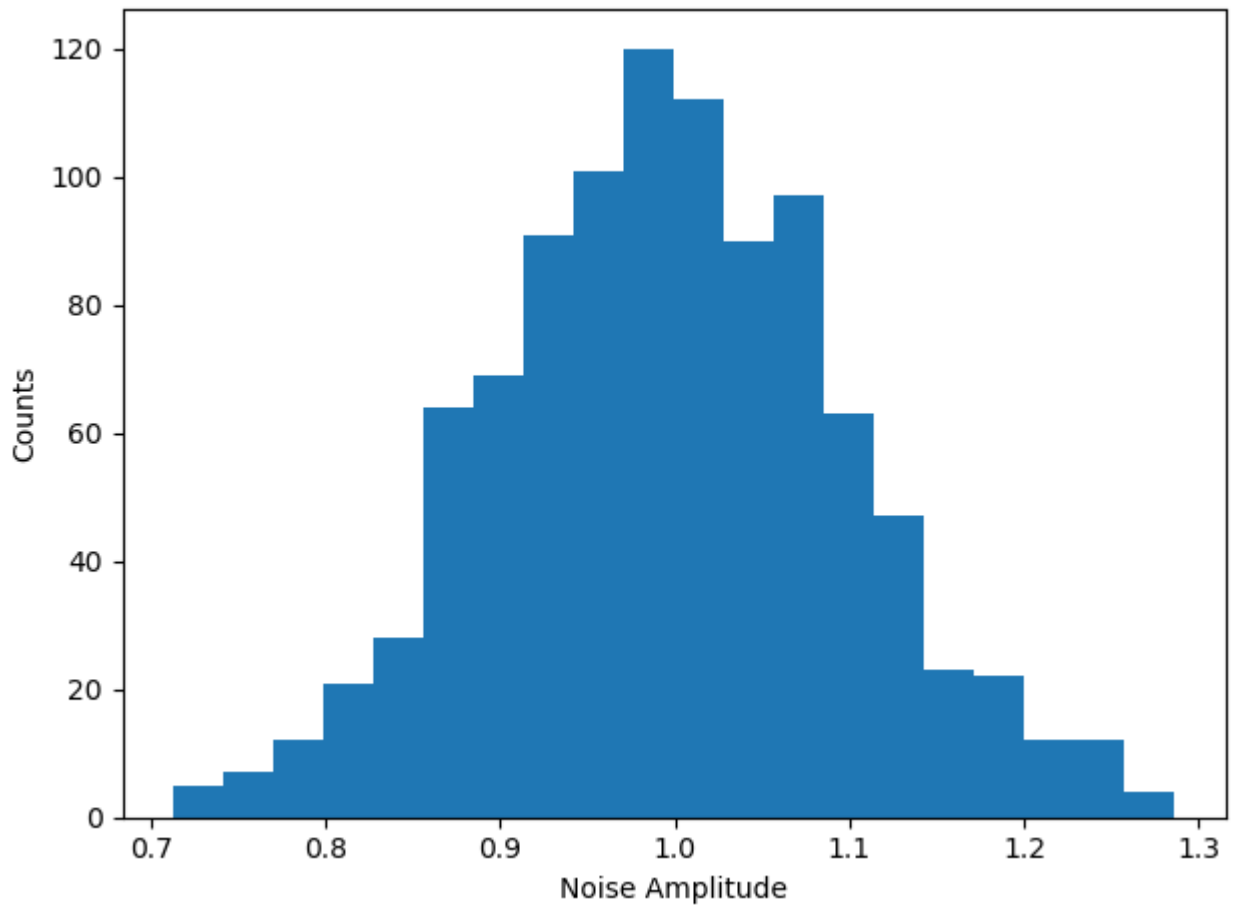
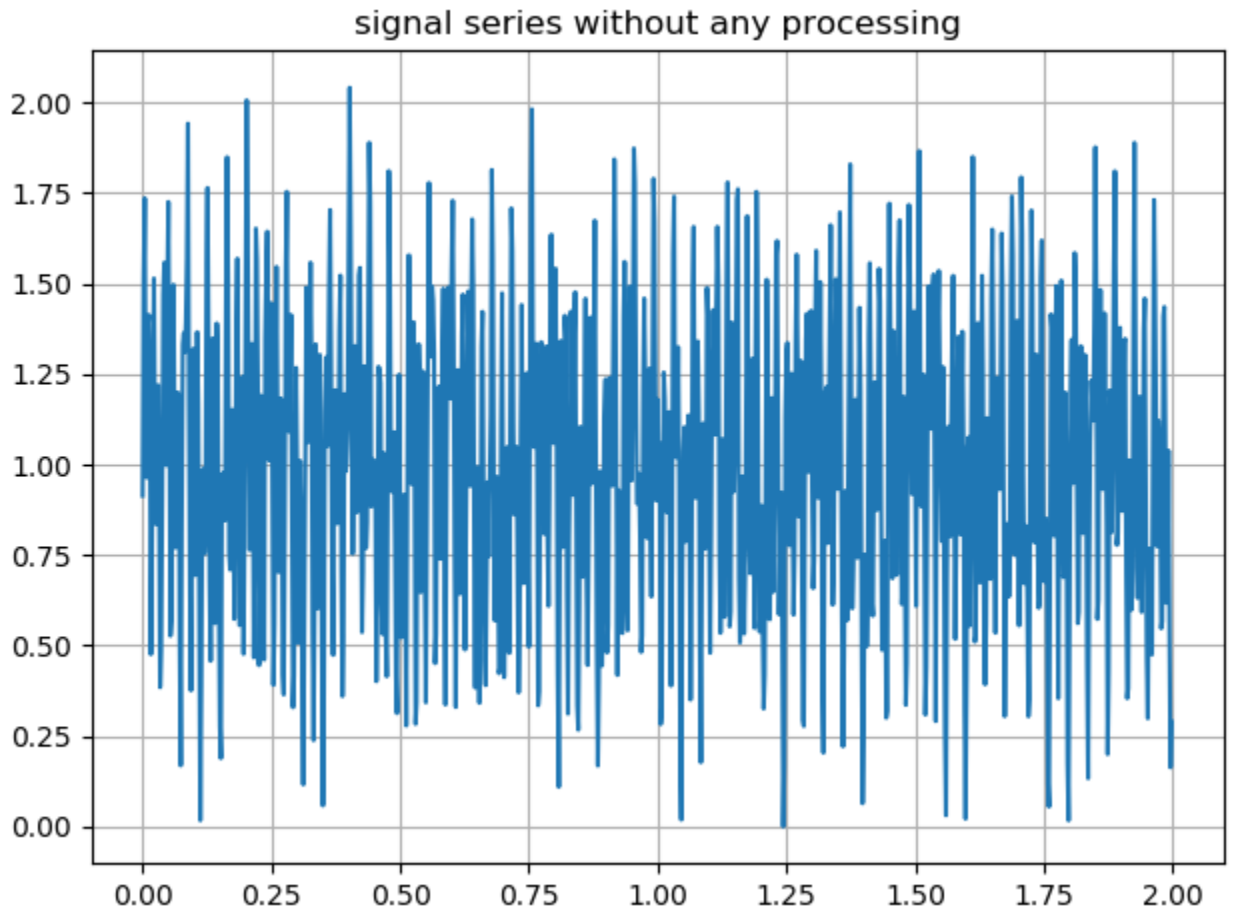
```python
import numpy as np
import scipy.signal as signal
import matplotlib.pyplot as plt
from scipy.fftpack import fft

N = 1000;#the amount of samples
fs = 500;#Sampling frequency
```

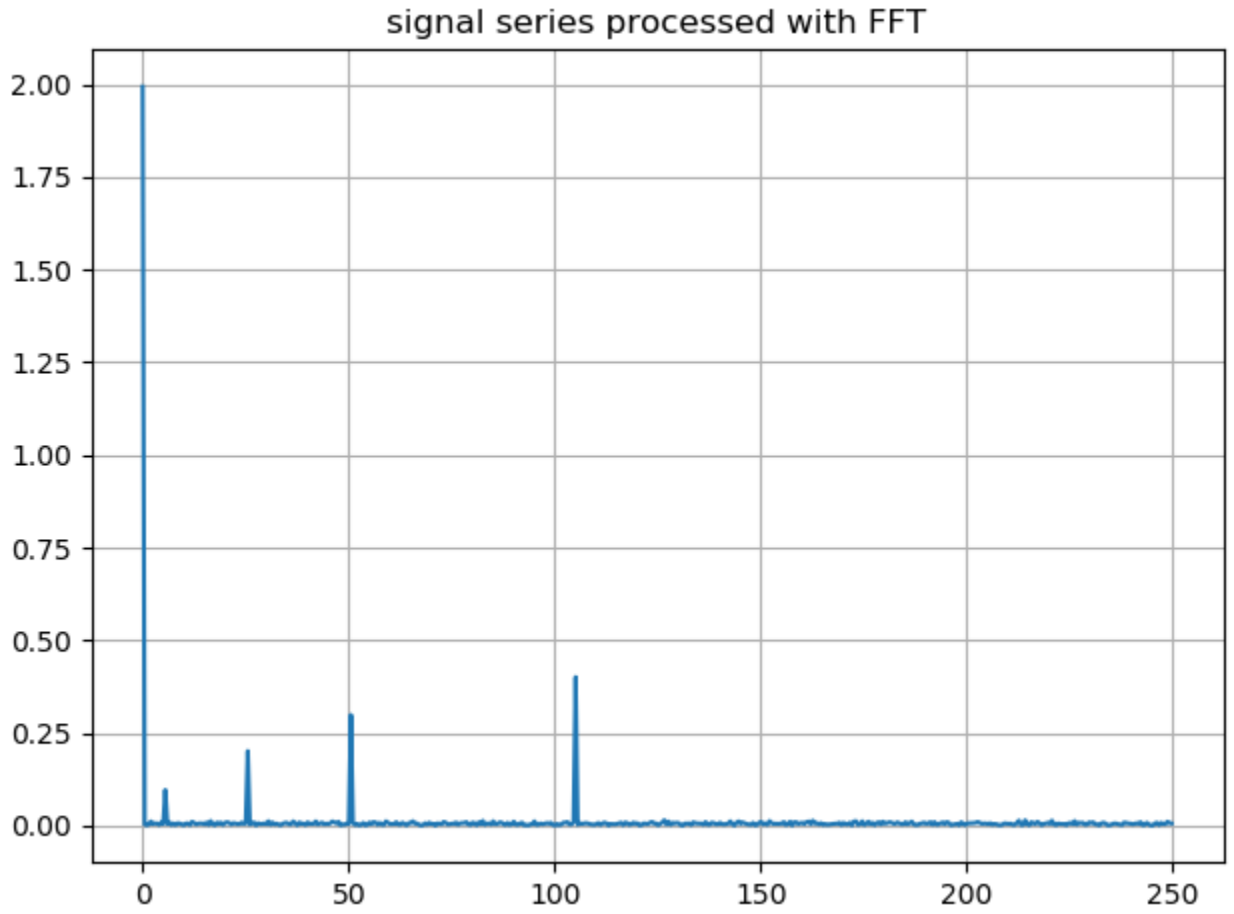
```
#to generate a noise series which obeies the normal distribution N(mu,sigma^2)
sigma=0.1;
mu=1;
noise=(sigma * np.random.randn(1,N)+ mu).flatten();
plt.hist(noise, bins=20)
plt.grid(False)
plt.xlabel('Noise Amplitude')
plt.ylabel('Counts')
plt.show();
```



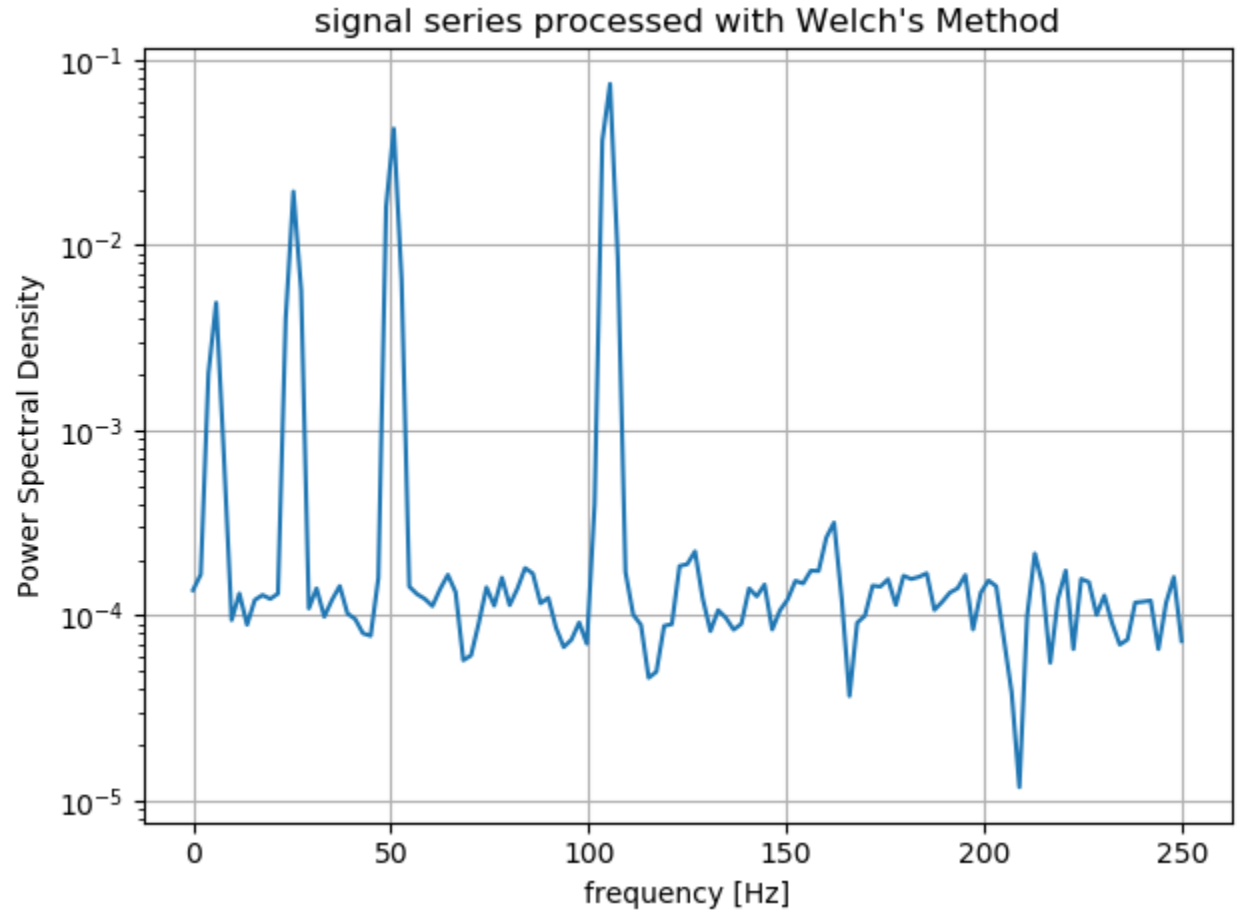
```
#signal series
freq = 50;
amp=0.1;#the amplitude of sine signals
s=1*amp*np.sin(0.11*freq*2.0*np.pi*t)+\
  2*amp*np.sin(0.51*freq*2.0*np.pi*t)+\
  3*amp*np.sin(1.01*freq*2.0*np.pi*t)+\
  4*amp*np.sin(2.10*freq*2.0*np.pi*t)+\
  noise;

#no transform
plt.plot(t, np.abs(s[0:N]))
plt.grid()
plt.title("signal series without any processing")
plt.show();
```



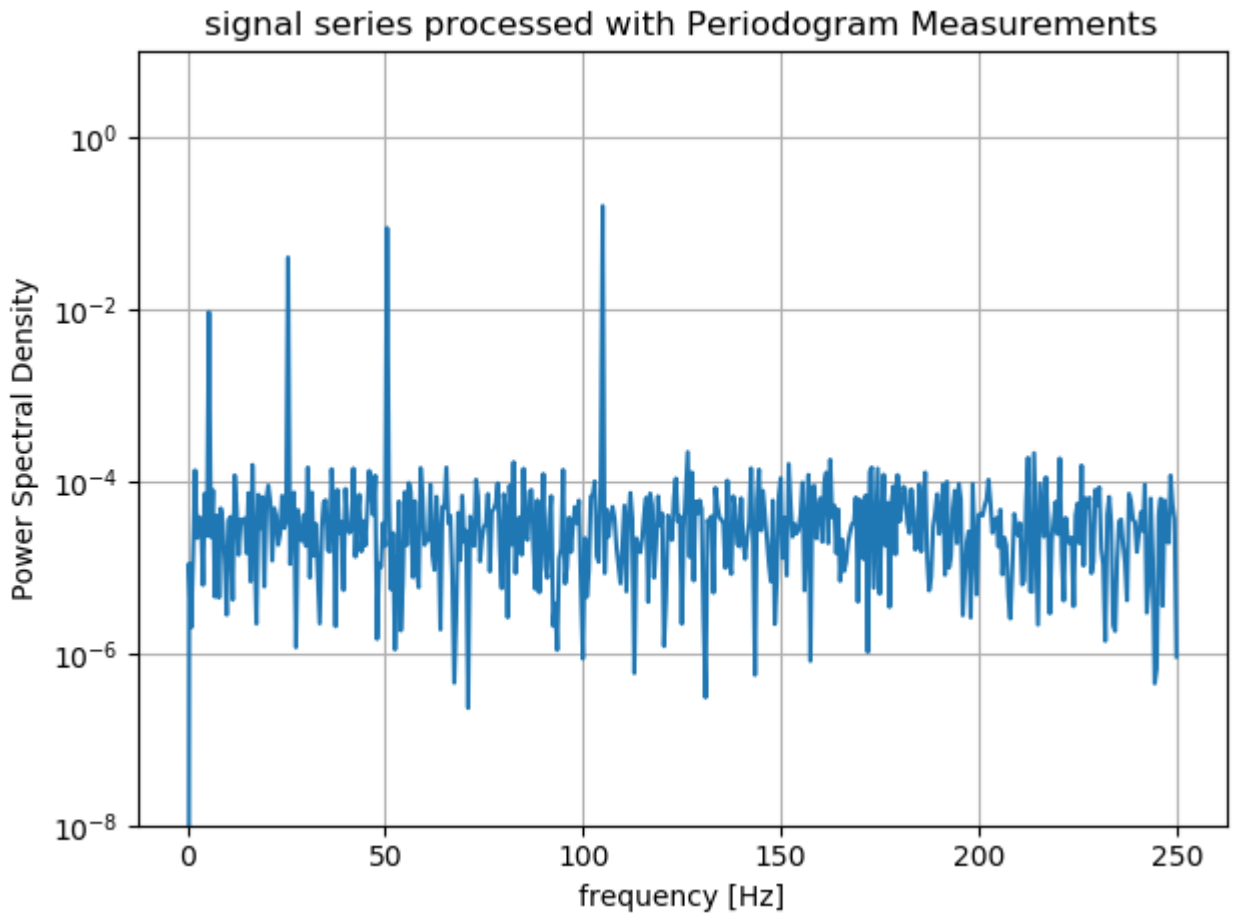
```
#Fast Fourier Transform
sf=fft(s);
plt.plot(tf[0:N//2], np.abs(sf[0:N//2])/(N)*2)
plt.grid()
plt.title("signal series processed with FFT")
plt.show();
```



```
#Welch's Method
f, Pwelch_spec = signal.welch(s, fs, scaling='spectrum')
plt.semilogy(f, Pwelch_spec)
plt.title("signal series processed with Welch's Method")
plt.xlabel('frequency [Hz]')
plt.ylabel('Power Spectral Density')
plt.grid()
plt.show();
```

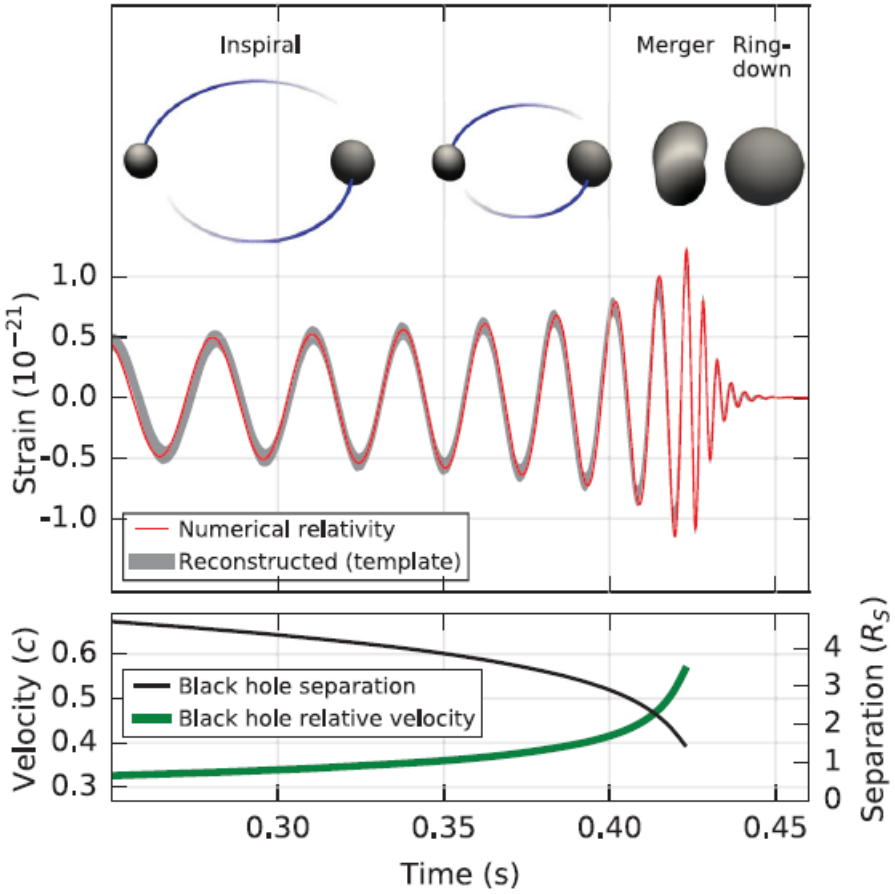


```
#Periodogram Measurements
f, Pxx_den = signal.periodogram(s, fs)
plt.semilogy(f, Pxx_den)
plt.ylim([1e-8, 1e1])
plt.title("signal series processed with Periodogram Measurements")
plt.xlabel('frequency [Hz]')
plt.ylabel('Power Spectral Density')
plt.grid()
plt.show();
```



What shape of signals do we expect?

Peak(Particle) or Wave?
Transient or Constant?



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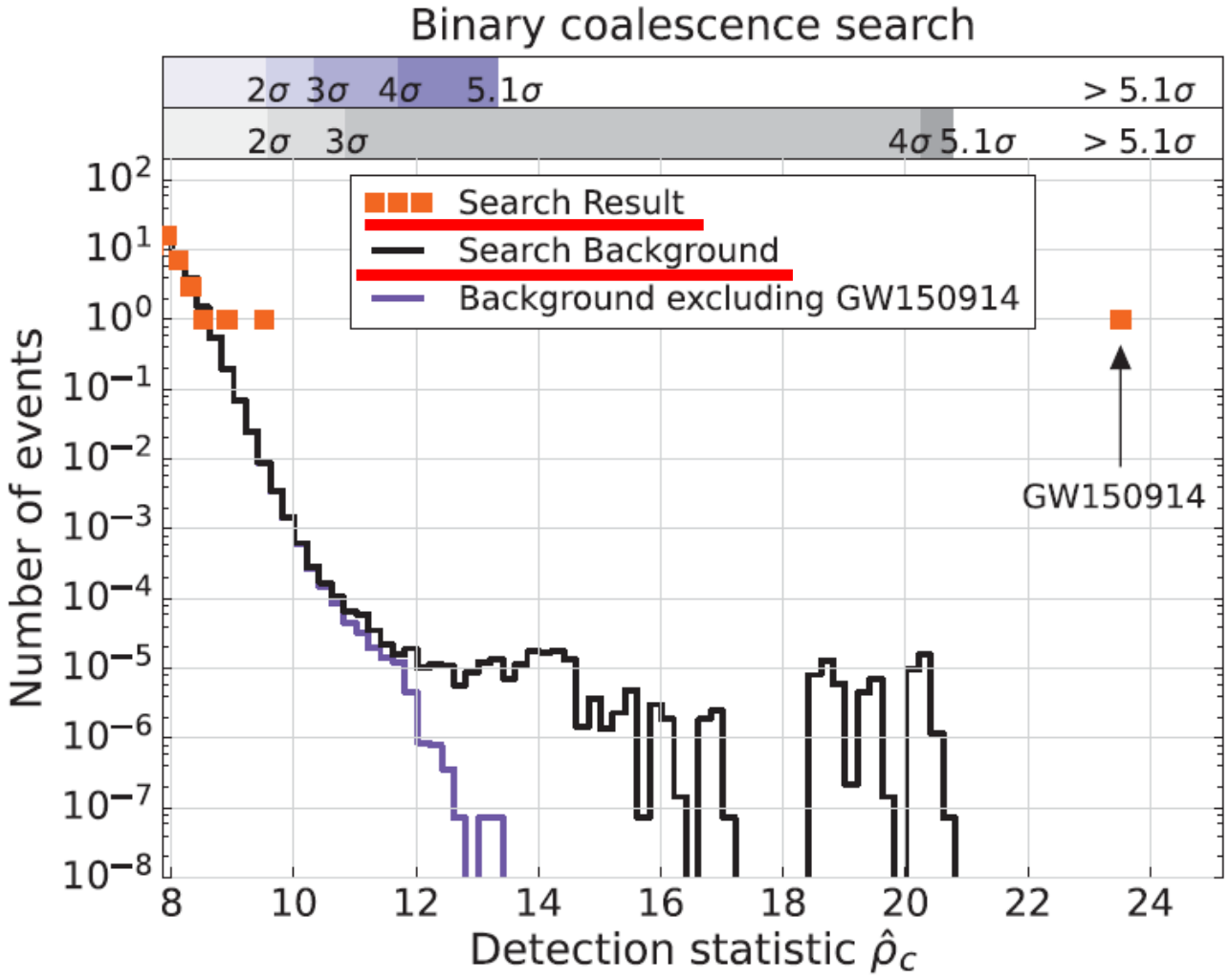
Whatever the shape of signals is,
Could signals be **buried** beneath the background?



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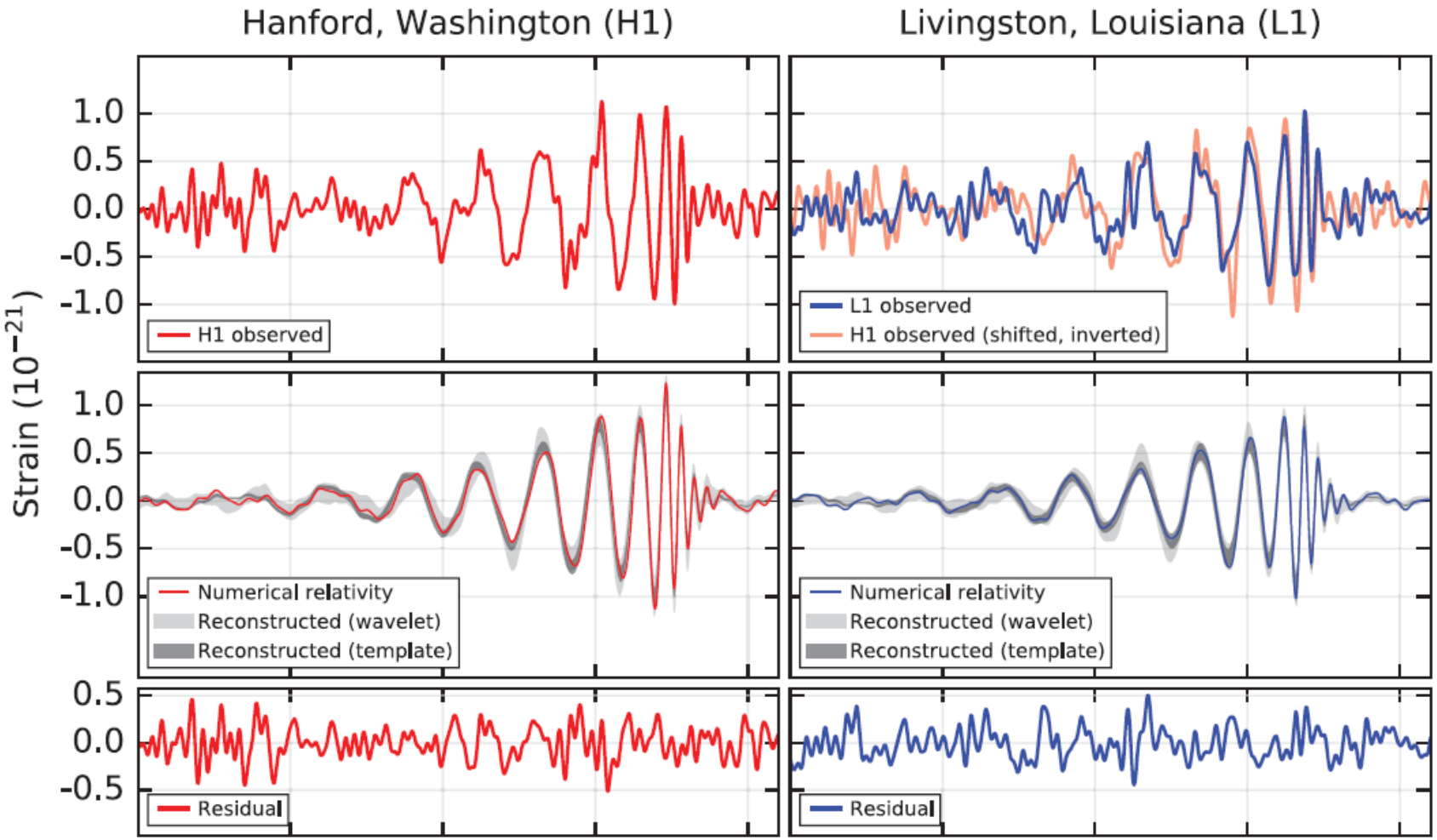
An assumption

- Normally,
- When there's no actual signal,
- Signal series(arranged by time) from two sensors are irrelevant random noise.

How to understand 'normal' or 'abnormal'

Why mention time order here

Random means they are not alike



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