44-44-44-64-6-beta-13-twist-1

November 6, 2024

[2]:

```python
%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
from modules import globals
import numpy as np
import matplotlib.pyplot as plt
import os
import glob
```

1 Load data

[3]:

```python
folders = utility.list_all_folders(globals.data_path,"60-60-86-6")
```

```
../data/output-measure-surface/su4-60-60-86-6/beta-10.80-twist-1-60-60-86-6 ,
index: 0
../data/output-measure-surface/su4-60-60-86-6/beta-10.80-twist-2-60-60-86-6 ,
index: 1
../data/output-measure-surface/su4-60-60-86-6/beta-10.82-twist-1-60-60-86-6 ,
index: 2
../data/output-measure-surface/su4-60-60-86-6/beta-10.82-twist-2-60-60-86-6 ,
index: 3
../data/output-measure-surface/su4-60-60-86-6/beta-10.83-twist-1-60-60-86-6 ,
index: 4
../data/output-measure-surface/su4-60-60-86-6/beta-10.85-twist-1-60-60-86-6 ,
index: 5
../data/output-measure-surface/su4-60-60-86-6/beta-10.85-twist-1-wrap-fix ,
index: 6
../data/output-measure-surface/su4-60-60-86-6/beta-10.85-twist-2-60-60-86-6 ,
index: 7
../data/output-measure-surface/su4-60-60-86-6/beta-10.95-twist-1-60-60-86-6 ,
index: 8
../data/output-measure-surface/su4-60-60-86-6/beta-10.95-twist-2-60-60-86-6 ,
index: 9
```

```
../data/output-measure-surface/su4-60-60-86-6/beta-11.5-twist-1-60-60-86-6 ,
index: 10
../data/output-measure-surface/su4-60-60-86-6/beta-11.5-twist-2-60-60-86-6 ,
index: 11
../data/output-measure-surface/su4-60-60-86-6/beta-12-twist-1-60-60-86-6 ,
index: 12
../data/output-measure-surface/su4-60-60-86-6/beta-12-twist-2-60-60-86-6 ,
index: 13
../data/output-measure-surface/su4-60-60-86-6/beta-13-twist-1-60-60-86-6 ,
index: 14
```

[4]:

```
smooth_surfaces= {}
choose_folder = 14
folder = folders[choose_folder]
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
```

[5]:

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

[6]:

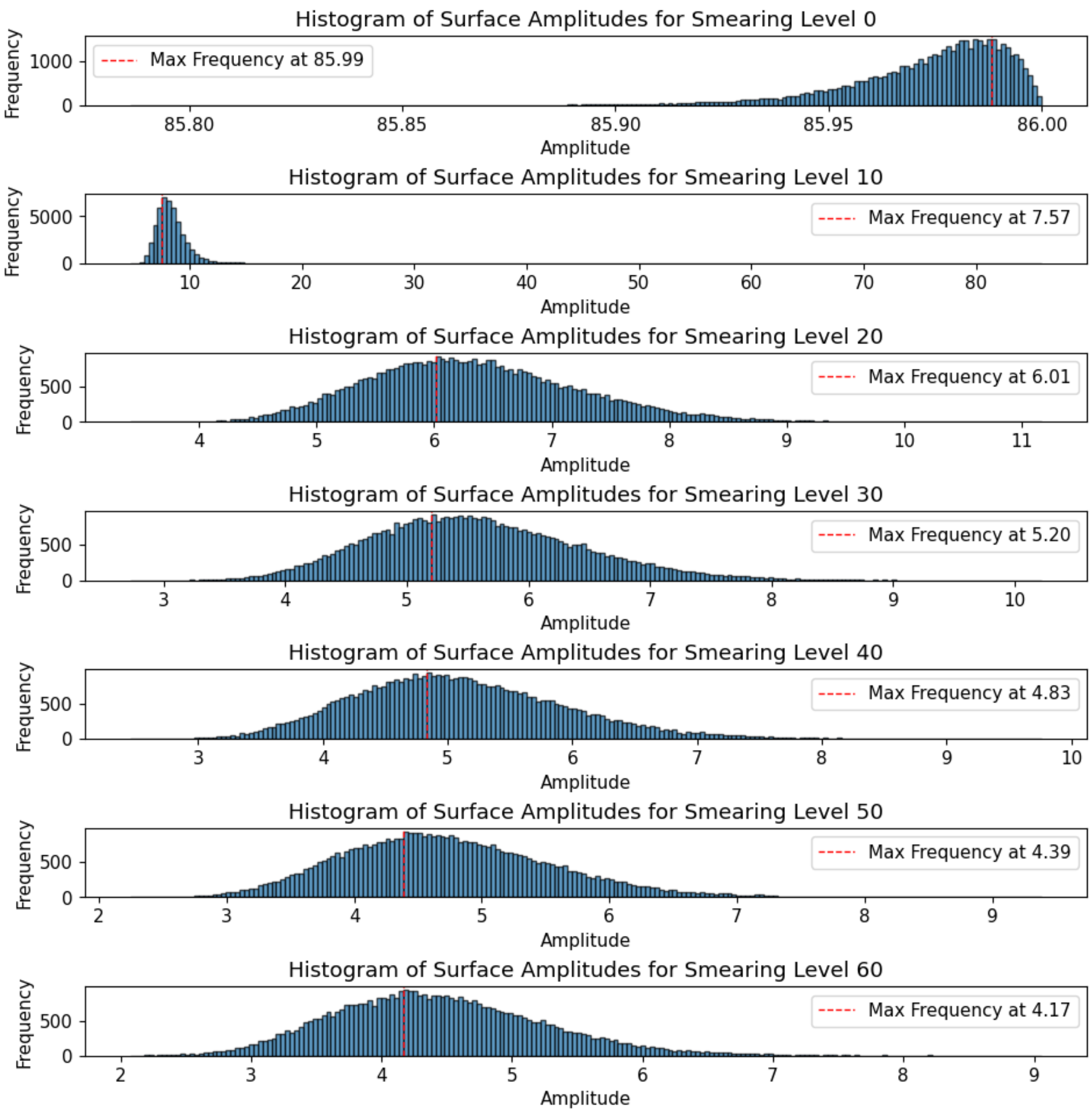
```
utility.display_markdown_title(folder)
```

2 SU(4), V = ['60', '60', '86', '6'], $\beta = 13$, twist coeff = 1

[7]:

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

```
Smearing Level: 0
Smearing Level: 10
Smearing Level: 20
Smearing Level: 30
Smearing Level: 40
Smearing Level: 50
Smearing Level: 60
```

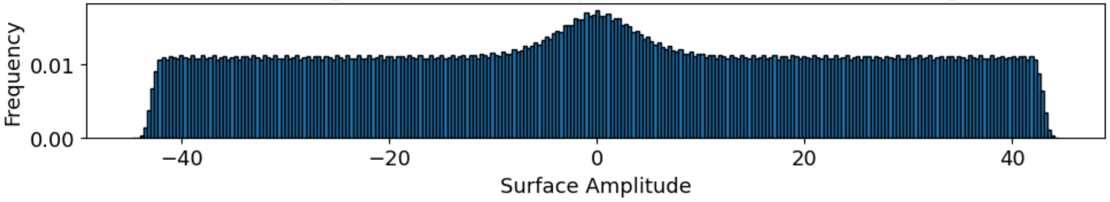


```
{'0': (85.97313600920184, 85.7862, 85.9999), '10': (9.464898189842549,
4.7301400000000005, 85.82419999999999), '20': (6.337652624496599,
3.4164399999999997, 11.16504), '30': (5.579293595292457, 2.725361,
10.218940000000002), '40': (5.091016324312302, 2.4560000000000013,
9.759800000000002), '50': (4.7300021504160235, 2.2446, 9.386920000000002), '60':
(4.443129433477256, 2.0754, 9.057870000000001)}
```

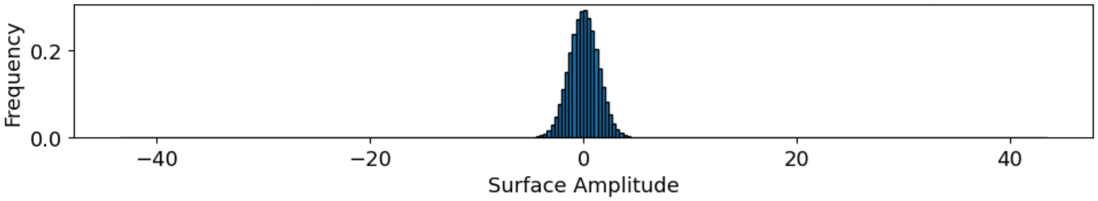
[8]:

```
# 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()
```

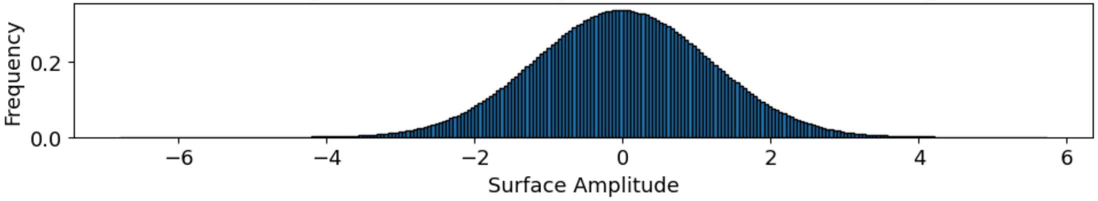
Normalized Histogram of Surface Amplitude Fluctuations (Smearing Level: 0)



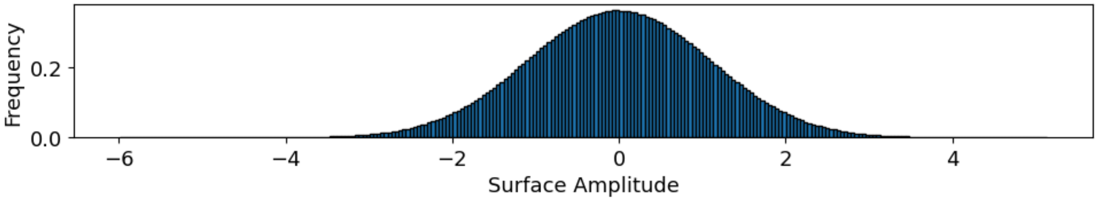
Normalized Histogram of Surface Amplitude Fluctuations (Smearing Level: 10)



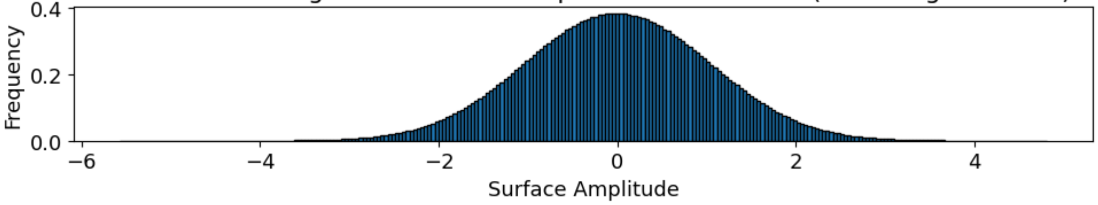
Normalized Histogram of Surface Amplitude Fluctuations (Smearing Level: 20)



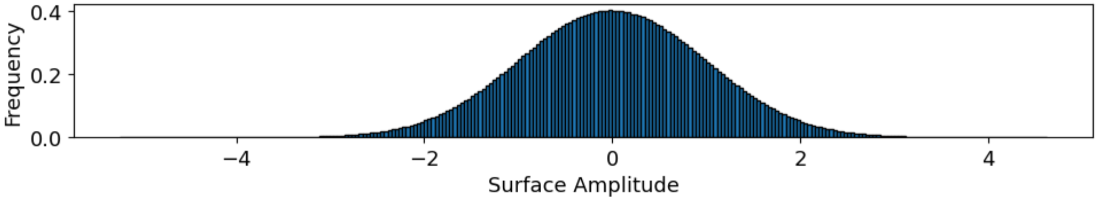
Normalized Histogram of Surface Amplitude Fluctuations (Smearing Level: 30)



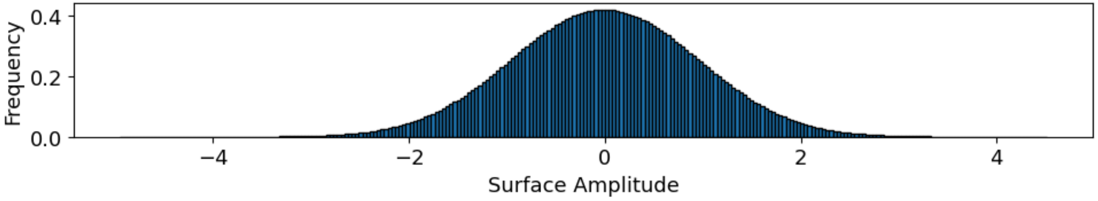
Normalized Histogram of Surface Amplitude Fluctuations (Smearing Level: 40)



Normalized Histogram of Surface Amplitude Fluctuations (Smearing Level: 50)



Normalized Histogram of Surface Amplitude Fluctuations (Smearing Level: 60)



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