# 44-44-44-64-6-beta-10.85-twist-2

October 30, 2024

[26]:

```
%load_ext autoreload
%autoreload 2
from modules import read_and_write
from modules import polyakov
from modules import utility
from modules import fourier_surface
from modules import surface_amplitudes as sf
import numpy as np
import matplotlib.pyplot as plt
import os
import glob
```

```
The autoreload extension is already loaded. To reload it, use:
  %reload_ext autoreload
```

## 1 Load data

[32]:

```
from modules.globals import folder_names

smooth_surfaces= {}
choose_folder = 2
folder = folder_names[choose_folder-1]
files = glob.glob(os.path.join(folder, "surface_smooth_*"))
for file in files:
    file_name = file.split("/")[-1]
    smearing_level = file_name.split("_")[-1]
    volume, surface = read_and_write.read_surface_data(folder, file_name)
    smooth_surfaces[smearing_level] = surface
```

[34]:

```
smooth_surfaces = dict(sorted(smooth_surfaces.items(), key=lambda item:␣
  ↪int(item[0])))
```

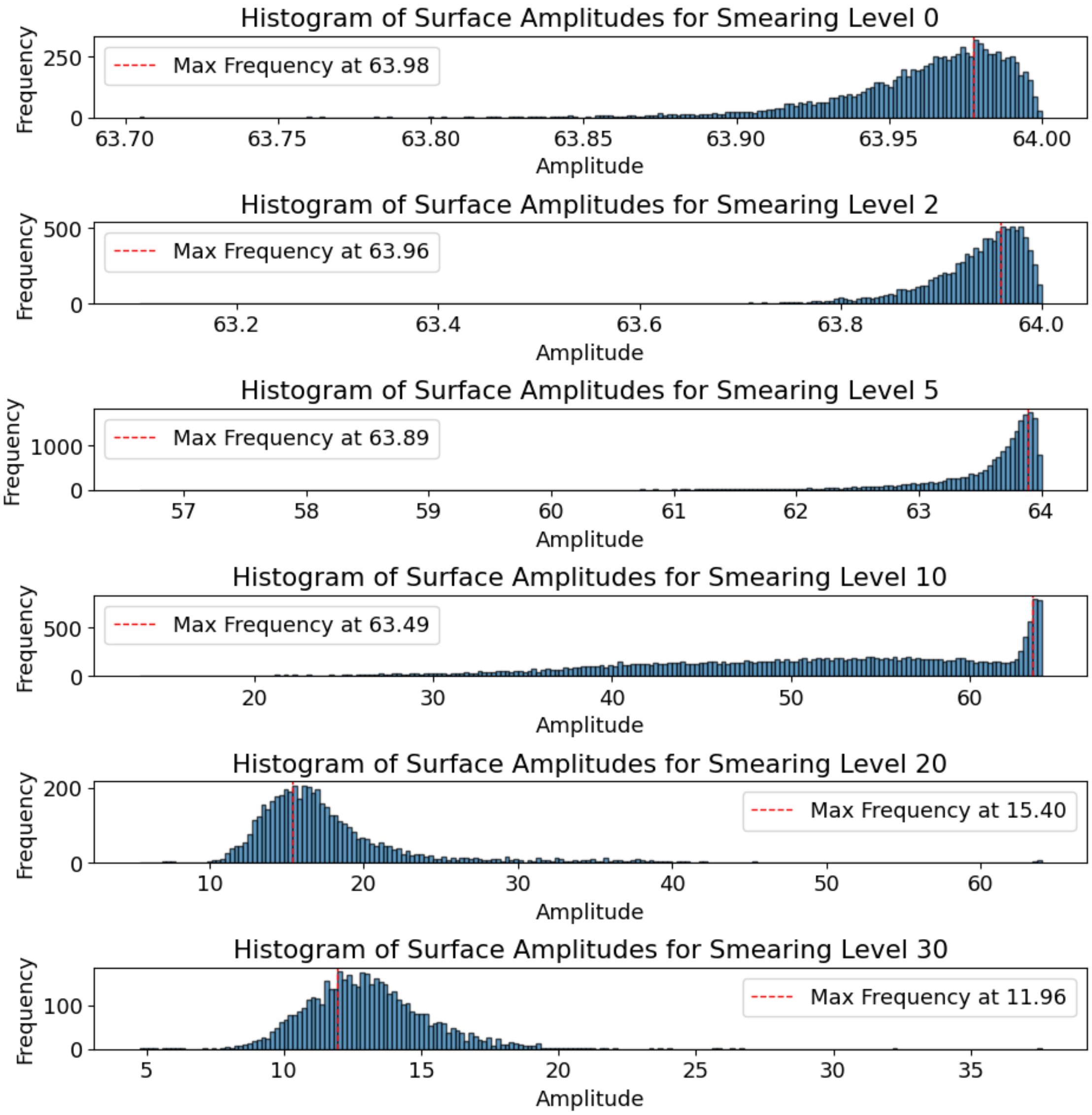
[35]:

```
utility.display_markdown_title(folder)
```

## 2 SU(4), $V =$ [‘44’, ‘44’, ‘64’, ‘6’], $\beta = 10.85$, twist coeff $= 2$

```
[36]: indices = sf.surface_amplitudes(smooth_surfaces=smooth_surfaces,␣
       ↪return_threshold=40,thermalization=10)
```

```
Smearing Level: 0
Smearing Level: 2
Smearing Level: 5
Smearing Level: 10
Smearing Level: 20
Smearing Level: 30
```



```
{'0': (63.96187752752752, 63.7046, 63.9998), '2': (63.93299576576576,
63.102999999999994, 63.999300000000005), '5': (63.5303900250125,
56.638000000000005, 63.999399999999994), '10': (50.78202395747874,
13.564799999999998, 63.9987), '20': (17.89884637867936, 5.45718, 63.9363), '30':
(13.04411513252505, 4.74111, 37.5735)}
```

[37]:

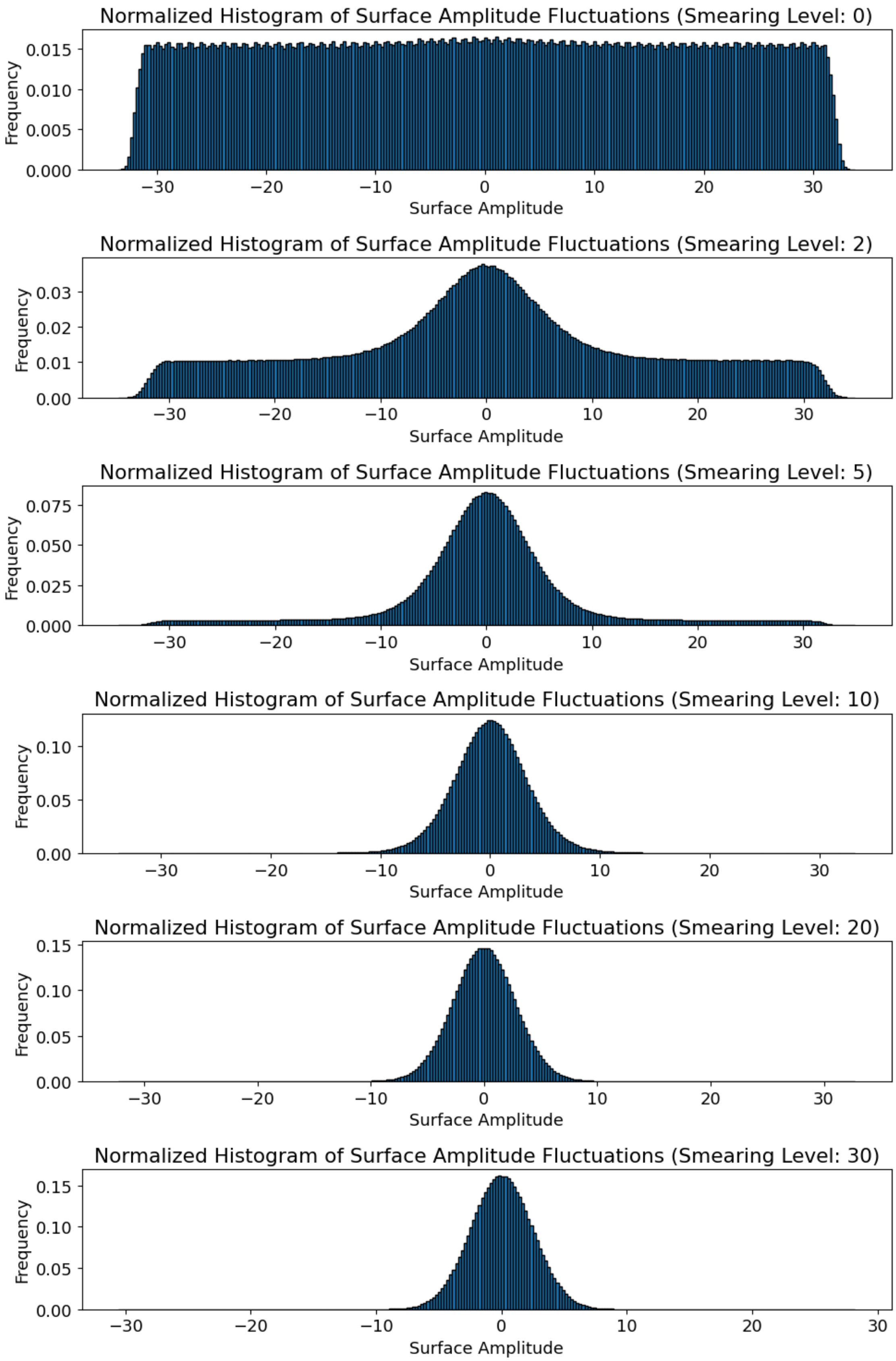
```
# Create a dictionary to store fluctuations for each smearing level
fluctuations_dict = {}
thermalization = 1000
plt.rcParams.update({'font.size': 13})

for smearing_level, surface_data in smooth_surfaces.items():
    post_thermalization_data = surface_data[thermalization:thermalization+10000]
    mean_z_values = np.mean(post_thermalization_data[:, :, 2], axis=1)
    fluctuations = post_thermalization_data[:, :, 2] - mean_z_values[:, np.
 ↪newaxis]
    fluctuations_dict[smearing_level] = fluctuations.flatten()

# Plotting all histograms in subplots
num_plots = len(fluctuations_dict)
fig, axes = plt.subplots(num_plots, 1, figsize=(10,15))

for ax, (smearing_level, fluctuations) in zip(axes, fluctuations_dict.items()):
    ax.hist(fluctuations, edgecolor='black', bins=64*4, density=True)
    ax.set_xlabel('Surface Amplitude')
    ax.set_ylabel('Frequency')
    ax.set_title(f'Normalized Histogram of Surface Amplitude Fluctuations␣
 ↪(Smearing Level: {smearing_level})')

plt.tight_layout()
plt.show()
```


Normalized Histogram of Surface Amplitude Fluctuations (Smearing Level: 0)
Frequency
0.000
0.005
0.010
0.015
−30
−20
−10
0
10
20
30
Surface Amplitude
Normalized Histogram of Surface Amplitude Fluctuations (Smearing Level: 2)
Frequency
0.00
0.01
0.02
0.03
−30
−20
−10
0
10
20
30
Surface Amplitude
Normalized Histogram of Surface Amplitude Fluctuations (Smearing Level: 5)
Frequency
0.000
0.025
0.050
0.075
−30
−20
−10
0
10
20
30
Surface Amplitude
Normalized Histogram of Surface Amplitude Fluctuations (Smearing Level: 10)
Frequency
0.00
0.05
0.10
−30
−20
−10
0
10
20
30
Surface Amplitude
Normalized Histogram of Surface Amplitude Fluctuations (Smearing Level: 20)
Frequency
0.00
0.05
0.10
0.15
−30
−20
−10
0
10
20
30
Surface Amplitude
Normalized Histogram of Surface Amplitude Fluctuations (Smearing Level: 30)
Frequency
0.00
0.05
0.10
0.15
−30
−20
−10
0
10
20
30
Surface Amplitude

$$5$$

[ ]:

```
```