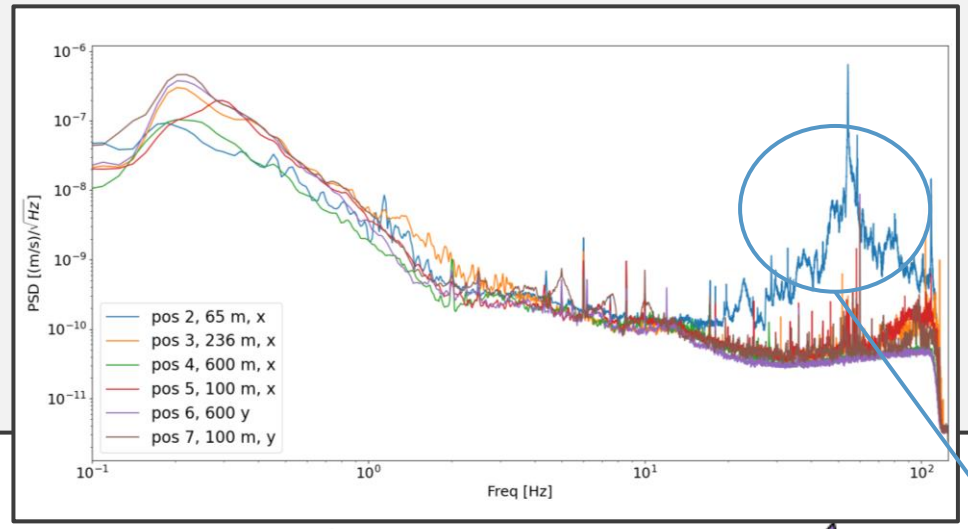
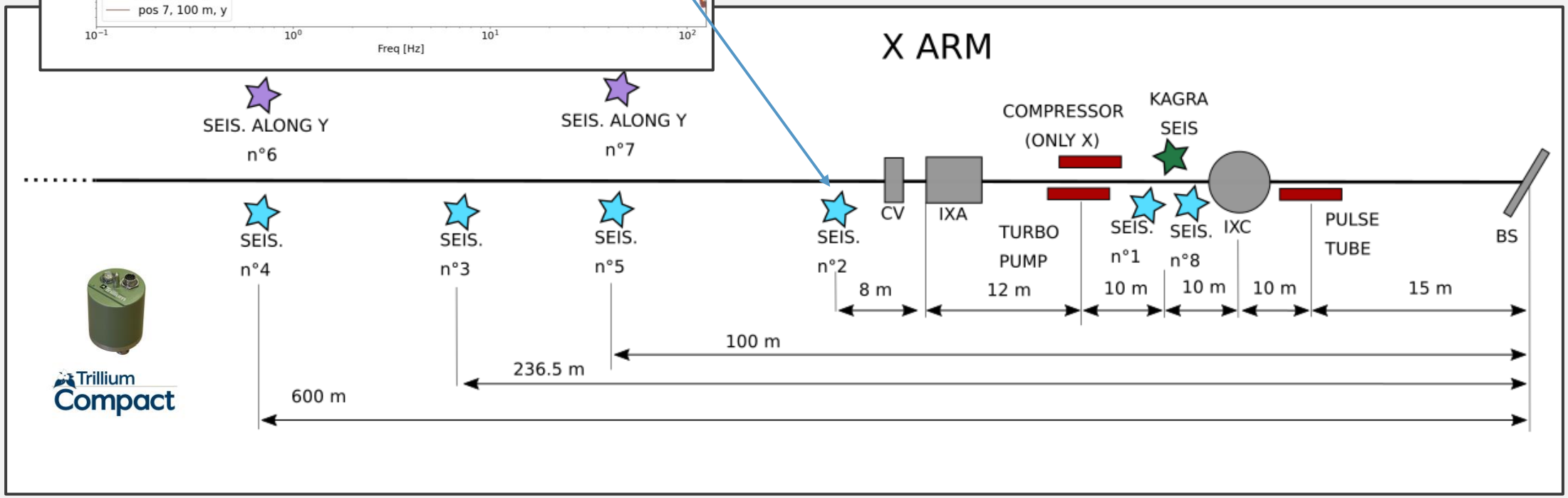
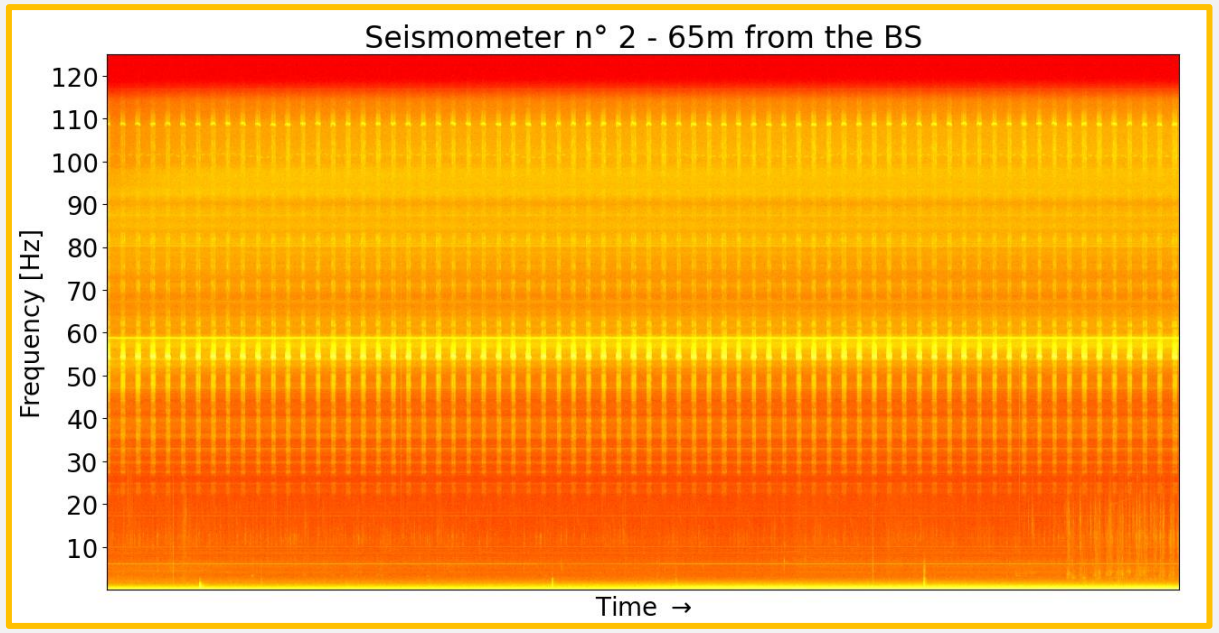
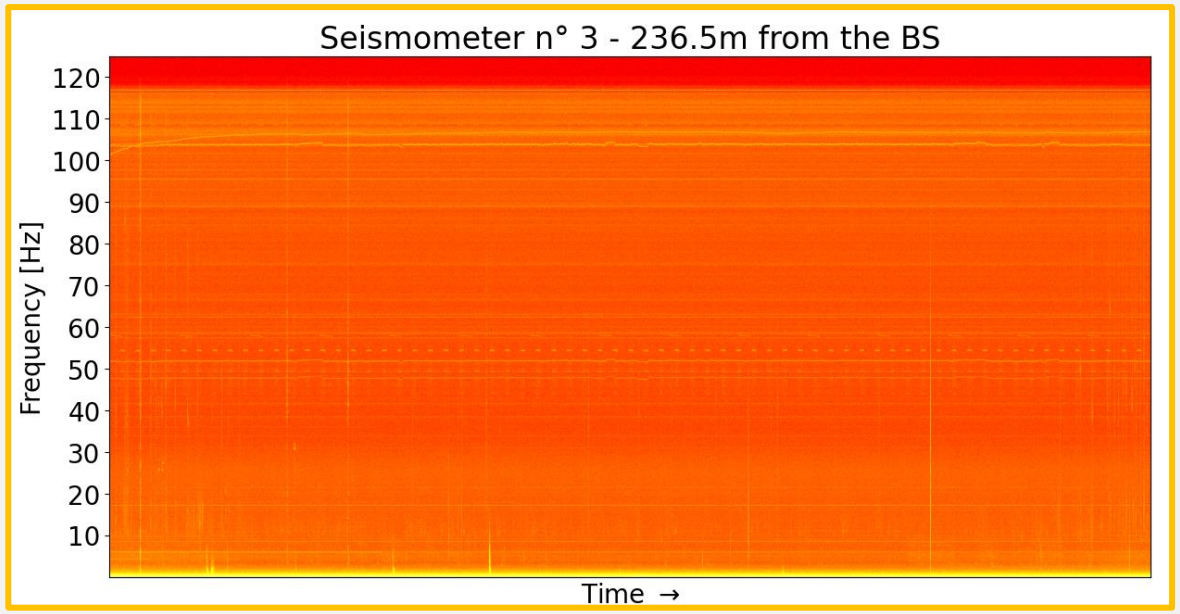
Newtonian and Seismic noise in underground GW detectors

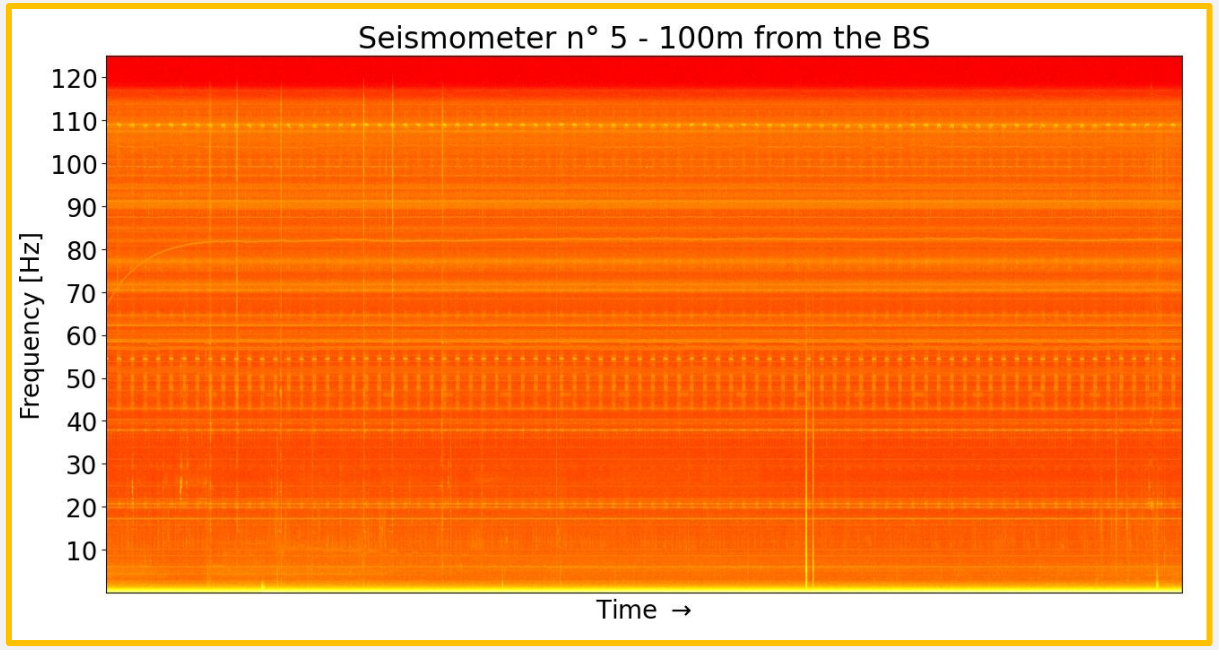
Estimate the NN and assess the impact of the infrastructure in an underground detector

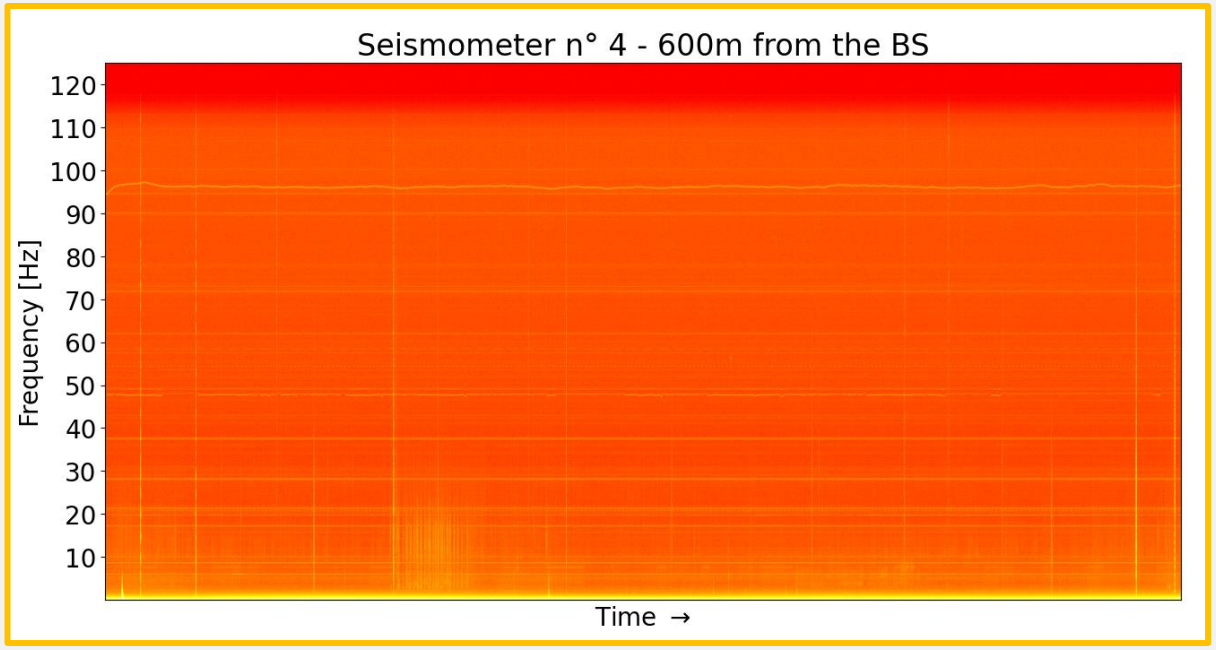


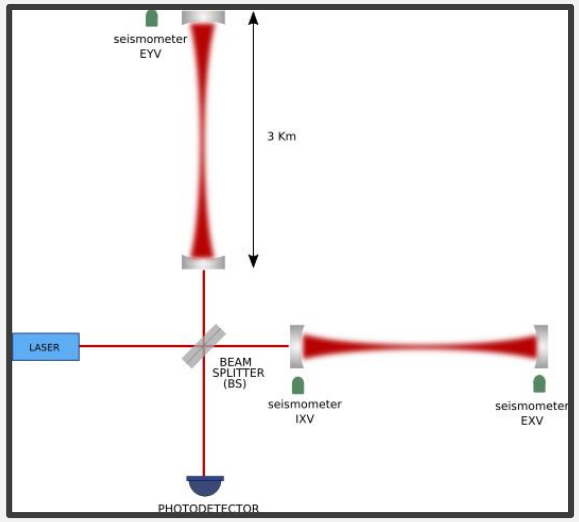



Seismometer n° 2 - 65m from the BS
Frequency [Hz]
120
110
100
90
80
70
60
50
40
30
20
10
Time →

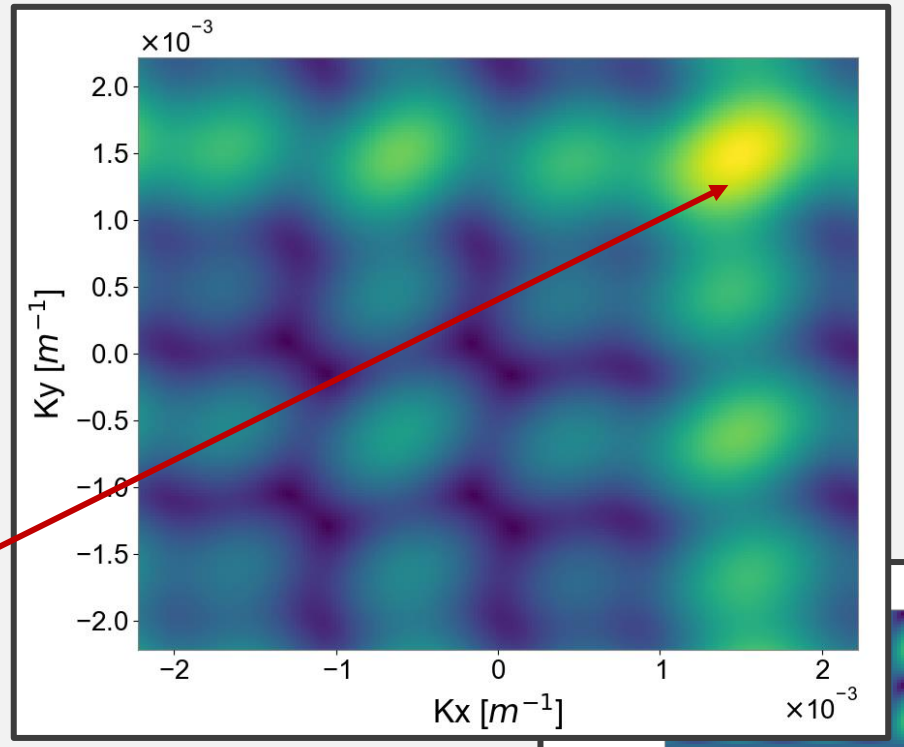

Seismometer n° 3 - 236.5m from the BS
Frequency [Hz]
120
110
100
90
80
70
60
50
40
30
20
10
Time →

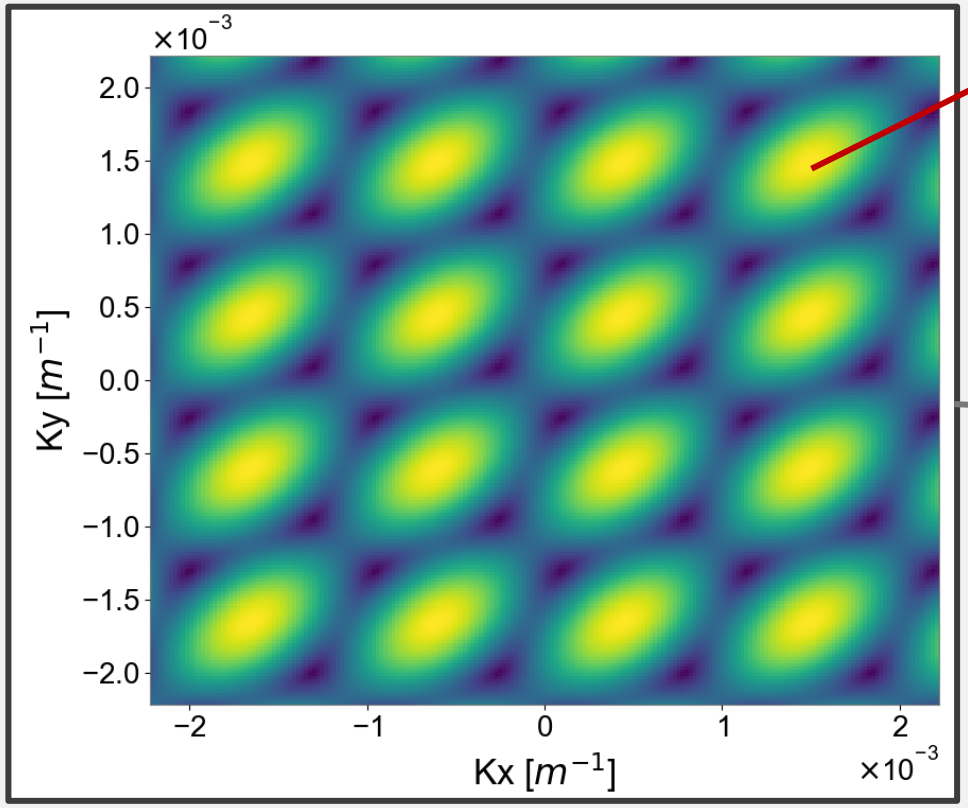

Seismometer n° 5 - 100m from the BS
Frequency [Hz]
120
110
100
90
80
70
60
50
40
30
20
10
Time →


Seismometer n° 4 - 600m from the BS
Frequency [Hz]
120
110
100
90
80
70
60
50
40
30
20
10
Time →

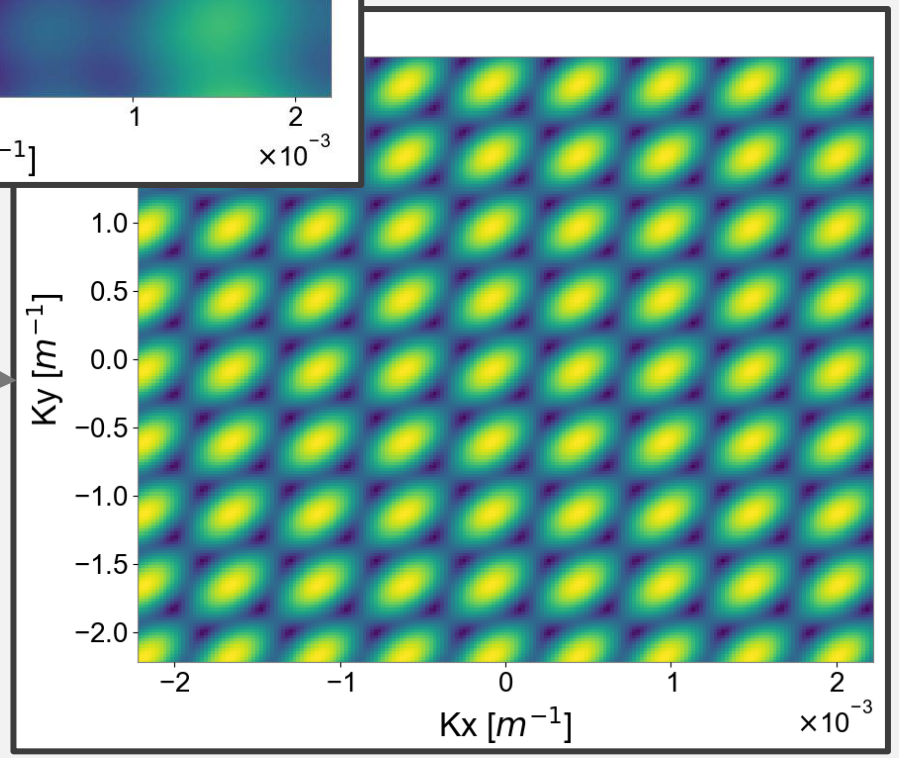


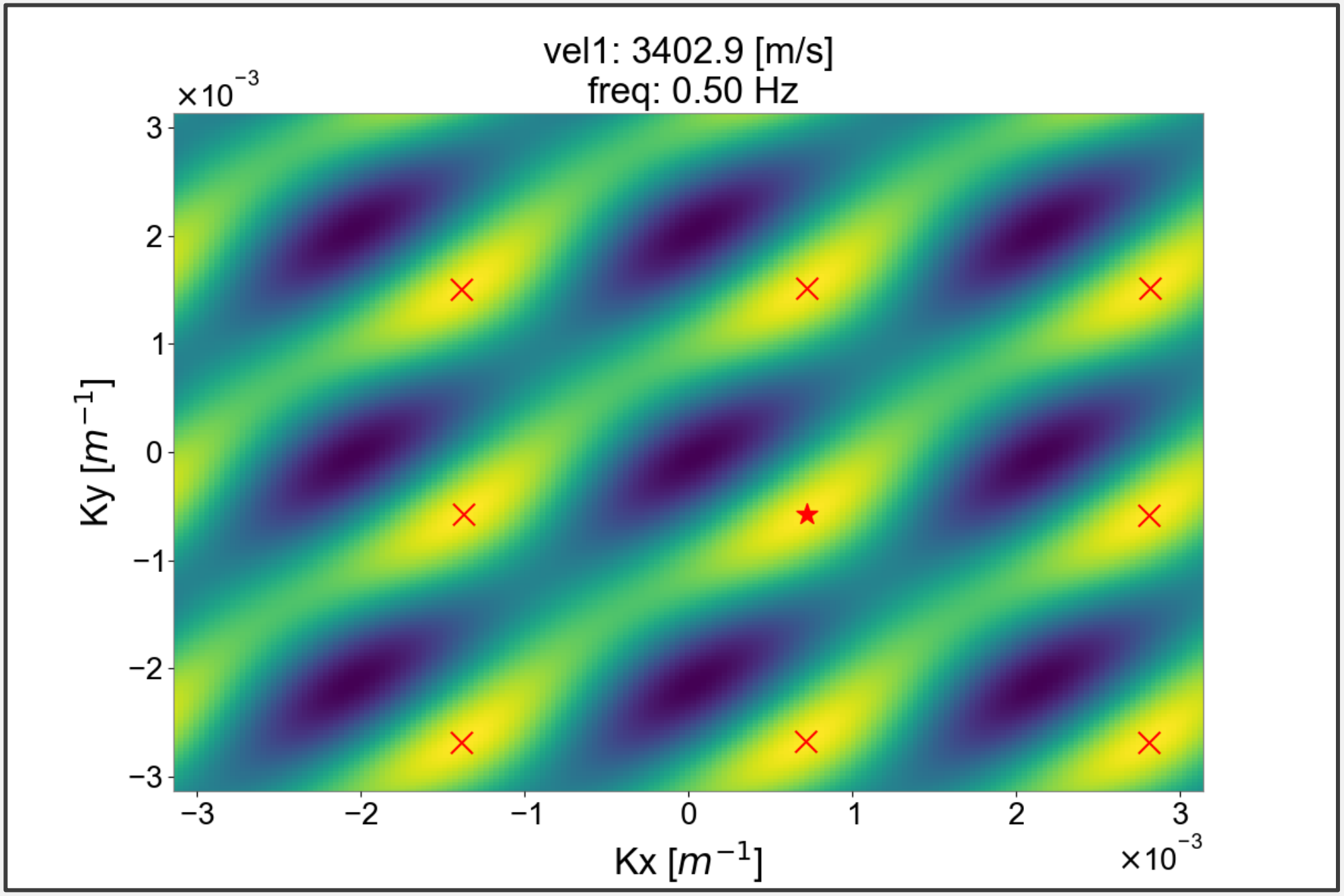
The more the better!

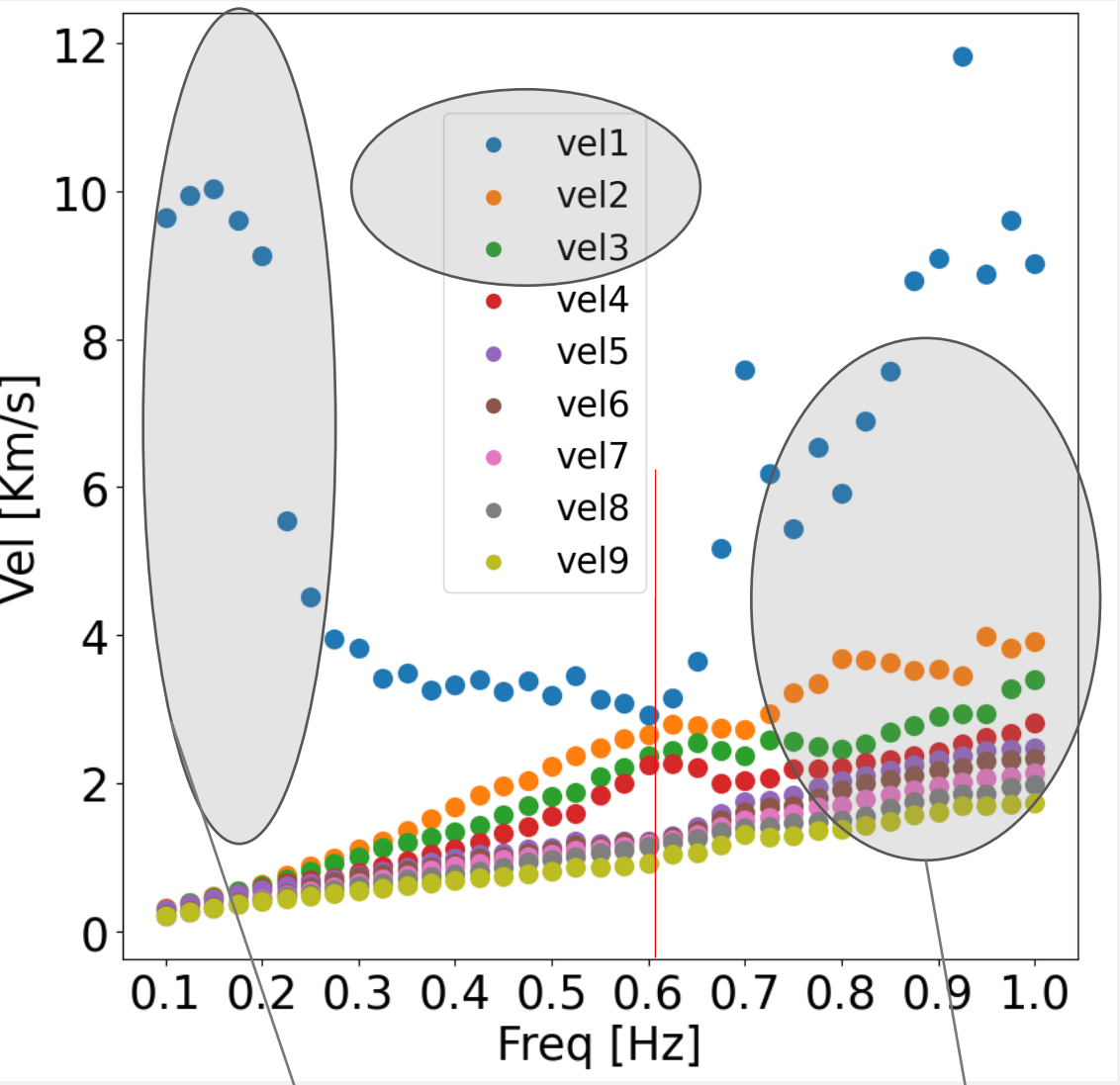




The bigger the better!

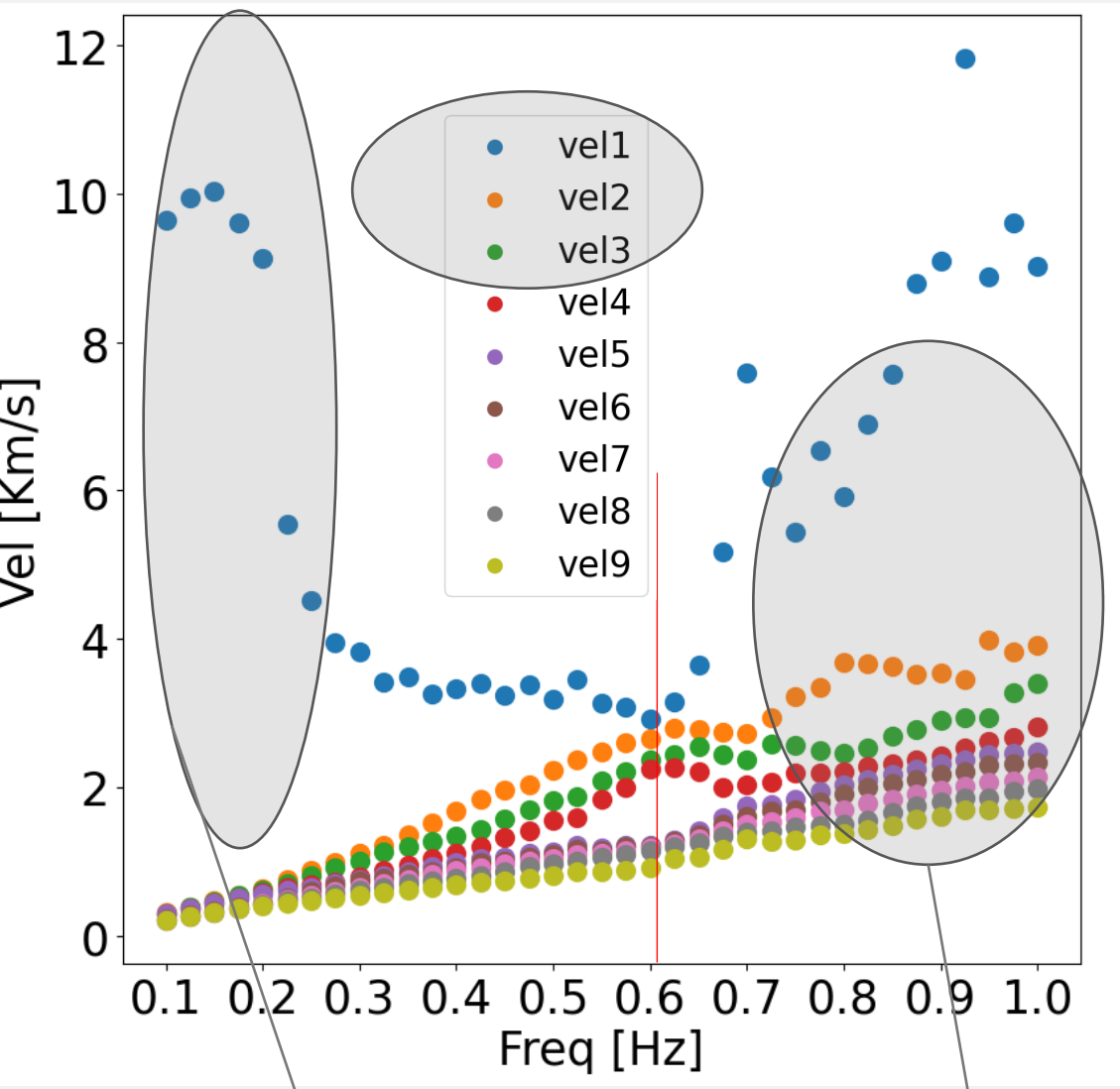



vel1: 3402.9 [m/s]
freq: 0.50 Hz
×10^−3
3
2
1
0
−1
−2
−3
Ky [m^−1]
−3
−2
−1
0
1
2
3
Kx [m^−1]
×10^−3



Bad resolution→need more distance between seismometers

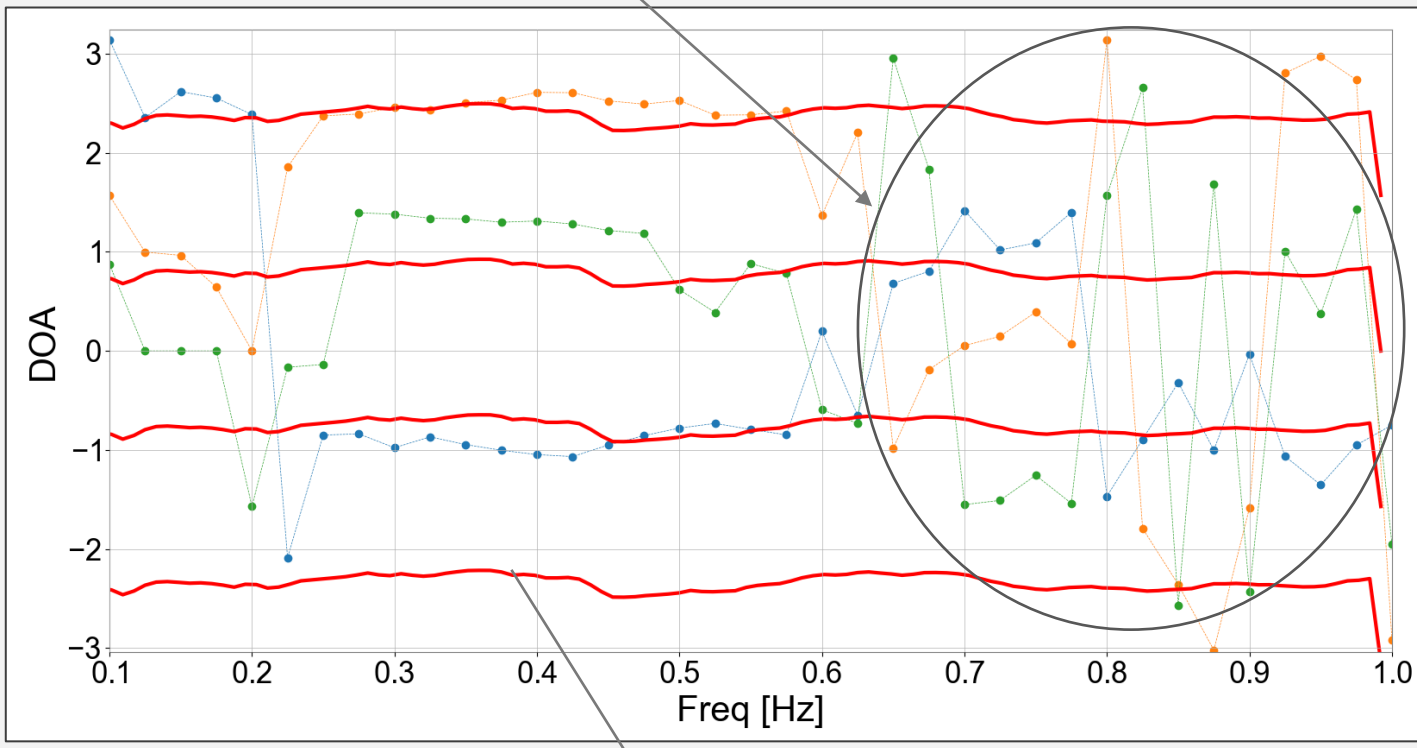
Aliasing effect → ?!?!



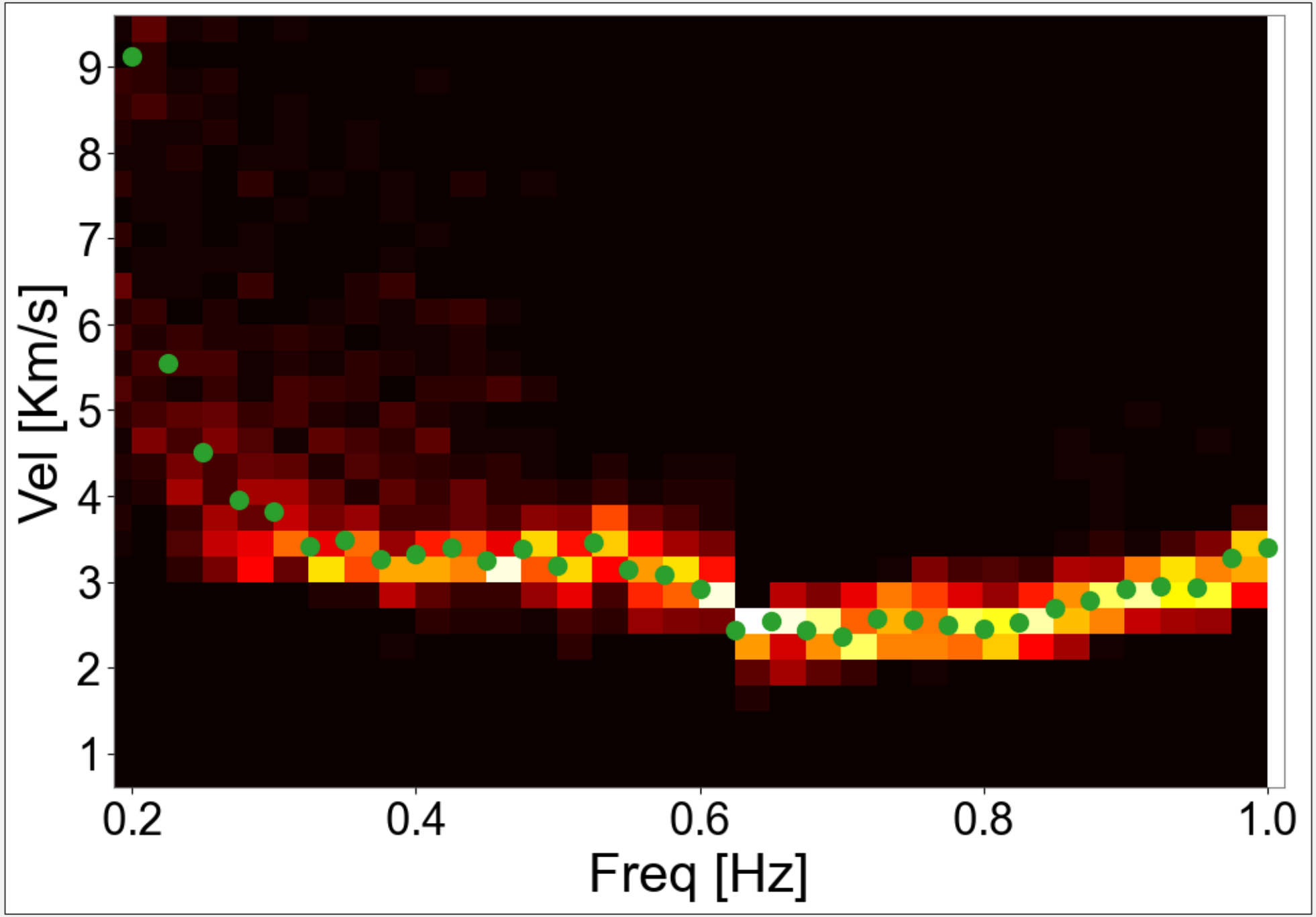
Bad resolution→need more distance between seismometers

Aliasing effect → ?!?!

Scattering? For f>0.6 Hz Wavelength of the order of Mountain sizes



Horizontal displacement: Love + Rayleigh (should dominate)
Arctan(PSD_x/PSD_y) → idea on the right direction


Vel [Km/s]
9
8
7
6
5
4
3
2
1
0.2
0.4
0.6
0.8
1.0
Freq [Hz]

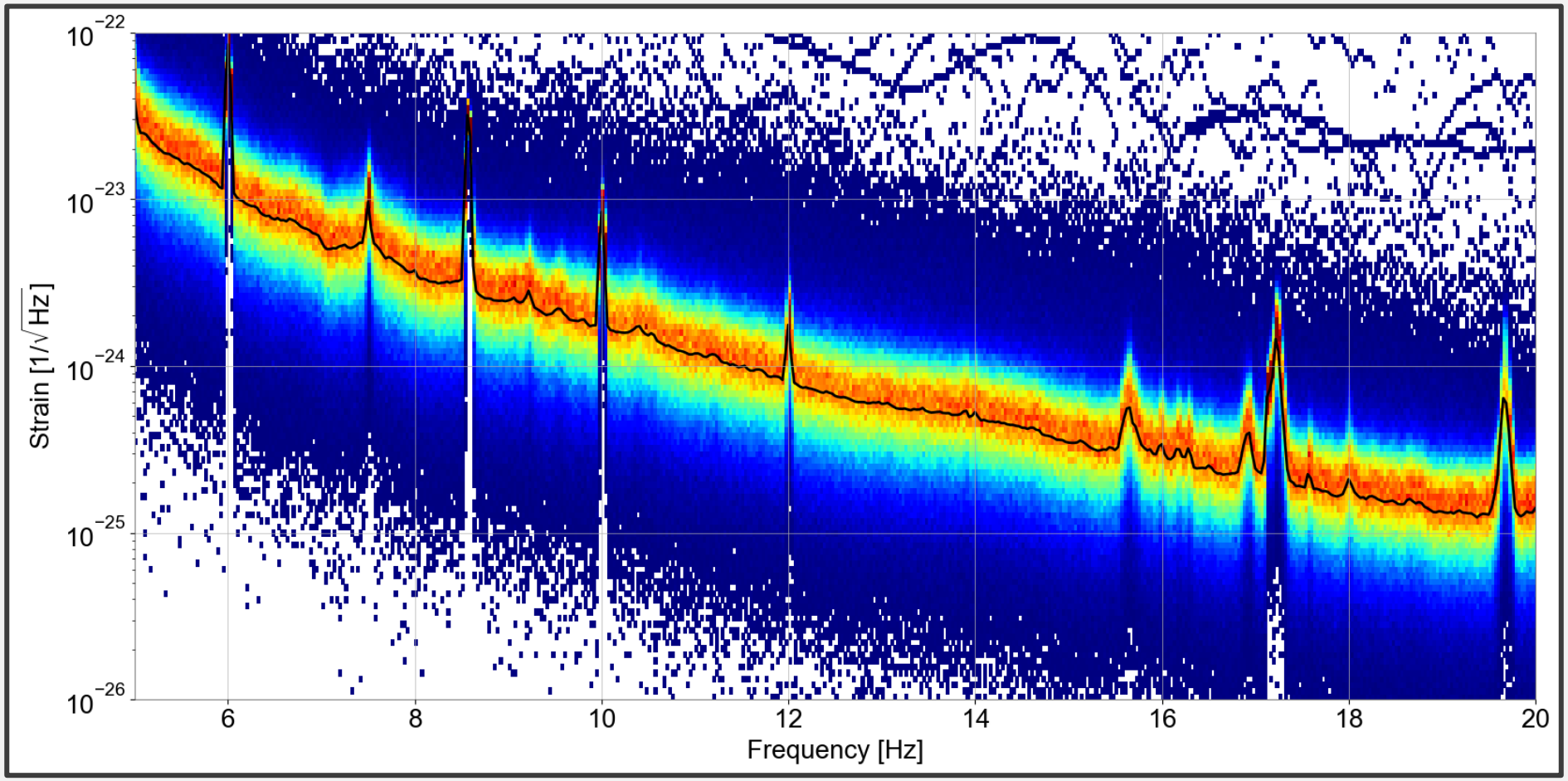
$$S^P(\delta a_x;\omega) = \left(\frac{8\pi}{3}G\rho_0\right)^2 S(\xi_z^P;\omega)$$

Displacement [m/s]

Density 3000 [Kg/m^3]

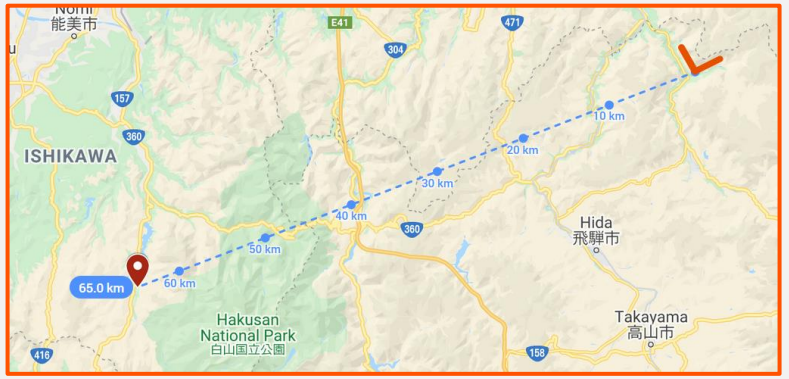
NN acceleration on ONE test mass

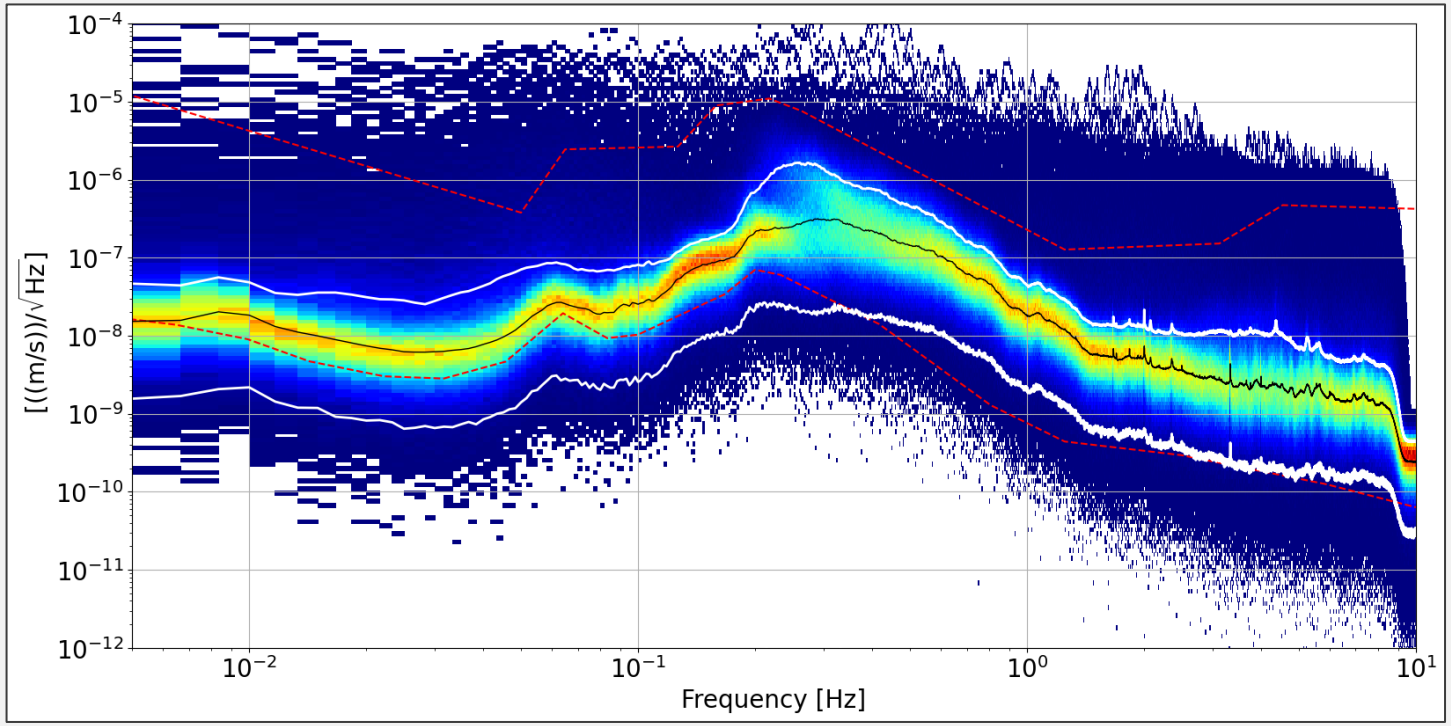
NN from body waves



What about NN from surface waves (Rayleigh waves)?

→ F-net station (SRN)





What about NN from surface waves (Rayleigh waves)?

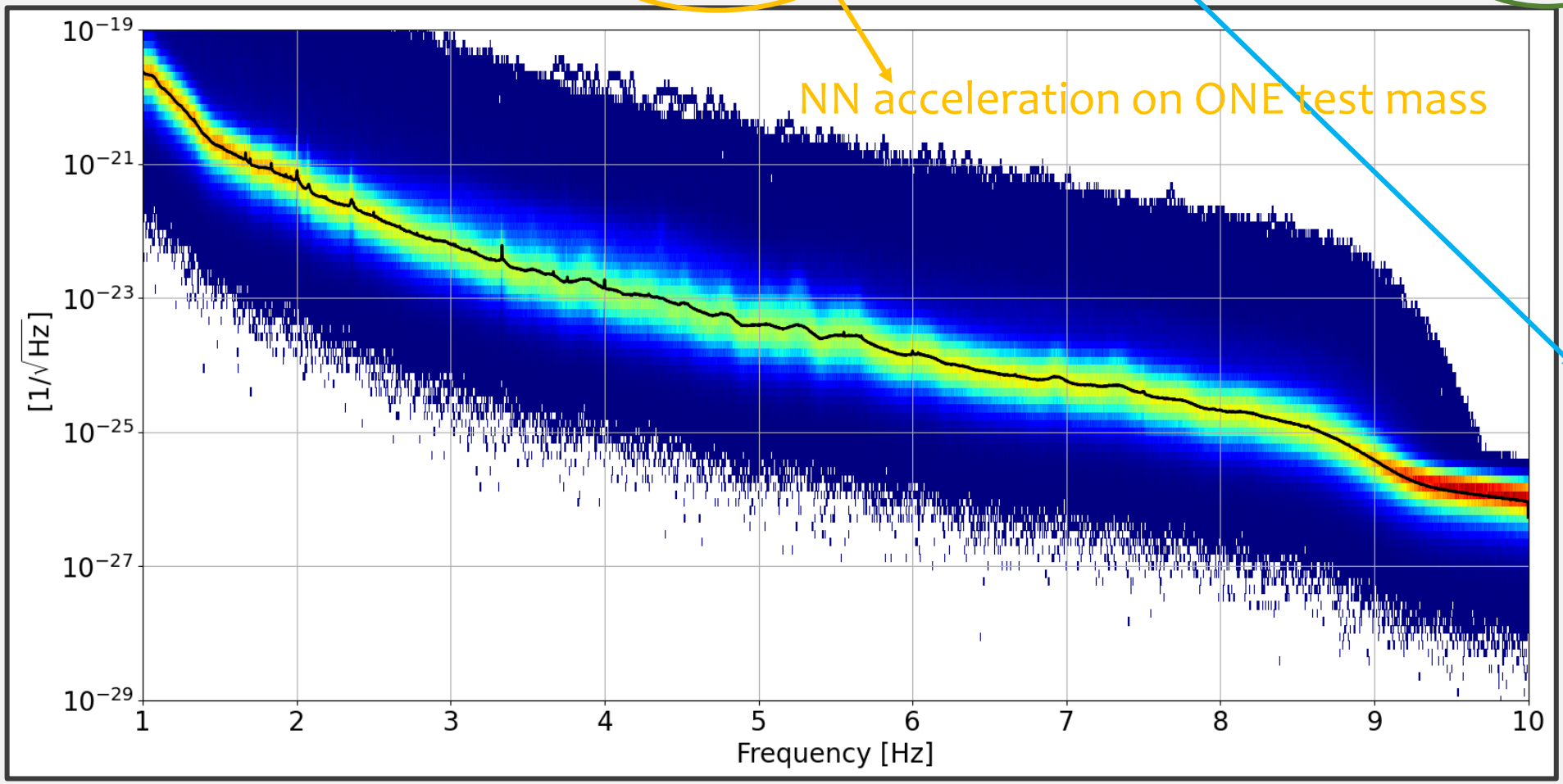
Distance of the test mass from the surface ~ 200 m

$$S^R(\delta a_x;\omega) = \left(2\pi G \rho_0 e^{-hk}\gamma\right)^2 \frac{1}{2} S(\xi_z^R;\omega)$$

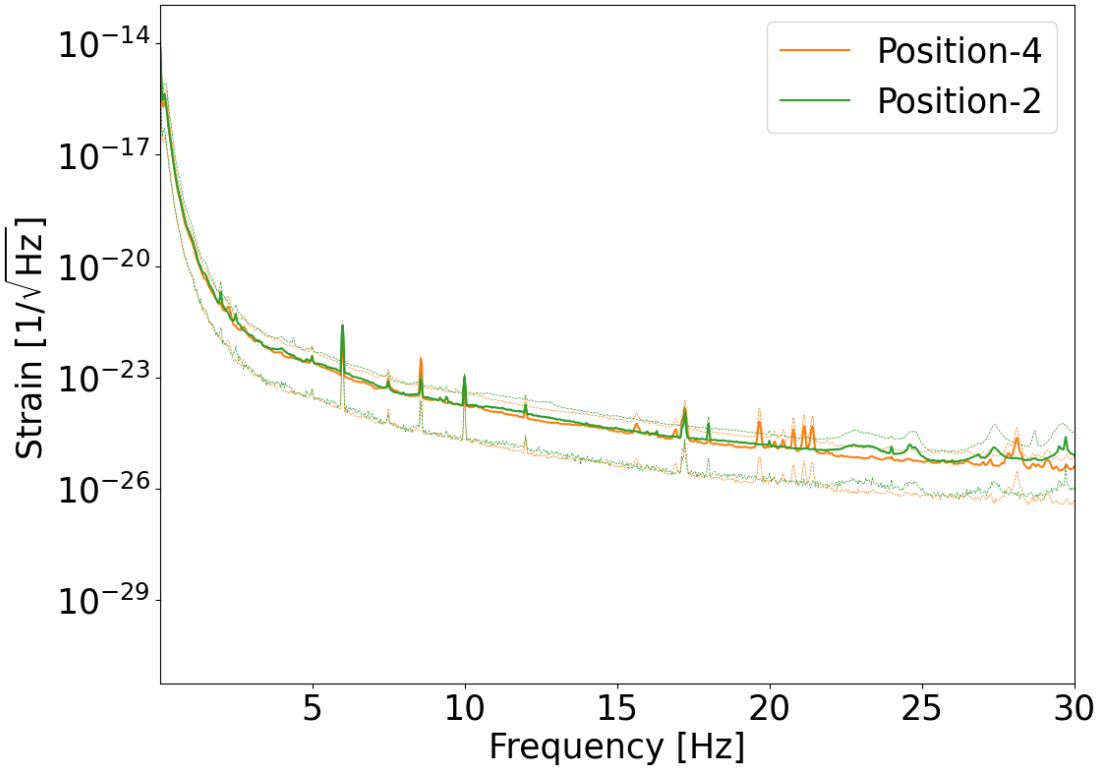
NN acceleration on ONE test mass

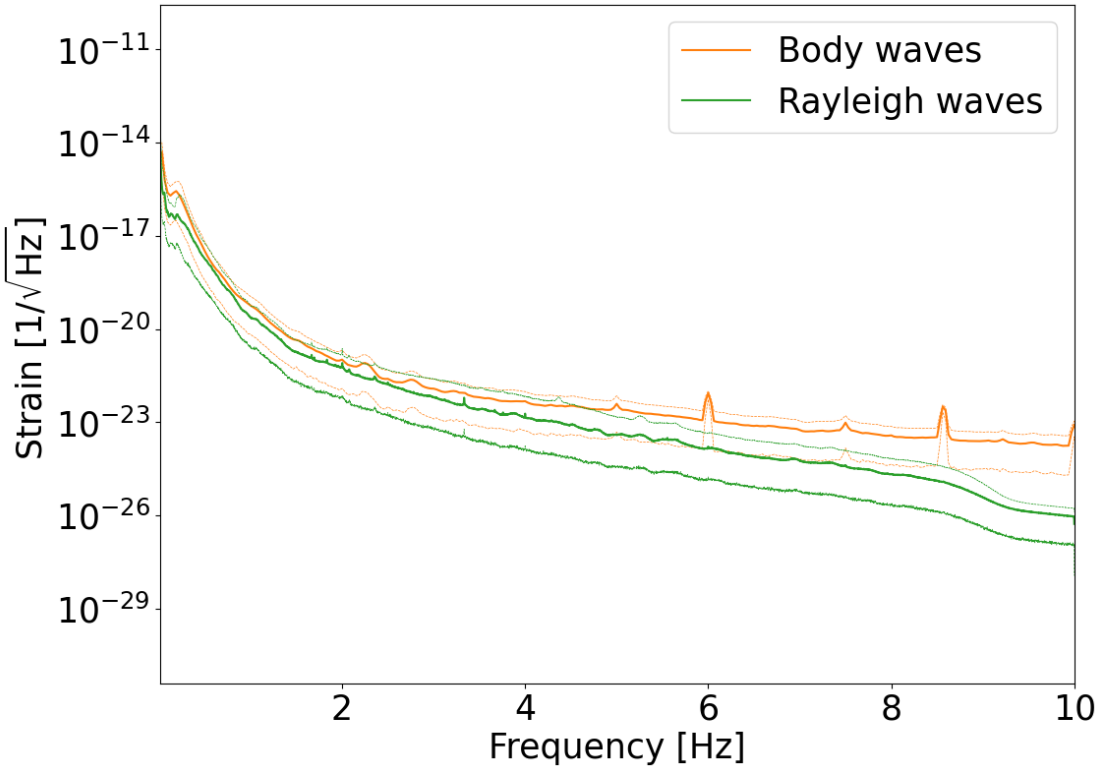
Displacement [m/s]

Density 3000 [Kg/m^3]



Atmospheric (from internal sound) noise budget?


Position-4
Position-2
Strain [1/√Hz]
10^{-14}
10^{-17}
10^{-20}
10^{-23}
10^{-26}
10^{-29}
5
10
15
20
25
30
Frequency [Hz]


Body waves
Rayleigh waves
Strain [1/√Hz]
10^{-11}
10^{-14}
10^{-17}
10^{-20}
10^{-23}
10^{-26}
10^{-29}
2
4
6
8
10
Frequency [Hz]