amortized_bouncingball-Copy1

October 27, 2018

In [1]:
```
import numpy as np
import torch.nn as nn
import torch.nn.functional as F
import matplotlib.pyplot as plt
%matplotlib inline
from util_data import *
from util_hmm_variational_gibbs import *
from smc import *
from util_plots import *
from scipy.stats import invwishart, dirichlet
from torch.distributions.dirichlet import Dirichlet
sys.path.append('/home/hao/Research/probtorch/')
from probtorch.util import expand_inputs
import probtorch
print('probtorch:', probtorch.__version__,
      'torch:', torch.__version__,
      'cuda:', torch.cuda.is_available())
```

```
probtorch: 0.0+5a2c637 torch: 0.5.0a0+3bb8c5e cuda: True
```

In [2]:
```
## Dataset parameters
num_series = 1
T = 50
K = 4
D = 2
dt = 10
Boundary = 30
noise_ratio = 0.5

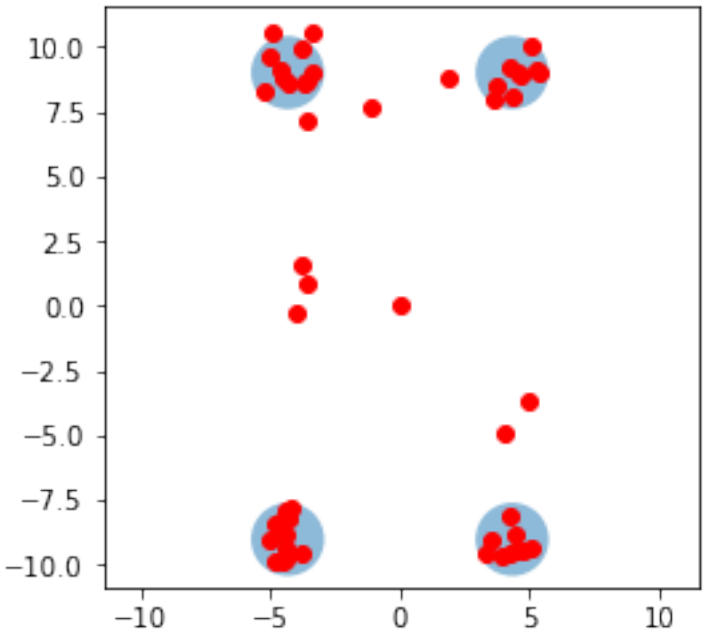
## Model Parameters
num_particles_rws = 50
mcmc_steps = 3
num_particles_smc = 50
NUM_HIDDEN = 128
NUM_LATENTS = K*K
NUM_OBS = 2 * K
```

```
NUM_EPOCHS = 1000
LEARNING_RATE = 1e-3
CUDA = False
```

In [3]:
```
noise_cov = np.array([[1, 0], [0, 1]]) * noise_ratio
init_v = np.random.random(2) * np.random.choice([-1,1], size=2)
v_norm = ((init_v ** 2 ).sum()) ** 0.5 ## compute norm for each initial velocity
init_v = init_v / v_norm * dt ## to make the velocity lying on a circle

STATE, Disp, A_true, Zs_true = generate_seq(T, dt, Boundary, init_v, noise_cov)
## true global variables
cov_true = np.tile(noise_cov, (K, 1, 1))
dirs = np.array([[1, 1], [1, -1], [-1, -1], [-1, 1]])
mu_true = np.tile(np.absolute(init_v), (K, 1)) * dirs
Pi_true = np.ones(K) * (1/K)

plot_clusters(Disp, mu_true, cov_true, K)
Zs_true = torch.from_numpy(Zs_true).float()
cov_ks = torch.from_numpy(cov_true).float()
mu_ks = torch.from_numpy(mu_true).float()
Pi = torch.from_numpy(Pi_true).float()
A_init = torch.from_numpy(A_true).float()
## piror of A
alpha_trans_0 = initial_trans_prior(K)
## Y
Y = torch.from_numpy(Disp).float()
print(mu_true)
```



```
[[ 4.33659344  9.01076897]
 [ 4.33659344 -9.01076897]
 [-4.33659344 -9.01076897]
 [-4.33659344  9.01076897]]
```

In [4]:
```
# A_samples = A_init
# Zs, log_weights, log_normalizer = smc_hmm(Pi, A_samples, mu_ks, cov_ks, Y, T, D, K, nu
# Z_ret = resampling_smc(Zs, log_weights)
# plot_smc_sample(Zs_true, Z_ret)
```

In [5]:
```
## return samples in order to compute the weights and
class Encoder(nn.Module):
    def __init__(self, num_obs=NUM_OBS,
                       num_hidden=NUM_HIDDEN,
                       num_latents=NUM_LATENTS):
        super(self.__class__, self).__init__()
        self.enc_hidden = nn.Sequential(
            nn.Linear(num_obs, num_hidden),
            nn.ReLU(),
            nn.Linear(num_hidden, num_hidden),
            nn.ReLU())
        self.latent_dir = nn.Sequential(
            nn.Linear(num_hidden, num_latents))

    def forward(self, obs, prior_sum, T):
        A_samples = torch.zeros((K, K))
        hidden = self.enc_hidden(obs)
        latents_dirs = torch.exp(self.latent_dir(hidden)).sum(0).view(K, K)
        latents_dirs_norm = latents_dirs / latents_dirs.sum() * (prior_sum + T-1)
        for k in range(K):
            A_samples[k] = Dirichlet(latents_dirs_norm[k]).sample()
        return latents_dirs_norm, A_samples
```

In [6]:
```
def initialize():
    enc = Encoder()
    if CUDA:
        enc.cuda()
    optimizer =  torch.optim.Adam(list(enc.parameters()),lr=LEARNING_RATE)
    return enc, optimizer
enc, optimizer = initialize()
```

In [7]:
```
KLs = []
EUBOs = []
log_p_conds = []
log_qs = []
```

```
ESSs = []

for epoch in range(NUM_EPOCHS):
    time_start = time.time()
    optimizer.zero_grad()
    init_v = np.random.random(2) * np.random.choice([-1,1], size=2)
    v_norm = ((init_v ** 2 ).sum()) ** 0.5 ## compute norm for each initial velocity
    init_v = init_v / v_norm * dt ## to make the velocity lying on a circle
    T = np.random.randint(30, 50)
    STATE, Disp, A_true, Zs_true = generate_seq(T, dt, Boundary, init_v, noise_cov)
    ## true global variables
    cov_true = np.tile(noise_cov, (K, 1, 1))
    dirs = np.array([[1, 1], [1, -1], [-1, -1], [-1, 1]])
    mu_true = np.tile(np.absolute(init_v), (K, 1)) * dirs
    Pi_true = np.ones(K) * (1/K)
    cov_ks = torch.from_numpy(cov_true).float()
    mu_ks = torch.from_numpy(mu_true).float()
    Pi = torch.from_numpy(Pi_true).float()
    A_init = initial_trans(alpha_trans_0, K)
#     A_init = torch.from_numpy(A_true).float()
    alpha_trans_0 = initial_trans_prior(K)
    Y = torch.from_numpy(Disp).float()


    enc, loss_infer, eubo, kl, ess, latents_dirs, Z_ret = rws(enc, A_init, alpha_trans_0
#     kl_est = torch.mul(weights_rws, log_p_conds - log_qs).sum().detach().item()
    log_q = - loss_infer
    eubo.backward()
    KLs.append(kl.item())
    EUBOs.append(eubo)
    ESSs.append(ess)
    log_qs.append(log_q)
    optimizer.step()
#     A_samples = A_samples.detach()
    time_end = time.time()
    print('epoch : %d, eubo : %f, log_q : %f, KL : %f (%ds)' % (epoch, eubo, log_q, kl,
```

```
epoch : 0, eubo : -298.273804, log_q : 9.448774, KL : 37.554684 (28s)
epoch : 1, eubo : -490.380280, log_q : 7.841568, KL : 44.095093 (35s)
epoch : 2, eubo : -261.754333, log_q : 12.575440, KL : 37.145733 (31s)
epoch : 3, eubo : -332.655853, log_q : 11.576880, KL : 40.200768 (35s)
epoch : 4, eubo : -571.242920, log_q : 9.155947, KL : 41.643127 (39s)
epoch : 5, eubo : -277.523865, log_q : 10.106085, KL : 32.591038 (28s)
epoch : 6, eubo : -366.486145, log_q : 6.913643, KL : 39.167252 (36s)
epoch : 7, eubo : -616.914185, log_q : 14.492699, KL : 48.515911 (38s)
epoch : 8, eubo : -448.479767, log_q : 8.628434, KL : 30.490988 (30s)
epoch : 9, eubo : -345.232086, log_q : 13.066997, KL : 31.915226 (32s)
epoch : 10, eubo : -370.199799, log_q : 9.582536, KL : 26.152922 (25s)
```

```
epoch : 11, eubo : -436.706696, log_q : 11.051342, KL : 38.898109 (36s)
epoch : 12, eubo : -348.371246, log_q : 10.074614, KL : 32.379608 (33s)
epoch : 13, eubo : -480.040161, log_q : 10.438270, KL : 32.218891 (33s)
epoch : 14, eubo : -407.904175, log_q : 9.920262, KL : 34.424419 (34s)
epoch : 15, eubo : -428.299500, log_q : 9.410131, KL : 23.161238 (31s)
epoch : 16, eubo : -600.395996, log_q : 11.753858, KL : 14.312126 (37s)
epoch : 17, eubo : -284.395874, log_q : 12.773524, KL : 24.567400 (30s)
epoch : 18, eubo : -367.975922, log_q : 9.681188, KL : 24.811420 (27s)
epoch : 19, eubo : -457.217896, log_q : 12.771615, KL : 24.097775 (35s)
epoch : 20, eubo : -386.769775, log_q : 12.547107, KL : 16.340925 (27s)
epoch : 21, eubo : -409.202789, log_q : 8.284793, KL : 27.417143 (37s)
epoch : 22, eubo : -339.983215, log_q : 12.647115, KL : 15.513058 (26s)
epoch : 23, eubo : -285.942444, log_q : 12.102280, KL : 16.122839 (28s)
epoch : 24, eubo : -401.777710, log_q : 10.024640, KL : 20.674156 (34s)
epoch : 25, eubo : -325.850952, log_q : 12.475881, KL : 11.706086 (27s)
epoch : 26, eubo : -286.887756, log_q : 11.391227, KL : 9.678822 (23s)
epoch : 27, eubo : -257.786987, log_q : 11.176572, KL : 7.379326 (24s)
epoch : 28, eubo : -287.675232, log_q : 14.568459, KL : 8.626765 (25s)
epoch : 29, eubo : -683.997925, log_q : 12.000840, KL : 10.420929 (32s)
epoch : 30, eubo : -339.498627, log_q : 14.674341, KL : 6.406673 (28s)
epoch : 31, eubo : -409.171021, log_q : 10.228552, KL : 7.819756 (36s)
epoch : 32, eubo : -353.599915, log_q : 14.854986, KL : 4.339269 (31s)
epoch : 33, eubo : -352.446472, log_q : 14.806960, KL : 3.372931 (25s)
epoch : 34, eubo : -340.176971, log_q : 16.892445, KL : 1.385369 (37s)
epoch : 35, eubo : -394.093658, log_q : 17.647495, KL : 3.994424 (31s)
epoch : 36, eubo : -391.252167, log_q : 17.576859, KL : 1.057769 (27s)
epoch : 37, eubo : -496.810730, log_q : 18.793627, KL : 2.012038 (39s)
epoch : 38, eubo : -472.553131, log_q : 16.517998, KL : 6.994607 (29s)
epoch : 39, eubo : -356.345032, log_q : 18.052383, KL : 5.156797 (33s)
epoch : 40, eubo : -398.808807, log_q : 16.141459, KL : 3.524261 (38s)
epoch : 41, eubo : -289.420685, log_q : 18.602627, KL : 9.376857 (26s)
epoch : 42, eubo : -385.281433, log_q : 19.383808, KL : 3.369222 (32s)
epoch : 43, eubo : -296.491180, log_q : 18.284466, KL : 3.676613 (24s)
epoch : 44, eubo : -326.907043, log_q : 18.148472, KL : 3.640398 (26s)
epoch : 45, eubo : -280.118286, log_q : 18.716583, KL : 4.846742 (32s)
epoch : 46, eubo : -357.868713, log_q : 17.450180, KL : 7.438820 (25s)
epoch : 47, eubo : -287.070801, log_q : 16.296049, KL : 2.238043 (32s)
epoch : 48, eubo : -417.879517, log_q : 18.406487, KL : 2.401223 (33s)
epoch : 49, eubo : -387.245728, log_q : 15.466473, KL : 2.425316 (30s)
epoch : 50, eubo : -343.886749, log_q : 16.146608, KL : 2.649437 (31s)
epoch : 51, eubo : -528.566711, log_q : 18.675173, KL : 3.640340 (38s)
epoch : 52, eubo : -553.850220, log_q : 16.037279, KL : 5.659231 (28s)
epoch : 53, eubo : -494.313080, log_q : 17.983601, KL : 4.497597 (34s)
epoch : 54, eubo : -393.456055, log_q : 14.339174, KL : 2.009734 (27s)
epoch : 55, eubo : -331.033142, log_q : 16.037432, KL : 1.671190 (27s)
epoch : 56, eubo : -451.314514, log_q : 17.008963, KL : 1.566726 (35s)
epoch : 57, eubo : -466.696075, log_q : 16.506720, KL : 1.896669 (31s)
epoch : 58, eubo : -244.407318, log_q : 16.066725, KL : 1.662532 (25s)
```

```
epoch : 59, eubo : -381.627899, log_q : 17.465357, KL : 1.745288 (35s)
epoch : 60, eubo : -317.830566, log_q : 15.587760, KL : 4.539798 (28s)
epoch : 61, eubo : -355.538300, log_q : 10.042151, KL : 3.392144 (29s)
epoch : 62, eubo : -455.324829, log_q : 13.651762, KL : 2.531496 (26s)
epoch : 63, eubo : -374.530823, log_q : 16.996645, KL : 5.559757 (36s)
epoch : 64, eubo : -302.814911, log_q : 17.479437, KL : 2.049828 (30s)
epoch : 65, eubo : -376.412781, log_q : 15.783342, KL : 2.452813 (28s)
epoch : 66, eubo : -402.807037, log_q : 16.264915, KL : 2.990363 (23s)
epoch : 67, eubo : -641.640930, log_q : 17.228092, KL : 3.943035 (30s)
epoch : 68, eubo : -466.453339, log_q : 16.822220, KL : 2.401042 (24s)
epoch : 69, eubo : -410.784637, log_q : 16.331686, KL : 1.441466 (34s)
epoch : 70, eubo : -339.565582, log_q : 16.685040, KL : 2.815962 (31s)
epoch : 71, eubo : -344.680817, log_q : 14.616891, KL : 1.680296 (26s)
epoch : 72, eubo : -252.058273, log_q : 16.641411, KL : 3.159987 (24s)
epoch : 73, eubo : -319.933289, log_q : 16.072790, KL : 1.375196 (32s)
epoch : 74, eubo : -400.856659, log_q : 17.829609, KL : 2.896039 (33s)
epoch : 75, eubo : -456.893005, log_q : 17.613752, KL : 1.381824 (35s)
epoch : 76, eubo : -382.274567, log_q : 18.358166, KL : 0.911667 (37s)
epoch : 77, eubo : -330.942932, log_q : 17.642523, KL : 2.035800 (28s)
epoch : 78, eubo : -407.841736, log_q : 17.718170, KL : 0.695275 (32s)
epoch : 79, eubo : -345.640137, log_q : 15.094039, KL : 2.524614 (29s)
epoch : 80, eubo : -350.247498, log_q : 11.111247, KL : 8.214913 (33s)
epoch : 81, eubo : -358.107361, log_q : 18.485041, KL : 2.346084 (34s)
epoch : 82, eubo : -353.428375, log_q : 18.925713, KL : 1.421503 (27s)
epoch : 83, eubo : -353.344360, log_q : 14.062432, KL : 3.906918 (27s)
epoch : 84, eubo : -414.427368, log_q : 18.123720, KL : 2.103130 (32s)
epoch : 85, eubo : -578.732361, log_q : 16.506887, KL : 5.615972 (38s)
epoch : 86, eubo : -395.637695, log_q : 13.435905, KL : 2.000355 (28s)
epoch : 87, eubo : -309.097412, log_q : 16.160072, KL : 3.910518 (27s)
epoch : 88, eubo : -337.572815, log_q : 18.513956, KL : 2.237223 (27s)
epoch : 89, eubo : -263.534302, log_q : 15.028343, KL : 2.017335 (29s)
epoch : 90, eubo : -456.594482, log_q : 16.503311, KL : 2.918827 (38s)
epoch : 91, eubo : -271.482025, log_q : 16.774843, KL : 1.790133 (25s)
epoch : 92, eubo : -341.940063, log_q : 16.571249, KL : 2.885595 (24s)
epoch : 93, eubo : -319.229675, log_q : 16.238831, KL : 1.986996 (25s)
epoch : 94, eubo : -356.542053, log_q : 19.823097, KL : 2.429285 (29s)
epoch : 95, eubo : -305.528961, log_q : 14.598892, KL : 2.737179 (24s)
epoch : 96, eubo : -311.743896, log_q : 15.539683, KL : 1.981552 (25s)
epoch : 97, eubo : -325.082733, log_q : 15.567098, KL : 3.668419 (30s)
epoch : 98, eubo : -508.818542, log_q : 16.708298, KL : 4.176743 (29s)
epoch : 99, eubo : -292.456696, log_q : 17.669525, KL : 2.020574 (29s)
epoch : 100, eubo : -308.095612, log_q : 15.086339, KL : 5.232762 (38s)
epoch : 101, eubo : -295.648743, log_q : 14.562576, KL : 1.279030 (24s)
epoch : 102, eubo : -372.525879, log_q : 15.095675, KL : 2.364120 (25s)
epoch : 103, eubo : -331.955170, log_q : 17.299168, KL : 3.364976 (32s)
epoch : 104, eubo : -370.413727, log_q : 15.709971, KL : 4.547471 (33s)
epoch : 105, eubo : -464.268097, log_q : 15.439687, KL : 2.926134 (24s)
epoch : 106, eubo : -248.192780, log_q : 16.169588, KL : 3.570449 (25s)
```

```
epoch : 107, eubo : -398.489899, log_q : 17.303804, KL : 3.698082 (37s)
epoch : 108, eubo : -437.996063, log_q : 16.427856, KL : 6.522080 (30s)
epoch : 109, eubo : -374.205841, log_q : 17.888472, KL : 1.603946 (34s)
epoch : 110, eubo : -354.692749, log_q : 18.282804, KL : 1.458023 (33s)
epoch : 111, eubo : -314.224609, log_q : 16.950445, KL : 3.422090 (35s)
epoch : 112, eubo : -440.915588, log_q : 16.038292, KL : 1.674259 (29s)
epoch : 113, eubo : -411.193298, log_q : 15.272798, KL : 5.620481 (28s)
epoch : 114, eubo : -424.624969, log_q : 16.306408, KL : 2.795149 (32s)
epoch : 115, eubo : -537.316711, log_q : 14.410906, KL : 2.642760 (38s)
epoch : 116, eubo : -410.824982, log_q : 17.439610, KL : 3.212133 (33s)
epoch : 117, eubo : -298.469910, log_q : 15.404733, KL : 1.567032 (26s)
epoch : 118, eubo : -445.556702, log_q : 16.976305, KL : 3.053238 (37s)
epoch : 119, eubo : -275.185425, log_q : 16.809410, KL : 2.185658 (23s)
epoch : 120, eubo : -371.661316, log_q : 16.125727, KL : 2.428146 (30s)
epoch : 121, eubo : -359.756409, log_q : 15.404736, KL : 2.665367 (26s)
epoch : 122, eubo : -459.391418, log_q : 17.039480, KL : 5.318342 (31s)
epoch : 123, eubo : -330.352692, log_q : 17.498680, KL : 2.219334 (26s)
epoch : 124, eubo : -379.056641, log_q : 17.004528, KL : 2.857303 (29s)
epoch : 125, eubo : -570.933472, log_q : 17.825031, KL : 3.122470 (34s)
epoch : 126, eubo : -500.484161, log_q : 17.221279, KL : 1.703647 (38s)
epoch : 127, eubo : -400.447449, log_q : 16.607826, KL : 0.920572 (39s)
epoch : 128, eubo : -319.127594, log_q : 15.868568, KL : 4.867704 (26s)
epoch : 129, eubo : -329.240601, log_q : 17.524725, KL : 4.247757 (29s)
epoch : 130, eubo : -517.526062, log_q : 15.397471, KL : 3.855153 (37s)
epoch : 131, eubo : -489.086487, log_q : 17.076540, KL : 2.268029 (28s)
epoch : 132, eubo : -515.064636, log_q : 17.911100, KL : 5.711354 (35s)
epoch : 133, eubo : -470.335419, log_q : 19.431253, KL : 3.461971 (36s)
epoch : 134, eubo : -366.539337, log_q : 17.592846, KL : 3.841598 (31s)
epoch : 135, eubo : -332.015503, log_q : 14.964234, KL : 2.963116 (24s)
epoch : 136, eubo : -512.414246, log_q : 17.534689, KL : 2.453425 (34s)
epoch : 137, eubo : -555.809570, log_q : 16.514977, KL : 6.450750 (38s)
epoch : 138, eubo : -382.800934, log_q : 16.200552, KL : 3.965732 (25s)
epoch : 139, eubo : -471.058319, log_q : 14.040981, KL : 4.602490 (29s)
epoch : 140, eubo : -388.690063, log_q : 15.770889, KL : 1.983873 (33s)
epoch : 141, eubo : -416.613098, log_q : 15.030550, KL : 2.296808 (24s)
epoch : 142, eubo : -325.212372, log_q : 15.206175, KL : 1.693987 (28s)
epoch : 143, eubo : -466.235596, log_q : 16.389509, KL : 3.047432 (38s)
epoch : 144, eubo : -235.895248, log_q : 15.656930, KL : 3.809256 (25s)
epoch : 145, eubo : -482.422485, log_q : 17.234324, KL : 0.761534 (35s)
epoch : 146, eubo : -497.415527, log_q : 13.923457, KL : 3.766909 (26s)
epoch : 147, eubo : -447.971924, log_q : 16.443138, KL : 2.045191 (31s)
epoch : 148, eubo : -212.778656, log_q : 14.628251, KL : 0.990569 (25s)
epoch : 149, eubo : -251.570526, log_q : 17.156464, KL : 2.572573 (24s)
epoch : 150, eubo : -303.050629, log_q : 15.928371, KL : 2.658022 (29s)
epoch : 151, eubo : -400.396484, log_q : 17.884005, KL : 1.089277 (38s)
epoch : 152, eubo : -457.084778, log_q : 17.463524, KL : 2.402693 (30s)
epoch : 153, eubo : -442.950806, log_q : 16.350136, KL : 2.380741 (29s)
epoch : 154, eubo : -542.069336, log_q : 16.742352, KL : 1.905044 (37s)
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```
epoch : 155, eubo : -419.820221, log_q : 15.599718, KL : 3.734450 (34s)
epoch : 156, eubo : -300.692596, log_q : 15.495742, KL : 1.338733 (25s)
epoch : 157, eubo : -414.227905, log_q : 16.181789, KL : 3.807055 (34s)
epoch : 158, eubo : -402.781769, log_q : 17.142250, KL : 2.743799 (35s)
epoch : 159, eubo : -425.489899, log_q : 14.904883, KL : 2.196611 (31s)
epoch : 160, eubo : -341.845734, log_q : 15.591482, KL : 2.830688 (31s)
epoch : 161, eubo : -406.213593, log_q : 16.648149, KL : 1.275751 (29s)
epoch : 162, eubo : -469.331299, log_q : 17.076185, KL : 1.050710 (36s)
epoch : 163, eubo : -284.584167, log_q : 15.169856, KL : 2.382107 (24s)
epoch : 164, eubo : -417.367767, log_q : 15.964227, KL : 2.338281 (34s)
epoch : 165, eubo : -415.606781, log_q : 17.198572, KL : 5.448287 (36s)
epoch : 166, eubo : -289.868286, log_q : 16.492500, KL : 2.155246 (24s)
epoch : 167, eubo : -263.830994, log_q : 15.752190, KL : 1.473715 (26s)
epoch : 168, eubo : -362.061523, log_q : 15.234180, KL : 3.907118 (36s)
epoch : 169, eubo : -427.210785, log_q : 15.530626, KL : 1.809325 (32s)
epoch : 170, eubo : -450.556458, log_q : 15.957463, KL : 5.136100 (35s)
epoch : 171, eubo : -382.377594, log_q : 17.929213, KL : 0.806308 (32s)
epoch : 172, eubo : -387.007690, log_q : 18.208578, KL : 8.060217 (37s)
epoch : 173, eubo : -502.954224, log_q : 17.616148, KL : 1.138999 (36s)
epoch : 174, eubo : -460.420227, log_q : 17.024761, KL : 2.530178 (24s)
epoch : 175, eubo : -294.772888, log_q : 13.480402, KL : 2.939100 (24s)
epoch : 176, eubo : -487.241730, log_q : 17.934610, KL : 4.309195 (37s)
epoch : 177, eubo : -443.476349, log_q : 15.610840, KL : 1.634656 (33s)
epoch : 178, eubo : -309.261993, log_q : 17.273304, KL : 2.727803 (24s)
epoch : 179, eubo : -563.342590, log_q : 18.825834, KL : 5.246183 (36s)
epoch : 180, eubo : -318.464417, log_q : 17.270918, KL : 3.052181 (24s)
epoch : 181, eubo : -215.424072, log_q : 14.110024, KL : 4.655702 (23s)
epoch : 182, eubo : -292.508545, log_q : 18.008739, KL : 5.155136 (27s)
epoch : 183, eubo : -383.719086, log_q : 16.019819, KL : 0.786351 (36s)
epoch : 184, eubo : -464.236908, log_q : 17.463764, KL : 2.042263 (29s)
epoch : 185, eubo : -344.424530, log_q : 17.450424, KL : 2.687609 (28s)
epoch : 186, eubo : -405.940704, log_q : 15.415128, KL : 2.544065 (29s)
epoch : 187, eubo : -372.369293, log_q : 17.043928, KL : 2.574130 (31s)
epoch : 188, eubo : -299.796417, log_q : 16.721325, KL : 3.503550 (24s)
epoch : 189, eubo : -394.865234, log_q : 17.727652, KL : 1.710909 (35s)
epoch : 190, eubo : -372.344147, log_q : 14.244291, KL : 2.663265 (33s)
epoch : 191, eubo : -434.261688, log_q : 16.258272, KL : 2.110730 (27s)
epoch : 192, eubo : -232.971863, log_q : 16.387985, KL : 2.369947 (27s)
epoch : 193, eubo : -417.675751, log_q : 17.755966, KL : 1.904249 (24s)
epoch : 194, eubo : -448.511841, log_q : 17.220760, KL : 2.458612 (36s)
epoch : 195, eubo : -314.798004, log_q : 16.886593, KL : 3.599150 (31s)
epoch : 196, eubo : -279.675232, log_q : 15.186293, KL : 2.868634 (28s)
epoch : 197, eubo : -380.036621, log_q : 16.391218, KL : 1.608190 (24s)
epoch : 198, eubo : -362.390015, log_q : 16.900206, KL : 1.731019 (27s)
epoch : 199, eubo : -298.310089, log_q : 14.385067, KL : 3.166228 (32s)
epoch : 200, eubo : -288.358582, log_q : 16.587027, KL : 1.592906 (24s)
epoch : 201, eubo : -285.497070, log_q : 16.877493, KL : 2.454830 (33s)
epoch : 202, eubo : -423.868530, log_q : 16.874086, KL : 2.172854 (32s)
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epoch : 203, eubo : -397.381226, log_q : 15.312684, KL : 1.614824 (24s)
epoch : 204, eubo : -442.197876, log_q : 18.082504, KL : 2.885747 (31s)
epoch : 205, eubo : -405.666626, log_q : 17.241562, KL : 2.891054 (39s)
epoch : 206, eubo : -396.684021, log_q : 15.742287, KL : 4.358569 (34s)
epoch : 207, eubo : -390.109985, log_q : 16.033148, KL : 1.865455 (28s)
epoch : 208, eubo : -401.140076, log_q : 16.205679, KL : 2.348297 (29s)
epoch : 209, eubo : -415.458649, log_q : 17.249880, KL : 2.960684 (32s)
epoch : 210, eubo : -475.342926, log_q : 16.041494, KL : 2.808665 (37s)
epoch : 211, eubo : -354.610321, log_q : 13.823147, KL : 3.032911 (28s)
epoch : 212, eubo : -405.670502, log_q : 17.440947, KL : 1.913331 (28s)
epoch : 213, eubo : -335.717194, log_q : 17.093809, KL : 1.880800 (23s)
epoch : 214, eubo : -290.476624, log_q : 13.937004, KL : 1.785295 (28s)
epoch : 215, eubo : -290.333588, log_q : 15.505877, KL : 2.205322 (24s)
epoch : 216, eubo : -411.569550, log_q : 16.249104, KL : 2.967149 (35s)
epoch : 217, eubo : -429.379333, log_q : 14.720279, KL : 3.233096 (36s)
epoch : 218, eubo : -279.461700, log_q : 18.408354, KL : 1.945489 (31s)
epoch : 219, eubo : -458.106842, log_q : 17.488771, KL : 1.810016 (35s)
epoch : 220, eubo : -425.317719, log_q : 15.905993, KL : 2.518941 (36s)
epoch : 221, eubo : -376.729309, log_q : 16.764105, KL : 5.454622 (28s)
epoch : 222, eubo : -351.717621, log_q : 16.461882, KL : 5.250047 (35s)
epoch : 223, eubo : -310.134155, log_q : 16.130608, KL : 2.489393 (30s)
epoch : 224, eubo : -359.610809, log_q : 15.193655, KL : 4.389604 (26s)
epoch : 225, eubo : -613.805725, log_q : 17.793596, KL : 6.367037 (30s)
epoch : 226, eubo : -543.036804, log_q : 18.587774, KL : 3.060884 (31s)
epoch : 227, eubo : -321.237305, log_q : 15.660946, KL : 1.256853 (28s)
epoch : 228, eubo : -382.777863, log_q : 16.672258, KL : 1.562194 (31s)
epoch : 229, eubo : -527.604675, log_q : 16.070021, KL : 3.277818 (36s)
epoch : 230, eubo : -287.077057, log_q : 15.935903, KL : 6.062313 (32s)
epoch : 231, eubo : -356.912964, log_q : 16.443230, KL : 7.768414 (35s)
epoch : 232, eubo : -453.249023, log_q : 14.729959, KL : 2.363685 (27s)
epoch : 233, eubo : -527.975037, log_q : 18.823973, KL : 2.680692 (27s)
epoch : 234, eubo : -260.393188, log_q : 19.066526, KL : 2.677616 (32s)
epoch : 235, eubo : -644.167053, log_q : 19.037466, KL : 6.304718 (41s)
epoch : 236, eubo : -342.929657, log_q : 17.315926, KL : 1.473225 (30s)
epoch : 237, eubo : -390.941895, log_q : 17.086433, KL : 4.088924 (28s)
epoch : 238, eubo : -313.472076, log_q : 13.666621, KL : 6.908520 (28s)
epoch : 239, eubo : -323.304779, log_q : 15.627875, KL : 1.222409 (32s)
epoch : 240, eubo : -442.536530, log_q : 17.913971, KL : 5.356425 (38s)
epoch : 241, eubo : -371.124329, log_q : 12.126379, KL : 3.647349 (30s)
epoch : 242, eubo : -236.562149, log_q : 16.499109, KL : 2.600563 (32s)
epoch : 243, eubo : -378.903229, log_q : 14.599708, KL : 2.037359 (23s)
epoch : 244, eubo : -373.429932, log_q : 17.742434, KL : 4.701058 (37s)
epoch : 245, eubo : -316.238647, log_q : 14.927875, KL : 3.226736 (33s)
epoch : 246, eubo : -453.049683, log_q : 17.955322, KL : 4.821055 (38s)
epoch : 247, eubo : -369.710327, log_q : 14.687886, KL : 2.532715 (30s)
epoch : 248, eubo : -291.991669, log_q : 14.864038, KL : 1.668844 (31s)
epoch : 249, eubo : -288.718872, log_q : 15.179873, KL : 3.449393 (25s)
epoch : 250, eubo : -374.987457, log_q : 16.251993, KL : 7.598789 (35s)
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epoch : 251, eubo : -341.207336, log_q : 16.518698, KL : 4.218339 (29s)
epoch : 252, eubo : -281.611359, log_q : 16.161491, KL : 3.883382 (25s)
epoch : 253, eubo : -366.009460, log_q : 16.394646, KL : 1.070127 (25s)
epoch : 254, eubo : -301.391510, log_q : 15.780614, KL : 2.218046 (24s)
epoch : 255, eubo : -637.040344, log_q : 13.525035, KL : 3.619509 (32s)
epoch : 256, eubo : -323.950470, log_q : 16.014429, KL : 9.098585 (38s)
epoch : 257, eubo : -315.272614, log_q : 17.364578, KL : 2.434709 (33s)
epoch : 258, eubo : -314.255615, log_q : 16.666954, KL : 3.335928 (30s)
epoch : 259, eubo : -460.921417, log_q : 18.305761, KL : 1.029218 (38s)
epoch : 260, eubo : -361.302124, log_q : 18.204546, KL : 3.210831 (38s)
epoch : 261, eubo : -362.389771, log_q : 16.647835, KL : 1.526867 (31s)
epoch : 262, eubo : -312.425049, log_q : 15.446305, KL : 2.521523 (31s)
epoch : 263, eubo : -382.601196, log_q : 18.263779, KL : 1.337425 (26s)
epoch : 264, eubo : -500.758942, log_q : 14.725943, KL : 6.358147 (36s)
epoch : 265, eubo : -365.163116, log_q : 18.270119, KL : 3.754756 (33s)
epoch : 266, eubo : -235.999420, log_q : 17.381302, KL : 4.079279 (27s)
epoch : 267, eubo : -408.583801, log_q : 18.351538, KL : 4.343737 (31s)
epoch : 268, eubo : -357.018311, log_q : 17.049063, KL : 5.375226 (37s)
epoch : 269, eubo : -365.695282, log_q : 15.665623, KL : 1.937316 (24s)
epoch : 270, eubo : -339.878540, log_q : 17.609184, KL : 2.011117 (32s)
epoch : 271, eubo : -395.187042, log_q : 19.081121, KL : 1.875710 (37s)
epoch : 272, eubo : -399.392517, log_q : 17.994379, KL : 6.882630 (32s)
epoch : 273, eubo : -217.480667, log_q : 17.405499, KL : 4.691710 (24s)
epoch : 274, eubo : -342.889038, log_q : 15.071000, KL : 3.568895 (33s)
epoch : 275, eubo : -524.182251, log_q : 16.716812, KL : 1.768105 (32s)
epoch : 276, eubo : -416.751373, log_q : 13.118222, KL : 3.455674 (25s)
epoch : 277, eubo : -480.207397, log_q : 15.795816, KL : 5.535789 (33s)
epoch : 278, eubo : -454.007507, log_q : 18.537163, KL : 2.292138 (27s)
epoch : 279, eubo : -404.728424, log_q : 18.385174, KL : 1.745667 (35s)
epoch : 280, eubo : -423.128937, log_q : 18.199028, KL : 5.700635 (38s)
epoch : 281, eubo : -369.541565, log_q : 14.870957, KL : 1.230479 (31s)
epoch : 282, eubo : -455.250946, log_q : 18.921144, KL : 3.954468 (29s)
epoch : 283, eubo : -434.006927, log_q : 17.635546, KL : 2.352790 (33s)
epoch : 284, eubo : -297.990295, log_q : 11.643064, KL : 3.617521 (31s)
epoch : 285, eubo : -397.148376, log_q : 17.646021, KL : 3.013209 (34s)
epoch : 286, eubo : -511.172882, log_q : 18.236149, KL : 4.765949 (37s)
epoch : 287, eubo : -413.146820, log_q : 16.633614, KL : 2.666892 (37s)
epoch : 288, eubo : -330.281128, log_q : 16.189030, KL : 0.940907 (25s)
epoch : 289, eubo : -317.417419, log_q : 17.797321, KL : 1.990201 (39s)
epoch : 290, eubo : -311.103027, log_q : 17.829767, KL : 1.547094 (31s)
epoch : 291, eubo : -279.295868, log_q : 15.711862, KL : 4.028832 (25s)
epoch : 292, eubo : -440.992828, log_q : 13.277161, KL : 4.600315 (29s)
epoch : 293, eubo : -381.188843, log_q : 17.131727, KL : 2.880163 (33s)
epoch : 294, eubo : -336.215332, log_q : 15.134282, KL : 1.929736 (25s)
epoch : 295, eubo : -358.281006, log_q : 17.589777, KL : 1.627583 (27s)
epoch : 296, eubo : -409.210236, log_q : 18.059084, KL : 2.267318 (36s)
epoch : 297, eubo : -428.068085, log_q : 15.643689, KL : 3.876947 (36s)
epoch : 298, eubo : -362.222321, log_q : 15.547218, KL : 1.845946 (28s)
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epoch : 299, eubo : -325.184082, log_q : 17.403509, KL : 2.178241 (30s)
epoch : 300, eubo : -417.069733, log_q : 18.220699, KL : 6.468502 (35s)
epoch : 301, eubo : -439.298004, log_q : 17.427999, KL : 1.539493 (31s)
epoch : 302, eubo : -306.672607, log_q : 17.048103, KL : 2.451517 (27s)
epoch : 303, eubo : -378.690002, log_q : 16.629198, KL : 2.899195 (38s)
epoch : 304, eubo : -306.039673, log_q : 15.246995, KL : 1.530123 (26s)
epoch : 305, eubo : -546.736023, log_q : 14.184856, KL : 2.584646 (34s)
epoch : 306, eubo : -328.082581, log_q : 13.114574, KL : 3.003135 (33s)
epoch : 307, eubo : -425.149048, log_q : 19.014732, KL : 3.319215 (38s)
epoch : 308, eubo : -596.461060, log_q : 17.802130, KL : 3.160066 (38s)
epoch : 309, eubo : -386.161957, log_q : 15.682401, KL : 3.655746 (33s)
epoch : 310, eubo : -476.637085, log_q : 18.494404, KL : 1.589079 (38s)
epoch : 311, eubo : -339.124878, log_q : 18.758255, KL : 1.994195 (29s)
epoch : 312, eubo : -388.265778, log_q : 15.310721, KL : 2.165220 (28s)
epoch : 313, eubo : -404.953094, log_q : 17.171991, KL : 5.947131 (35s)
epoch : 314, eubo : -405.088715, log_q : 14.878335, KL : 3.044301 (33s)
epoch : 315, eubo : -392.397644, log_q : 17.933693, KL : 2.005789 (31s)
epoch : 316, eubo : -251.091553, log_q : 16.693052, KL : 1.913185 (31s)
epoch : 317, eubo : -361.345276, log_q : 10.098268, KL : 3.310507 (28s)
epoch : 318, eubo : -292.809418, log_q : 17.571968, KL : 3.060344 (24s)
epoch : 319, eubo : -320.208344, log_q : 15.173835, KL : 2.059921 (29s)
epoch : 320, eubo : -288.528870, log_q : 16.176773, KL : 2.272276 (24s)
epoch : 321, eubo : -254.207550, log_q : 15.574590, KL : 2.593122 (23s)
epoch : 322, eubo : -455.456604, log_q : 14.644861, KL : 3.567803 (35s)
epoch : 323, eubo : -425.129974, log_q : 17.039457, KL : 4.549921 (26s)
epoch : 324, eubo : -320.025665, log_q : 17.702471, KL : 4.653277 (26s)
epoch : 325, eubo : -272.657166, log_q : 16.414270, KL : 1.698367 (25s)
epoch : 326, eubo : -216.236313, log_q : 15.381929, KL : 3.735530 (25s)
epoch : 327, eubo : -284.671509, log_q : 18.643007, KL : 2.603939 (32s)
epoch : 328, eubo : -387.425995, log_q : 17.110544, KL : 3.425429 (31s)
epoch : 329, eubo : -388.126526, log_q : 15.396317, KL : 1.723307 (25s)
epoch : 330, eubo : -276.535675, log_q : 16.573851, KL : 4.350832 (23s)
epoch : 331, eubo : -271.834076, log_q : 17.999506, KL : 1.845024 (24s)
epoch : 332, eubo : -281.695160, log_q : 16.640360, KL : 4.899424 (27s)
epoch : 333, eubo : -228.695419, log_q : 18.067783, KL : 1.397080 (24s)
epoch : 334, eubo : -436.073334, log_q : 16.478041, KL : 3.151027 (38s)
epoch : 335, eubo : -231.055969, log_q : 15.271778, KL : 4.065928 (27s)
epoch : 336, eubo : -416.932434, log_q : 17.121265, KL : 2.130493 (31s)
epoch : 337, eubo : -250.820847, log_q : 15.556638, KL : 3.776457 (32s)
epoch : 338, eubo : -298.197449, log_q : 17.421211, KL : 5.076538 (30s)
epoch : 339, eubo : -311.035858, log_q : 17.813135, KL : 1.730231 (25s)
epoch : 340, eubo : -380.229919, log_q : 17.270996, KL : 2.305761 (33s)
epoch : 341, eubo : -406.027008, log_q : 15.407647, KL : 3.651824 (27s)
epoch : 342, eubo : -324.377686, log_q : 17.191586, KL : 3.872106 (31s)
epoch : 343, eubo : -256.078613, log_q : 15.674550, KL : 2.377815 (26s)
epoch : 344, eubo : -288.660583, log_q : 15.935801, KL : 3.285551 (27s)
epoch : 345, eubo : -343.900726, log_q : 17.107988, KL : 2.888333 (26s)
epoch : 346, eubo : -380.609833, log_q : 17.101334, KL : 2.487957 (28s)
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epoch : 347, eubo : -261.833160, log_q : 18.300514, KL : 2.313713 (29s)
epoch : 348, eubo : -435.726379, log_q : 14.704967, KL : 2.511796 (35s)
epoch : 349, eubo : -455.170349, log_q : 13.771671, KL : 2.392801 (29s)
epoch : 350, eubo : -382.366302, log_q : 16.448606, KL : 5.689947 (34s)
epoch : 351, eubo : -279.970032, log_q : 15.222084, KL : 2.141555 (25s)
epoch : 352, eubo : -290.358490, log_q : 15.501561, KL : 3.418506 (27s)
epoch : 353, eubo : -407.810913, log_q : 14.528196, KL : 4.200962 (33s)
epoch : 354, eubo : -429.981720, log_q : 16.900476, KL : 3.332460 (39s)
epoch : 355, eubo : -308.558258, log_q : 16.313482, KL : 3.960818 (32s)
epoch : 356, eubo : -415.382141, log_q : 18.832848, KL : 5.859595 (39s)
epoch : 357, eubo : -361.167389, log_q : 16.479153, KL : 2.787720 (38s)
epoch : 358, eubo : -585.047119, log_q : 16.968224, KL : 4.724185 (27s)
epoch : 359, eubo : -317.843384, log_q : 17.697208, KL : 2.645572 (26s)
epoch : 360, eubo : -307.346466, log_q : 17.564684, KL : 2.959305 (36s)
epoch : 361, eubo : -627.368286, log_q : 17.733332, KL : 1.634875 (36s)
epoch : 362, eubo : -279.797760, log_q : 15.591573, KL : 2.240423 (36s)
epoch : 363, eubo : -374.104736, log_q : 16.977421, KL : 3.815144 (29s)
epoch : 364, eubo : -346.131744, log_q : 15.050259, KL : 1.586309 (25s)
epoch : 365, eubo : -463.311401, log_q : 14.828537, KL : 2.574778 (33s)
epoch : 366, eubo : -336.201416, log_q : 14.607278, KL : 2.664958 (27s)
epoch : 367, eubo : -497.357849, log_q : 18.267633, KL : 1.949404 (35s)
epoch : 368, eubo : -540.591064, log_q : 13.993727, KL : 5.677840 (34s)
epoch : 369, eubo : -381.192383, log_q : 13.299253, KL : 2.966446 (27s)
epoch : 370, eubo : -462.551514, log_q : 15.421443, KL : 3.695892 (39s)
epoch : 371, eubo : -469.901428, log_q : 15.880393, KL : 2.492344 (26s)
epoch : 372, eubo : -396.590118, log_q : 15.077354, KL : 2.270425 (35s)
epoch : 373, eubo : -473.714478, log_q : 16.720316, KL : 3.415098 (26s)
epoch : 374, eubo : -380.994049, log_q : 15.150709, KL : 1.428718 (26s)
epoch : 375, eubo : -369.266724, log_q : 17.156870, KL : 1.281447 (34s)
epoch : 376, eubo : -307.522705, log_q : 15.992589, KL : 1.864068 (27s)
epoch : 377, eubo : -403.796051, log_q : 16.539055, KL : 2.338799 (37s)
epoch : 378, eubo : -589.311951, log_q : 16.840651, KL : 1.478752 (30s)
epoch : 379, eubo : -307.417389, log_q : 17.504171, KL : 3.270001 (30s)
epoch : 380, eubo : -310.106934, log_q : 16.647072, KL : 3.298281 (34s)
epoch : 381, eubo : -344.124786, log_q : 16.631069, KL : 1.474646 (28s)
epoch : 382, eubo : -282.181213, log_q : 17.267494, KL : 2.805428 (34s)
epoch : 383, eubo : -572.481201, log_q : 15.990396, KL : 3.095660 (37s)
epoch : 384, eubo : -392.916077, log_q : 15.201445, KL : 1.032360 (31s)
epoch : 385, eubo : -456.206848, log_q : 17.958452, KL : 2.420737 (38s)
epoch : 386, eubo : -283.332367, log_q : 15.167668, KL : 2.016958 (24s)
epoch : 387, eubo : -612.035095, log_q : 14.494102, KL : 5.740266 (35s)
epoch : 388, eubo : -426.629822, log_q : 13.252797, KL : 2.350962 (36s)
epoch : 389, eubo : -313.734131, log_q : 17.455746, KL : 3.224468 (28s)
epoch : 390, eubo : -393.112274, log_q : 15.921500, KL : 2.629132 (32s)
epoch : 391, eubo : -351.519226, log_q : 15.712122, KL : 2.386188 (27s)
epoch : 392, eubo : -375.927551, log_q : 16.672077, KL : 1.774284 (33s)
epoch : 393, eubo : -379.616669, log_q : 17.275963, KL : 1.516855 (28s)
epoch : 394, eubo : -332.190430, log_q : 15.594770, KL : 5.366845 (38s)
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epoch : 395, eubo : -403.168030, log_q : 16.418615, KL : 4.174392 (39s)
epoch : 396, eubo : -294.200928, log_q : 16.339113, KL : 1.894423 (24s)
epoch : 397, eubo : -287.609192, log_q : 15.263258, KL : 1.918980 (24s)
epoch : 398, eubo : -282.371948, log_q : 16.750820, KL : 1.592606 (31s)
epoch : 399, eubo : -486.505066, log_q : 15.993940, KL : 2.155228 (35s)
epoch : 400, eubo : -351.882660, log_q : 15.577254, KL : 2.117367 (32s)
epoch : 401, eubo : -376.218536, log_q : 18.295317, KL : 1.698077 (37s)
epoch : 402, eubo : -261.781158, log_q : 14.075134, KL : 5.295600 (24s)
epoch : 403, eubo : -195.899170, log_q : 16.550035, KL : 1.852216 (23s)
epoch : 404, eubo : -339.659393, log_q : 16.447060, KL : 4.146360 (29s)
epoch : 405, eubo : -402.494965, log_q : 17.102568, KL : 8.749620 (38s)
epoch : 406, eubo : -369.653870, log_q : 15.577884, KL : 3.193588 (32s)
epoch : 407, eubo : -287.084778, log_q : 15.835610, KL : 0.913843 (27s)
epoch : 408, eubo : -330.816620, log_q : 17.044491, KL : 1.794398 (29s)
epoch : 409, eubo : -409.870239, log_q : 13.522021, KL : 3.927897 (28s)
epoch : 410, eubo : -518.532043, log_q : 17.790926, KL : 2.080787 (34s)
epoch : 411, eubo : -349.023865, log_q : 17.179625, KL : 3.846757 (27s)
epoch : 412, eubo : -430.725708, log_q : 17.093327, KL : 2.561358 (37s)
epoch : 413, eubo : -437.728149, log_q : 17.651302, KL : 2.916089 (33s)
epoch : 414, eubo : -336.359375, log_q : 14.504870, KL : 5.195116 (29s)
epoch : 415, eubo : -299.623413, log_q : 17.141560, KL : 1.124628 (33s)
epoch : 416, eubo : -536.098572, log_q : 15.422858, KL : 1.631000 (34s)
epoch : 417, eubo : -318.016693, log_q : 15.224666, KL : 2.467106 (36s)
epoch : 418, eubo : -343.973846, log_q : 16.880003, KL : 1.112014 (40s)
epoch : 419, eubo : -621.297729, log_q : 19.619728, KL : 2.966421 (38s)
epoch : 420, eubo : -369.147278, log_q : 17.623528, KL : 1.227485 (31s)
epoch : 421, eubo : -325.217346, log_q : 15.681190, KL : 7.059834 (27s)
epoch : 422, eubo : -388.203644, log_q : 15.656656, KL : 2.388616 (36s)
epoch : 423, eubo : -415.506104, log_q : 15.062422, KL : 3.333357 (26s)
epoch : 424, eubo : -389.655975, log_q : 13.055593, KL : 8.637403 (35s)
epoch : 425, eubo : -523.906067, log_q : 18.595760, KL : 3.260015 (27s)
epoch : 426, eubo : -312.668671, log_q : 18.708115, KL : 2.589932 (37s)
epoch : 427, eubo : -307.022339, log_q : 17.128366, KL : 1.420245 (34s)
epoch : 428, eubo : -471.663025, log_q : 16.134537, KL : 4.152127 (38s)
epoch : 429, eubo : -346.895050, log_q : 17.062222, KL : 2.700551 (29s)
epoch : 430, eubo : -396.264984, log_q : 16.968382, KL : 1.148234 (26s)
epoch : 431, eubo : -348.748749, log_q : 18.599762, KL : 3.293789 (31s)
epoch : 432, eubo : -539.583313, log_q : 17.388666, KL : 2.778646 (37s)
epoch : 433, eubo : -491.109314, log_q : 18.989023, KL : 4.517523 (28s)
epoch : 434, eubo : -387.500549, log_q : 18.086870, KL : 1.929605 (28s)
epoch : 435, eubo : -326.178070, log_q : 17.347744, KL : 2.753504 (34s)
epoch : 436, eubo : -372.826080, log_q : 16.806023, KL : 2.438990 (30s)
epoch : 437, eubo : -253.538193, log_q : 16.711912, KL : 2.313024 (25s)
epoch : 438, eubo : -385.389313, log_q : 16.908081, KL : 1.882704 (32s)
epoch : 439, eubo : -304.686371, log_q : 15.763509, KL : 2.163262 (24s)
epoch : 440, eubo : -351.029114, log_q : 16.542500, KL : 1.820030 (27s)
epoch : 441, eubo : -276.461517, log_q : 15.836444, KL : 2.464336 (30s)
epoch : 442, eubo : -366.173401, log_q : 16.598253, KL : 1.903373 (26s)
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epoch : 443, eubo : -322.547913, log_q : 16.499861, KL : 2.225521 (24s)
epoch : 444, eubo : -194.866516, log_q : 16.115341, KL : 5.139611 (26s)
epoch : 445, eubo : -352.927704, log_q : 16.799566, KL : 4.024583 (26s)
epoch : 446, eubo : -304.906738, log_q : 16.246029, KL : 4.218128 (38s)
epoch : 447, eubo : -376.830566, log_q : 18.001411, KL : 3.441222 (37s)
epoch : 448, eubo : -388.626953, log_q : 16.668074, KL : 3.365282 (35s)
epoch : 449, eubo : -408.982544, log_q : 14.956812, KL : 5.000977 (28s)
epoch : 450, eubo : -341.475067, log_q : 15.346227, KL : 2.184431 (23s)
epoch : 451, eubo : -431.568298, log_q : 16.804235, KL : 2.883224 (34s)
epoch : 452, eubo : -431.976532, log_q : 17.449192, KL : 3.882422 (34s)
epoch : 453, eubo : -320.431183, log_q : 16.143383, KL : 2.103282 (27s)
epoch : 454, eubo : -388.954315, log_q : 16.709881, KL : 2.443400 (34s)
epoch : 455, eubo : -401.014221, log_q : 19.028021, KL : 4.046175 (35s)
epoch : 456, eubo : -310.441986, log_q : 14.720784, KL : 3.815219 (26s)
epoch : 457, eubo : -310.340729, log_q : 15.670018, KL : 2.238005 (24s)
epoch : 458, eubo : -318.767792, log_q : 16.240879, KL : 1.349567 (23s)
epoch : 459, eubo : -399.808075, log_q : 15.172206, KL : 1.908732 (30s)
epoch : 460, eubo : -311.544922, log_q : 12.643716, KL : 2.643067 (26s)
epoch : 461, eubo : -436.305542, log_q : 15.666748, KL : 3.693596 (24s)
epoch : 462, eubo : -338.640808, log_q : 12.050681, KL : 1.468961 (24s)
epoch : 463, eubo : -315.597412, log_q : 16.500854, KL : 1.253057 (23s)
epoch : 464, eubo : -219.083923, log_q : 16.030979, KL : 4.531825 (25s)
epoch : 465, eubo : -412.536591, log_q : 17.479433, KL : 2.286294 (34s)
epoch : 466, eubo : -407.702637, log_q : 16.617310, KL : 6.365664 (32s)
epoch : 467, eubo : -391.220856, log_q : 16.950489, KL : 4.807759 (33s)
epoch : 468, eubo : -241.984268, log_q : 13.895028, KL : 2.709865 (23s)
epoch : 469, eubo : -396.664551, log_q : 17.946665, KL : 1.435864 (37s)
epoch : 470, eubo : -437.593750, log_q : 15.125411, KL : 4.703937 (33s)
epoch : 471, eubo : -327.401062, log_q : 14.838508, KL : 2.838947 (31s)
epoch : 472, eubo : -492.577057, log_q : 14.780385, KL : 5.171742 (35s)
epoch : 473, eubo : -283.745117, log_q : 16.126974, KL : 1.402805 (24s)
epoch : 474, eubo : -363.688568, log_q : 14.906826, KL : 4.105711 (30s)
epoch : 475, eubo : -399.189850, log_q : 14.169639, KL : 5.126552 (29s)
epoch : 476, eubo : -208.987061, log_q : 15.732272, KL : 2.106180 (24s)
epoch : 477, eubo : -350.437469, log_q : 15.443347, KL : 3.262405 (23s)
epoch : 478, eubo : -552.831238, log_q : 16.751835, KL : 4.871598 (38s)
epoch : 479, eubo : -342.837891, log_q : 15.983848, KL : 3.039416 (26s)
epoch : 480, eubo : -468.151703, log_q : 17.042673, KL : 2.576272 (37s)
epoch : 481, eubo : -302.934174, log_q : 15.033577, KL : 2.802493 (23s)
epoch : 482, eubo : -285.583984, log_q : 15.529265, KL : 0.832836 (24s)
epoch : 483, eubo : -353.243774, log_q : 18.614277, KL : 1.382977 (36s)
epoch : 484, eubo : -388.330627, log_q : 16.608446, KL : 1.450003 (38s)
epoch : 485, eubo : -319.160187, log_q : 16.944151, KL : 2.425403 (25s)
epoch : 486, eubo : -451.625275, log_q : 18.284336, KL : 1.096902 (36s)
epoch : 487, eubo : -400.311798, log_q : 13.987202, KL : 5.265399 (35s)
epoch : 488, eubo : -316.360168, log_q : 16.647938, KL : 1.723364 (24s)
epoch : 489, eubo : -310.080017, log_q : 17.922235, KL : 6.112573 (36s)
epoch : 490, eubo : -464.326202, log_q : 16.252951, KL : 2.848540 (38s)
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epoch : 491, eubo : -260.483063, log_q : 15.732661, KL : 2.433900 (32s)
epoch : 492, eubo : -346.430603, log_q : 13.789384, KL : 2.379546 (31s)
epoch : 493, eubo : -327.381226, log_q : 15.661793, KL : 1.746062 (30s)
epoch : 494, eubo : -234.754974, log_q : 17.564802, KL : 1.680858 (24s)
epoch : 495, eubo : -397.278198, log_q : 16.033644, KL : 2.567505 (26s)
epoch : 496, eubo : -394.973633, log_q : 16.625900, KL : 1.467908 (34s)
epoch : 497, eubo : -417.133514, log_q : 15.480379, KL : 2.254953 (32s)
epoch : 498, eubo : -478.948212, log_q : 17.147928, KL : 2.665343 (35s)
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epoch : 500, eubo : -338.495758, log_q : 13.743483, KL : 1.568896 (25s)
epoch : 501, eubo : -352.294189, log_q : 15.225636, KL : 2.281144 (26s)
epoch : 502, eubo : -431.270477, log_q : 15.243892, KL : 4.422692 (34s)
epoch : 503, eubo : -294.671631, log_q : 15.224144, KL : 3.781462 (26s)
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epoch : 505, eubo : -401.582336, log_q : 17.911743, KL : 2.148146 (32s)
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epoch : 509, eubo : -376.536407, log_q : 16.314390, KL : 3.477159 (28s)
epoch : 510, eubo : -601.601868, log_q : 13.842055, KL : 5.459618 (34s)
epoch : 511, eubo : -435.659668, log_q : 15.304475, KL : 6.696513 (35s)
epoch : 512, eubo : -262.718140, log_q : 12.645077, KL : 2.445715 (25s)
epoch : 513, eubo : -388.918945, log_q : 17.542170, KL : 1.908440 (38s)
epoch : 514, eubo : -366.748901, log_q : 14.643231, KL : 2.601591 (31s)
epoch : 515, eubo : -295.848480, log_q : 16.315737, KL : 2.023380 (24s)
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epoch : 519, eubo : -303.255432, log_q : 10.744966, KL : 5.380640 (29s)
epoch : 520, eubo : -444.460388, log_q : 16.543318, KL : 3.241919 (34s)
epoch : 521, eubo : -397.026398, log_q : 15.256988, KL : 4.511176 (29s)
epoch : 522, eubo : -413.130920, log_q : 16.259560, KL : 5.364383 (38s)
epoch : 523, eubo : -419.620575, log_q : 17.960289, KL : 2.892534 (37s)
epoch : 524, eubo : -375.332520, log_q : 17.019861, KL : 5.672530 (37s)
epoch : 525, eubo : -333.004944, log_q : 17.291368, KL : 2.403701 (35s)
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epoch : 531, eubo : -342.858612, log_q : 16.253313, KL : 2.125144 (28s)
epoch : 532, eubo : -457.089630, log_q : 19.522724, KL : 3.289925 (38s)
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epoch : 534, eubo : -354.279022, log_q : 17.070116, KL : 2.914929 (38s)
epoch : 535, eubo : -331.617218, log_q : 15.390621, KL : 1.884787 (24s)
epoch : 536, eubo : -273.148987, log_q : 14.261980, KL : 3.205117 (28s)
epoch : 537, eubo : -241.949448, log_q : 16.339128, KL : 1.804364 (33s)
epoch : 538, eubo : -373.068604, log_q : 15.476432, KL : 0.991198 (31s)
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epoch : 539, eubo : -364.958435, log_q : 17.952997, KL : 3.332161 (36s)
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epoch : 541, eubo : -362.599548, log_q : 16.346384, KL : 1.938851 (28s)
epoch : 542, eubo : -412.146606, log_q : 16.655872, KL : 2.266719 (37s)
epoch : 543, eubo : -321.079926, log_q : 16.036943, KL : 2.385681 (29s)
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epoch : 545, eubo : -364.467163, log_q : 11.416189, KL : 2.144854 (29s)
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epoch : 552, eubo : -348.232330, log_q : 15.183197, KL : 2.991740 (27s)
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epoch : 557, eubo : -361.473297, log_q : 16.012222, KL : 2.143781 (25s)
epoch : 558, eubo : -359.725494, log_q : 17.754227, KL : 1.465093 (34s)
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epoch : 562, eubo : -422.785156, log_q : 17.555998, KL : 2.111294 (34s)
epoch : 563, eubo : -393.279053, log_q : 16.540247, KL : 1.228521 (32s)
epoch : 564, eubo : -290.983154, log_q : 17.655697, KL : 1.548825 (25s)
epoch : 565, eubo : -523.703308, log_q : 13.928816, KL : 4.843256 (32s)
epoch : 566, eubo : -410.632172, log_q : 17.578588, KL : 1.871218 (34s)
epoch : 567, eubo : -323.417114, log_q : 16.413000, KL : 1.192112 (25s)
epoch : 568, eubo : -424.094238, log_q : 16.020712, KL : 2.228342 (32s)
epoch : 569, eubo : -377.783661, log_q : 17.400751, KL : 2.224264 (29s)
epoch : 570, eubo : -274.155243, log_q : 17.899479, KL : 4.838509 (33s)
epoch : 571, eubo : -398.740631, log_q : 17.490643, KL : 1.239622 (35s)
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epoch : 573, eubo : -446.686432, log_q : 16.714104, KL : 1.421908 (30s)
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epoch : 575, eubo : -460.743011, log_q : 19.072206, KL : 1.503201 (36s)
epoch : 576, eubo : -477.242096, log_q : 17.571714, KL : 3.312417 (24s)
epoch : 577, eubo : -436.797089, log_q : 15.057225, KL : 3.005568 (31s)
epoch : 578, eubo : -457.445831, log_q : 17.904755, KL : 1.287508 (39s)
epoch : 579, eubo : -527.142029, log_q : 18.515564, KL : 3.220287 (26s)
epoch : 580, eubo : -546.450623, log_q : 20.111267, KL : 5.806343 (32s)
epoch : 581, eubo : -293.147247, log_q : 17.778767, KL : 3.246284 (34s)
epoch : 582, eubo : -271.162659, log_q : 17.299179, KL : 3.044027 (33s)
epoch : 583, eubo : -370.067230, log_q : 17.128336, KL : 2.143322 (30s)
epoch : 584, eubo : -317.999481, log_q : 16.813181, KL : 2.443688 (28s)
epoch : 585, eubo : -366.051453, log_q : 16.620747, KL : 2.038040 (28s)
epoch : 586, eubo : -309.032379, log_q : 16.091661, KL : 3.181570 (27s)
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epoch : 587, eubo : -454.548370, log_q : 14.898870, KL : 0.918211 (29s)
epoch : 588, eubo : -379.967041, log_q : 16.438150, KL : 3.199594 (26s)
epoch : 589, eubo : -328.734222, log_q : 14.303680, KL : 3.408434 (24s)
epoch : 590, eubo : -544.243042, log_q : 16.671074, KL : 4.106085 (38s)
epoch : 591, eubo : -446.119934, log_q : 17.065372, KL : 3.278379 (32s)
epoch : 592, eubo : -494.551849, log_q : 16.337479, KL : 5.990207 (33s)
epoch : 593, eubo : -335.856537, log_q : 19.507086, KL : 4.648629 (36s)
epoch : 594, eubo : -495.161774, log_q : 18.905157, KL : 3.314170 (38s)
epoch : 595, eubo : -482.375275, log_q : 15.661196, KL : 1.387219 (35s)
epoch : 596, eubo : -467.705627, log_q : 15.224342, KL : 3.707891 (34s)
epoch : 597, eubo : -451.597412, log_q : 14.267850, KL : 9.220252 (37s)
epoch : 598, eubo : -454.399597, log_q : 17.538549, KL : 2.342250 (32s)
epoch : 599, eubo : -382.817810, log_q : 17.322760, KL : 1.561883 (29s)
epoch : 600, eubo : -356.666016, log_q : 17.703529, KL : 3.776468 (33s)
epoch : 601, eubo : -433.137817, log_q : 17.058304, KL : 2.475959 (36s)
epoch : 602, eubo : -495.203918, log_q : 17.680923, KL : 3.135134 (29s)
epoch : 603, eubo : -333.885925, log_q : 16.725863, KL : 7.702111 (33s)
epoch : 604, eubo : -308.605682, log_q : 16.195868, KL : 2.054306 (27s)
epoch : 605, eubo : -530.475586, log_q : 15.477218, KL : 4.684437 (35s)
epoch : 606, eubo : -304.386200, log_q : 15.978887, KL : 2.467133 (25s)
epoch : 607, eubo : -464.629272, log_q : 16.344952, KL : 3.467619 (38s)
epoch : 608, eubo : -384.845306, log_q : 16.625822, KL : 1.398117 (31s)
epoch : 609, eubo : -282.408783, log_q : 15.904650, KL : 1.941213 (26s)
epoch : 610, eubo : -319.142517, log_q : 14.668893, KL : 1.157763 (24s)
epoch : 611, eubo : -243.385620, log_q : 14.204205, KL : 2.535421 (27s)
epoch : 612, eubo : -284.835632, log_q : 16.328978, KL : 1.768888 (25s)
epoch : 613, eubo : -290.651947, log_q : 15.273066, KL : 2.613564 (27s)
epoch : 614, eubo : -349.419281, log_q : 15.617916, KL : 2.008565 (32s)
epoch : 615, eubo : -262.369934, log_q : 17.355604, KL : 2.670833 (26s)
epoch : 616, eubo : -305.729553, log_q : 15.332662, KL : 1.993379 (24s)
epoch : 617, eubo : -432.218903, log_q : 18.491106, KL : 2.254007 (31s)
epoch : 618, eubo : -392.722778, log_q : 16.594423, KL : 1.573557 (32s)
epoch : 619, eubo : -338.507843, log_q : 17.066208, KL : 1.718067 (31s)
epoch : 620, eubo : -447.385437, log_q : 15.667255, KL : 6.146036 (36s)
epoch : 621, eubo : -369.726532, log_q : 17.036350, KL : 1.502559 (33s)
epoch : 622, eubo : -379.729736, log_q : 16.530422, KL : 3.247777 (36s)
epoch : 623, eubo : -416.138428, log_q : 17.399944, KL : 4.132660 (38s)
epoch : 624, eubo : -521.943420, log_q : 17.219091, KL : 1.686560 (38s)
epoch : 625, eubo : -309.107910, log_q : 12.586323, KL : 7.812041 (31s)
epoch : 626, eubo : -424.232483, log_q : 16.924139, KL : 5.424005 (35s)
epoch : 627, eubo : -448.060669, log_q : 18.207129, KL : 0.635415 (37s)
epoch : 628, eubo : -401.518250, log_q : 17.198599, KL : 3.432060 (32s)
epoch : 629, eubo : -486.852753, log_q : 13.519466, KL : 4.444394 (26s)
epoch : 630, eubo : -220.849304, log_q : 17.053986, KL : 3.896752 (24s)
epoch : 631, eubo : -321.678528, log_q : 16.878736, KL : 1.512596 (27s)
epoch : 632, eubo : -542.281128, log_q : 15.090379, KL : 2.501595 (34s)
epoch : 633, eubo : -461.727142, log_q : 17.215492, KL : 2.031281 (37s)
epoch : 634, eubo : -272.515869, log_q : 16.449381, KL : 1.170857 (24s)
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epoch : 635, eubo : -345.337738, log_q : 15.719020, KL : 2.952836 (26s)
epoch : 636, eubo : -438.472717, log_q : 17.415956, KL : 1.550004 (37s)
epoch : 637, eubo : -589.325439, log_q : 15.954034, KL : 2.051069 (35s)
epoch : 638, eubo : -376.782684, log_q : 16.116722, KL : 1.436984 (29s)
epoch : 639, eubo : -375.918182, log_q : 16.122965, KL : 1.967754 (38s)
epoch : 640, eubo : -507.938507, log_q : 16.392849, KL : 4.445142 (37s)
epoch : 641, eubo : -466.491241, log_q : 16.965630, KL : 3.340379 (38s)
epoch : 642, eubo : -266.226044, log_q : 15.663785, KL : 2.580184 (26s)
epoch : 643, eubo : -327.136353, log_q : 14.526144, KL : 2.757265 (25s)
epoch : 644, eubo : -314.627228, log_q : 13.783744, KL : 3.612465 (28s)
epoch : 645, eubo : -454.320190, log_q : 16.493231, KL : 1.980213 (34s)
epoch : 646, eubo : -249.985626, log_q : 15.774285, KL : 1.554784 (25s)
epoch : 647, eubo : -363.804871, log_q : 14.741767, KL : 3.570137 (31s)
epoch : 648, eubo : -257.113129, log_q : 15.778798, KL : 1.656880 (27s)
epoch : 649, eubo : -254.075104, log_q : 15.176622, KL : 1.697326 (24s)
epoch : 650, eubo : -305.583130, log_q : 14.817211, KL : 1.823668 (23s)
epoch : 651, eubo : -387.349243, log_q : 16.775322, KL : 2.147022 (38s)
epoch : 652, eubo : -472.396698, log_q : 16.757641, KL : 3.673781 (32s)
epoch : 653, eubo : -312.206909, log_q : 17.096237, KL : 1.665039 (30s)
epoch : 654, eubo : -326.688629, log_q : 15.087825, KL : 1.074721 (26s)
epoch : 655, eubo : -382.328186, log_q : 17.919744, KL : 1.813178 (36s)
epoch : 656, eubo : -382.053070, log_q : 17.009008, KL : 2.132601 (33s)
epoch : 657, eubo : -361.458069, log_q : 16.460413, KL : 1.417610 (27s)
epoch : 658, eubo : -439.092743, log_q : 17.255358, KL : 3.759849 (34s)
epoch : 659, eubo : -501.600067, log_q : 18.174963, KL : 2.329056 (24s)
epoch : 660, eubo : -427.211517, log_q : 13.052346, KL : 5.830421 (38s)
epoch : 661, eubo : -444.919128, log_q : 17.364733, KL : 1.078769 (35s)
epoch : 662, eubo : -292.607300, log_q : 15.733370, KL : 1.019485 (25s)
epoch : 663, eubo : -561.689697, log_q : 16.770313, KL : 2.471341 (36s)
epoch : 664, eubo : -494.888092, log_q : 17.148327, KL : 3.044744 (27s)
epoch : 665, eubo : -552.311035, log_q : 18.066282, KL : 3.117685 (35s)
epoch : 666, eubo : -431.870209, log_q : 17.046936, KL : 1.916659 (33s)
epoch : 667, eubo : -476.143829, log_q : 17.521727, KL : 2.148836 (35s)
epoch : 668, eubo : -496.682831, log_q : 15.392089, KL : 2.424529 (24s)
epoch : 669, eubo : -427.220001, log_q : 14.711068, KL : 4.354198 (33s)
epoch : 670, eubo : -365.560242, log_q : 16.864304, KL : 2.850887 (30s)
epoch : 671, eubo : -432.771240, log_q : 17.118877, KL : 2.020866 (28s)
epoch : 672, eubo : -417.434784, log_q : 17.154488, KL : 2.581411 (26s)
epoch : 673, eubo : -400.559052, log_q : 17.772026, KL : 2.212234 (35s)
epoch : 674, eubo : -371.683319, log_q : 17.432278, KL : 0.650006 (33s)
epoch : 675, eubo : -499.734039, log_q : 18.144995, KL : 1.586765 (36s)
epoch : 676, eubo : -422.101135, log_q : 17.168619, KL : 5.819009 (35s)
epoch : 677, eubo : -507.072144, log_q : 17.912203, KL : 2.726888 (39s)
epoch : 678, eubo : -380.878265, log_q : 16.162651, KL : 2.413043 (24s)
epoch : 679, eubo : -323.381256, log_q : 13.231591, KL : 1.751810 (28s)
epoch : 680, eubo : -461.902863, log_q : 17.728516, KL : 4.835316 (33s)
epoch : 681, eubo : -420.141785, log_q : 16.438168, KL : 2.758807 (28s)
epoch : 682, eubo : -455.674805, log_q : 16.311481, KL : 2.235252 (34s)
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epoch : 683, eubo : -360.753876, log_q : 17.554790, KL : 1.239574 (32s)
epoch : 684, eubo : -369.955048, log_q : 17.067076, KL : 1.816548 (25s)
epoch : 685, eubo : -384.186584, log_q : 17.579151, KL : 1.938961 (27s)
epoch : 686, eubo : -321.597046, log_q : 16.207460, KL : 2.572343 (24s)
epoch : 687, eubo : -465.356293, log_q : 16.862869, KL : 3.154693 (36s)
epoch : 688, eubo : -221.422363, log_q : 17.694946, KL : 1.218957 (24s)
epoch : 689, eubo : -473.376129, log_q : 15.613817, KL : 4.008412 (33s)
epoch : 690, eubo : -447.859344, log_q : 13.899929, KL : 2.992679 (24s)
epoch : 691, eubo : -469.271118, log_q : 15.750133, KL : 2.751644 (33s)
epoch : 692, eubo : -380.356232, log_q : 16.816967, KL : 2.106279 (31s)
epoch : 693, eubo : -524.806519, log_q : 17.056339, KL : 3.418999 (32s)
epoch : 694, eubo : -302.427856, log_q : 16.967896, KL : 1.604097 (29s)
epoch : 695, eubo : -336.882751, log_q : 13.864320, KL : 4.191883 (33s)
epoch : 696, eubo : -348.531647, log_q : 16.899195, KL : 1.562195 (31s)
epoch : 697, eubo : -312.277893, log_q : 16.576666, KL : 2.248626 (28s)
epoch : 698, eubo : -534.362549, log_q : 18.111031, KL : 2.279380 (27s)
epoch : 699, eubo : -341.511993, log_q : 16.144163, KL : 1.077612 (29s)
epoch : 700, eubo : -512.725220, log_q : 18.502409, KL : 2.385030 (37s)
epoch : 701, eubo : -365.096893, log_q : 17.671595, KL : 1.268814 (33s)
epoch : 702, eubo : -416.078705, log_q : 17.151438, KL : 0.878779 (38s)
epoch : 703, eubo : -281.903748, log_q : 16.384676, KL : 2.427520 (25s)
epoch : 704, eubo : -511.973022, log_q : 19.430439, KL : 5.877750 (38s)
epoch : 705, eubo : -318.651154, log_q : 17.349779, KL : 2.742218 (29s)
epoch : 706, eubo : -320.892975, log_q : 16.720652, KL : 1.820303 (29s)
epoch : 707, eubo : -271.369934, log_q : 12.447495, KL : 2.373221 (28s)
epoch : 708, eubo : -405.927307, log_q : 16.165731, KL : 1.677187 (28s)
epoch : 709, eubo : -435.319366, log_q : 16.245384, KL : 3.005863 (38s)
epoch : 710, eubo : -506.030701, log_q : 16.494328, KL : 3.431800 (27s)
epoch : 711, eubo : -401.693390, log_q : 17.269539, KL : 2.833745 (35s)
epoch : 712, eubo : -364.886169, log_q : 17.346962, KL : 3.094459 (32s)
epoch : 713, eubo : -545.601685, log_q : 15.102524, KL : 5.440231 (33s)
epoch : 714, eubo : -275.435913, log_q : 12.655615, KL : 3.116178 (36s)
epoch : 715, eubo : -366.042175, log_q : 17.248569, KL : 1.449028 (23s)
epoch : 716, eubo : -278.513367, log_q : 15.527659, KL : 2.473814 (26s)
epoch : 717, eubo : -394.155396, log_q : 16.844784, KL : 0.456194 (31s)
epoch : 718, eubo : -373.691101, log_q : 15.215773, KL : 2.279427 (26s)
epoch : 719, eubo : -334.340454, log_q : 15.750984, KL : 2.984323 (33s)
epoch : 720, eubo : -367.485016, log_q : 17.822594, KL : 1.937911 (30s)
epoch : 721, eubo : -409.476562, log_q : 16.220695, KL : 2.051993 (31s)
epoch : 722, eubo : -338.221893, log_q : 16.905220, KL : 2.815834 (28s)
epoch : 723, eubo : -481.214661, log_q : 17.979595, KL : 1.486214 (37s)
epoch : 724, eubo : -373.161957, log_q : 17.444586, KL : 2.407276 (38s)
epoch : 725, eubo : -247.272949, log_q : 15.913788, KL : 2.408351 (26s)
epoch : 726, eubo : -360.243683, log_q : 13.196140, KL : 4.623004 (32s)
epoch : 727, eubo : -351.014984, log_q : 14.860618, KL : 1.894154 (29s)
epoch : 728, eubo : -519.822876, log_q : 16.281946, KL : 2.414857 (35s)
epoch : 729, eubo : -553.338867, log_q : 17.182535, KL : 5.586082 (33s)
epoch : 730, eubo : -370.703949, log_q : 14.846630, KL : 1.760471 (28s)
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epoch : 731, eubo : -305.337158, log_q : 16.965450, KL : 1.766032 (25s)
epoch : 732, eubo : -398.173676, log_q : 19.040783, KL : 1.204133 (35s)
epoch : 733, eubo : -355.922943, log_q : 17.225201, KL : 1.862854 (28s)
epoch : 734, eubo : -386.922424, log_q : 18.048697, KL : 1.471745 (32s)
epoch : 735, eubo : -396.577271, log_q : 15.830302, KL : 2.469371 (36s)
epoch : 736, eubo : -355.003296, log_q : 19.428993, KL : 0.660157 (38s)
epoch : 737, eubo : -302.460602, log_q : 16.560352, KL : 1.664862 (29s)
epoch : 738, eubo : -555.170593, log_q : 16.293715, KL : 1.455457 (34s)
epoch : 739, eubo : -789.677368, log_q : 9.006637, KL : 3.968902 (33s)
epoch : 740, eubo : -382.987885, log_q : 16.651709, KL : 1.842382 (29s)
epoch : 741, eubo : -451.204315, log_q : 17.854383, KL : 2.305068 (38s)
epoch : 742, eubo : -485.909729, log_q : 18.234882, KL : 2.950492 (36s)
epoch : 743, eubo : -504.660736, log_q : 15.800174, KL : 3.875883 (38s)
epoch : 744, eubo : -356.623138, log_q : 17.152817, KL : 0.930255 (29s)
epoch : 745, eubo : -372.202759, log_q : 14.927410, KL : 2.845547 (32s)
epoch : 746, eubo : -379.346619, log_q : 10.478546, KL : 4.466419 (28s)
epoch : 747, eubo : -339.959595, log_q : 15.518980, KL : 3.360784 (29s)
epoch : 748, eubo : -359.718903, log_q : 15.336138, KL : 2.498826 (32s)
epoch : 749, eubo : -412.924255, log_q : 14.868521, KL : 2.246138 (24s)
epoch : 750, eubo : -344.171967, log_q : 17.304972, KL : 0.701099 (34s)
epoch : 751, eubo : -438.031708, log_q : 17.128830, KL : 2.326534 (36s)
epoch : 752, eubo : -363.420319, log_q : 16.613461, KL : 3.062547 (30s)
epoch : 753, eubo : -334.608521, log_q : 17.402990, KL : 0.757014 (35s)
epoch : 754, eubo : -404.400452, log_q : 16.597475, KL : 4.396088 (35s)
epoch : 755, eubo : -301.148407, log_q : 15.502953, KL : 1.541540 (32s)
epoch : 756, eubo : -402.284271, log_q : 17.377344, KL : 1.980206 (36s)
epoch : 757, eubo : -550.398132, log_q : 13.384265, KL : 2.775406 (38s)
epoch : 758, eubo : -624.223328, log_q : 15.950739, KL : 4.679642 (35s)
epoch : 759, eubo : -294.712769, log_q : 17.978466, KL : 1.843514 (27s)
epoch : 760, eubo : -336.415161, log_q : 17.161856, KL : 1.793993 (27s)
epoch : 761, eubo : -336.754425, log_q : 15.280334, KL : 1.335364 (28s)
epoch : 762, eubo : -605.159668, log_q : 13.435327, KL : 6.008960 (34s)
epoch : 763, eubo : -402.055786, log_q : 17.879148, KL : 1.963982 (32s)
epoch : 764, eubo : -333.338898, log_q : 15.743997, KL : 2.062727 (27s)
epoch : 765, eubo : -535.395691, log_q : 17.223335, KL : 4.921543 (37s)
epoch : 766, eubo : -348.655090, log_q : 16.292490, KL : 2.245982 (24s)
epoch : 767, eubo : -299.109558, log_q : 17.294075, KL : 1.939697 (27s)
epoch : 768, eubo : -374.047211, log_q : 16.162380, KL : 1.900484 (26s)
epoch : 769, eubo : -293.878387, log_q : 15.885114, KL : 2.024001 (25s)
epoch : 770, eubo : -337.148712, log_q : 15.427090, KL : 2.154344 (23s)
epoch : 771, eubo : -345.945740, log_q : 17.546137, KL : 2.305582 (33s)
epoch : 772, eubo : -494.487396, log_q : 16.465282, KL : 2.799804 (34s)
epoch : 773, eubo : -512.015747, log_q : 15.729387, KL : 4.179039 (37s)
epoch : 774, eubo : -355.187897, log_q : 17.493113, KL : 1.322371 (26s)
epoch : 775, eubo : -286.093903, log_q : 16.905609, KL : 2.414881 (29s)
epoch : 776, eubo : -311.200836, log_q : 17.129559, KL : 3.431994 (29s)
epoch : 777, eubo : -466.945251, log_q : 16.735514, KL : 2.751986 (27s)
epoch : 778, eubo : -371.549011, log_q : 14.064586, KL : 3.148118 (28s)
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epoch : 779, eubo : -308.963867, log_q : 14.968560, KL : 3.415528 (26s)
epoch : 780, eubo : -322.961700, log_q : 13.534775, KL : 1.073344 (27s)
epoch : 781, eubo : -265.991791, log_q : 13.081039, KL : 3.893854 (25s)
epoch : 782, eubo : -428.619080, log_q : 17.055246, KL : 1.267469 (28s)
epoch : 783, eubo : -241.959000, log_q : 16.248167, KL : 2.940261 (24s)
epoch : 784, eubo : -395.809845, log_q : 17.242102, KL : 3.227952 (34s)
epoch : 785, eubo : -331.450897, log_q : 16.962847, KL : 1.702457 (28s)
epoch : 786, eubo : -307.578430, log_q : 16.742577, KL : 3.538219 (24s)
epoch : 787, eubo : -367.769104, log_q : 15.994943, KL : 2.097975 (26s)
epoch : 788, eubo : -641.829773, log_q : 16.774702, KL : 2.585115 (34s)
epoch : 789, eubo : -324.019989, log_q : 10.856264, KL : 1.571885 (24s)
epoch : 790, eubo : -395.624786, log_q : 16.347288, KL : 3.454002 (35s)
epoch : 791, eubo : -286.234924, log_q : 13.977327, KL : 6.090926 (29s)
epoch : 792, eubo : -381.710480, log_q : 15.716391, KL : 1.707446 (31s)
epoch : 793, eubo : -333.282593, log_q : 16.879393, KL : 2.562956 (34s)
epoch : 794, eubo : -322.820374, log_q : 15.749115, KL : 2.131392 (31s)
epoch : 795, eubo : -399.387756, log_q : 15.410885, KL : 1.886232 (24s)
epoch : 796, eubo : -361.839050, log_q : 14.262653, KL : 2.439627 (24s)
epoch : 797, eubo : -495.839996, log_q : 16.072496, KL : 1.679118 (31s)
epoch : 798, eubo : -320.991791, log_q : 17.004942, KL : 2.410321 (25s)
epoch : 799, eubo : -452.112671, log_q : 16.509558, KL : 1.890585 (30s)
epoch : 800, eubo : -356.299255, log_q : 16.368883, KL : 3.181397 (25s)
epoch : 801, eubo : -380.469147, log_q : 16.766661, KL : 1.962183 (30s)
epoch : 802, eubo : -560.404663, log_q : 16.811584, KL : 3.907121 (38s)
epoch : 803, eubo : -321.961609, log_q : 17.418493, KL : 1.798016 (23s)
epoch : 804, eubo : -463.440216, log_q : 16.166239, KL : 5.721415 (31s)
epoch : 805, eubo : -405.300537, log_q : 17.337593, KL : 0.949172 (32s)
epoch : 806, eubo : -294.048309, log_q : 15.247086, KL : 1.247153 (29s)
epoch : 807, eubo : -231.274155, log_q : 12.713734, KL : 6.252661 (27s)
epoch : 808, eubo : -412.180817, log_q : 15.322757, KL : 0.998557 (25s)
epoch : 809, eubo : -302.055328, log_q : 18.184805, KL : 1.564156 (25s)
epoch : 810, eubo : -304.829224, log_q : 16.886515, KL : 3.900795 (31s)
epoch : 811, eubo : -294.252167, log_q : 12.817013, KL : 1.188126 (25s)
epoch : 812, eubo : -286.467010, log_q : 15.746570, KL : 1.553990 (23s)
epoch : 813, eubo : -335.370575, log_q : 15.249539, KL : 1.004317 (30s)
epoch : 814, eubo : -429.934875, log_q : 16.260063, KL : 5.081661 (35s)
epoch : 815, eubo : -318.342896, log_q : 15.398110, KL : 2.074827 (35s)
epoch : 816, eubo : -317.726349, log_q : 14.496724, KL : 2.053702 (29s)
epoch : 817, eubo : -392.922729, log_q : 16.395887, KL : 2.108577 (26s)
epoch : 818, eubo : -394.706146, log_q : 18.045845, KL : 0.983200 (39s)
epoch : 819, eubo : -240.750488, log_q : 17.080742, KL : 1.899900 (29s)
epoch : 820, eubo : -454.568512, log_q : 16.134407, KL : 3.763781 (38s)
epoch : 821, eubo : -396.400452, log_q : 16.384432, KL : 2.871729 (35s)
epoch : 822, eubo : -381.204041, log_q : 16.184486, KL : 1.707296 (35s)
epoch : 823, eubo : -401.967316, log_q : 15.967928, KL : 3.402773 (38s)
epoch : 824, eubo : -273.833710, log_q : 16.062590, KL : 2.009129 (25s)
epoch : 825, eubo : -286.618561, log_q : 18.454622, KL : 1.867167 (35s)
epoch : 826, eubo : -311.071747, log_q : 16.292450, KL : 2.446352 (26s)
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epoch : 827, eubo : -643.888550, log_q : 15.334954, KL : 7.095534 (34s)
epoch : 828, eubo : -355.689423, log_q : 14.792487, KL : 1.910572 (27s)
epoch : 829, eubo : -341.107635, log_q : 15.191285, KL : 0.741745 (30s)
epoch : 830, eubo : -350.388489, log_q : 17.049950, KL : 2.893248 (32s)
epoch : 831, eubo : -282.938843, log_q : 14.313253, KL : 1.612689 (24s)
epoch : 832, eubo : -318.122345, log_q : 15.110835, KL : 1.052976 (30s)
epoch : 833, eubo : -495.529053, log_q : 17.152954, KL : 2.171726 (38s)
epoch : 834, eubo : -500.781799, log_q : 15.005857, KL : 3.614226 (34s)
epoch : 835, eubo : -214.966644, log_q : 18.864635, KL : 1.523572 (28s)
epoch : 836, eubo : -389.967896, log_q : 17.739519, KL : 1.443266 (36s)
epoch : 837, eubo : -380.426178, log_q : 14.852134, KL : 1.653989 (25s)
epoch : 838, eubo : -323.940521, log_q : 15.227904, KL : 2.058179 (28s)
epoch : 839, eubo : -359.241333, log_q : 14.241154, KL : 3.112584 (32s)
epoch : 840, eubo : -232.581253, log_q : 16.613573, KL : 3.150120 (29s)
epoch : 841, eubo : -445.719269, log_q : 16.679562, KL : 2.578870 (36s)
epoch : 842, eubo : -480.455200, log_q : 16.643539, KL : 2.215003 (33s)
epoch : 843, eubo : -443.198090, log_q : 16.589872, KL : 1.636110 (31s)
epoch : 844, eubo : -490.488373, log_q : 17.809862, KL : 2.058870 (38s)
epoch : 845, eubo : -435.304504, log_q : 17.279497, KL : 1.808235 (38s)
epoch : 846, eubo : -509.288788, log_q : 17.203745, KL : 3.299486 (38s)
epoch : 847, eubo : -383.713837, log_q : 15.891288, KL : 1.883511 (31s)
epoch : 848, eubo : -322.173309, log_q : 16.589003, KL : 2.337186 (29s)
epoch : 849, eubo : -340.299011, log_q : 13.260200, KL : 4.206014 (35s)
epoch : 850, eubo : -416.026123, log_q : 18.461586, KL : 2.951197 (34s)
epoch : 851, eubo : -463.573456, log_q : 17.109461, KL : 5.262644 (28s)
epoch : 852, eubo : -353.072601, log_q : 16.239428, KL : 1.303162 (26s)
epoch : 853, eubo : -336.520874, log_q : 14.927846, KL : 1.924666 (25s)
epoch : 854, eubo : -376.980255, log_q : 15.059440, KL : 2.760818 (27s)
epoch : 855, eubo : -319.089020, log_q : 18.133547, KL : 3.202520 (35s)
epoch : 856, eubo : -328.428619, log_q : 16.692636, KL : 3.700253 (27s)
epoch : 857, eubo : -433.040466, log_q : 16.485468, KL : 3.819472 (26s)
epoch : 858, eubo : -413.458282, log_q : 18.086460, KL : 4.884961 (35s)
epoch : 859, eubo : -350.433716, log_q : 15.176722, KL : 2.847545 (32s)
epoch : 860, eubo : -433.871582, log_q : 15.367345, KL : 1.765034 (33s)
epoch : 861, eubo : -399.557404, log_q : 13.976418, KL : 2.973993 (29s)
epoch : 862, eubo : -332.056793, log_q : 17.526602, KL : 1.222856 (33s)
epoch : 863, eubo : -430.782318, log_q : 16.788675, KL : 2.200649 (35s)
epoch : 864, eubo : -333.493683, log_q : 16.434820, KL : 1.521947 (27s)
epoch : 865, eubo : -336.203369, log_q : 16.789200, KL : 1.256522 (26s)
epoch : 866, eubo : -673.385559, log_q : 17.423923, KL : 3.355527 (34s)
epoch : 867, eubo : -348.161285, log_q : 16.260370, KL : 1.820233 (28s)
epoch : 868, eubo : -432.413666, log_q : 16.196661, KL : 1.799497 (36s)
epoch : 869, eubo : -357.918793, log_q : 15.570499, KL : 1.921556 (29s)
epoch : 870, eubo : -426.338257, log_q : 13.769674, KL : 1.279868 (24s)
epoch : 871, eubo : -268.088531, log_q : 16.220474, KL : 3.268607 (28s)
epoch : 872, eubo : -421.152405, log_q : 17.530840, KL : 1.886687 (30s)
epoch : 873, eubo : -438.149933, log_q : 16.758787, KL : 3.368521 (38s)
epoch : 874, eubo : -364.152069, log_q : 16.764275, KL : 0.909179 (33s)
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epoch : 875, eubo : -248.792114, log_q : 16.764343, KL : 1.650856 (24s)
epoch : 876, eubo : -295.645294, log_q : 16.322229, KL : 1.754287 (33s)
epoch : 877, eubo : -461.333099, log_q : 16.536354, KL : 1.438631 (29s)
epoch : 878, eubo : -363.861084, log_q : 13.950355, KL : 1.167689 (31s)
epoch : 879, eubo : -330.977051, log_q : 15.306058, KL : 2.398725 (33s)
epoch : 880, eubo : -329.270142, log_q : 15.823084, KL : 2.949373 (25s)
epoch : 881, eubo : -281.894592, log_q : 14.701015, KL : 3.866969 (24s)
epoch : 882, eubo : -495.521912, log_q : 16.390501, KL : 0.926342 (36s)
epoch : 883, eubo : -502.980713, log_q : 18.829559, KL : 1.930986 (38s)
epoch : 884, eubo : -350.204773, log_q : 16.684639, KL : 2.562192 (35s)
epoch : 885, eubo : -369.941040, log_q : 15.647202, KL : 3.598286 (38s)
epoch : 886, eubo : -454.498474, log_q : 18.745470, KL : 1.489842 (36s)
epoch : 887, eubo : -555.892761, log_q : 15.075957, KL : 1.497243 (36s)
epoch : 888, eubo : -381.864838, log_q : 16.308218, KL : 1.462654 (33s)
epoch : 889, eubo : -389.169098, log_q : 15.520334, KL : 2.702273 (32s)
epoch : 890, eubo : -379.860901, log_q : 16.406504, KL : 3.586352 (36s)
epoch : 891, eubo : -396.368408, log_q : 13.147629, KL : 1.138914 (30s)
epoch : 892, eubo : -463.269684, log_q : 17.734673, KL : 2.892095 (34s)
epoch : 893, eubo : -410.887604, log_q : 18.567019, KL : 4.570740 (28s)
epoch : 894, eubo : -378.845245, log_q : 16.227888, KL : 2.574943 (27s)
epoch : 895, eubo : -479.836243, log_q : 18.395330, KL : 2.524222 (37s)
epoch : 896, eubo : -476.165222, log_q : 17.513363, KL : 1.296154 (30s)
epoch : 897, eubo : -425.222107, log_q : 15.808339, KL : 1.704191 (27s)
epoch : 898, eubo : -507.910767, log_q : 16.699343, KL : 3.852036 (39s)
epoch : 899, eubo : -391.007141, log_q : 17.448996, KL : 1.258388 (34s)
epoch : 900, eubo : -343.728394, log_q : 14.567299, KL : 7.348006 (33s)
epoch : 901, eubo : -440.076111, log_q : 16.371481, KL : 2.496924 (37s)
epoch : 902, eubo : -529.633789, log_q : 13.463956, KL : 3.564532 (25s)
epoch : 903, eubo : -379.469635, log_q : 15.010326, KL : 1.094439 (28s)
epoch : 904, eubo : -329.098846, log_q : 14.036174, KL : 2.532981 (29s)
epoch : 905, eubo : -561.258484, log_q : 15.839856, KL : 3.681057 (38s)
epoch : 906, eubo : -522.673950, log_q : 18.062948, KL : 1.555088 (38s)
epoch : 907, eubo : -376.984772, log_q : 16.811232, KL : 1.132746 (31s)
epoch : 908, eubo : -444.710358, log_q : 10.242741, KL : 4.493292 (25s)
epoch : 909, eubo : -288.536987, log_q : 14.631446, KL : 2.100625 (23s)
epoch : 910, eubo : -675.120605, log_q : 15.655763, KL : 2.403484 (27s)
epoch : 911, eubo : -330.358978, log_q : 15.015454, KL : 1.273517 (28s)
epoch : 912, eubo : -305.931152, log_q : 14.817801, KL : 0.875156 (24s)
epoch : 913, eubo : -347.642151, log_q : 15.844829, KL : 1.497051 (25s)
epoch : 914, eubo : -348.902222, log_q : 16.774006, KL : 2.308029 (29s)
epoch : 915, eubo : -374.163940, log_q : 15.784935, KL : 0.774981 (25s)
epoch : 916, eubo : -370.859100, log_q : 16.710964, KL : 1.950842 (32s)
epoch : 917, eubo : -338.279297, log_q : 14.992950, KL : 2.673447 (29s)
epoch : 918, eubo : -341.260101, log_q : 16.352797, KL : 5.361441 (32s)
epoch : 919, eubo : -362.993225, log_q : 15.887271, KL : 0.664464 (25s)
epoch : 920, eubo : -338.809082, log_q : 18.673807, KL : 1.173138 (37s)
epoch : 921, eubo : -352.428864, log_q : 16.279486, KL : 1.256157 (27s)
epoch : 922, eubo : -427.453369, log_q : 16.475496, KL : 2.393285 (34s)
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epoch : 923, eubo : -370.863678, log_q : 16.209610, KL : 4.815606 (27s)
epoch : 924, eubo : -555.249451, log_q : 19.196638, KL : 3.030605 (36s)
epoch : 925, eubo : -279.171112, log_q : 15.406196, KL : 2.897206 (23s)
epoch : 926, eubo : -220.682205, log_q : 15.613251, KL : 3.682109 (27s)
epoch : 927, eubo : -613.779053, log_q : 17.172878, KL : 2.546878 (27s)
epoch : 928, eubo : -480.826263, log_q : 15.881774, KL : 3.459826 (37s)
epoch : 929, eubo : -637.263184, log_q : 16.581163, KL : 0.992492 (35s)
epoch : 930, eubo : -435.522339, log_q : 16.739935, KL : 1.182525 (35s)
epoch : 931, eubo : -428.782745, log_q : 15.195005, KL : 3.126185 (35s)
epoch : 932, eubo : -371.278931, log_q : 17.353613, KL : 1.637678 (38s)
epoch : 933, eubo : -339.587738, log_q : 17.622835, KL : 2.307661 (38s)
epoch : 934, eubo : -389.164703, log_q : 17.866852, KL : 1.298123 (33s)
epoch : 935, eubo : -298.514343, log_q : 15.682941, KL : 3.279471 (28s)
epoch : 936, eubo : -363.301819, log_q : 16.880760, KL : 2.907623 (32s)
epoch : 937, eubo : -435.940521, log_q : 12.407154, KL : 2.171502 (33s)
epoch : 938, eubo : -434.022491, log_q : 17.606846, KL : 3.364509 (30s)
epoch : 939, eubo : -377.677338, log_q : 16.534435, KL : 5.207154 (36s)
epoch : 940, eubo : -280.957031, log_q : 15.193818, KL : 3.582856 (37s)
epoch : 941, eubo : -448.139587, log_q : 19.178106, KL : 4.563923 (38s)
epoch : 942, eubo : -396.328766, log_q : 14.544640, KL : 2.389345 (33s)
epoch : 943, eubo : -377.433838, log_q : 15.374900, KL : 5.002192 (39s)
epoch : 944, eubo : -446.552612, log_q : 17.060474, KL : 1.909451 (29s)
epoch : 945, eubo : -320.558899, log_q : 16.938742, KL : 1.612053 (30s)
epoch : 946, eubo : -301.631256, log_q : 14.147567, KL : 1.818430 (24s)
epoch : 947, eubo : -303.536285, log_q : 15.651561, KL : 0.940023 (24s)
epoch : 948, eubo : -241.797943, log_q : 16.552017, KL : 2.286334 (28s)
epoch : 949, eubo : -475.423828, log_q : 17.476435, KL : 2.273085 (38s)
epoch : 950, eubo : -375.815033, log_q : 15.969707, KL : 1.144771 (33s)
epoch : 951, eubo : -383.928528, log_q : 17.397448, KL : 1.445530 (27s)
epoch : 952, eubo : -468.484711, log_q : 17.948622, KL : 0.760363 (38s)
epoch : 953, eubo : -418.014465, log_q : 16.924755, KL : 1.337374 (34s)
epoch : 954, eubo : -340.574677, log_q : 16.256092, KL : 1.746632 (27s)
epoch : 955, eubo : -292.702393, log_q : 15.294810, KL : 1.798282 (26s)
epoch : 956, eubo : -380.256653, log_q : 16.390591, KL : 1.774646 (31s)
epoch : 957, eubo : -327.546417, log_q : 16.492573, KL : 1.303141 (25s)
epoch : 958, eubo : -400.564392, log_q : 19.128407, KL : 3.687231 (33s)
epoch : 959, eubo : -360.363495, log_q : 15.912144, KL : 3.914831 (33s)
epoch : 960, eubo : -227.686081, log_q : 15.179854, KL : 4.273640 (24s)
epoch : 961, eubo : -452.700195, log_q : 17.756380, KL : 1.850405 (28s)
epoch : 962, eubo : -561.822693, log_q : 17.251226, KL : 3.091175 (35s)
epoch : 963, eubo : -460.247406, log_q : 17.549124, KL : 1.639312 (35s)
epoch : 964, eubo : -266.985718, log_q : 17.166805, KL : 1.038985 (34s)
epoch : 965, eubo : -535.847900, log_q : 18.287125, KL : 2.447597 (38s)
epoch : 966, eubo : -393.516174, log_q : 19.194088, KL : 2.044373 (33s)
epoch : 967, eubo : -453.949402, log_q : 17.500280, KL : 1.718731 (35s)
epoch : 968, eubo : -418.659607, log_q : 16.405781, KL : 1.335859 (34s)
epoch : 969, eubo : -452.223175, log_q : 17.652719, KL : 0.951233 (37s)
epoch : 970, eubo : -432.002533, log_q : 17.821451, KL : 2.177911 (34s)
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epoch : 971, eubo : -268.353973, log_q : 16.819778, KL : 0.956480 (26s)
epoch : 972, eubo : -491.642151, log_q : 14.648636, KL : 2.203411 (32s)
epoch : 973, eubo : -458.495819, log_q : 19.526007, KL : 2.065653 (36s)
epoch : 974, eubo : -408.616516, log_q : 16.377748, KL : 4.095376 (35s)
epoch : 975, eubo : -498.386505, log_q : 15.855541, KL : 1.807217 (33s)
epoch : 976, eubo : -381.919067, log_q : 17.576641, KL : 3.185019 (37s)
epoch : 977, eubo : -301.109802, log_q : 15.010254, KL : 2.301680 (27s)
epoch : 978, eubo : -638.542297, log_q : 18.544228, KL : 1.937451 (39s)
epoch : 979, eubo : -452.306213, log_q : 16.323515, KL : 2.309188 (34s)
epoch : 980, eubo : -300.226837, log_q : 13.081654, KL : 1.697874 (26s)
epoch : 981, eubo : -290.781250, log_q : 16.089100, KL : 0.860685 (26s)
epoch : 982, eubo : -480.958313, log_q : 18.945251, KL : 3.307883 (36s)
epoch : 983, eubo : -538.249573, log_q : 15.538972, KL : 2.045856 (33s)
epoch : 984, eubo : -457.677887, log_q : 16.677563, KL : 0.800336 (22s)
epoch : 985, eubo : -337.311737, log_q : 16.691034, KL : 1.801143 (21s)
epoch : 986, eubo : -471.436676, log_q : 16.704550, KL : 2.680400 (24s)
epoch : 987, eubo : -298.455963, log_q : 18.049063, KL : 2.859049 (17s)
epoch : 988, eubo : -362.144928, log_q : 15.412296, KL : 3.934243 (24s)
epoch : 989, eubo : -381.421661, log_q : 17.058588, KL : 1.475537 (25s)
epoch : 990, eubo : -372.400879, log_q : 17.269135, KL : 1.411143 (21s)
epoch : 991, eubo : -444.058563, log_q : 16.516846, KL : 0.690112 (22s)
epoch : 992, eubo : -311.244446, log_q : 14.220315, KL : 1.012808 (16s)
epoch : 993, eubo : -314.867340, log_q : 15.313847, KL : 1.235830 (16s)
epoch : 994, eubo : -403.226990, log_q : 15.667820, KL : 1.821821 (18s)
epoch : 995, eubo : -310.830200, log_q : 16.841318, KL : 1.740780 (18s)
epoch : 996, eubo : -243.358139, log_q : 16.974195, KL : 1.351847 (17s)
epoch : 997, eubo : -378.411163, log_q : 16.844929, KL : 1.650303 (20s)
epoch : 998, eubo : -411.794067, log_q : 14.731246, KL : 2.340077 (19s)
epoch : 999, eubo : -382.974182, log_q : 16.816166, KL : 2.150967 (24s)
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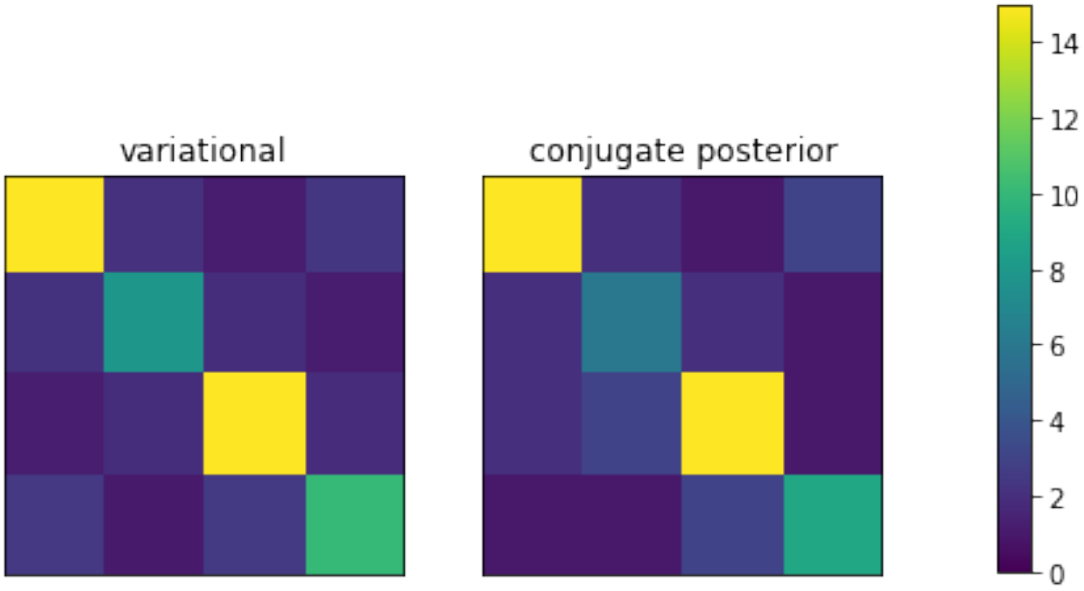
In [8]: learned_dicichlet_post = latents_dirs
        true_dirichlet_post = alpha_trans_0 + pairwise(torch.from_numpy(Zs_true).float(), T).sum
        print('variational : ')
        print(learned_dicichlet_post)
        print('conjugate posterior :')
        print(true_dirichlet_post)
        plot_dirs(learned_dicichlet_post.data.numpy(), true_dirichlet_post.data.numpy(), vmax=15
```

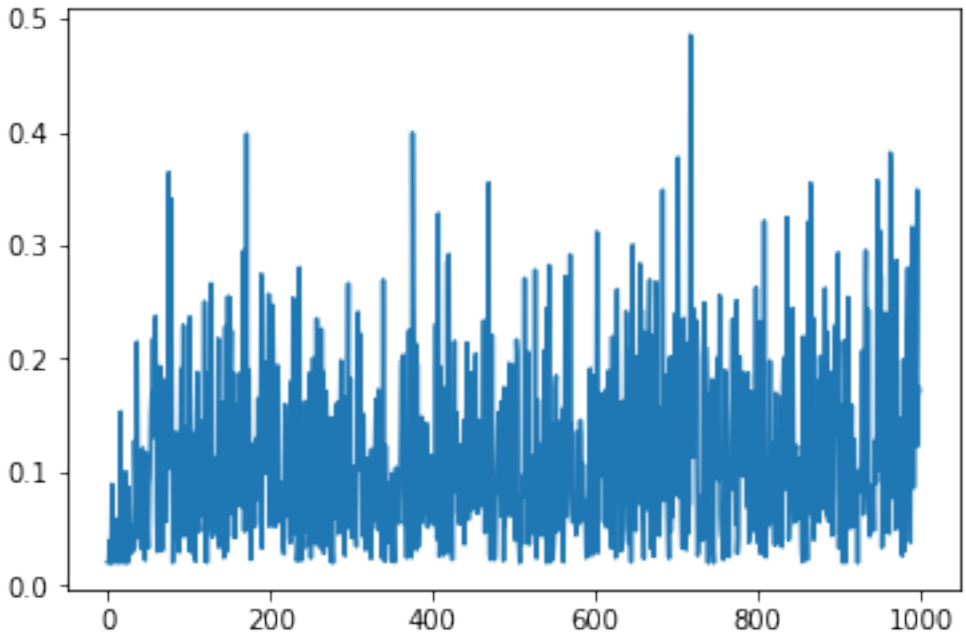
```
variational :
tensor([[17.7570,  2.1230,  1.1428,  2.3973],
        [ 2.2116,  7.9228,  1.9368,  1.1389],
        [ 1.2883,  1.9698, 15.0871,  1.8928],
        [ 2.4628,  1.0835,  2.5405, 10.0450]], grad_fn=<MulBackward>)
conjugate posterior :
tensor([[18.,  2.,  1.,  3.],
        [ 2.,  6.,  2.,  1.],
        [ 2.,  3., 18.,  1.],
```

```
       [ 1.,  1.,  3.,  9.]])
```



In [9]:
```
plt.plot(np.array(ESSs) / num_particles_rws)
```

Out[9]:
```
[<matplotlib.lines.Line2D at 0x7f54e050afd0>]
```



```
In [10]: learned_dicichlet_post.sum()

Out[10]: tensor(73., grad_fn=<SumBackward0>)
```