.01 0.024 0.023]]
 The mean of the samples was -0.63
 Iteration 304
 Acquisition function convergence reached at iteration 68.
 The final EI loss was -0.009 with predicted mean of [-1.457]
 The next parameters to simulate from are [[0.298 0.64 0.009 0.01 0.038 0.02]]
 The mean of the samples was -1.511
 Iteration 305
 Acquisition function convergence reached at iteration 74.

The final EI loss was -0.003 with predicted mean of [-0.922]
 The next parameters to simulate from are [[0.003 0.387 0.025 0.016 0.005 0.033]]
 The mean of the samples was -0.992
 Iteration 306
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [-0.671]
 The next parameters to simulate from are [[0.15 0.167 0.022 0.01 0.024 0.023]]
 The mean of the samples was -0.677
 Iteration 307
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [0.436]
 The next parameters to simulate from are [[0.805 0.587 0.007 0.01 0.011 0.065]]
 The mean of the samples was 0.438
 Iteration 308
 Acquisition function convergence reached at iteration 29.
 The final EI loss was -0.001 with predicted mean of [-0.069]
 The next parameters to simulate from are [[0.979 0.83 0.033 0.015 0.038 0.004]]
 The mean of the samples was -0.009
 Iteration 309
 Acquisition function convergence reached at iteration 38.
 The final EI loss was -0.006 with predicted mean of [-1.391]
 The next parameters to simulate from are [[0.36 0.607 0.008 0.012 0.032 0.016]]
 The mean of the samples was -1.619
 Iteration 310
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [0.414]
 The next parameters to simulate from are [[0.15 0.133 0.006 0.019 0.038 0.023]]
 The mean of the samples was 0.287
 Iteration 311
 Acquisition function convergence reached at iteration 39.
 The final EI loss was -0.003 with predicted mean of [-0.737]
 The next parameters to simulate from are [[0.377 0.123 0.033 0.011 0.031 0.035]]
 The mean of the samples was -0.967
 Iteration 312
 Acquisition function convergence reached at iteration 62.
 The final EI loss was -0.022 with predicted mean of [-1.804]
 The next parameters to simulate from are [[0.149 0.625 0.007 0.01 0.025 0.023]]
 The mean of the samples was -1.617
 Iteration 313
 Acquisition function convergence reached at iteration 44.
 The final EI loss was -0.002 with predicted mean of [-0.717]
 The next parameters to simulate from are [[0.227 0.999 0.033 0.016 0.001 0.044]]
 The mean of the samples was -0.585

Iteration 314
Acquisition function convergence reached at iteration 2.
The final EI loss was -0.0 with predicted mean of [-0.565]
The next parameters to simulate from are [[0.15 0.545 0.006 0.01 0.009 0.015]]
The mean of the samples was -0.753

Iteration 315
Acquisition function convergence reached at iteration 38.
The final EI loss was -0.005 with predicted mean of [-1.165]
The next parameters to simulate from are [[0. 0.562 0.008 0.006 0.035 0.031]]
The mean of the samples was -1.343

Iteration 316
Acquisition function convergence reached at iteration 68.
The final EI loss was -0.02 with predicted mean of [-1.797]
The next parameters to simulate from are [[0.137 0.631 0.007 0.01 0.024 0.023]]
The mean of the samples was -1.746

Iteration 317
Acquisition function convergence reached at iteration 2.
The final EI loss was -0.0 with predicted mean of [1.29]
The next parameters to simulate from are [[0.15 0.575 0.006 0.043 0.024 0.039]]
The mean of the samples was 1.257

Iteration 318
Acquisition function convergence reached at iteration 2.
The final EI loss was -0.0 with predicted mean of [0.116]
The next parameters to simulate from are [[0.15 0.576 0.006 0.01 0.002 0.042]]
The mean of the samples was 0.192

Iteration 319
Acquisition function convergence reached at iteration 2.
The final EI loss was -0.0 with predicted mean of [1.235]
The next parameters to simulate from are [[0.512 0.575 0.006 0.044 0.024 0.005]]
The mean of the samples was 1.3

Iteration 320
Acquisition function convergence reached at iteration 72.
The final EI loss was -0.019 with predicted mean of [-1.796]
The next parameters to simulate from are [[0.141 0.616 0.007 0.01 0.024 0.023]]
The mean of the samples was -1.895
Hyperparameter convergence reached at iteration 1886.
The minimum predicted mean of the observed indices is -1.805 at the point
[0.15 0.575 0.006 0.01 0.024 0.023]

Iteration 321
Acquisition function convergence reached at iteration 8.
The final EI loss was -0.003 with predicted mean of [-0.873]
The next parameters to simulate from are [[0.086 0.288 0.032 0.009 0.03 0.042]]
The mean of the samples was -0.771

Iteration 322
Acquisition function convergence reached at iteration 18.
The final EI loss was -0.001 with predicted mean of [-0.702]
The next parameters to simulate from are [[0.054 0.32 0.001 0.006 0.05 0.032]]
The mean of the samples was -0.068

Iteration 323
Acquisition function convergence reached at iteration 46.
The final EI loss was -0.004 with predicted mean of [-1.057]
The next parameters to simulate from are [[0.006 0.369 0.014 0.006 0.048 0.034]]
The mean of the samples was -0.911

Iteration 324
Acquisition function convergence reached at iteration 2.
The final EI loss was -0.0 with predicted mean of [1.466]
The next parameters to simulate from are [[0.15 0.575 0.006 0.042 0.044 0.031]]
The mean of the samples was 1.481

Iteration 325
Acquisition function convergence reached at iteration 40.
The final EI loss was -0.001 with predicted mean of [-0.142]
The next parameters to simulate from are [[0.989 0.023 0.033 0.018 0.002 0.01]]
The mean of the samples was 0.278

Iteration 326
Acquisition function convergence reached at iteration 2.
The final EI loss was -0.0 with predicted mean of [0.308]
The next parameters to simulate from are [[0.985 0.578 0.006 0.01 0.049 0.032]]
The mean of the samples was 0.432

Iteration 327
Acquisition function convergence reached at iteration 2.
The final EI loss was -0.0 with predicted mean of [-0.521]
The next parameters to simulate from are [[0.15 0.575 0.029 0.011 0.024 0.023]]
The mean of the samples was -0.52

Iteration 328
Acquisition function convergence reached at iteration 83.
The final EI loss was -0.002 with predicted mean of [-0.445]
The next parameters to simulate from are [[0.031 0.005 0.033 0.017 0.01 0.065]]
The mean of the samples was -0.768

Iteration 329
Acquisition function convergence reached at iteration 2.
The final EI loss was -0.0 with predicted mean of [0.321]
The next parameters to simulate from are [[0.89 0.575 0.006 0.01 0.024 0.023]]
The mean of the samples was 0.288

Iteration 330
Acquisition function convergence reached at iteration 65.
The final EI loss was -0.002 with predicted mean of [-0.598]

The next parameters to simulate from are [[0.295 0.975 0.025 0.009 0.043 0.051]]
 The mean of the samples was -0.516
 Iteration 331
 Acquisition function convergence reached at iteration 36.
 The final EI loss was -0.004 with predicted mean of [-1.414]
 The next parameters to simulate from are [[0.602 0.36 0.009 0.013 0.027 0.01]]
 The mean of the samples was -1.481
 Iteration 332
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [-0.397]
 The next parameters to simulate from are [[0.15 0.821 0.006 0.01 0.024 0.054]]
 The mean of the samples was -0.354
 Iteration 333
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [-0.417]
 The next parameters to simulate from are [[0.15 0.575 0.006 0.01 0.023 0.053]]
 The mean of the samples was -0.371
 Iteration 334
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [1.055]
 The next parameters to simulate from are [[0.315 0.625 0.006 0.04 0.024 0.039]]
 The mean of the samples was 1.034
 Iteration 335
 Acquisition function convergence reached at iteration 84.
 The final EI loss was -0.001 with predicted mean of [0.06]
 The next parameters to simulate from are [[0.607 0.999 0.033 0. 0. 0.001]]
 The mean of the samples was 0.471
 Iteration 336
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [1.213]
 The next parameters to simulate from are [[0.15 0.575 0.002 0.044 0.024 0.037]]
 The mean of the samples was 1.309
 Iteration 337
 Acquisition function convergence reached at iteration 40.
 The final EI loss was -0.004 with predicted mean of [-0.779]
 The next parameters to simulate from are [[0.265 0.076 0.026 0.009 0.046 0.038]]
 The mean of the samples was -0.928
 Iteration 338
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [1.357]
 The next parameters to simulate from are [[0.15 0.575 0.006 0.043 0.023 0.023]]
 The mean of the samples was 1.355
 Iteration 339

Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [0.995]
 The next parameters to simulate from are [[0.148 0.576 0.017 0.038 0.035 0.001]]
 The mean of the samples was 1.444
 Iteration 340
 Acquisition function convergence reached at iteration 49.
 The final EI loss was -0.002 with predicted mean of [-0.795]
 The next parameters to simulate from are [[0.133 0.663 0.02 0.02 0. 0.03]]
 The mean of the samples was -0.71
 Hyperparameter convergence reached at iteration 1951.
 The minimum predicted mean of the observed indices is -1.805 at the point
 [0.15 0.575 0.006 0.01 0.024 0.023]
 Iteration 341
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [-0.483]
 The next parameters to simulate from are [[0.15 0.303 0.009 0.01 0.024 0.056]]
 The mean of the samples was -0.468
 Iteration 342
 Acquisition function convergence reached at iteration 59.
 The final EI loss was -0.019 with predicted mean of [-1.802]
 The next parameters to simulate from are [[0.139 0.585 0.006 0.01 0.024 0.023]]
 The mean of the samples was -1.844
 Iteration 343
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [0.365]
 The next parameters to simulate from are [[0.874 0.626 0.006 0.01 0.024 0.039]]
 The mean of the samples was 0.362
 Iteration 344
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [-0.044]
 The next parameters to simulate from are [[0.743 0.576 0.019 0.01 0.01 0.023]]
 The mean of the samples was -0.045
 Iteration 345
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [0.311]
 The next parameters to simulate from are [[0.901 0.431 0.006 0.01 0.015 0.023]]
 The mean of the samples was 0.288
 Iteration 346
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [-0.644]
 The next parameters to simulate from are [[0.15 0.575 0.006 0.01 0.024 0.044]]
 The mean of the samples was -0.614
 Iteration 347

Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [1.231]
 The next parameters to simulate from are [[0.15 0.496 0.006 0.039 0.024 0.023]]
 The mean of the samples was 1.254
 Iteration 348
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [-0.366]
 The next parameters to simulate from are [[0.259 0.599 0.013 0.009 0.024 0.053]]
 The mean of the samples was -0.318
 Iteration 349
 Acquisition function convergence reached at iteration 66.
 The final EI loss was -0.004 with predicted mean of [-1.22]
 The next parameters to simulate from are [[0.45 0.625 0.013 0.014 0.024 0.017]]
 The mean of the samples was -1.128
 Iteration 350
 Acquisition function convergence reached at iteration 42.
 The final EI loss was -0.002 with predicted mean of [-0.399]
 The next parameters to simulate from are [[0.346 0.904 0.031 0.023 0.001 0.044]]
 The mean of the samples was -0.654
 Trained parameters:
 amplitude_champ:0 is 0.684

 length_scales_champ:0 is [0.28 0.5 0.009 0.005 0.018 0.013]

 observation_noise_variance_champ:0 is 0.071

 bias_mean:0 is 0.755

 Iteration 351
 Acquisition function convergence reached at iteration 57.
 The final EI loss was -0.018 with predicted mean of [-1.804]
 The next parameters to simulate from are [[0.137 0.621 0.006 0.01 0.024 0.022]]
 The mean of the samples was -1.831
 Iteration 352
 Acquisition function convergence reached at iteration 42.
 The final EI loss was -0.001 with predicted mean of [-0.15]
 The next parameters to simulate from are [[0.342 0.04 0.031 0.022 0. 0.067]]
 The mean of the samples was -0.302
 Iteration 353
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [-0.826]
 The next parameters to simulate from are [[0.15 0.575 0.001 0.01 0.024 0.023]]
 The mean of the samples was -0.727

Iteration 354
Acquisition function convergence reached at iteration 51.
The final EI loss was -0.003 with predicted mean of [-1.265]
The next parameters to simulate from are [[0.559 0.458 0.006 0.013 0.021 0.011]]
The mean of the samples was -1.54

Iteration 355
Acquisition function convergence reached at iteration 2.
The final EI loss was -0.0 with predicted mean of [0.06]
The next parameters to simulate from are [[0.286 0.221 0.032 0.016 0.022 0.008]]
The mean of the samples was 0.083

Iteration 356
Acquisition function convergence reached at iteration 2.
The final EI loss was -0.0 with predicted mean of [1.288]
The next parameters to simulate from are [[0.15 0.575 0.005 0.04 0.024 0.016]]
The mean of the samples was 1.302

Iteration 357
Acquisition function convergence reached at iteration 54.
The final EI loss was -0.003 with predicted mean of [-0.975]
The next parameters to simulate from are [[0.216 0.999 0.015 0.017 0.012 0.024]]
The mean of the samples was -1.094

Iteration 358
Acquisition function convergence reached at iteration 2.
The final EI loss was -0.0 with predicted mean of [0.926]
The next parameters to simulate from are [[0.479 0.575 0.025 0.04 0.019 0.023]]
The mean of the samples was 0.892

Iteration 359
Acquisition function convergence reached at iteration 35.
The final EI loss was -0.001 with predicted mean of [-0.5]
The next parameters to simulate from are [[0.158 0.632 0.024 0.008 0.035 0.066]]
The mean of the samples was -0.443

Iteration 360
Acquisition function convergence reached at iteration 2.
The final EI loss was -0.0 with predicted mean of [1.27]
The next parameters to simulate from are [[0.15 0.245 0.001 0.044 0.01 0.023]]
The mean of the samples was 1.328

Hyperparameter convergence reached at iteration 1959.
The minimum predicted mean of the observed indices is -1.805 at the point
[0.15 0.575 0.006 0.01 0.024 0.023]

Iteration 361
Acquisition function convergence reached at iteration 47.
The final EI loss was -0.001 with predicted mean of [-0.277]
The next parameters to simulate from are [[0.079 0.984 0.033 0.023 0.001 0.067]]
The mean of the samples was -0.557

Iteration 362

Acquisition function convergence reached at iteration 2.

The final EI loss was -0.0 with predicted mean of [0.894]

The next parameters to simulate from are [[0.307 0.66 0.014 0.034 0.043 0.045]]

The mean of the samples was 0.987

Iteration 363

Acquisition function convergence reached at iteration 69.

The final EI loss was -0.01 with predicted mean of [-1.503]

The next parameters to simulate from are [[0.207 0.008 0.011 0.011 0.02 0.025]]

The mean of the samples was -1.625

Iteration 364

Acquisition function convergence reached at iteration 2.

The final EI loss was -0.0 with predicted mean of [1.26]

The next parameters to simulate from are [[0.007 0.575 0.028 0.045 0.025 0.048]]

The mean of the samples was 1.423

Iteration 365

Acquisition function convergence reached at iteration 2.

The final EI loss was -0.0 with predicted mean of [-0.448]

The next parameters to simulate from are [[0.587 0.42 0.006 0.01 0.024 0.023]]

The mean of the samples was -0.429

Iteration 366

Acquisition function convergence reached at iteration 64.

The final EI loss was -0.002 with predicted mean of [-0.611]

The next parameters to simulate from are [[0.27 0.352 0.031 0.021 0.002 0.034]]

The mean of the samples was -0.951

Iteration 367

Acquisition function convergence reached at iteration 100.

The final EI loss was -0.018 with predicted mean of [-1.796]

The next parameters to simulate from are [[0.134 0.659 0.006 0.01 0.024 0.022]]

The mean of the samples was -1.814

Iteration 368

Acquisition function convergence reached at iteration 2.

The final EI loss was -0.0 with predicted mean of [0.808]

The next parameters to simulate from are [[0.811 0.621 0.006 0.041 0.024 0.022]]

The mean of the samples was 0.778

Iteration 369

Acquisition function convergence reached at iteration 36.

The final EI loss was -0.001 with predicted mean of [-0.07]

The next parameters to simulate from are [[0.849 0.011 0.033 0.008 0.049 0.]]

The mean of the samples was 0.24

Iteration 370

Acquisition function convergence reached at iteration 2.

The final EI loss was -0.0 with predicted mean of [0.034]

The next parameters to simulate from are [[0.156 0.602 0.006 0.017 0.012 0.061]]
 The mean of the samples was -0.164
 Iteration 371
 Acquisition function convergence reached at iteration 43.
 The final EI loss was -0.002 with predicted mean of [-0.684]
 The next parameters to simulate from are [[0.304 0.842 0.032 0.02 0. 0.029]]
 The mean of the samples was -0.91
 Iteration 372
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [0.547]
 The next parameters to simulate from are [[0.137 0.129 0.006 0.023 0.038 0.022]]
 The mean of the samples was 0.63
 Iteration 373
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [0.492]
 The next parameters to simulate from are [[0.017 0.624 0.006 0.022 0.034 0.034]]
 The mean of the samples was 0.602
 Iteration 374
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [0.416]
 The next parameters to simulate from are [[0.373 0.613 0.006 0.027 0.024 0.022]]
 The mean of the samples was 0.468
 Iteration 375
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [0.238]
 The next parameters to simulate from are [[0.137 0.621 0.006 0.01 0.024 0.002]]
 The mean of the samples was 0.245
 Iteration 376
 Acquisition function convergence reached at iteration 57.
 The final EI loss was -0.021 with predicted mean of [-1.797]
 The next parameters to simulate from are [[0.129 0.704 0.007 0.01 0.024 0.023]]
 The mean of the samples was -1.736
 Iteration 377
 Acquisition function convergence reached at iteration 75.
 The final EI loss was -0.002 with predicted mean of [-0.632]
 The next parameters to simulate from are [[0.01 0.002 0.023 0.007 0.05 0.041]]
 The mean of the samples was -0.713
 Iteration 378
 Acquisition function convergence reached at iteration 29.
 The final EI loss was -0.001 with predicted mean of [-0.536]
 The next parameters to simulate from are [[0.561 0.845 0.021 0.015 0.048 0.021]]
 The mean of the samples was -0.724
 Iteration 379

Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [-0.222]
 The next parameters to simulate from are [[0.147 0.575 0.001 0.01 0.024 0.044]]
 The mean of the samples was -0.192
 Iteration 380
 Acquisition function convergence reached at iteration 39.
 The final EI loss was -0.002 with predicted mean of [-0.913]
 The next parameters to simulate from are [[0.271 0.857 0.033 0.013 0.036 0.035]]
 The mean of the samples was -0.883
 Hyperparameter convergence reached at iteration 1925.
 The minimum predicted mean of the observed indices is -1.803 at the point
 [0.15 0.575 0.006 0.01 0.024 0.023]
 Iteration 381
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [-0.191]
 The next parameters to simulate from are [[0.149 0.404 0.006 0.003 0.024 0.023]]
 The mean of the samples was -0.178
 Iteration 382
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [0.1]
 The next parameters to simulate from are [[0.136 0.575 0.014 0.01 0.024 0.006]]
 The mean of the samples was -0.0
 Iteration 383
 Acquisition function convergence reached at iteration 42.
 The final EI loss was -0.006 with predicted mean of [-1.319]
 The next parameters to simulate from are [[0.014 0.995 0.007 0.011 0.022 0.023]]
 The mean of the samples was -1.298
 Iteration 384
 Acquisition function convergence reached at iteration 47.
 The final EI loss was -0.006 with predicted mean of [-1.384]
 The next parameters to simulate from are [[0.332 0.444 0.012 0.009 0.04 0.022]]
 The mean of the samples was -1.371
 Iteration 385
 Acquisition function convergence reached at iteration 49.
 The final EI loss was -0.017 with predicted mean of [-1.803]
 The next parameters to simulate from are [[0.141 0.583 0.006 0.01 0.024 0.022]]
 The mean of the samples was -1.739
 Iteration 386
 Acquisition function convergence reached at iteration 76.
 The final EI loss was -0.017 with predicted mean of [-1.806]
 The next parameters to simulate from are [[0.148 0.569 0.006 0.01 0.024 0.022]]
 The mean of the samples was -1.834
 Iteration 387

Acquisition function convergence reached at iteration 34.
 The final EI loss was -0.016 with predicted mean of [-1.801]
 The next parameters to simulate from are [[0.138 0.631 0.006 0.01 0.024 0.022]]
 The mean of the samples was -1.867
 Iteration 388
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [-0.378]
 The next parameters to simulate from are [[0.148 0.569 0.006 0.01 0.032 0.054]]
 The mean of the samples was -0.374
 Iteration 389
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [0.771]
 The next parameters to simulate from are [[0.715 0.569 0.006 0.036 0.033 0.022]]
 The mean of the samples was 0.817
 Iteration 390
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [-0.956]
 The next parameters to simulate from are [[0.148 0.569 0.006 0.01 0.043 0.022]]
 The mean of the samples was -1.059
 Iteration 391
 Acquisition function convergence reached at iteration 49.
 The final EI loss was -0.016 with predicted mean of [-1.794]
 The next parameters to simulate from are [[0.134 0.693 0.007 0.01 0.025 0.023]]
 The mean of the samples was -1.604
 Iteration 392
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [1.361]
 The next parameters to simulate from are [[0.67 0.051 0.006 0.049 0.039 0.012]]
 The mean of the samples was 1.617
 Iteration 393
 Acquisition function convergence reached at iteration 82.
 The final EI loss was -0.016 with predicted mean of [-1.805]
 The next parameters to simulate from are [[0.152 0.539 0.006 0.01 0.024 0.022]]
 The mean of the samples was -1.714
 Iteration 394
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [-1.285]
 The next parameters to simulate from are [[0.152 0.539 0.006 0.01 0.036 0.022]]
 The mean of the samples was -1.195
 Iteration 395
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [1.17]
 The next parameters to simulate from are [[0.152 0.539 0.029 0.043 0.014 0.022]]

The mean of the samples was 1.298
 Iteration 396
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [-0.391]
 The next parameters to simulate from are [[0.152 0.999 0.006 0.01 0.024 0.051]]
 The mean of the samples was -0.358
 Iteration 397
 Acquisition function convergence reached at iteration 49.
 The final EI loss was -0.002 with predicted mean of [-0.936]
 The next parameters to simulate from are [[0.496 0.017 0.028 0.012 0.025 0.026]]
 The mean of the samples was -1.081
 Iteration 398
 Acquisition function convergence reached at iteration 91.
 The final EI loss was -0.006 with predicted mean of [-1.401]
 The next parameters to simulate from are [[0.474 0. 0.014 0.01 0.03 0.02]]
 The mean of the samples was -1.607
 Iteration 399
 Acquisition function convergence reached at iteration 86.
 The final EI loss was -0.014 with predicted mean of [-1.771]
 The next parameters to simulate from are [[0.129 0.754 0.007 0.01 0.025 0.023]]
 The mean of the samples was -1.718
 Iteration 400
 Acquisition function convergence reached at iteration 52.
 The final EI loss was -0.002 with predicted mean of [-0.827]
 The next parameters to simulate from are [[0.438 0.005 0.028 0.013 0.041 0.035]]
 The mean of the samples was -0.673
 Hyperparameter convergence reached at iteration 1957.
 The minimum predicted mean of the observed indices is -1.803 at the point
 [0.152 0.539 0.006 0.01 0.024 0.022]
 Trained parameters:
 amplitude_champ:0 is 0.671

 length_scales_champ:0 is [0.272 0.5 0.009 0.005 0.018 0.013]

 observation_noise_variance_champ:0 is 0.071

 bias_mean:0 is 0.746

 Iteration 401
 Acquisition function convergence reached at iteration 62.
 The final EI loss was -0.001 with predicted mean of [0.036]
 The next parameters to simulate from are [[0.944 0.97 0.001 0. 0. 0.]]
 The mean of the samples was 0.376

Iteration 402
Acquisition function convergence reached at iteration 2.
The final EI loss was -0.0 with predicted mean of [1.323]
The next parameters to simulate from are [[0.152 0.539 0.006 0.041 0.024 0.021]]
The mean of the samples was 1.29

Iteration 403
Acquisition function convergence reached at iteration 58.
The final EI loss was -0.007 with predicted mean of [-1.488]
The next parameters to simulate from are [[0.268 0.002 0.013 0.011 0.022 0.027]]
The mean of the samples was -1.525

Iteration 404
Acquisition function convergence reached at iteration 57.
The final EI loss was -0.016 with predicted mean of [-1.804]
The next parameters to simulate from are [[0.152 0.534 0.006 0.01 0.024 0.022]]
The mean of the samples was -1.777

Iteration 405
Acquisition function convergence reached at iteration 28.
The final EI loss was -0.015 with predicted mean of [-1.8]
The next parameters to simulate from are [[0.146 0.566 0.006 0.01 0.024 0.022]]
The mean of the samples was -2.03

Iteration 406
Acquisition function convergence reached at iteration 115.
The final EI loss was -0.016 with predicted mean of [-1.804]
The next parameters to simulate from are [[0.155 0.548 0.006 0.01 0.024 0.022]]
The mean of the samples was -1.866

Iteration 407
Acquisition function convergence reached at iteration 28.
The final EI loss was -0.001 with predicted mean of [-0.65]
The next parameters to simulate from are [[0.529 0.25 0.019 0.01 0.046 0.015]]
The mean of the samples was -0.879

Iteration 408
Acquisition function convergence reached at iteration 50.
The final EI loss was -0.015 with predicted mean of [-1.804]
The next parameters to simulate from are [[0.155 0.542 0.006 0.01 0.024 0.022]]
The mean of the samples was -1.877

Iteration 409
Acquisition function convergence reached at iteration 2.
The final EI loss was -0.0 with predicted mean of [0.098]
The next parameters to simulate from are [[0.529 0.83 0.008 0.01 0.024 0.046]]
The mean of the samples was 0.125

Iteration 410
Acquisition function convergence reached at iteration 65.
The final EI loss was -0.017 with predicted mean of [-1.81]

The next parameters to simulate from are [[0.168 0.534 0.006 0.01 0.024 0.022]]
 The mean of the samples was -1.691
 Iteration 411
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [0.314]
 The next parameters to simulate from are [[0.155 0.542 0.006 0.023 0.024 0.056]]
 The mean of the samples was 0.338
 Iteration 412
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [0.801]
 The next parameters to simulate from are [[0.693 0.542 0.006 0.045 0.026 0.062]]
 The mean of the samples was 0.778
 Iteration 413
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [-0.717]
 The next parameters to simulate from are [[0.462 0.542 0.006 0.01 0.024 0.022]]
 The mean of the samples was -0.664
 Iteration 414
 Acquisition function convergence reached at iteration 49.
 The final EI loss was -0.004 with predicted mean of [-1.225]
 The next parameters to simulate from are [[0.367 0.741 0.012 0.011 0.047 0.02]]
 The mean of the samples was -1.293
 Iteration 415
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [-0.542]
 The next parameters to simulate from are [[0.155 0.542 0.026 0.01 0.024 0.022]]
 The mean of the samples was -0.542
 Iteration 416
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [-0.8]
 The next parameters to simulate from are [[0.155 0.542 0.017 0.01 0.024 0.022]]
 The mean of the samples was -0.832
 Iteration 417
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [0.381]
 The next parameters to simulate from are [[0.494 0.542 0.006 0.026 0.024 0.022]]
 The mean of the samples was 0.34
 Iteration 418
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [0.905]
 The next parameters to simulate from are [[0.129 0.542 0.006 0.036 0.024 0.065]]
 The mean of the samples was 0.959
 Iteration 419

Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [0.922]
 The next parameters to simulate from are [[0.155 0.743 0.006 0.035 0.024 0.065]]
 The mean of the samples was 0.855
 Iteration 420
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [0.346]
 The next parameters to simulate from are [[0.965 0.542 0.006 0.004 0.024 0.022]]
 The mean of the samples was 0.384
 Hyperparameter convergence reached at iteration 1961.
 The minimum predicted mean of the observed indices is -1.812 at the point
 [0.155 0.542 0.006 0.01 0.024 0.022]
 Iteration 421
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [0.361]
 The next parameters to simulate from are [[0.162 0.203 0.006 0.038 0.003 0.064]]
 The mean of the samples was 0.332
 Iteration 422
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [-0.378]
 The next parameters to simulate from are [[0.155 0.542 0.005 0.01 0.024 0.053]]
 The mean of the samples was -0.388
 Iteration 423
 Acquisition function convergence reached at iteration 59.
 The final EI loss was -0.001 with predicted mean of [-0.069]
 The next parameters to simulate from are [[0.419 0.999 0.032 0.028 0. 0.066]]
 The mean of the samples was -0.289
 Iteration 424
 Acquisition function convergence reached at iteration 29.
 The final EI loss was -0.016 with predicted mean of [-1.806]
 The next parameters to simulate from are [[0.169 0.544 0.006 0.01 0.024 0.022]]
 The mean of the samples was -1.637
 Iteration 425
 Acquisition function convergence reached at iteration 54.
 The final EI loss was -0.0 with predicted mean of [-0.002]
 The next parameters to simulate from are [[0.988 0.026 0.033 0.007 0.003 0.]]
 The mean of the samples was 0.226
 Iteration 426
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [-0.33]
 The next parameters to simulate from are [[0.152 0.786 0.008 0.01 0.009 0.036]]
 The mean of the samples was -0.238
 Iteration 427

Acquisition function convergence reached at iteration 48.
 The final EI loss was -0.0 with predicted mean of [0.07]
 The next parameters to simulate from are [[0.964 0.026 0.019 0. 0.049 0.001]]
 The mean of the samples was 0.321
 Iteration 428
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [-0.019]
 The next parameters to simulate from are [[0.269 0.75 0.006 0.01 0.001 0.023]]
 The mean of the samples was 0.032
 Iteration 429
 Acquisition function convergence reached at iteration 46.
 The final EI loss was -0.004 with predicted mean of [-1.076]
 The next parameters to simulate from are [[0.397 0.31 0.012 0.008 0.05 0.021]]
 The mean of the samples was -1.297
 Iteration 430
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [1.402]
 The next parameters to simulate from are [[0.152 0.212 0.016 0.045 0.024 0.022]]
 The mean of the samples was 1.461
 Iteration 431
 Acquisition function convergence reached at iteration 40.
 The final EI loss was -0.015 with predicted mean of [-1.808]
 The next parameters to simulate from are [[0.156 0.537 0.006 0.01 0.024 0.022]]
 The mean of the samples was -2.056
 Iteration 432
 Acquisition function convergence reached at iteration 58.
 The final EI loss was -0.002 with predicted mean of [-0.851]
 The next parameters to simulate from are [[0.533 0.477 0.033 0.014 0.034 0.033]]
 The mean of the samples was -0.886
 Iteration 433
 Acquisition function convergence reached at iteration 40.
 The final EI loss was -0.007 with predicted mean of [-1.4]
 The next parameters to simulate from are [[0.084 0.991 0.007 0.009 0.031 0.025]]
 The mean of the samples was -1.703
 Iteration 434
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [-1.157]
 The next parameters to simulate from are [[0.152 0.415 0.003 0.01 0.024 0.022]]
 The mean of the samples was -1.022
 Iteration 435
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [0.661]
 The next parameters to simulate from are [[0.152 0.058 0.014 0.028 0.024 0.022]]

The mean of the samples was 0.692
 Iteration 436
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [-0.463]
 The next parameters to simulate from are [[0.152 0.534 0.03 0.01 0.024 0.022]]
 The mean of the samples was -0.48
 Iteration 437
 Acquisition function convergence reached at iteration 49.
 The final EI loss was -0.015 with predicted mean of [-1.743]
 The next parameters to simulate from are [[0.112 0.817 0.007 0.01 0.026 0.025]]
 The mean of the samples was -1.877
 Iteration 438
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [-0.54]
 The next parameters to simulate from are [[0.15 0.199 0.028 0.01 0.024 0.023]]
 The mean of the samples was -0.553
 Iteration 439
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [0.667]
 The next parameters to simulate from are [[0.612 0.575 0.006 0.042 0.024 0.066]]
 The mean of the samples was 0.701
 Iteration 440
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [-0.751]
 The next parameters to simulate from are [[0.15 0.165 0.02 0.01 0.024 0.023]]
 The mean of the samples was -0.786
 Hyperparameter convergence reached at iteration 1939.
 The minimum predicted mean of the observed indices is -1.812 at the point
 [0.152 0.534 0.006 0.01 0.024 0.022]
 Iteration 441
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [-0.874]
 The next parameters to simulate from are [[0.634 0.545 0.006 0.01 0.024 0.007]]
 The mean of the samples was -0.901
 Iteration 442
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [1.612]
 The next parameters to simulate from are [[0.152 0.534 0.006 0.048 0.024 0.022]]
 The mean of the samples was 1.555
 Iteration 443
 Acquisition function convergence reached at iteration 29.
 The final EI loss was -0.001 with predicted mean of [-0.332]
 The next parameters to simulate from are [[0.683 0.063 0.02 0.017 0. 0.015]]

The mean of the samples was -0.6
 Iteration 444
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [1.127]
 The next parameters to simulate from are [[0.439 0.534 0.009 0.044 0.015 0.022]]
 The mean of the samples was 1.055
 Iteration 445
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [0.347]
 The next parameters to simulate from are [[0.153 0.984 0.006 0.026 0.024 0.06]]
 The mean of the samples was 0.385
 Iteration 446
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [-0.55]
 The next parameters to simulate from are [[0.152 0.528 0.006 0.01 0.022 0.047]]
 The mean of the samples was -0.504
 Iteration 447
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [-0.396]
 The next parameters to simulate from are [[0.152 0.534 0.006 0.01 0.006 0.022]]
 The mean of the samples was -0.397
 Iteration 448
 Acquisition function convergence reached at iteration 52.
 The final EI loss was -0.009 with predicted mean of [-1.698]
 The next parameters to simulate from are [[0.175 0.195 0.008 0.01 0.021 0.025]]
 The mean of the samples was -1.649
 Iteration 449
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [-0.911]
 The next parameters to simulate from are [[0.289 0.62 0.015 0.01 0.024 0.022]]
 The mean of the samples was -0.924
 Iteration 450
 Acquisition function convergence reached at iteration 35.
 The final EI loss was -0.001 with predicted mean of [-1.122]
 The next parameters to simulate from are [[0.085 0.344 0.02 0.014 0.019 0.036]]
 The mean of the samples was -1.296
 Trained parameters:
 amplitude_champ:0 is 0.661

 length_scales_champ:0 is [0.276 0.5 0.009 0.005 0.018 0.013]

 observation_noise_variance_champ:0 is 0.072

bias_mean:0 is 0.744

Iteration 451

Acquisition function convergence reached at iteration 2.

The final EI loss was -0.0 with predicted mean of [1.194]

The next parameters to simulate from are [[0.152 0.82 0.006 0.046 0.002 0.022]]

The mean of the samples was 1.277

Iteration 452

Acquisition function convergence reached at iteration 2.

The final EI loss was -0.0 with predicted mean of [0.641]

The next parameters to simulate from are [[0.261 0.534 0.006 0.036 0.016 0.051]]

The mean of the samples was 0.684

Iteration 453

Acquisition function convergence reached at iteration 80.

The final EI loss was -0.018 with predicted mean of [-1.758]

The next parameters to simulate from are [[0.112 0.823 0.007 0.01 0.026 0.025]]

The mean of the samples was -1.672

Iteration 454

Acquisition function convergence reached at iteration 2.

The final EI loss was -0.0 with predicted mean of [0.896]

The next parameters to simulate from are [[0.156 0.537 0.003 0.032 0.031 0.05]]

The mean of the samples was 1.026

Iteration 455

Acquisition function convergence reached at iteration 77.

The final EI loss was -0.015 with predicted mean of [-1.813]

The next parameters to simulate from are [[0.153 0.555 0.006 0.01 0.024 0.023]]

The mean of the samples was -1.943

Iteration 456

Acquisition function convergence reached at iteration 2.

The final EI loss was -0.0 with predicted mean of [0.062]

The next parameters to simulate from are [[0.828 0.555 0.014 0.01 0.024 0.023]]

The mean of the samples was 0.044

Iteration 457

Acquisition function convergence reached at iteration 55.

The final EI loss was -0.004 with predicted mean of [-1.526]

The next parameters to simulate from are [[0.152 0. 0.01 0.011 0.02 0.025]]

The mean of the samples was -1.824

Iteration 458

Acquisition function convergence reached at iteration 2.

The final EI loss was -0.0 with predicted mean of [-0.383]

The next parameters to simulate from are [[0.153 0.555 0.006 0.01 0.021 0.052]]

The mean of the samples was -0.397

Iteration 459

Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [-0.173]
 The next parameters to simulate from are [[0.153 0.126 0.006 0.01 0.015 0.059]]
 The mean of the samples was -0.179
 Iteration 460
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [0.162]
 The next parameters to simulate from are [[0.447 0.555 0.006 0.01 0.007 0.037]]
 The mean of the samples was 0.13
 Hyperparameter convergence reached at iteration 1964.
 The minimum predicted mean of the observed indices is -1.816 at the point
 [0.153 0.555 0.006 0.01 0.024 0.023]
 Iteration 461
 Acquisition function convergence reached at iteration 71.
 The final EI loss was -0.007 with predicted mean of [-1.66]
 The next parameters to simulate from are [[0.168 0.013 0.01 0.011 0.021 0.025]]
 The mean of the samples was -1.534
 Iteration 462
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [-1.016]
 The next parameters to simulate from are [[0.153 0.667 0.002 0.01 0.024 0.023]]
 The mean of the samples was -0.993
 Iteration 463
 Acquisition function convergence reached at iteration 36.
 The final EI loss was -0.001 with predicted mean of [-0.83]
 The next parameters to simulate from are [[0.199 0.03 0.025 0.008 0.035 0.046]]
 The mean of the samples was -0.762
 Iteration 464
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [0.332]
 The next parameters to simulate from are [[0.085 0.555 0.006 0.01 0.024 0.001]]
 The mean of the samples was 0.339
 Iteration 465
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [1.055]
 The next parameters to simulate from are [[0.036 0.555 0.006 0.035 0.024 0.023]]
 The mean of the samples was 1.114
 Iteration 466
 Acquisition function convergence reached at iteration 40.
 The final EI loss was -0.004 with predicted mean of [-1.321]
 The next parameters to simulate from are [[0.343 0.739 0.006 0.01 0.049 0.014]]
 The mean of the samples was -1.31
 Iteration 467

Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [-0.486]
 The next parameters to simulate from are [[0.622 0.274 0.006 0.01 0.024 0.023]]
 The mean of the samples was -0.49
 Iteration 468
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [0.381]
 The next parameters to simulate from are [[0.94 0.697 0.006 0.01 0.033 0.023]]
 The mean of the samples was 0.339
 Iteration 469
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [-1.075]
 The next parameters to simulate from are [[0.237 0.622 0.006 0.007 0.025 0.024]]
 The mean of the samples was -0.878
 Iteration 470
 Acquisition function convergence reached at iteration 42.
 The final EI loss was -0.004 with predicted mean of [-0.946]
 The next parameters to simulate from are [[0.011 0.998 0.006 0.006 0.05 0.031]]
 The mean of the samples was -1.078
 Iteration 471
 Acquisition function convergence reached at iteration 48.
 The final EI loss was -0.0 with predicted mean of [0.073]
 The next parameters to simulate from are [[0.999 0.016 0.033 0.05 0.001 0.064]]
 The mean of the samples was 0.618
 Iteration 472
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [-0.461]
 The next parameters to simulate from are [[0.156 0.537 0.006 0.01 0.02 0.048]]
 The mean of the samples was -0.42
 Iteration 473
 Acquisition function convergence reached at iteration 63.
 The final EI loss was -0.004 with predicted mean of [-1.324]
 The next parameters to simulate from are [[0.382 0.013 0.013 0.009 0.036 0.023]]
 The mean of the samples was -1.319
 Iteration 474
 Acquisition function convergence reached at iteration 68.
 The final EI loss was -0.002 with predicted mean of [-0.885]
 The next parameters to simulate from are [[0.003 0.996 0.024 0.015 0.015 0.043]]
 The mean of the samples was -1.047
 Iteration 475
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [0.506]
 The next parameters to simulate from are [[0.156 0.657 0.003 0.026 0.024 0.022]]

The mean of the samples was 0.547
 Iteration 476
 Acquisition function convergence reached at iteration 62.
 The final EI loss was -0.0 with predicted mean of [-0.107]
 The next parameters to simulate from are [[0.003 0.992 0.025 0. 0.049 0.066]]
 The mean of the samples was 0.073
 Iteration 477
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [-0.876]
 The next parameters to simulate from are [[0.156 0.537 0.009 0.01 0.026 0.014]]
 The mean of the samples was -0.757
 Iteration 478
 Acquisition function convergence reached at iteration 50.
 The final EI loss was -0.002 with predicted mean of [-1.013]
 The next parameters to simulate from are [[0.005 0.991 0.021 0.015 0.014 0.03]]
 The mean of the samples was -0.87
 Iteration 479
 Acquisition function convergence reached at iteration 62.
 The final EI loss was -0.015 with predicted mean of [-1.815]
 The next parameters to simulate from are [[0.159 0.548 0.006 0.01 0.024 0.023]]
 The mean of the samples was -1.674
 Iteration 480
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [-0.481]
 The next parameters to simulate from are [[0.153 0.555 0.006 0.01 0.01 0.009]]
 The mean of the samples was -0.454
 Hyperparameter convergence reached at iteration 1949.
 The minimum predicted mean of the observed indices is -1.814 at the point
 [0.153 0.555 0.006 0.01 0.024 0.023]
 Iteration 481
 Acquisition function convergence reached at iteration 8.
 The final EI loss was -0.0 with predicted mean of [-0.603]
 The next parameters to simulate from are [[0.113 0.493 0.024 0.014 0.035 0.056]]
 The mean of the samples was -0.53
 Iteration 482
 Acquisition function convergence reached at iteration 60.
 The final EI loss was -0.015 with predicted mean of [-1.813]
 The next parameters to simulate from are [[0.157 0.546 0.006 0.01 0.024 0.023]]
 The mean of the samples was -1.718
 Iteration 483
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [1.095]
 The next parameters to simulate from are [[0.153 0.555 0.015 0.036 0.024 0.023]]

The mean of the samples was 1.021
 Iteration 484
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [-0.719]
 The next parameters to simulate from are [[0.153 0.555 0.006 0.01 0.05 0.023]]
 The mean of the samples was -0.77
 Iteration 485
 Acquisition function convergence reached at iteration 74.
 The final EI loss was -0.013 with predicted mean of [-1.78]
 The next parameters to simulate from are [[0.138 0.735 0.007 0.01 0.025 0.024]]
 The mean of the samples was -1.699
 Iteration 486
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [0.426]
 The next parameters to simulate from are [[0.961 0.555 0.001 0.01 0.032 0.044]]
 The mean of the samples was 0.468
 Iteration 487
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [0.409]
 The next parameters to simulate from are [[0.413 0.555 0.027 0.026 0.04 0.023]]
 The mean of the samples was 0.358
 Iteration 488
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [-0.78]
 The next parameters to simulate from are [[0.153 0.555 0.019 0.01 0.024 0.023]]
 The mean of the samples was -0.806
 Iteration 489
 Acquisition function convergence reached at iteration 42.
 The final EI loss was -0.0 with predicted mean of [0.052]
 The next parameters to simulate from are [[0.008 0.977 0. 0. 0.001 0.002]]
 The mean of the samples was 0.387
 Iteration 490
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [-0.838]
 The next parameters to simulate from are [[0.153 0.796 0.006 0.015 0.024 0.023]]
 The mean of the samples was -0.712
 Iteration 491
 Acquisition function convergence reached at iteration 43.
 The final EI loss was -0.0 with predicted mean of [0.039]
 The next parameters to simulate from are [[0.956 0.003 0. 0.019 0.001 0.002]]
 The mean of the samples was 0.252
 Iteration 492
 Acquisition function convergence reached at iteration 44.

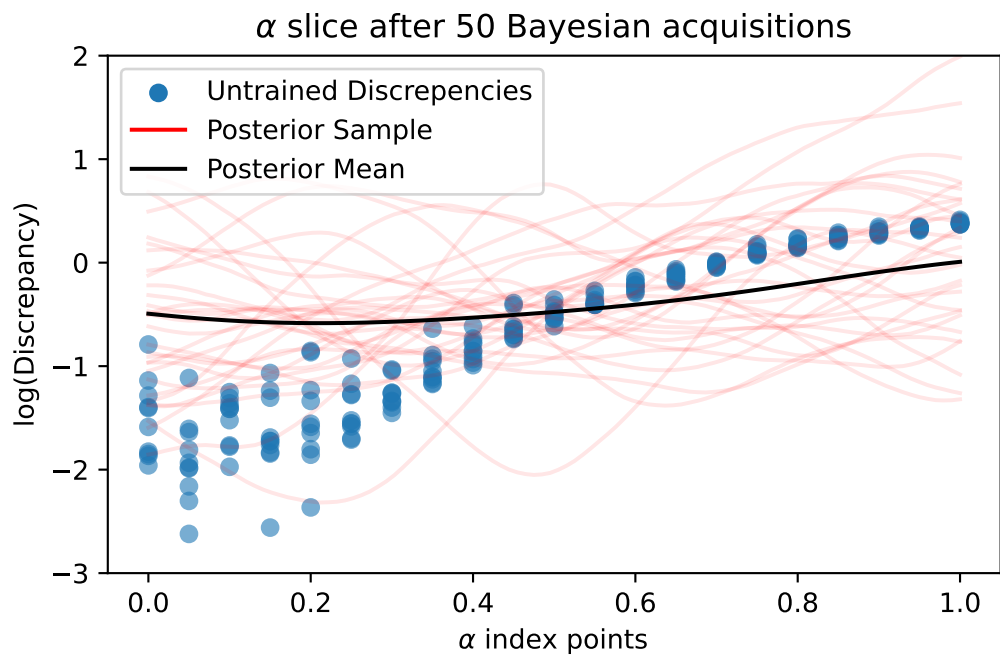
The final EI loss was -0.0 with predicted mean of [0.071]
 The next parameters to simulate from are [[0.988 0.981 0.033 0. 0.048 0.023]]
 The mean of the samples was 0.434
 Iteration 493
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [-0.277]
 The next parameters to simulate from are [[0.153 0.223 0.007 0.016 0.024 0.014]]
 The mean of the samples was -0.266
 Iteration 494
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [0.734]
 The next parameters to simulate from are [[0.69 0.555 0.006 0.039 0.024 0.032]]
 The mean of the samples was 0.707
 Iteration 495
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [0.434]
 The next parameters to simulate from are [[0.565 0.282 0.007 0.002 0.007 0.058]]
 The mean of the samples was 0.49
 Iteration 496
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [-0.44]
 The next parameters to simulate from are [[0.154 0.027 0.032 0.01 0.024 0.024]]
 The mean of the samples was -0.457
 Iteration 497
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [0.995]
 The next parameters to simulate from are [[0.153 0.556 0.022 0.036 0.048 0.023]]
 The mean of the samples was 1.139
 Iteration 498
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [-0.005]
 The next parameters to simulate from are [[0.696 0.555 0.017 0.01 0.004 0.023]]
 The mean of the samples was 0.024
 Iteration 499
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [0.034]
 The next parameters to simulate from are [[0.781 0.419 0.006 0.01 0.024 0.023]]
 The mean of the samples was 0.043
 Iteration 500
 Acquisition function convergence reached at iteration 10.
 The final EI loss was -0.0 with predicted mean of [-0.232]
 The next parameters to simulate from are [[0.183 0.96 0.024 0.014 0.047 0.014]]
 The mean of the samples was -0.202

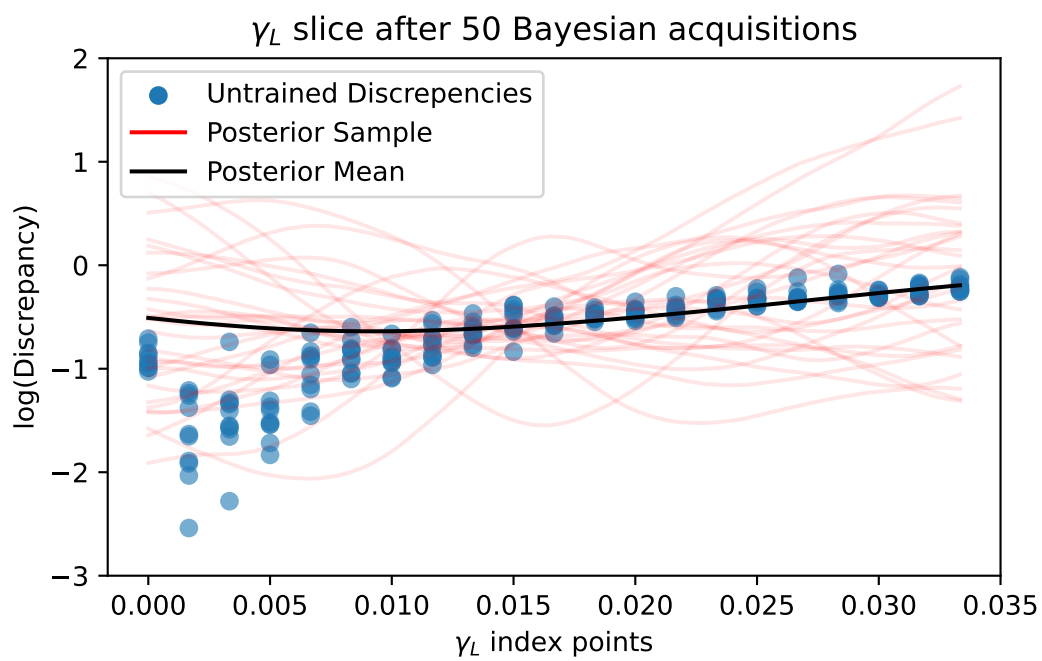
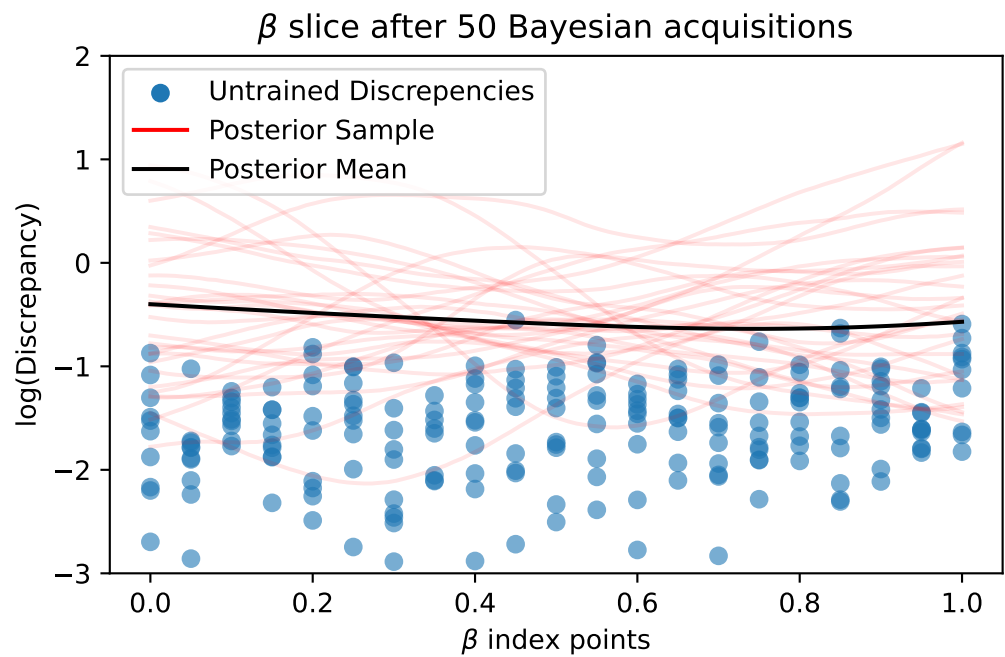
Hyperparameter convergence reached at iteration 1968.
The minimum predicted mean of the observed indices is -1.812 at the point
[0.153 0.555 0.006 0.01 0.024 0.023]
Trained parameters:
amplitude_champ:0 is 0.65

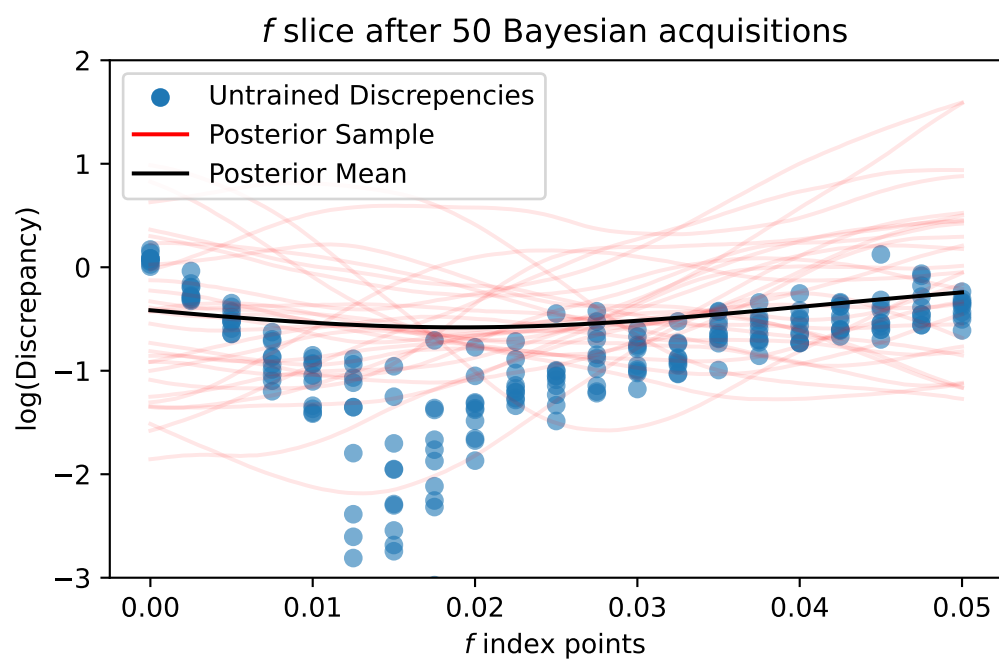
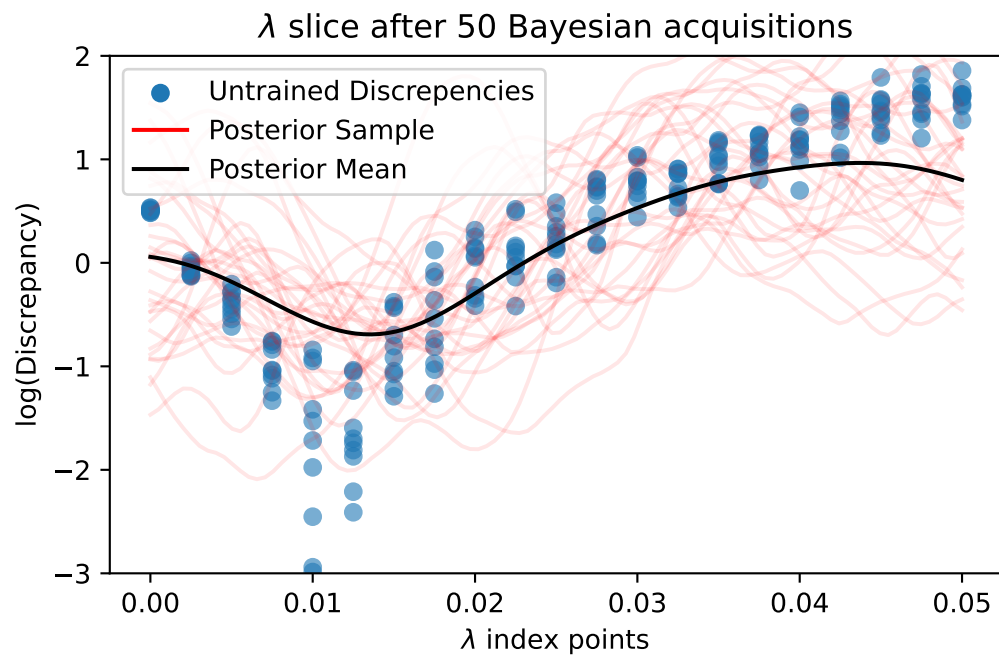
length_scales_champ:0 is [0.271 0.5 0.009 0.005 0.018 0.014]

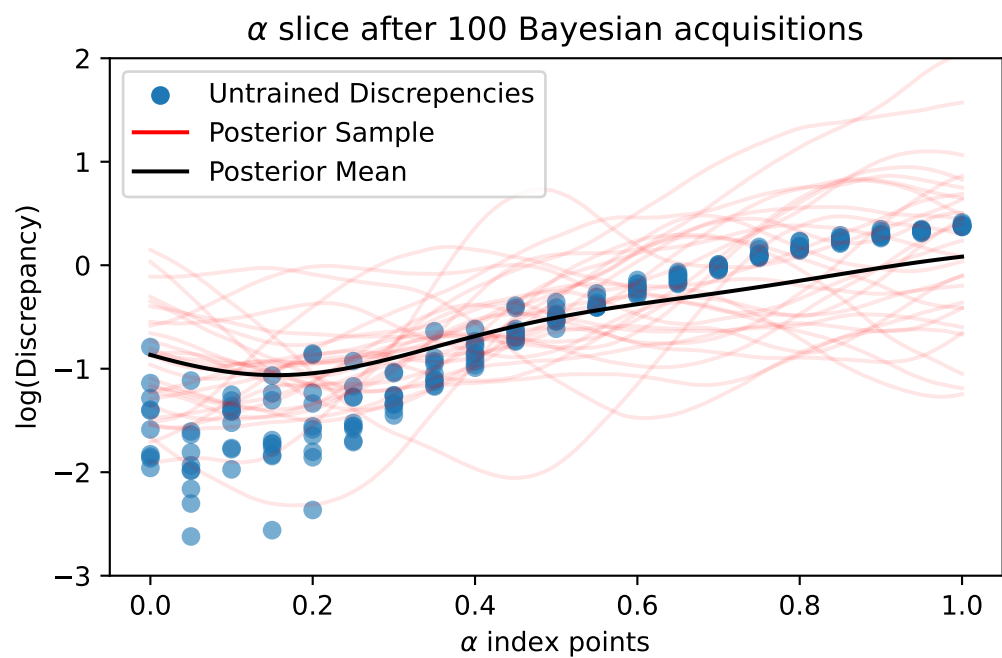
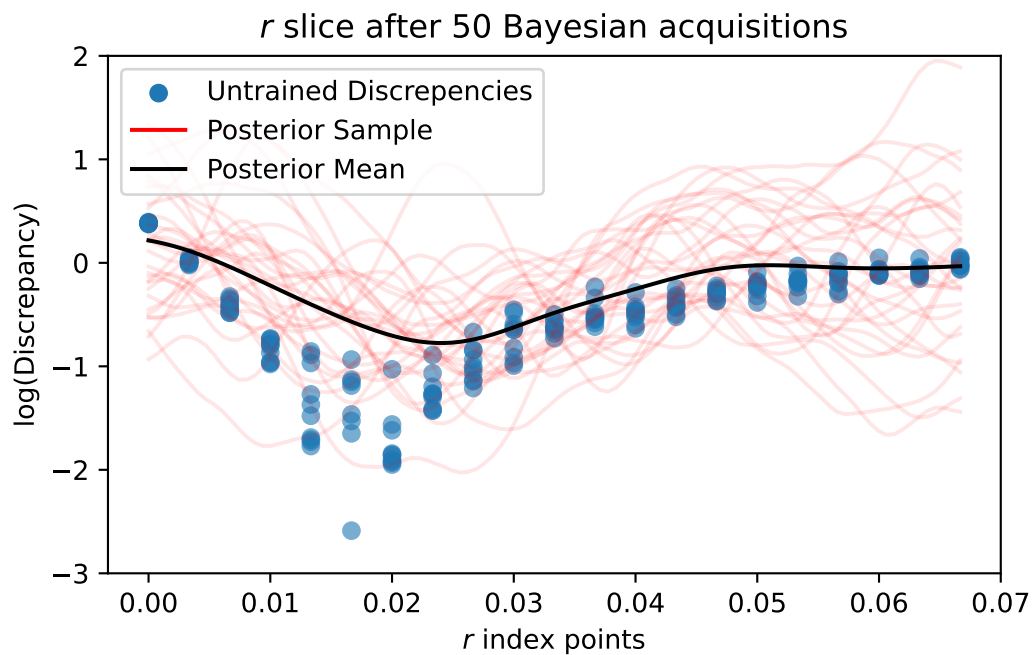
observation_noise_variance_champ:0 is 0.071

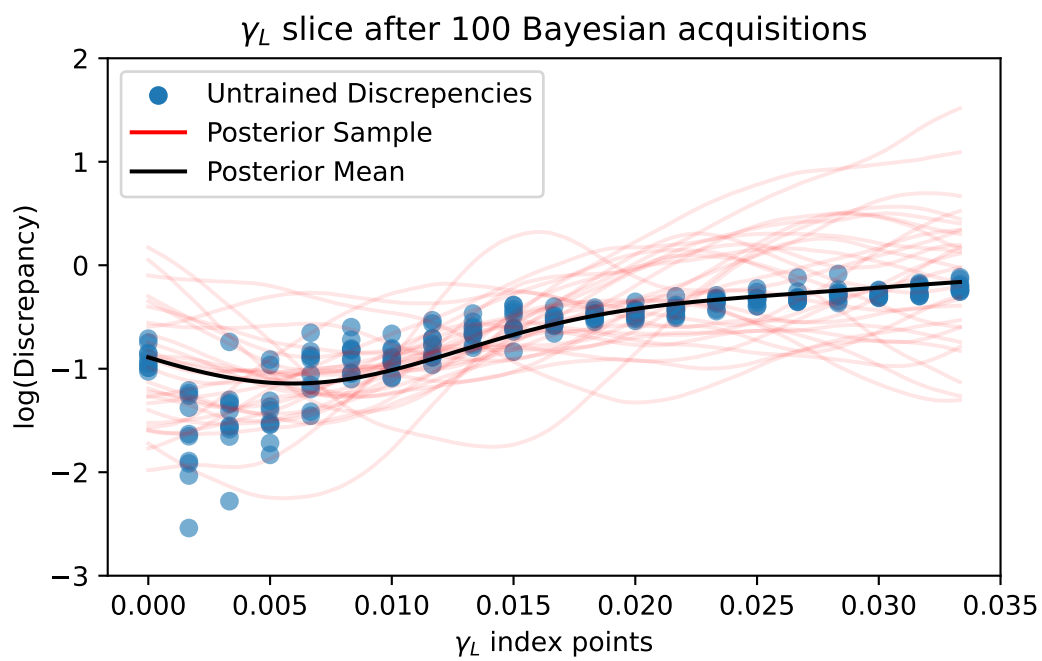
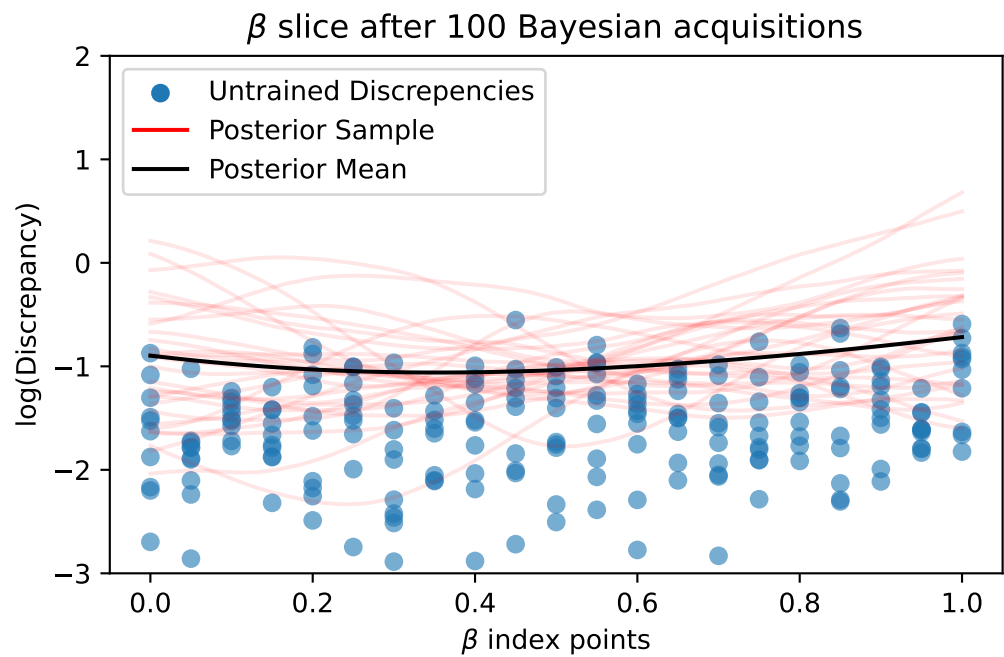
bias_mean:0 is 0.75

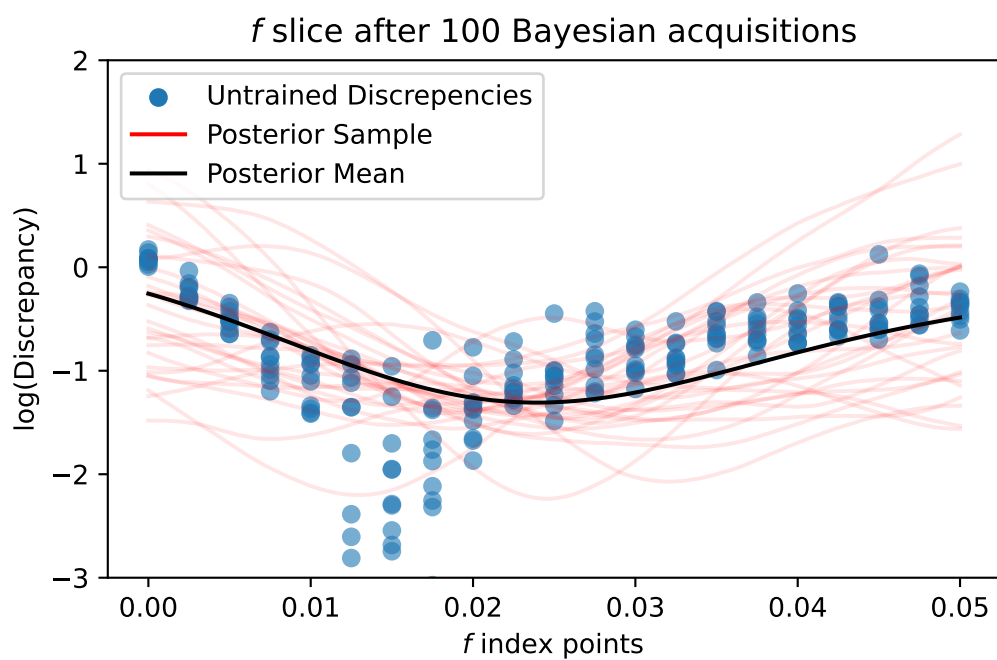
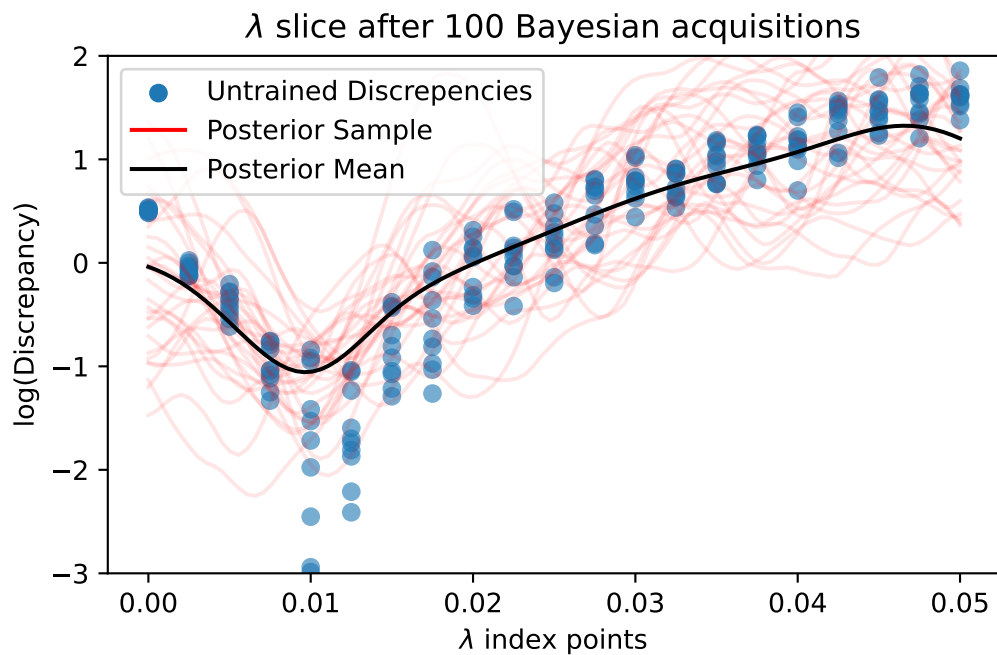


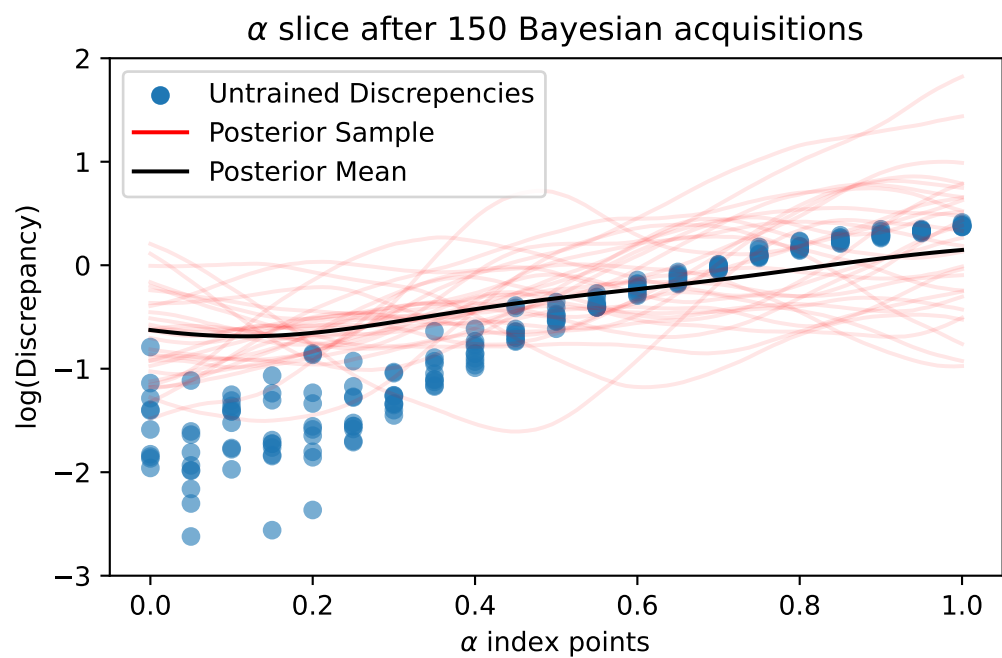
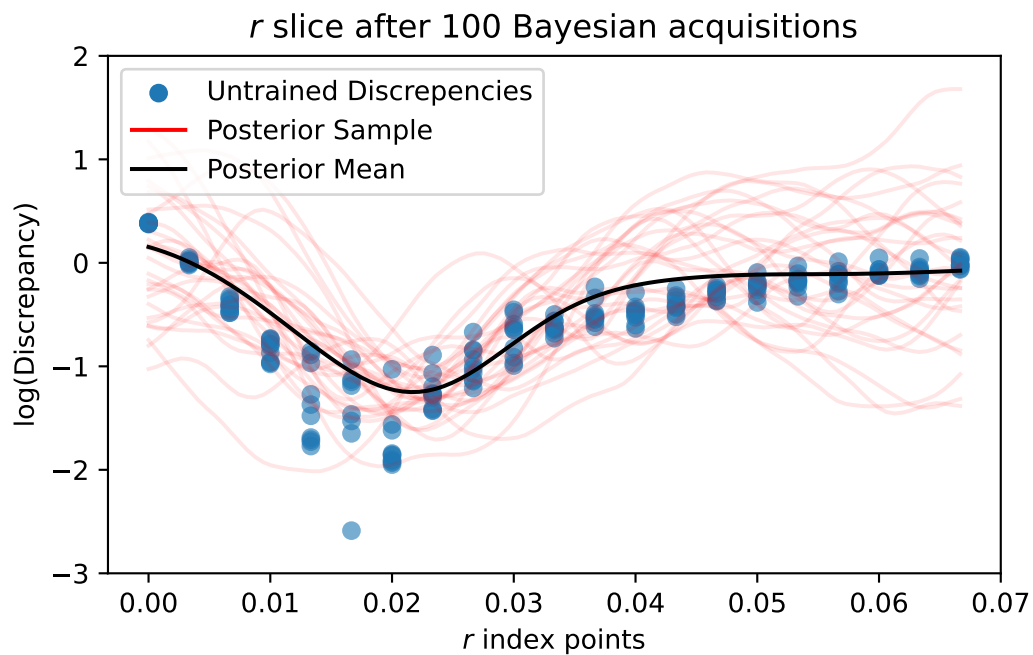


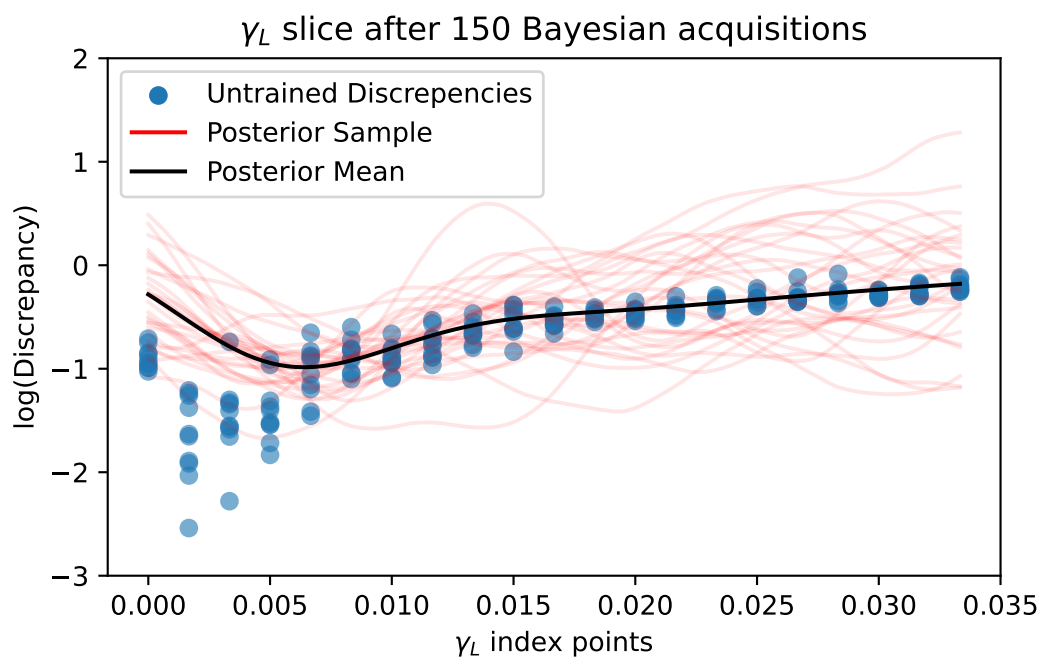
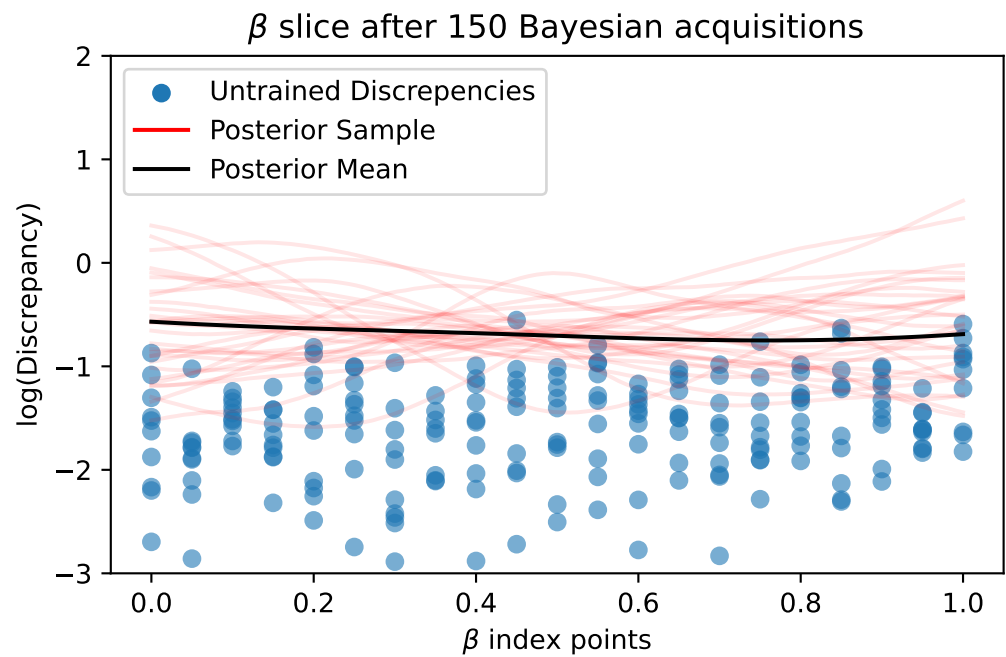


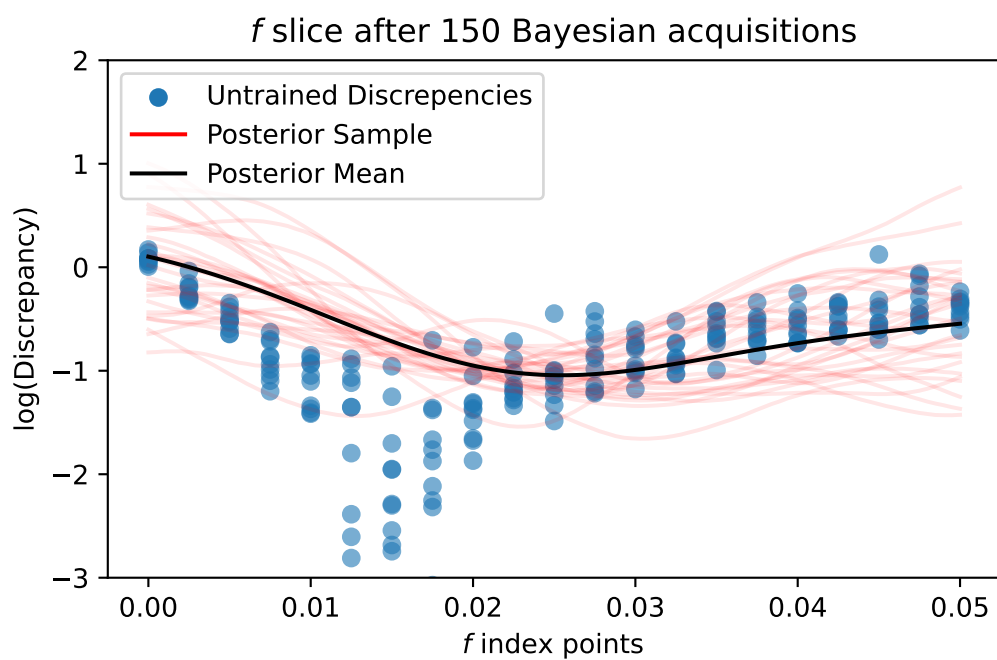
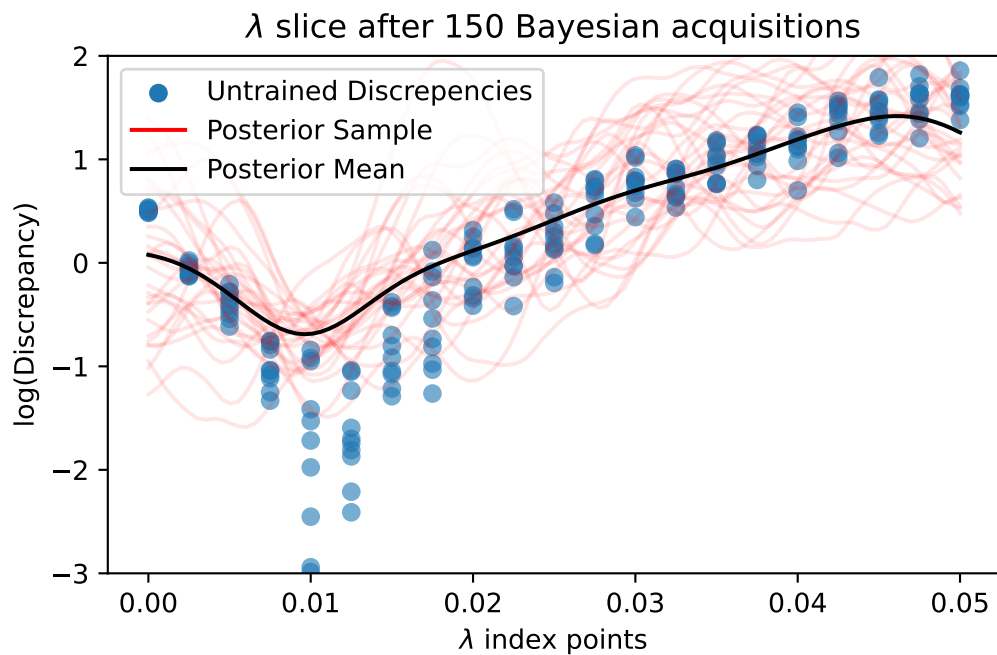


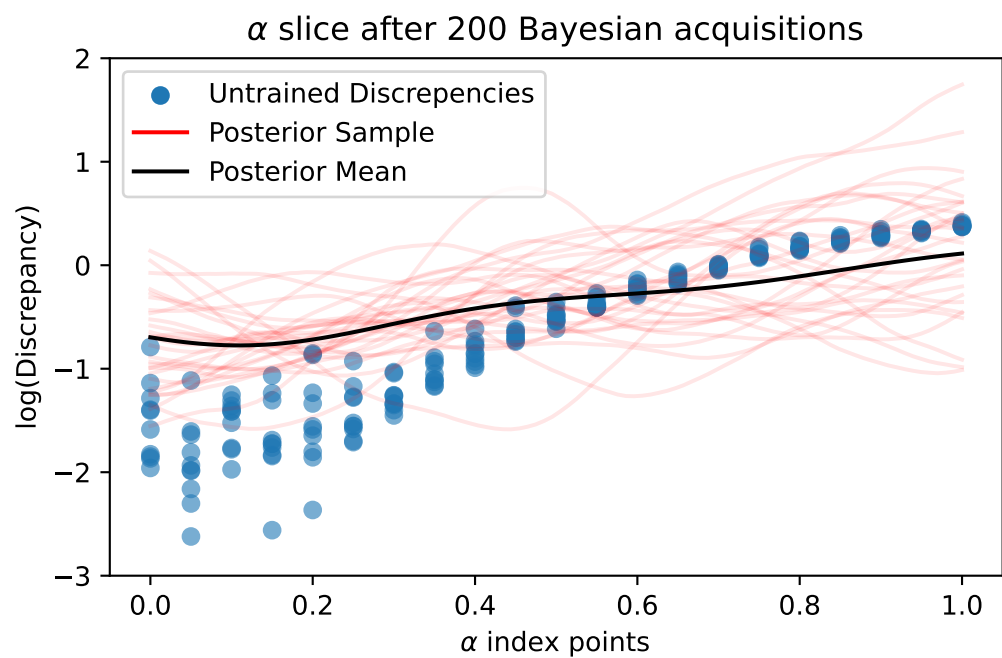
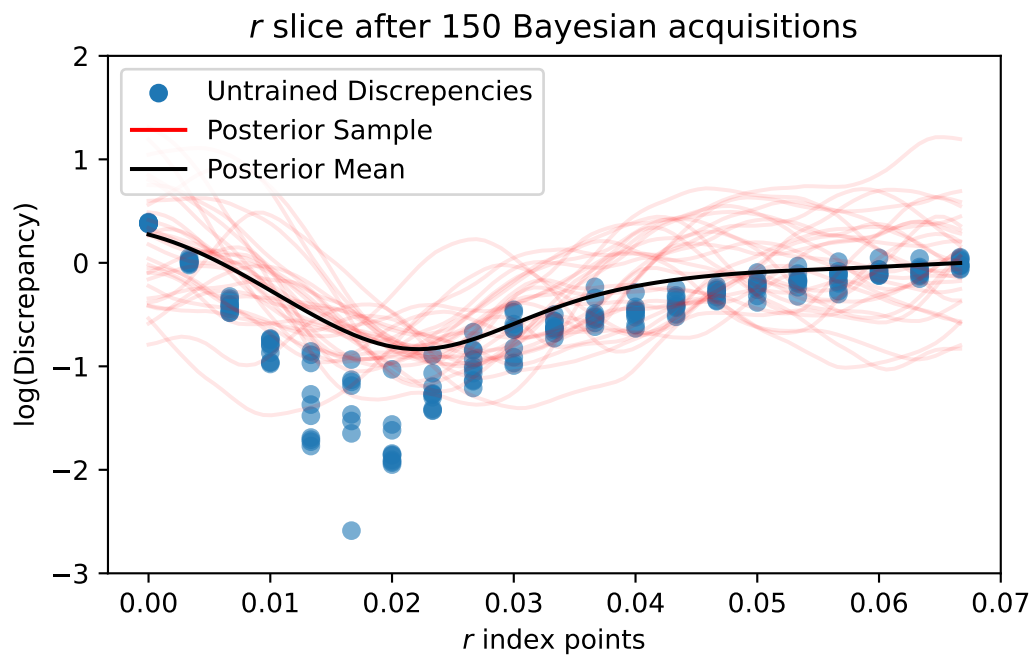


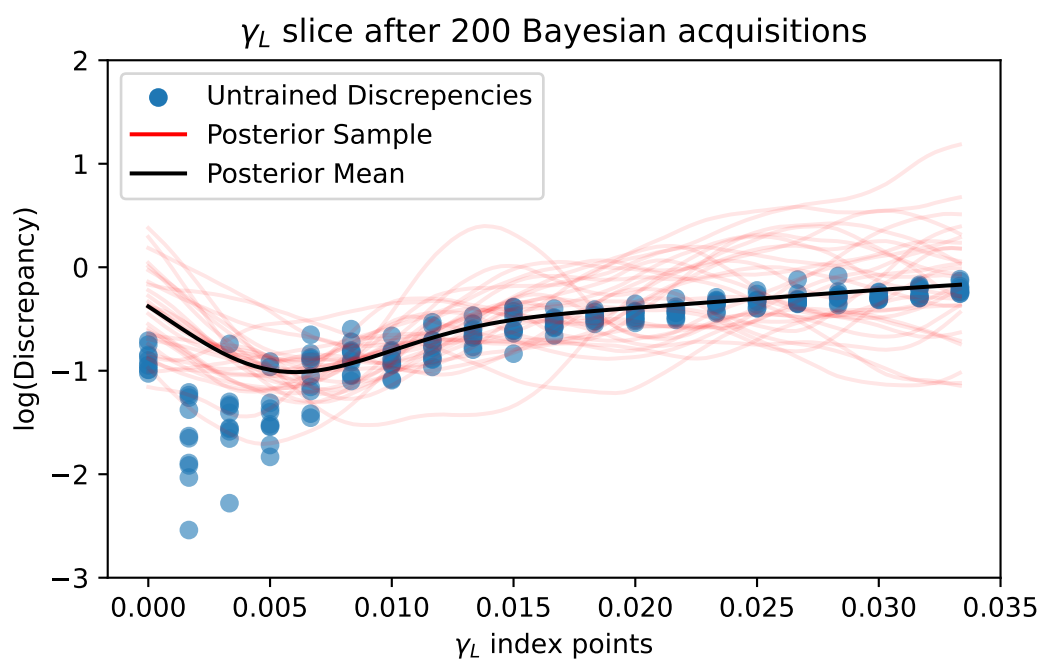
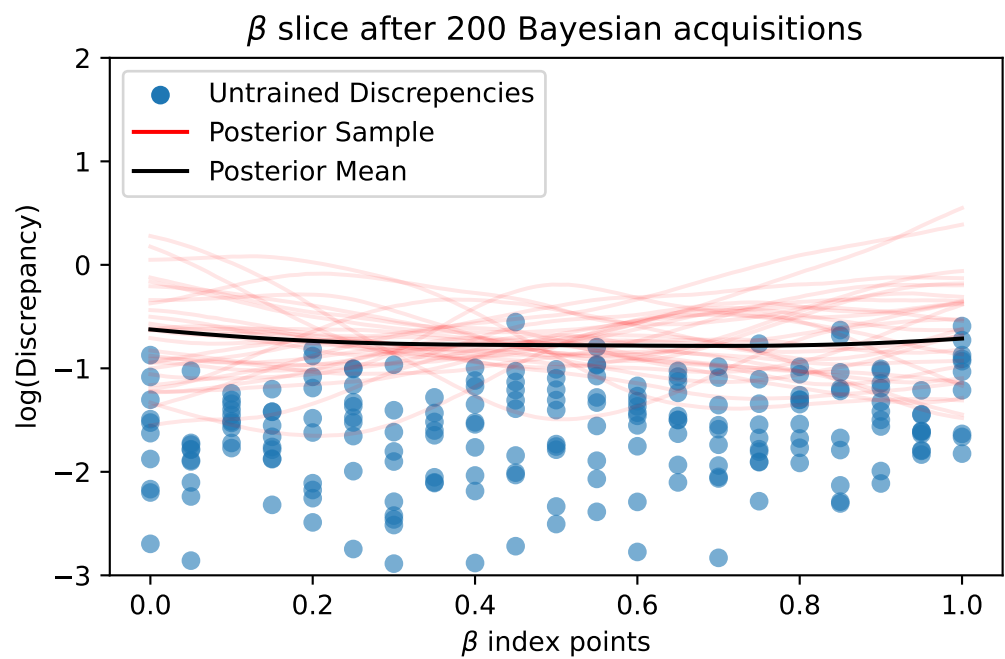


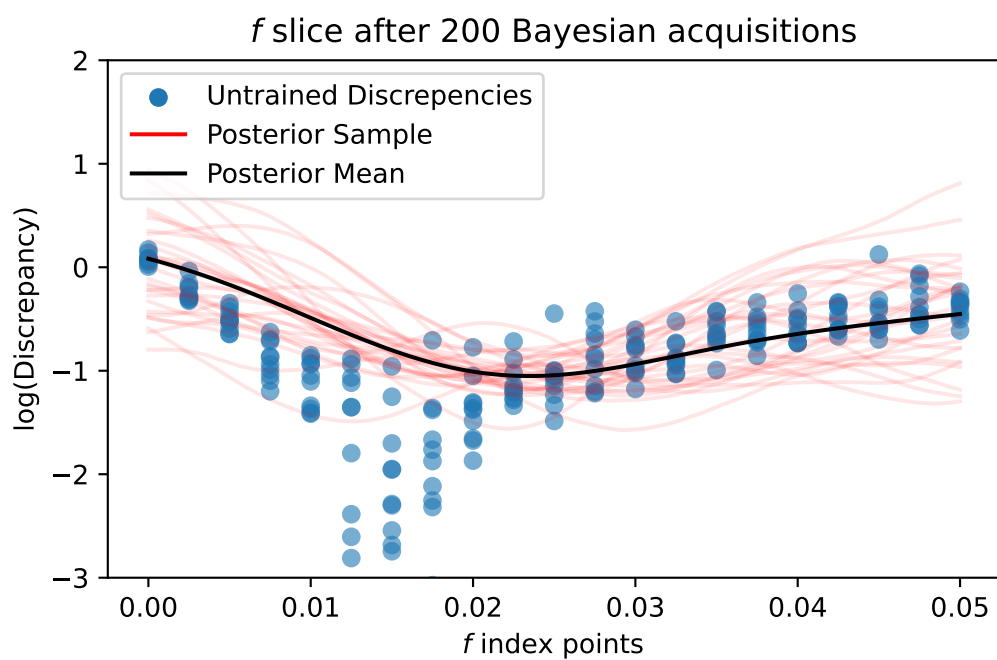
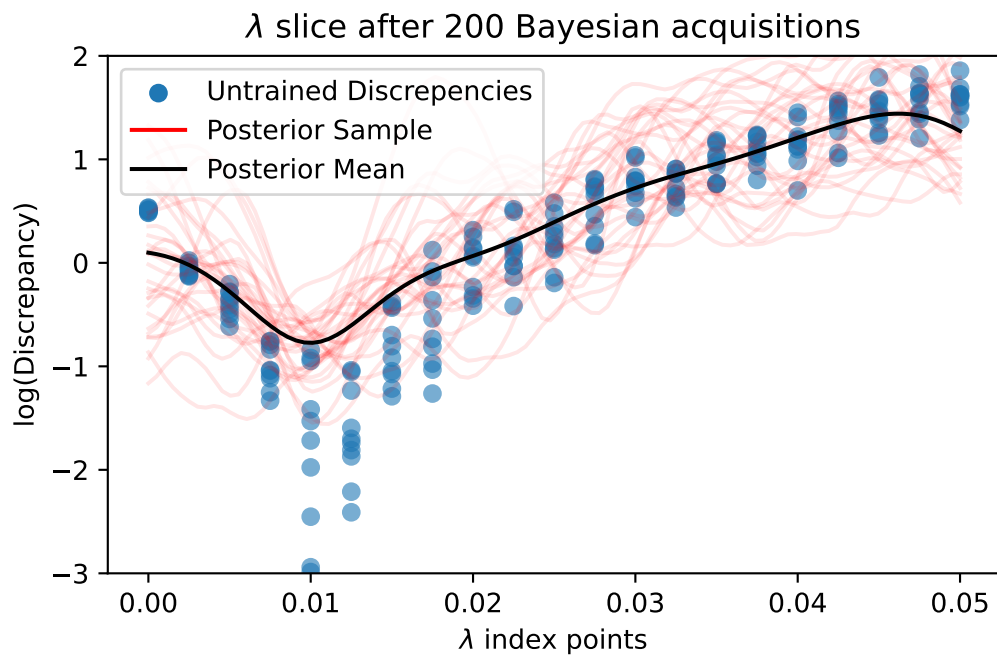


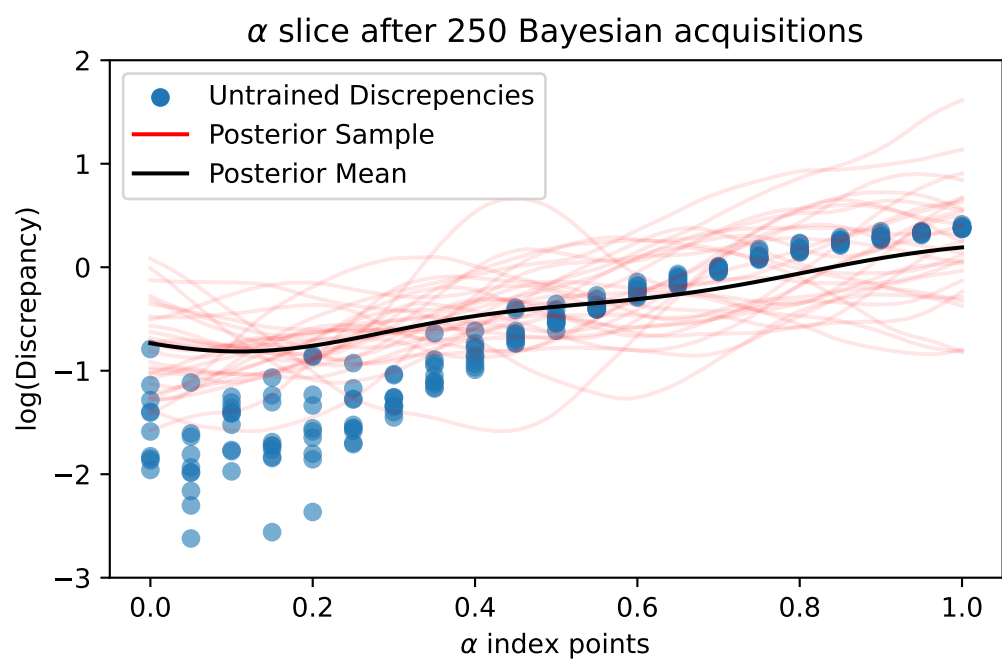
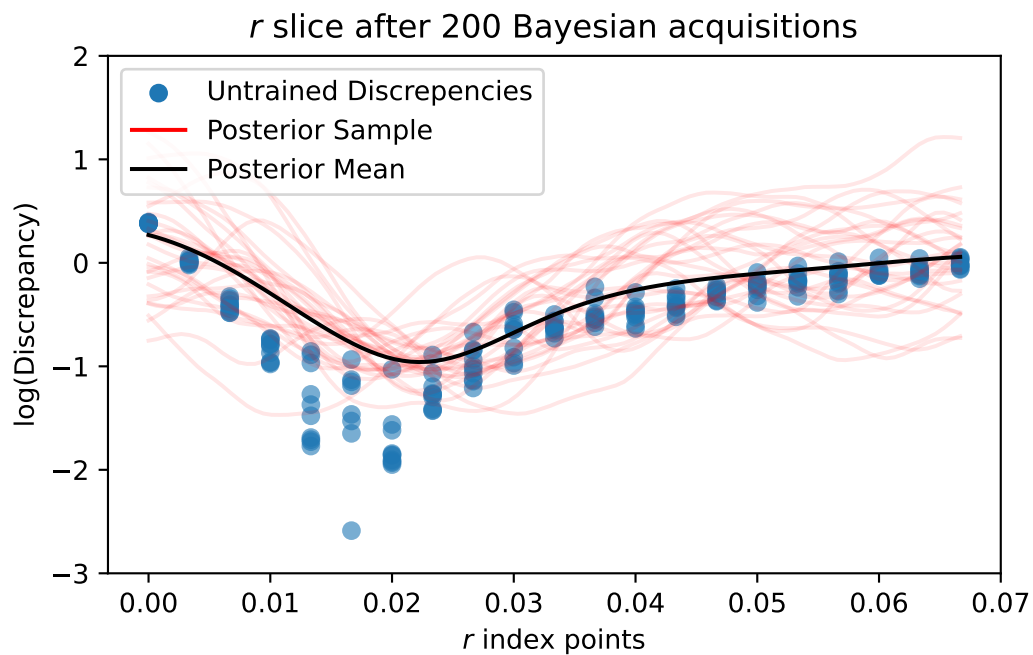


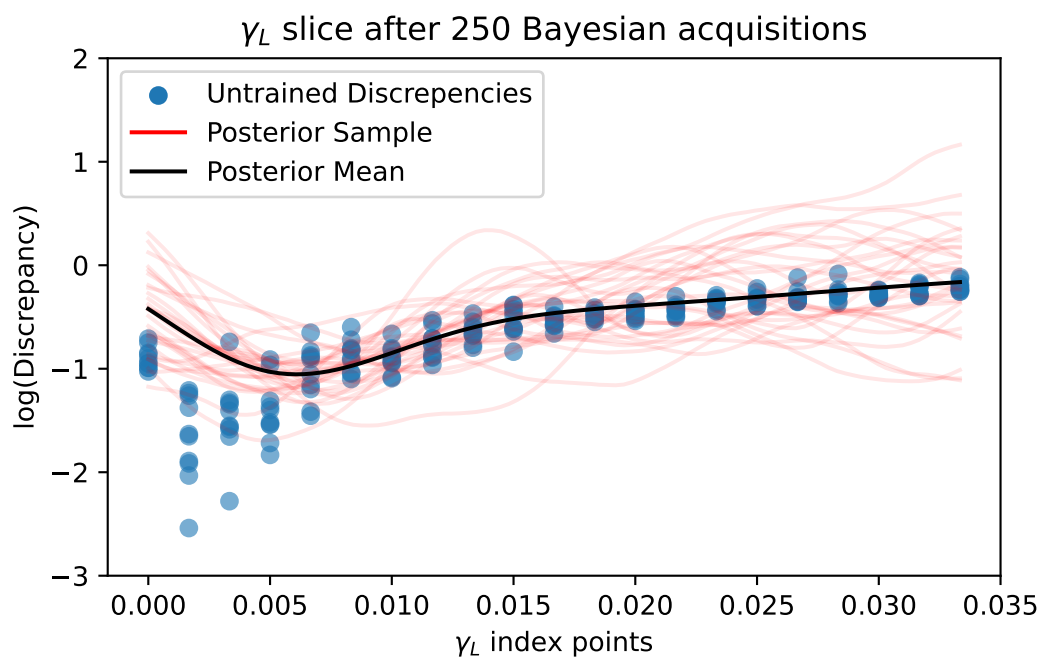
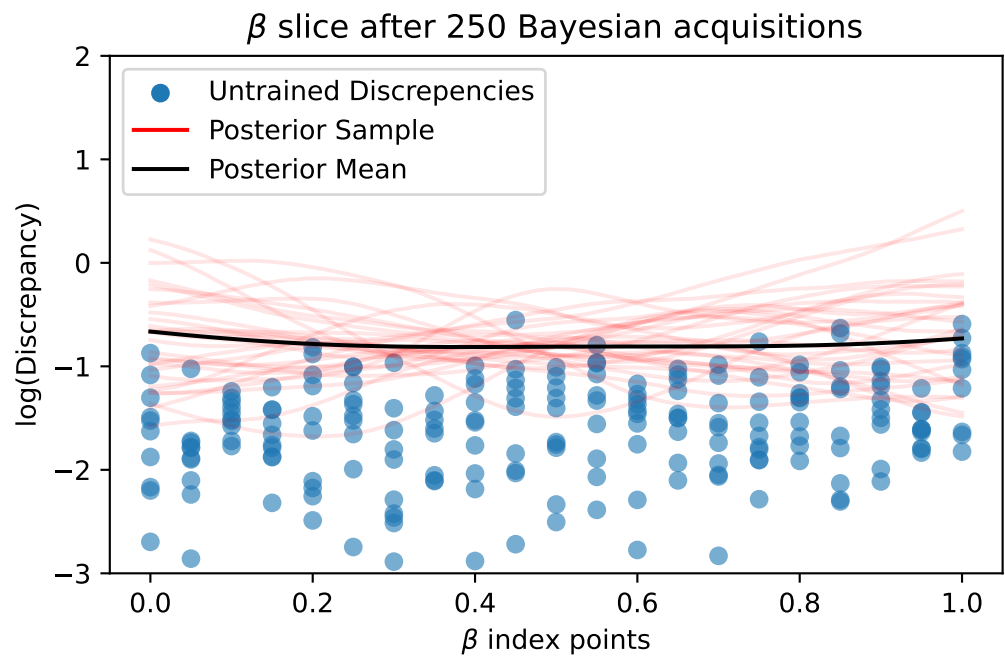


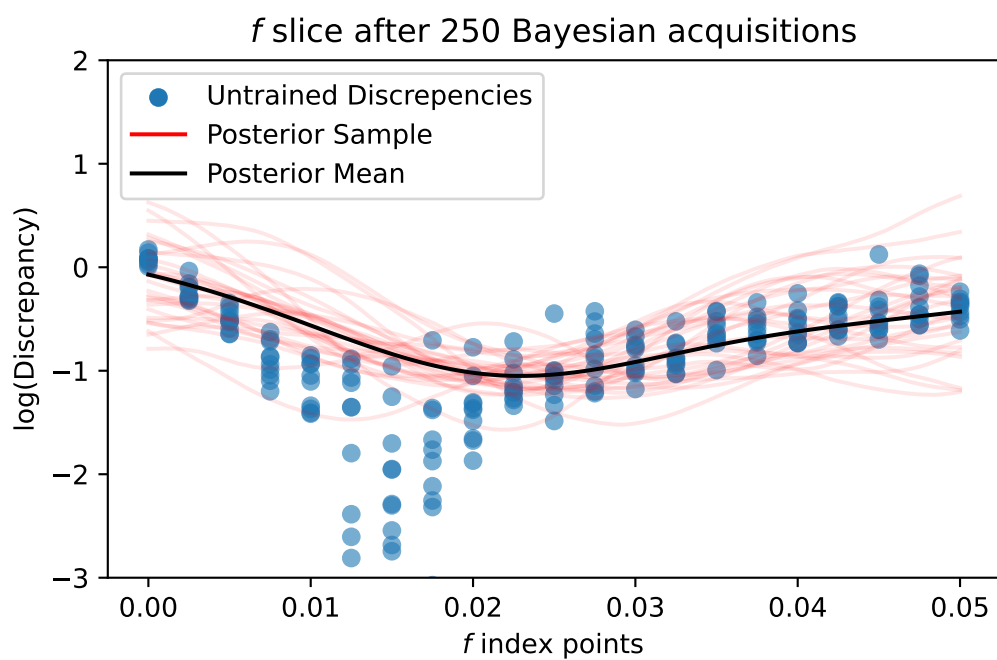
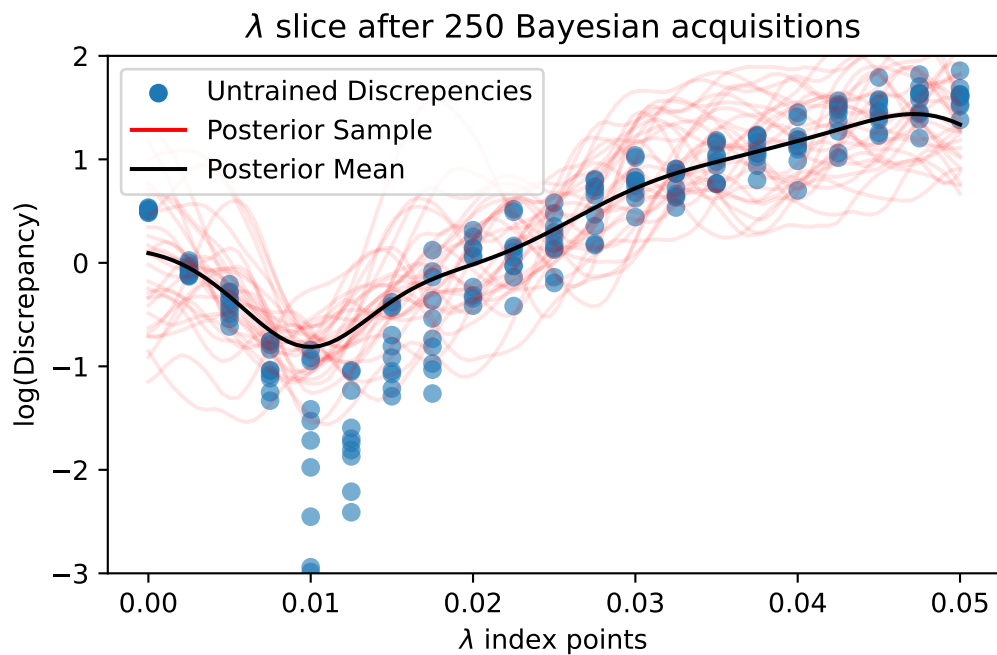


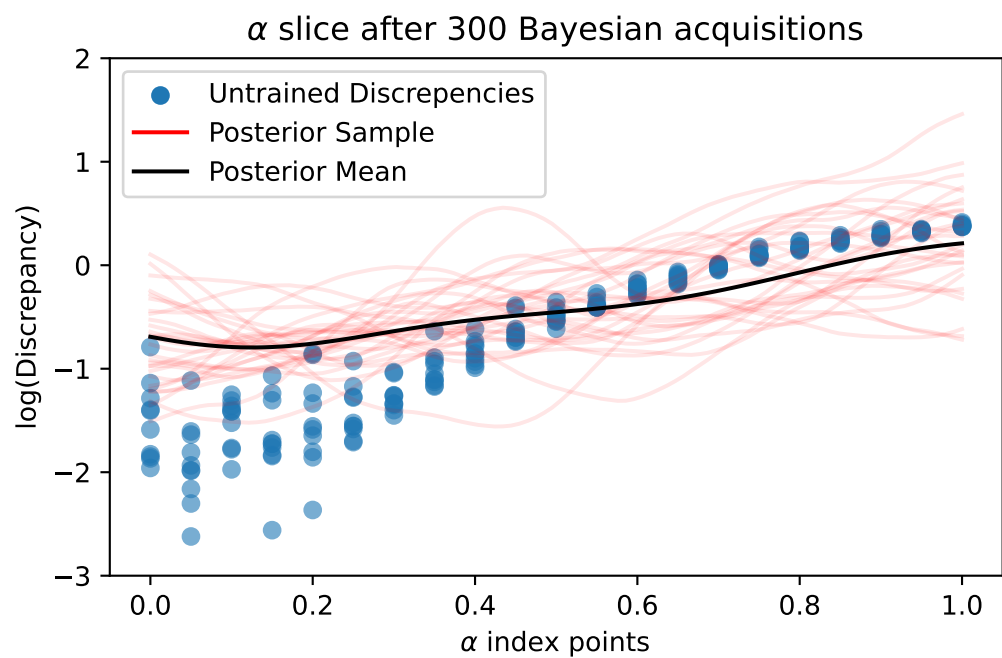
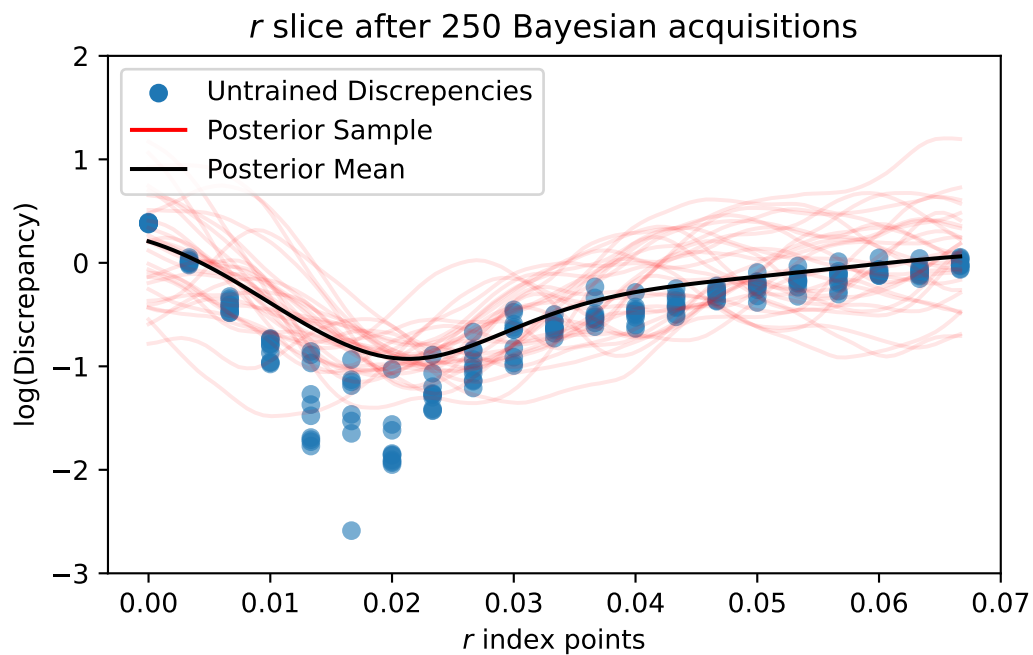


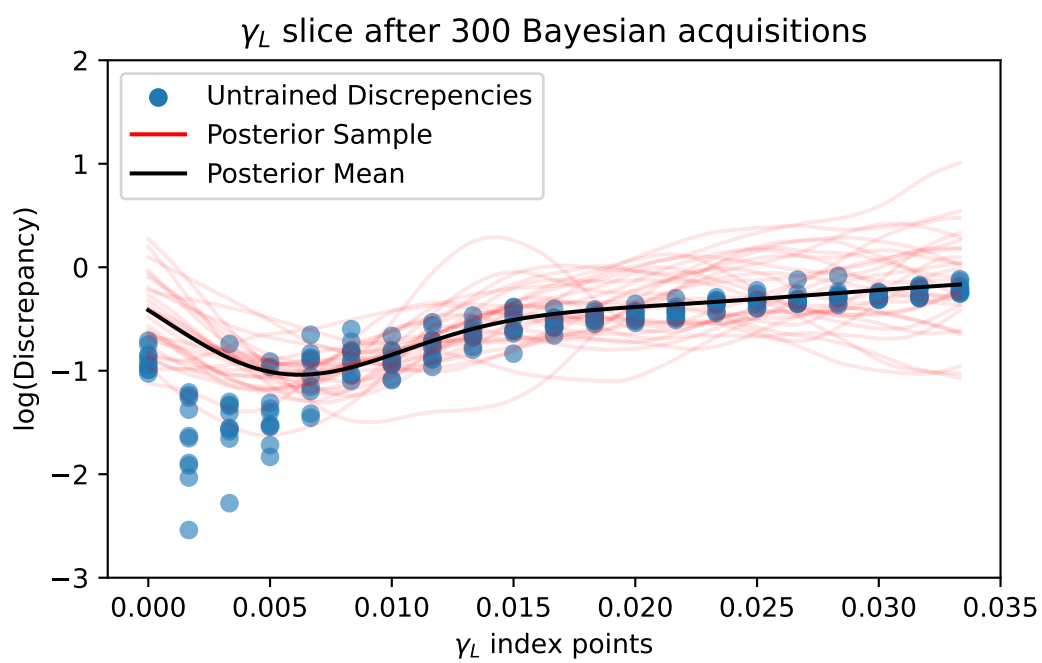
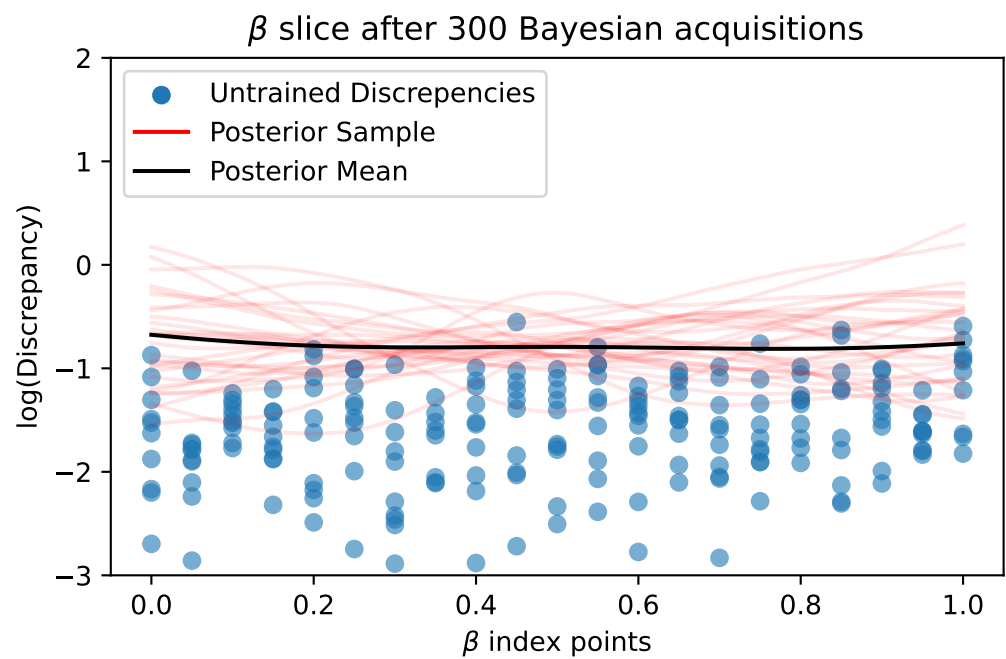


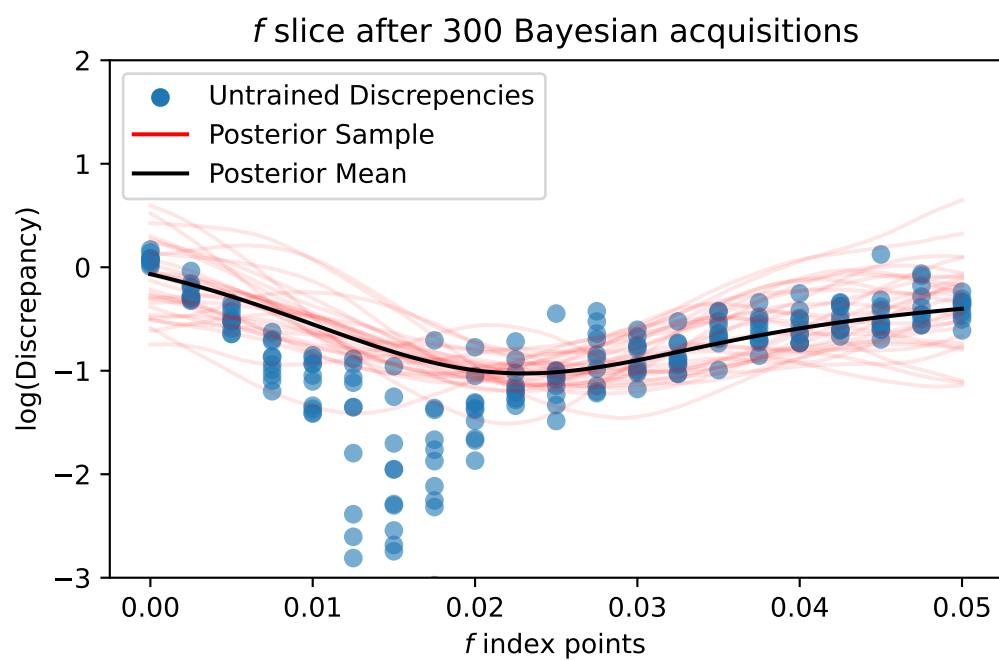
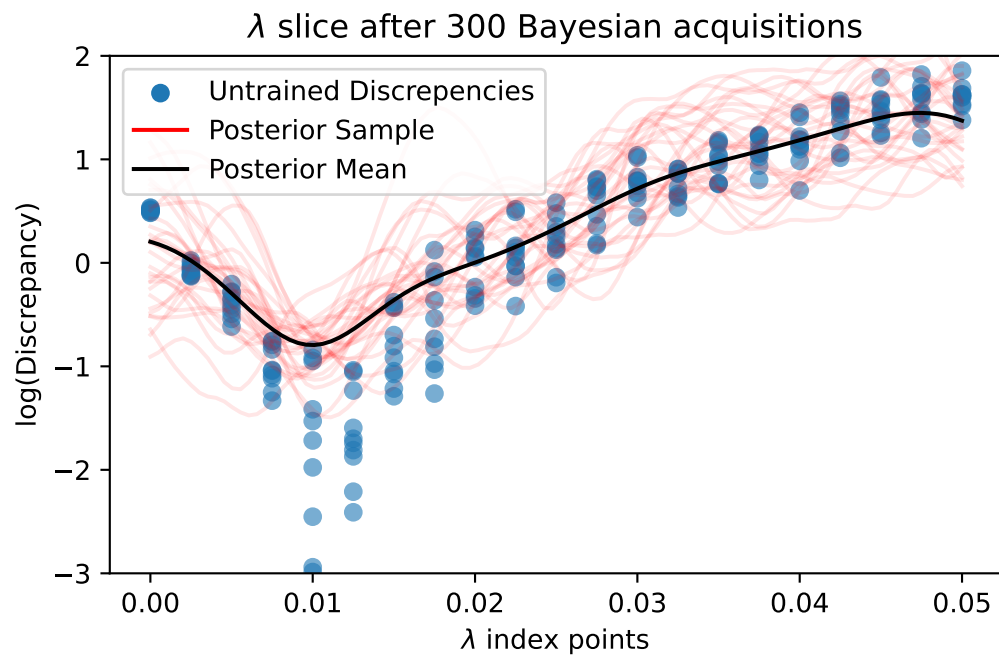


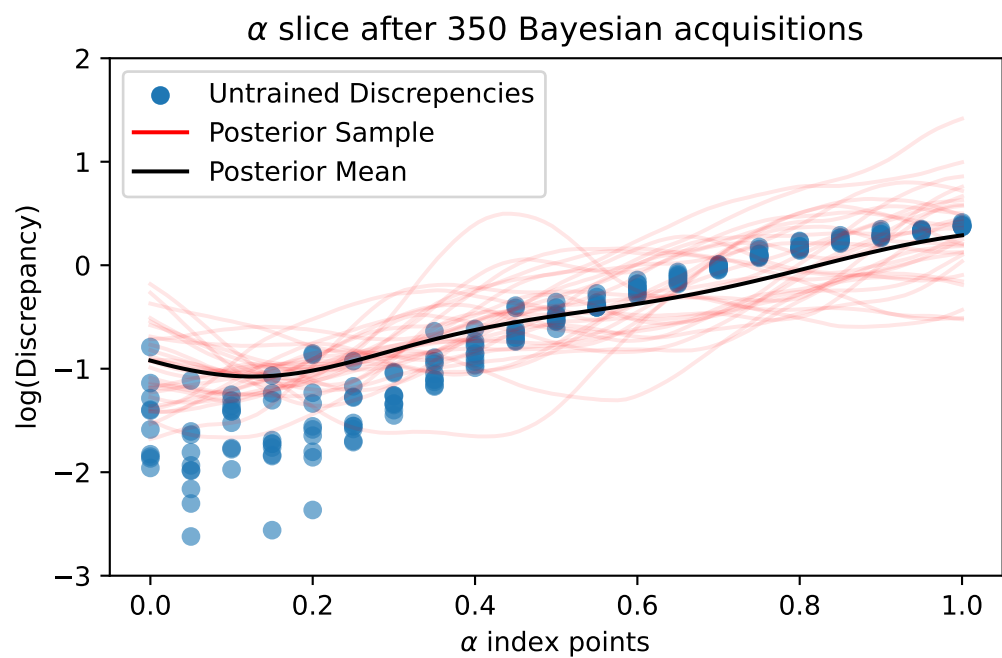
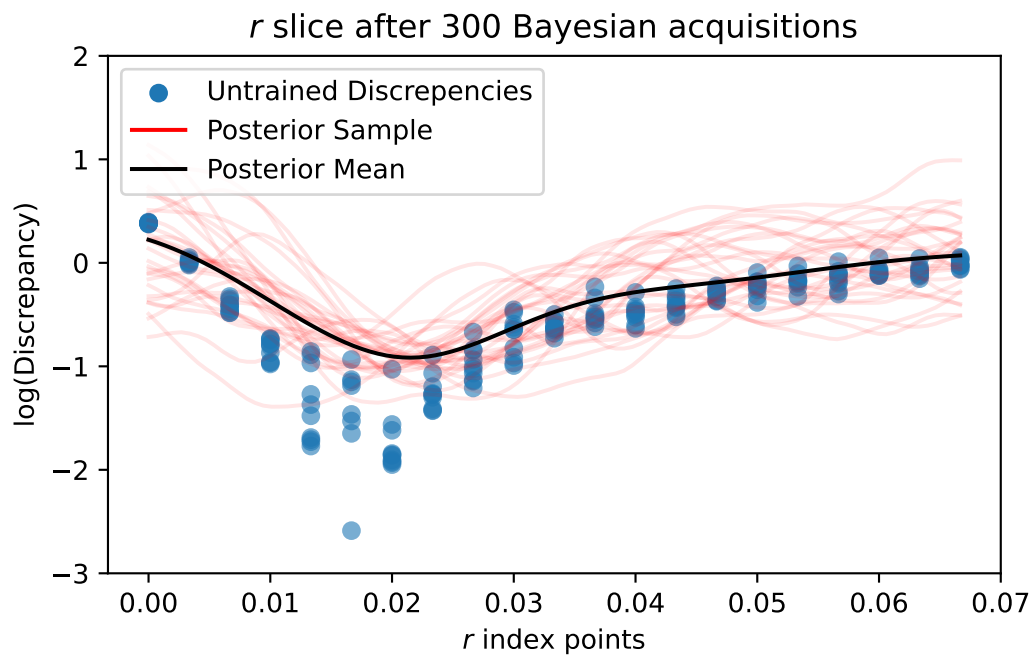


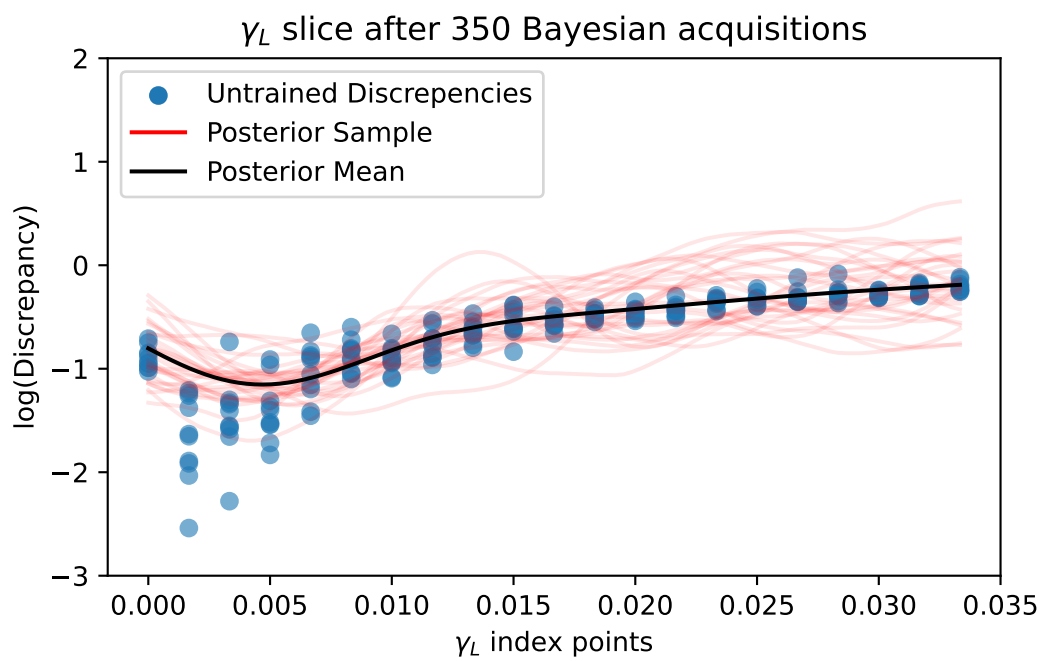
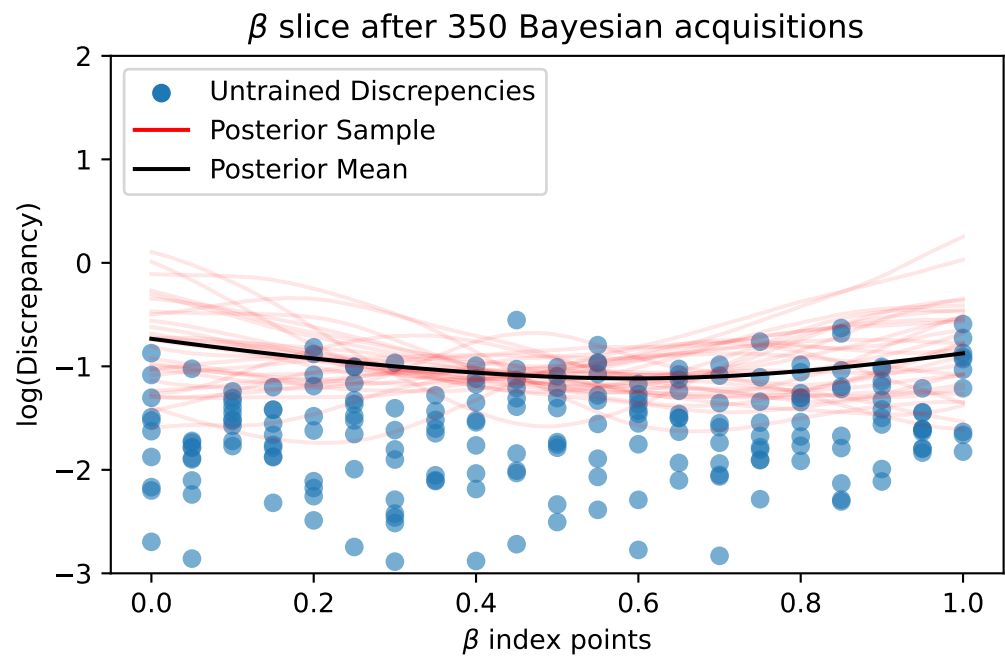


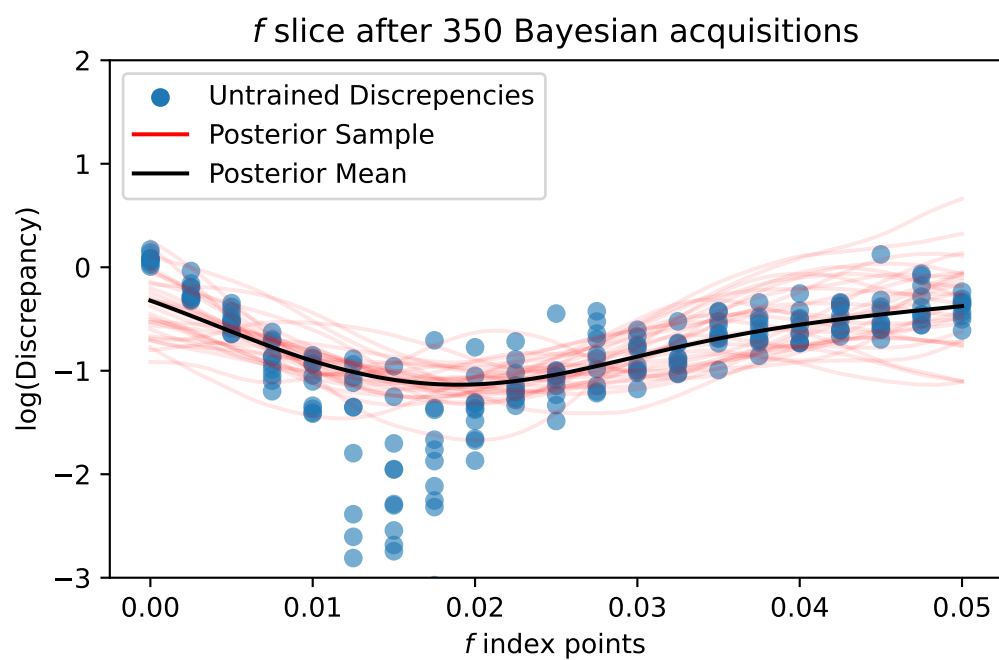
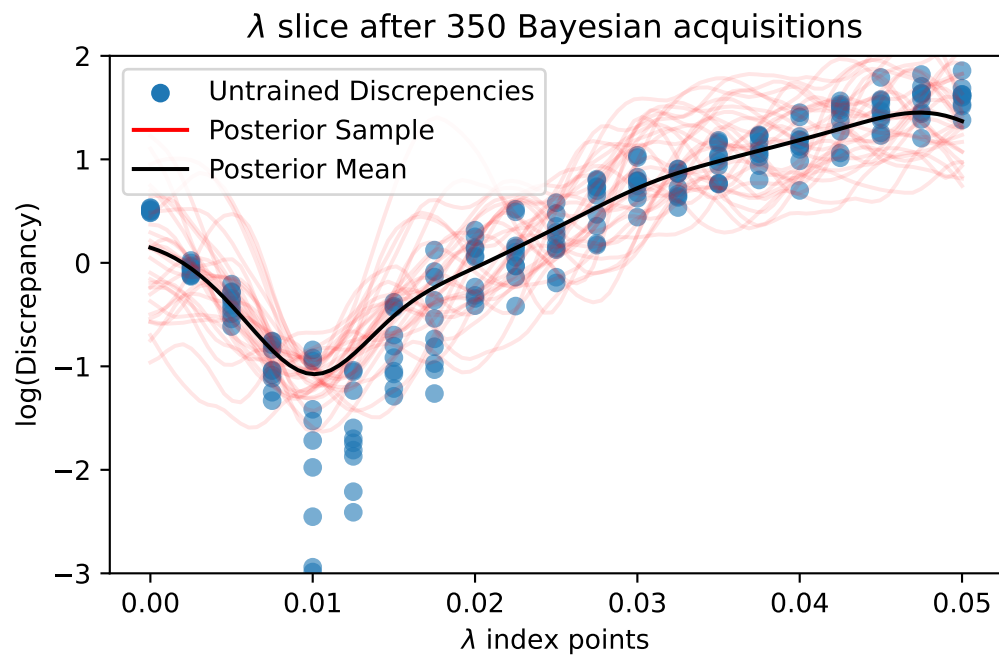


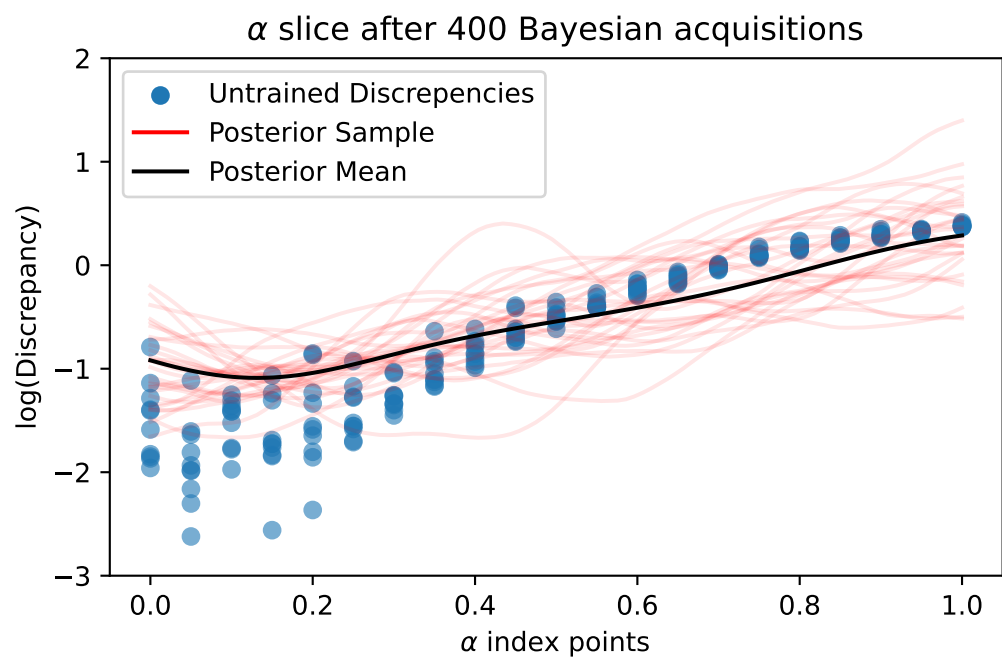
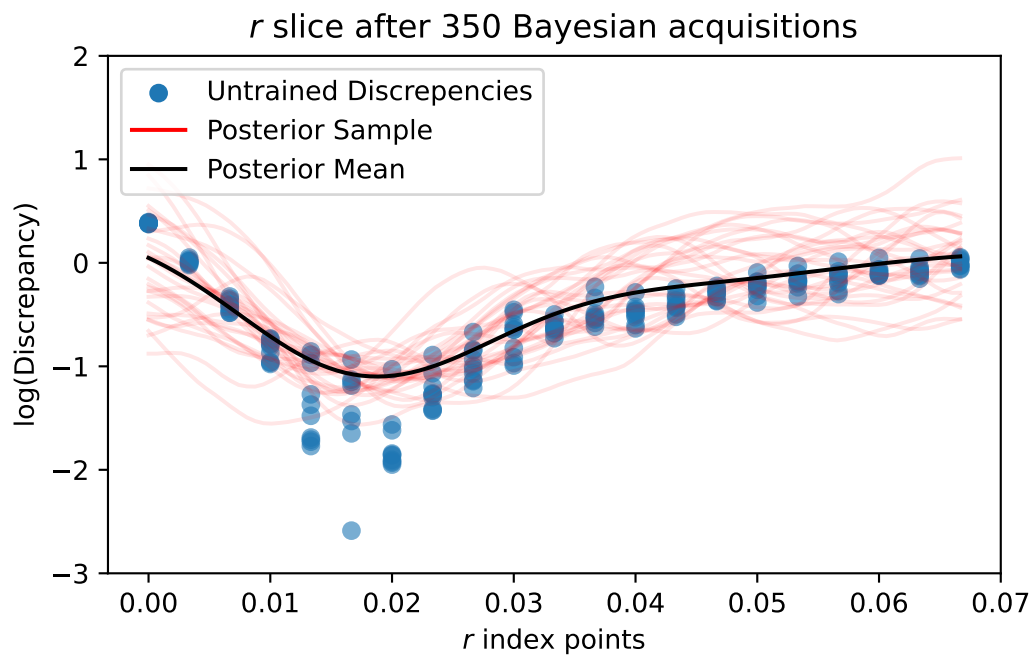


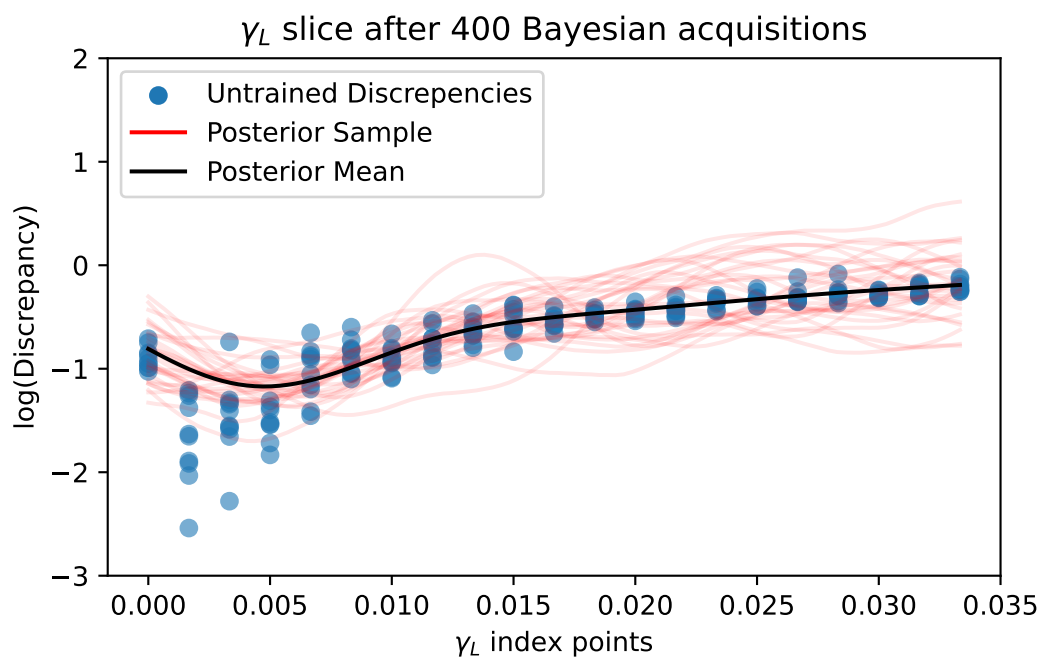
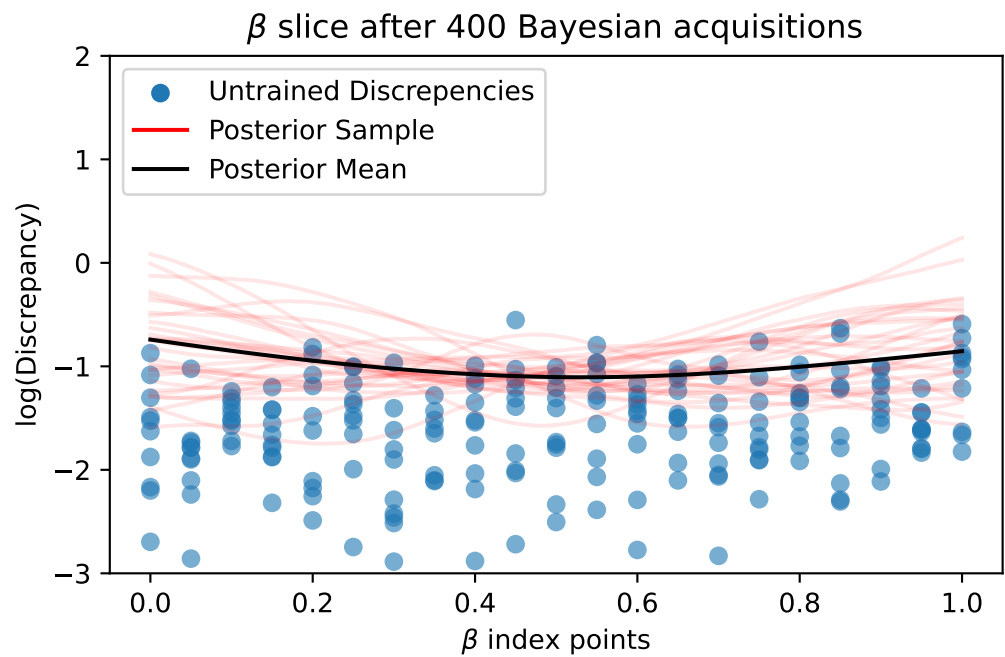


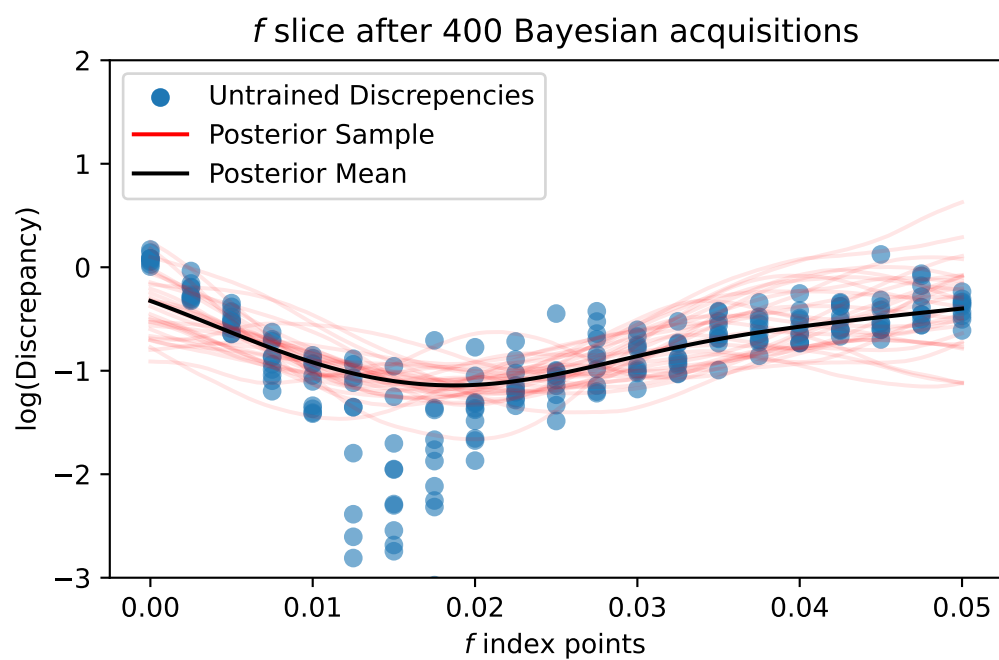
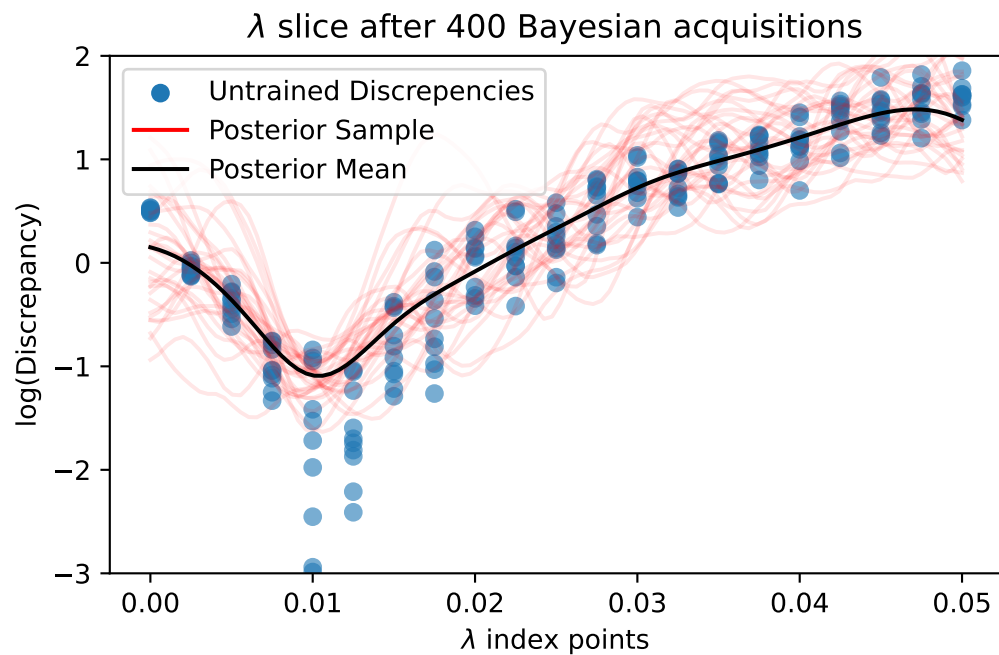


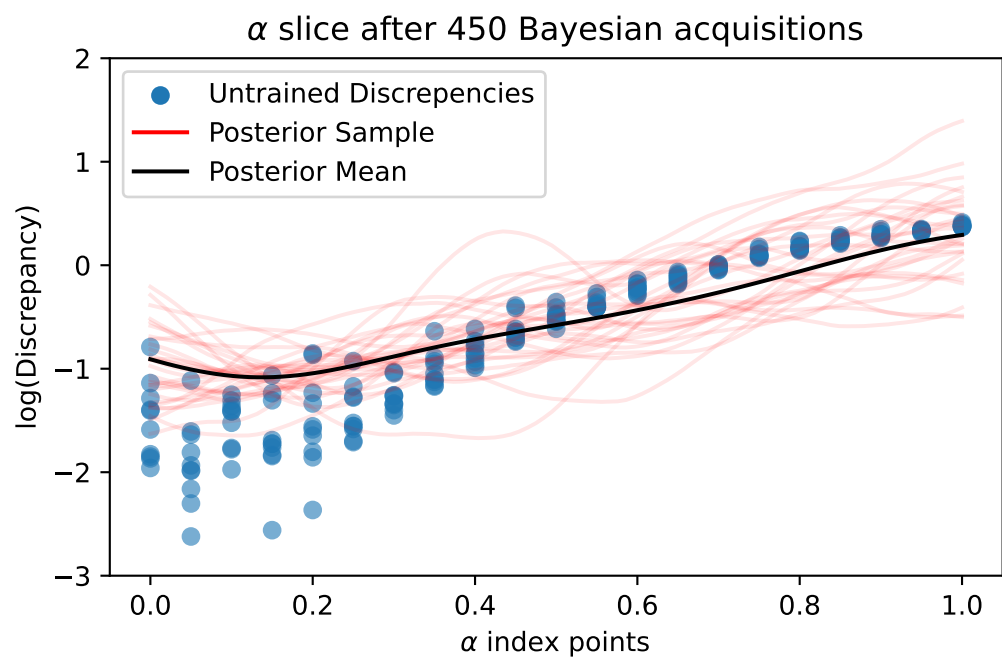
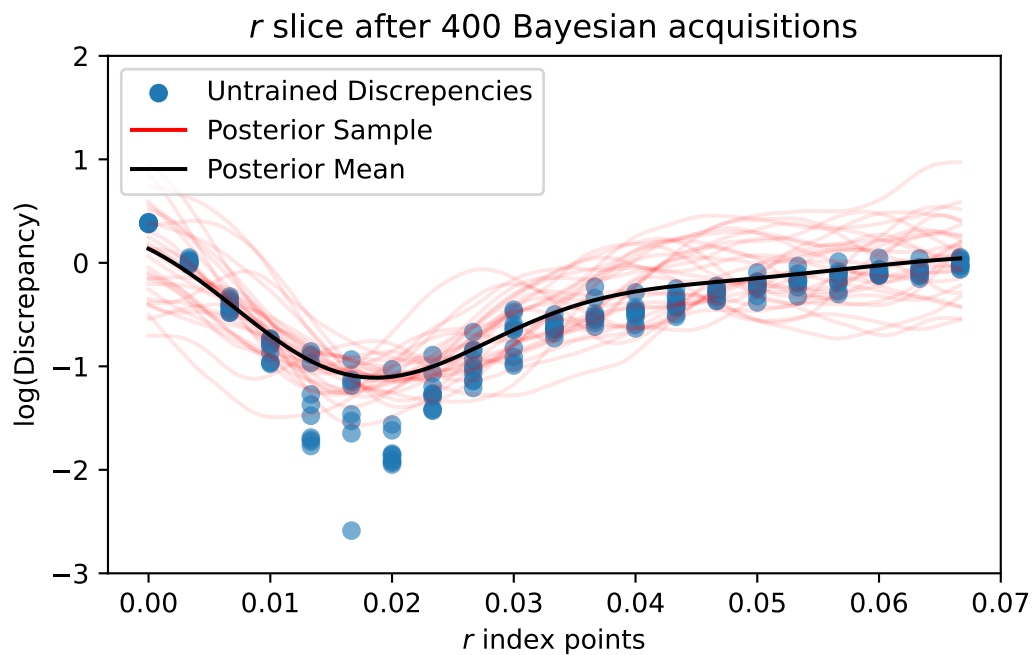


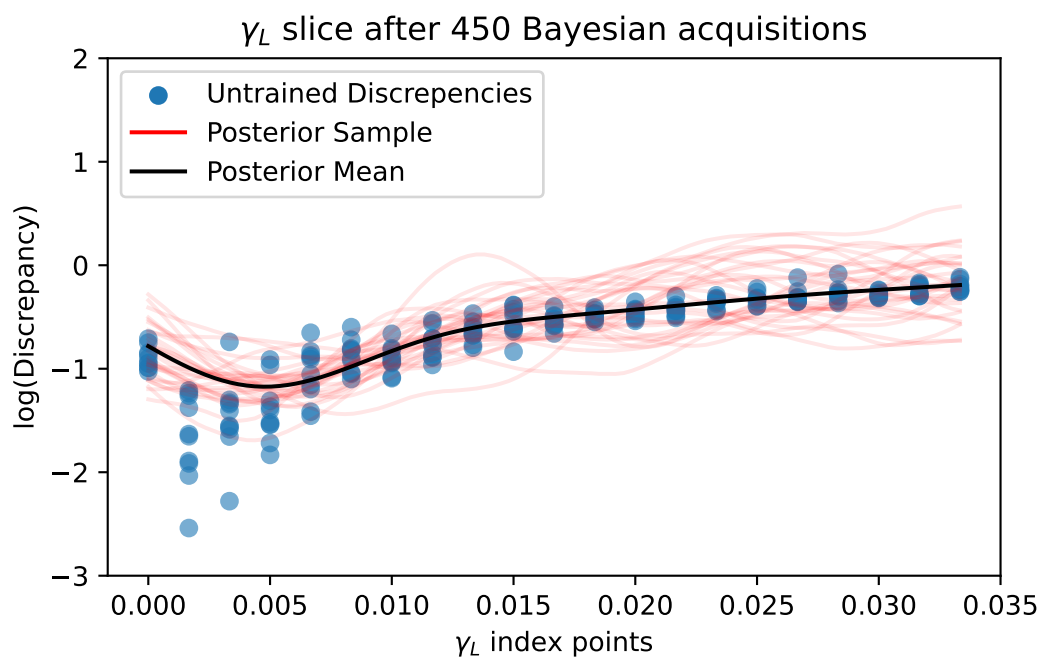
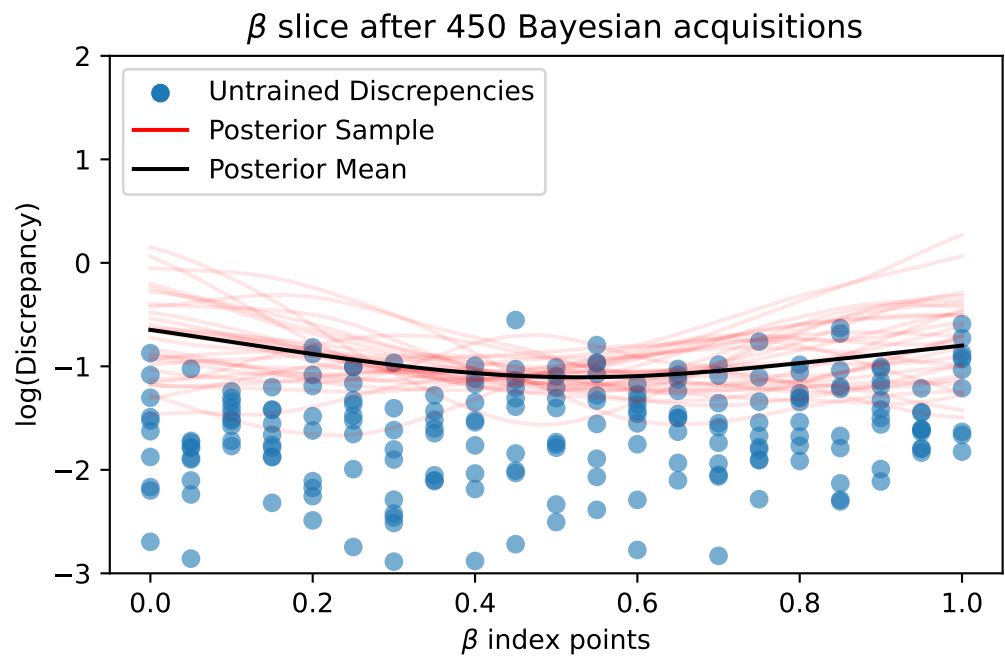


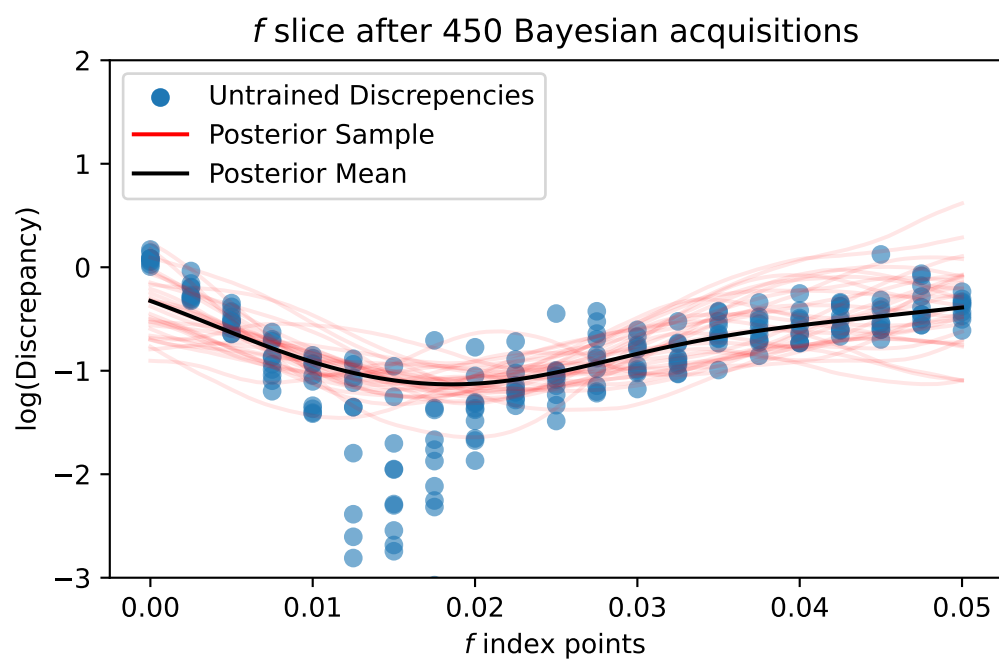
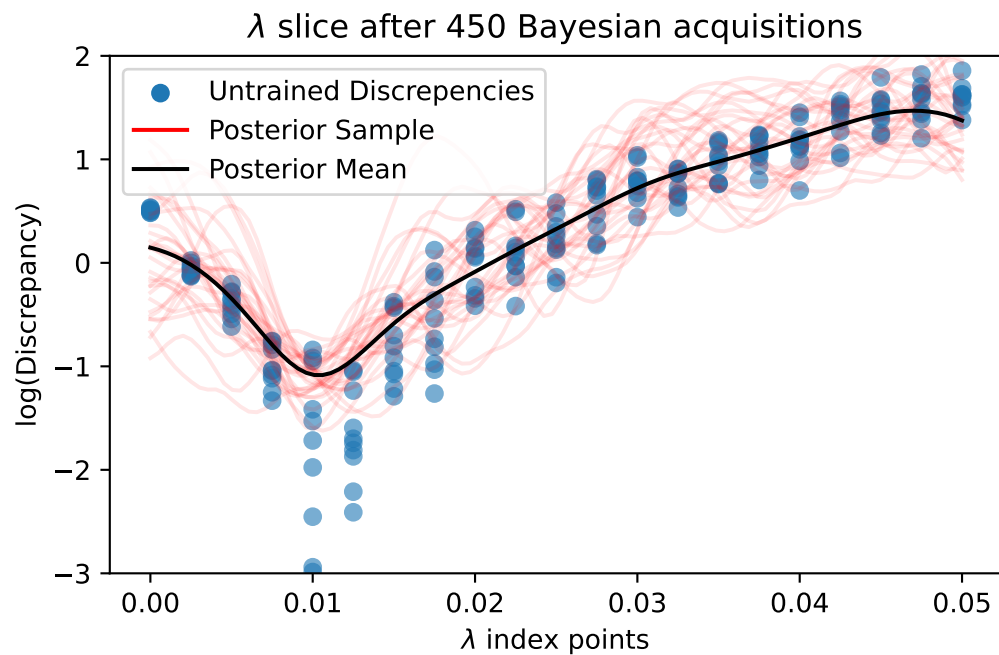


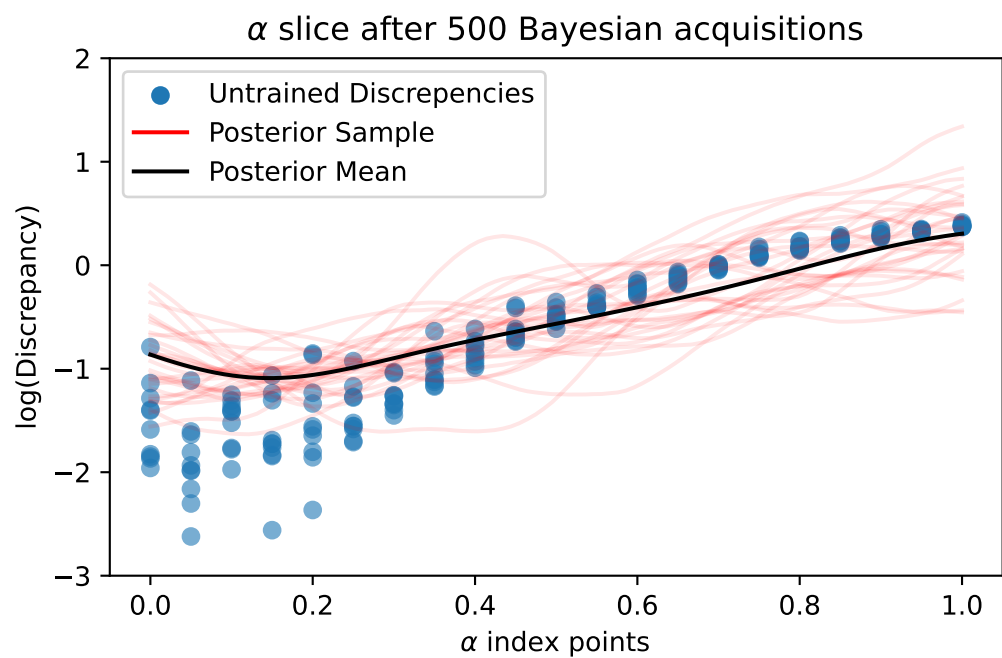
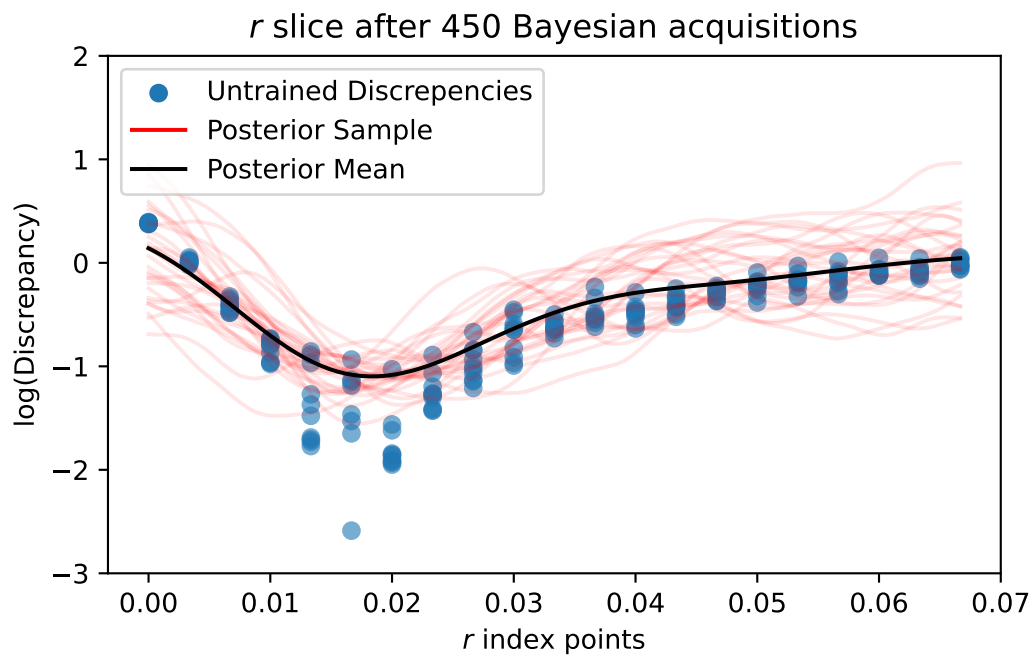


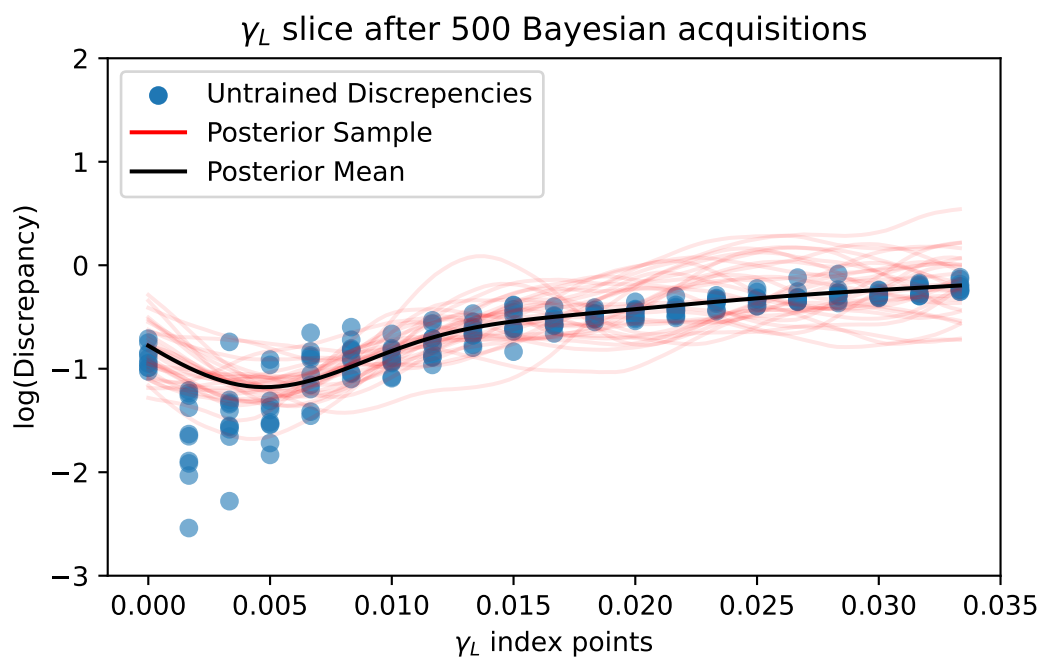
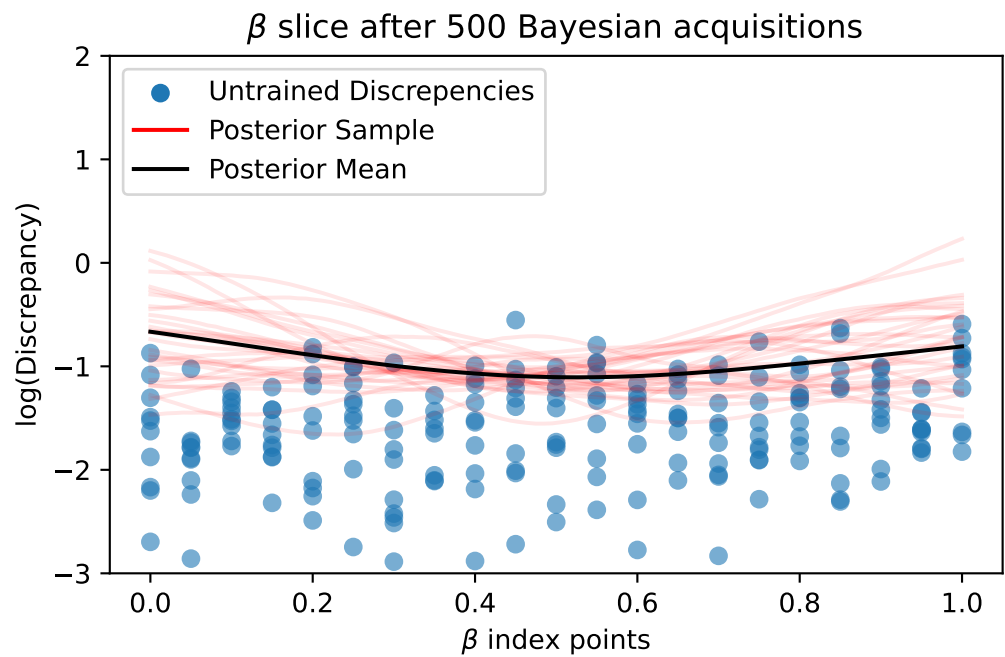


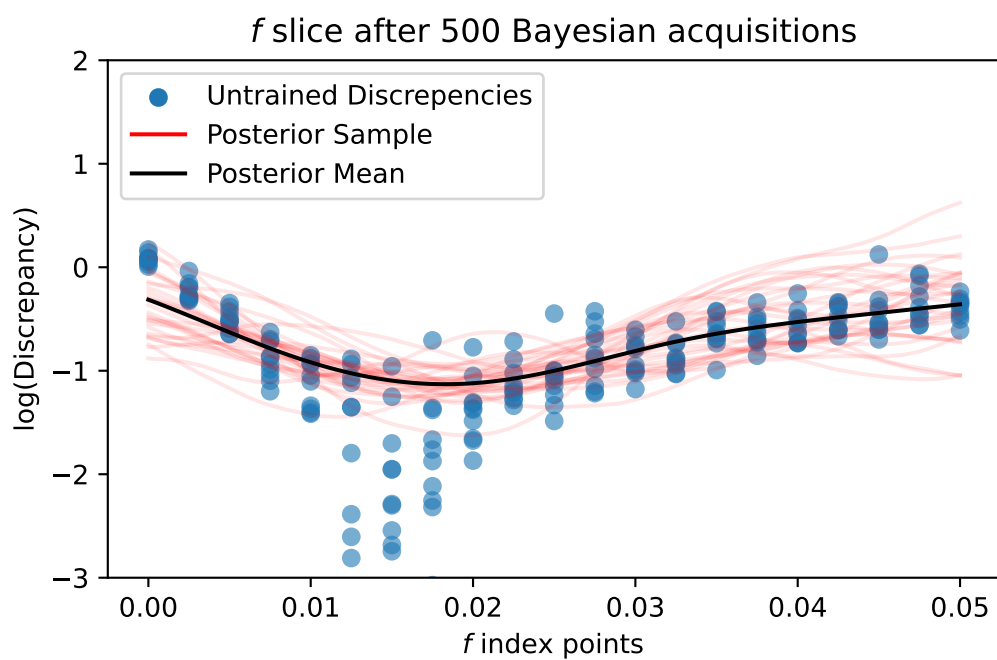
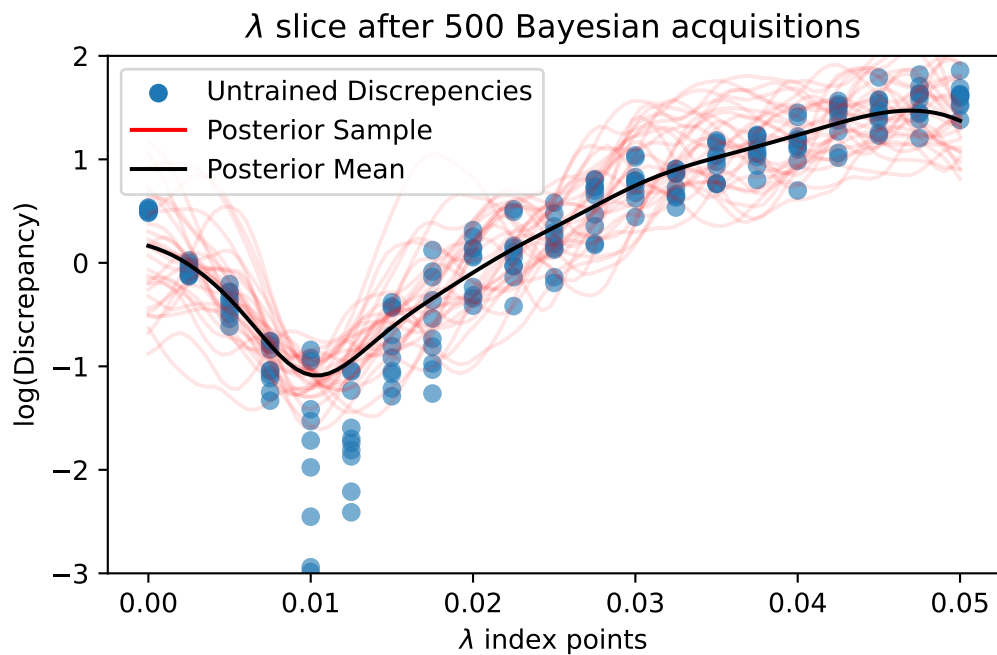


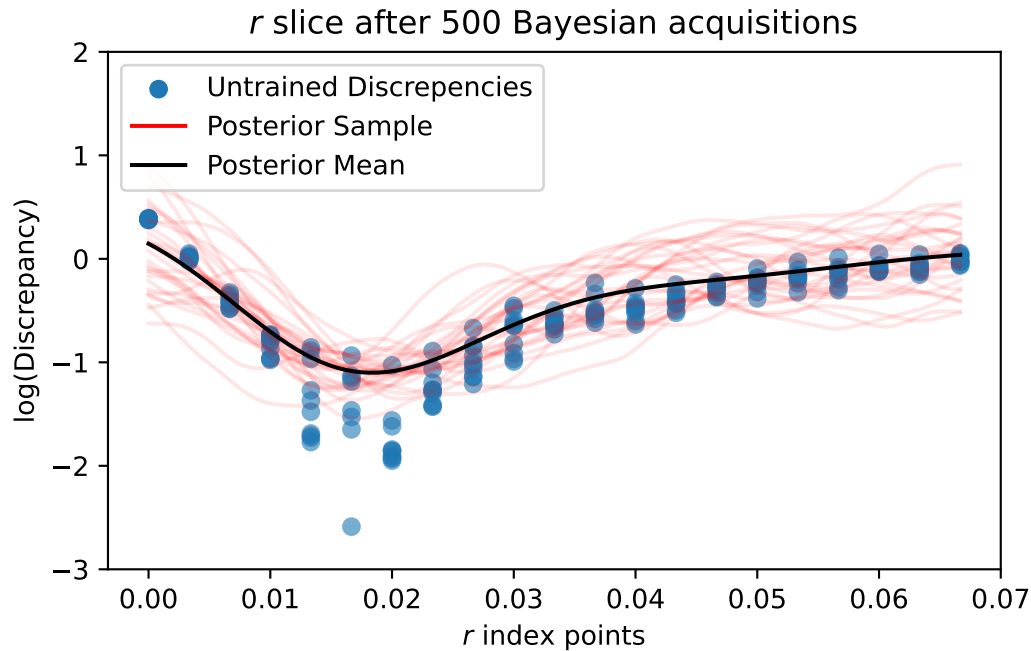












```

epsilon = -10

likelihood_dict = {}
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=const_mean_fn(),
    )

    indices_for_lik = slice_indices_dfs_dict[var + "_gp_indices_df"].values

    mean = champ_GP_reg.mean_fn(indices_for_lik)
    likelihood_dict[var + "_slice_means"] = mean
    variance = dis_mean_n**2 * observation_noise_variance_champ.numpy()
    post_std = np.sqrt(variance)
    log_cdf_vals = tfd.Normal(mean, post_std).log_cdf(epsilon)

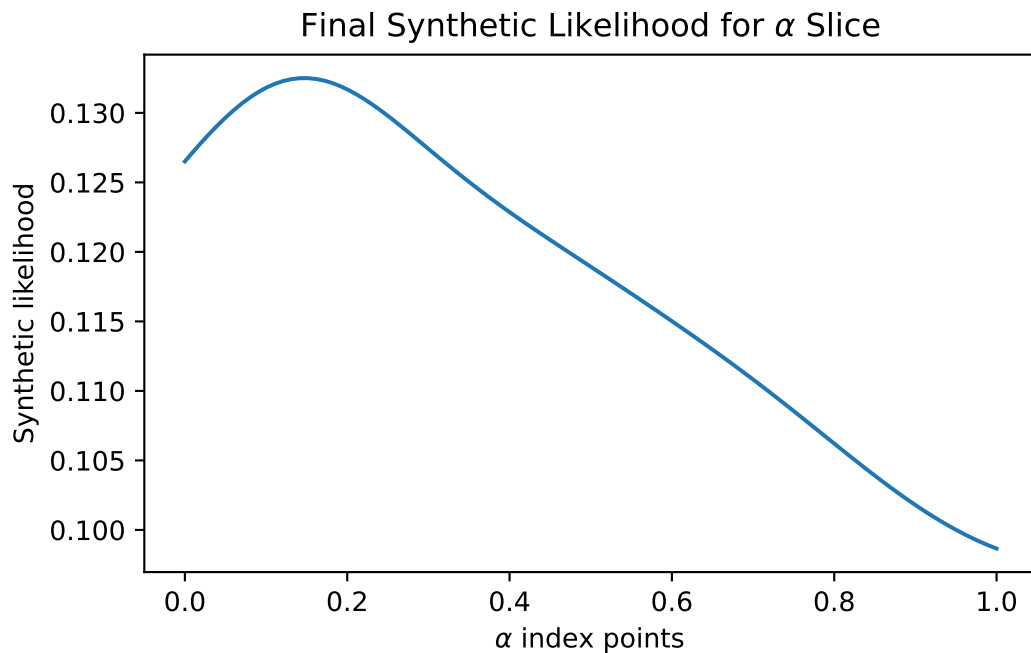
```

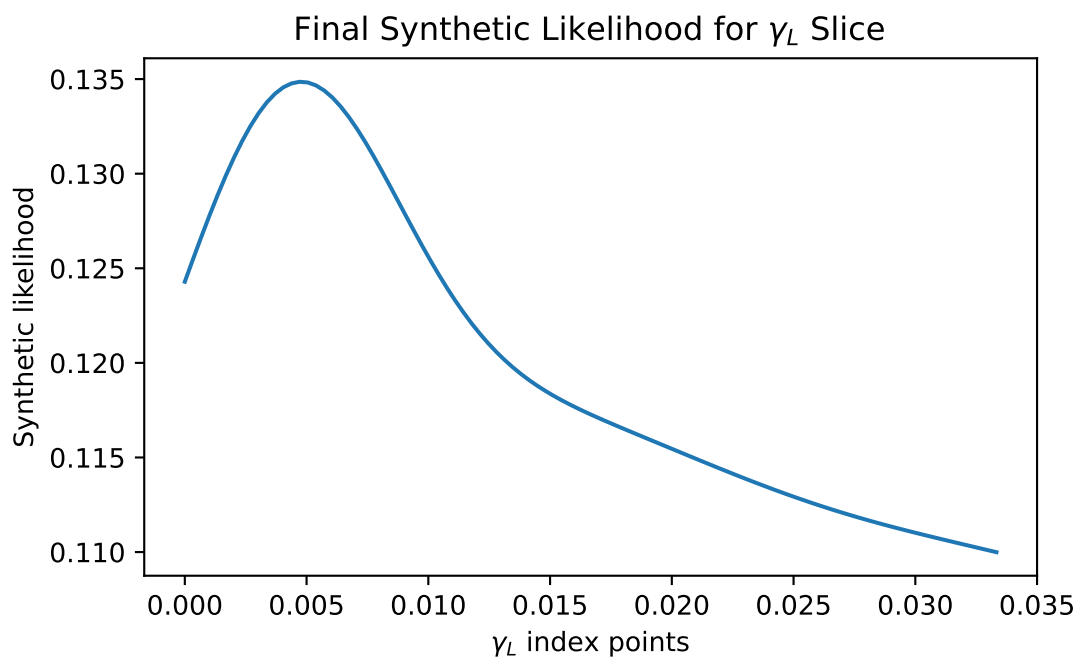
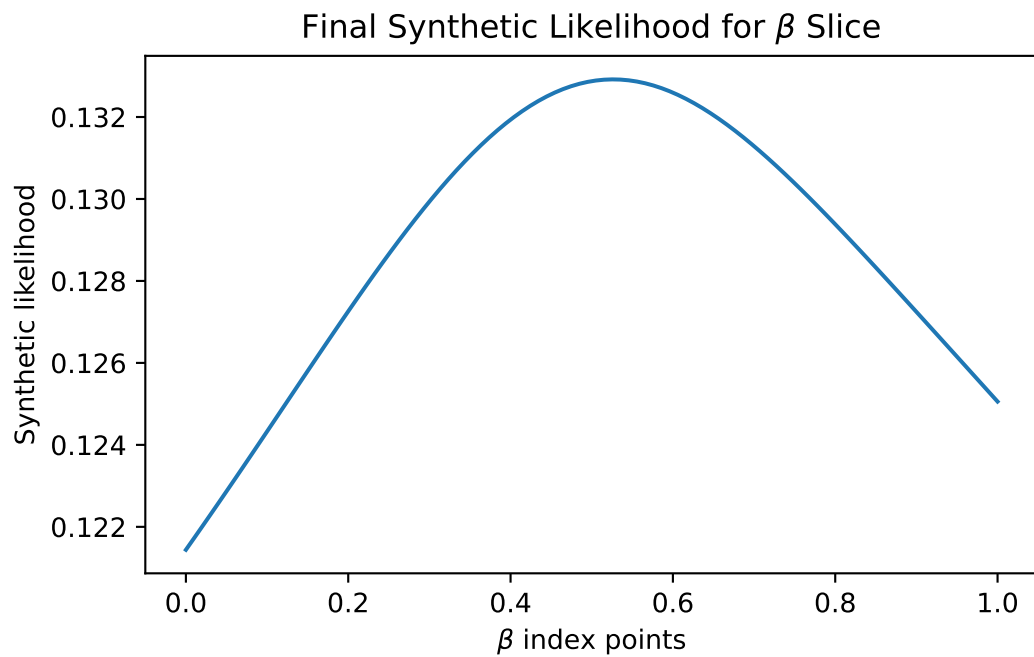
```

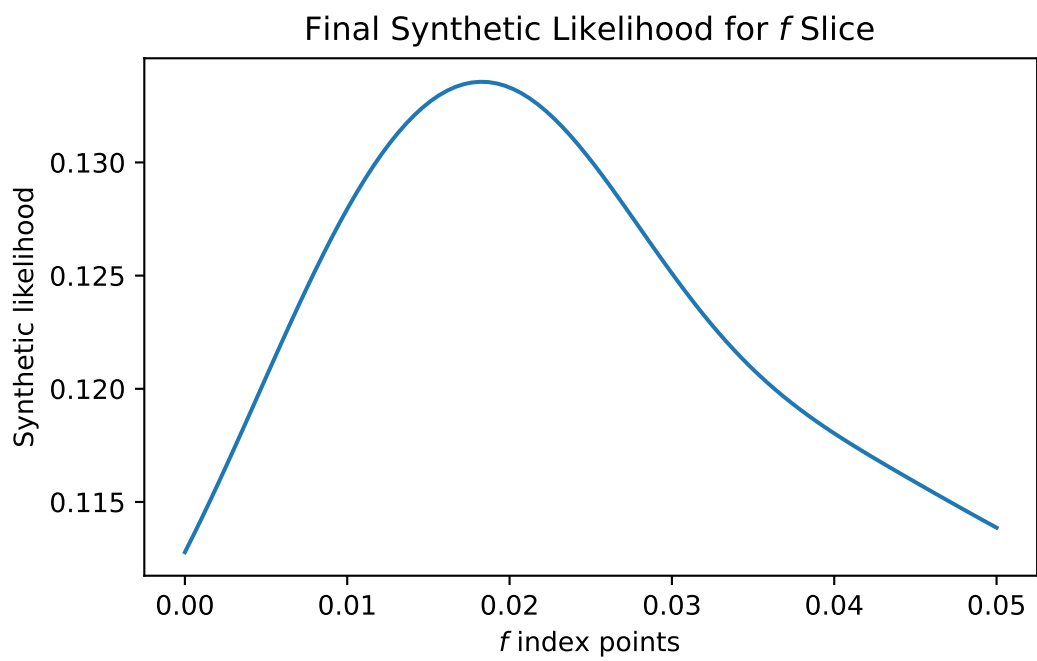
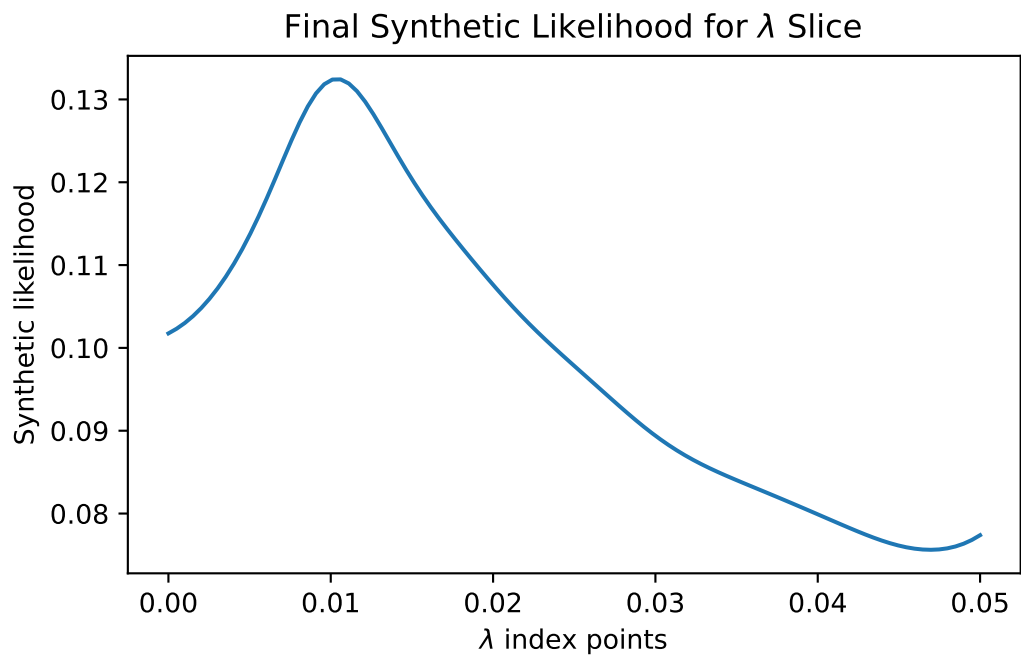
likelihood_dict[var + "_synth_log_lik"] = log_cdf_vals

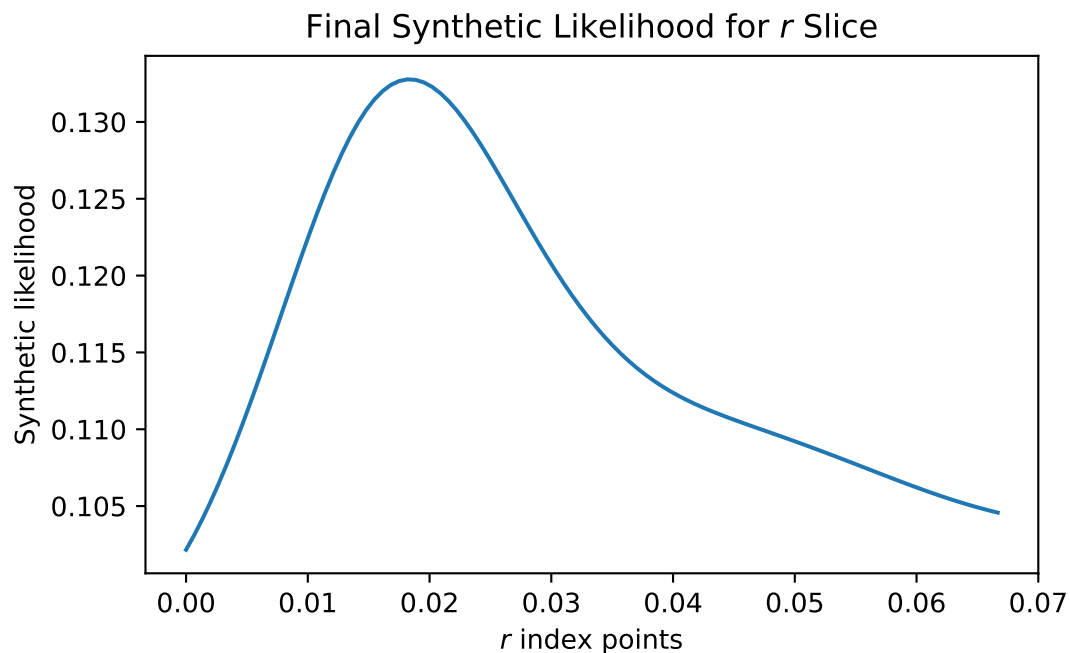
plt.figure(figsize=(6, 3.5))
plt.plot(
    slice_indices_dfs_dict[var + "_gp_indices_df"][var].values,
    np.exp(log_cdf_vals),
)
if var in ["f", "r"]:
    plt.xlabel("$" + var + "$ index points")
    plt.title("Final Synthetic Likelihood for $" + var + "$ Slice")
else:
    plt.xlabel("$\\" + var + "$ index points")
    plt.title("Final Synthetic Likelihood for $\\" + var + "$ Slice")
plt.ylabel("Synthetic likelihood")
plt.savefig(
    "champagne_GP_images/" + var + "_slice_" + str(t) + "_synth_likelihood.pdf"
)
plt.show()

```









```
# print(index_vals[-600,].round(3))
print(index_vals[-400,].round(3))
print(index_vals[-200,].round(3))
print(index_vals[-80,].round(3))
print(index_vals[-40,].round(3))
print(index_vals[-20,].round(3))
print(index_vals[-8,].round(3))
print(index_vals[-4,].round(3))
print(index_vals[-2,].round(3))
print(index_vals[-1,].round(3))
```

```
[0.162 0.689 0.006 0.038 0.003 0.064]
[0.168 0.013 0.01 0.011 0.021 0.038]
[0.138 0.735 0.007 0.01 0.025 0.028]
[0.153 0.411 0.007 0.016 0.024 0.014]
[0.153 0.556 0.022 0.036 0.048 0.028]
[0.781 0.24 0.006 0.01 0.024 0.023]
[0.183 0.96 0.012 0.014 0.047 0.014]
[0.183 0.96 0.023 0.014 0.047 0.014]
[0.183 0.96 0.024 0.014 0.047 0.014]
```

```
objects_to_preserve = [  
    index_vals,  
    discreps,  
    champ_samp,  
    initial_losses_LOOCV,  
    slice_samples_dict,  
    slice_discrepancies_dict,  
    LHC_indices_df,  
    gp_samples_dict,  
    likelihood_dict,  
]  
  
with open("gp_objs.pkl", "wb") as fp:  
    pickle.dump(objects_to_preserve, fp)  
    print("dictionary saved successfully to file")
```

dictionary saved successfully to file