ET - Specific on baffling strategy (M. Andrés, M. Martínez)

- Stray Light Simulations for ET
  - Beam losses and apertures
  - Baffles layout inside the ET tube
  - Preliminary noise estimations
- New studies
  - First studies on non-ideal configurations
  - Baffle vibrations
  - Tolerances on beam-pipe alignment
- Case for instrumented baffles

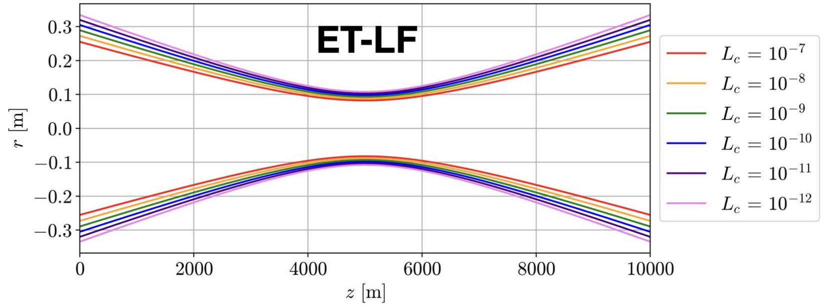
STRAY LIGHT NOISE SIMULATIONS

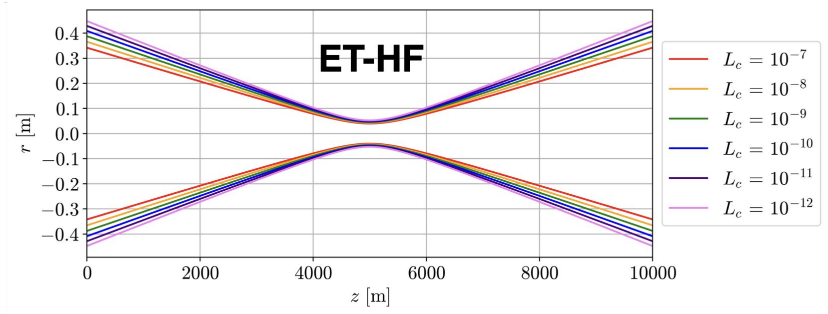
Minimum aperture of the tubes

To be able to set the minimum aperture of the vacuum tube to start iterating with the design, the level of Gaussian clipping losses is set to 1e-8. With this choice, and using the expression

$$r(z, L_c) = \frac{w(z)}{\sqrt{2}} \sqrt{\ln\left(\frac{1}{L_c}\right)} + r_{\text{offset}}$$

which allows for an additional beam offset, the minimum apertures of the baffles are of 84cm for ET-HF and 62cm for ET-LF. Assuming a typical baffle height of 8cm, the minimum diameter of the tubes are 1m and 0.8m, respectively.





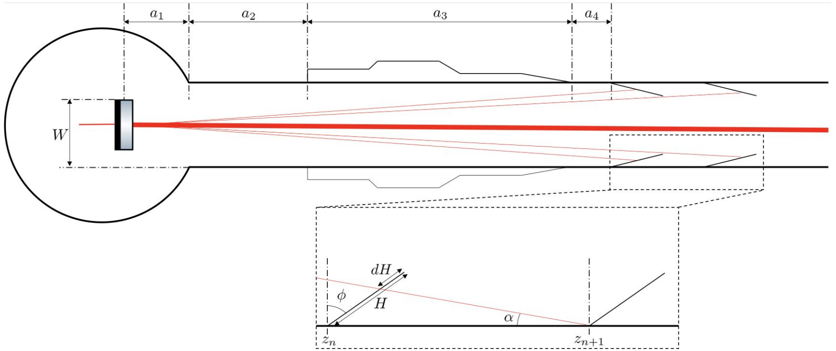
STRAY LIGHT NOISE SIMULATIONS

Baffle layout inside the main arms

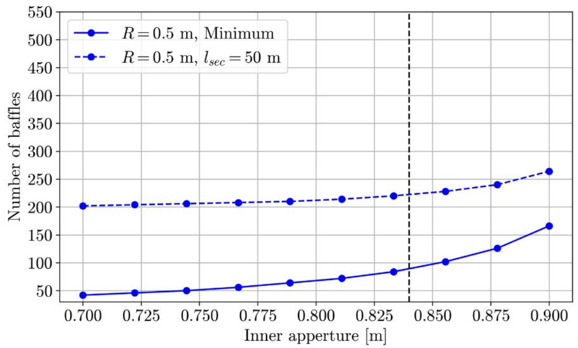
$$z_{n+1} = \frac{W\left[z_n + \sin(\phi)(H - dH)\right]}{W - \cos(\phi)(H - dH)}$$

The baffling strategy is that followed both in LIGO and Virgo:

- Using only geometrical arguments, all the pieces of the tube have to be shielded by a baffle.
- In the middle section, whenever z_{n+1} predicted by the geometrical arguments is larger than the length of a tube section, a baffle is placed at each intersection between sectors.



The number of baffles per FP cavity are 244 (ET-HF) and 222 (ET-LF).



STRAY LIGHT NOISE SIMULATIONS

Preliminary noise estimation

BACKSCATTERING

We use Thorne and Vinet's formula to compute the backscattering noise from the power distribution that will reach the baffles. This power is obtained using the simulation software SIS and then the noise calculated as

$$\mathrm{d}\tilde{h}^2(f) = \frac{1}{L^2}\left[\lambda^2 + \left(\frac{8\Gamma P_{circ}}{cM\pi f^2}\right)^2\right]\frac{\mathrm{d}P}{\mathrm{d}\Omega_{bs}}X^2(f)\mathrm{d}K$$

$$\mathrm{d}K = \frac{1}{z^2}\left(\frac{\mathrm{d}P}{\mathrm{d}\Omega_{ms}}\right)^2\delta\Omega_{ms}$$

DIFFRACTION

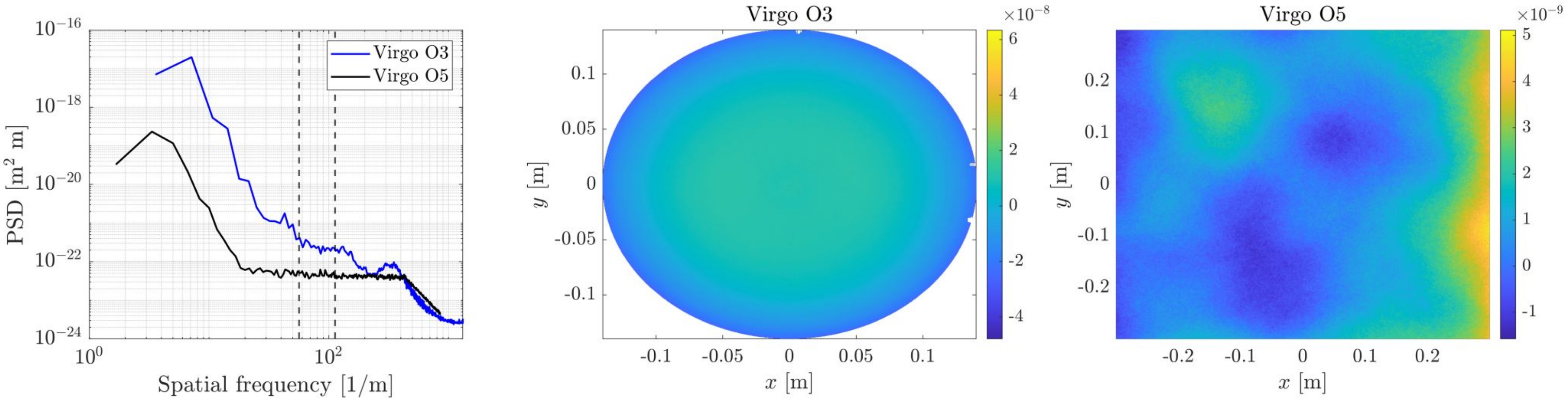
We use an analytical method to estimate the diffraction noise caused by randomly serrated baffles.

$$\tilde{h}_{\mathrm{diff}}(f) = \sqrt{1 + \left(\frac{8\Gamma P_{circ}}{cM\pi f^2}\right)^2\frac{1}{\lambda^2}}$$

$$\times \frac{\kappa\lambda X(f)\sqrt{N_B}}{LR}\left[\frac{\lambda L}{8\pi R\overline{\Delta H}}\right]\left[\frac{\sqrt{\lambda L/4}}{2\pi R}\right]^{1/2}$$

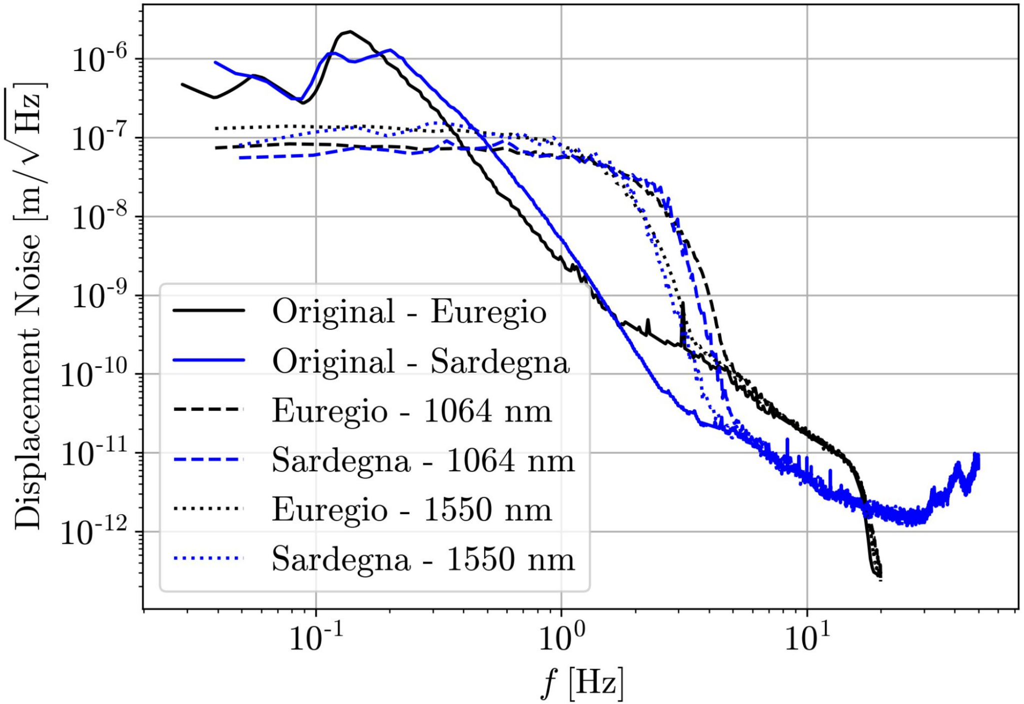
STRAY LIGHT NOISE SIMULATIONS

Preliminary noise estimation



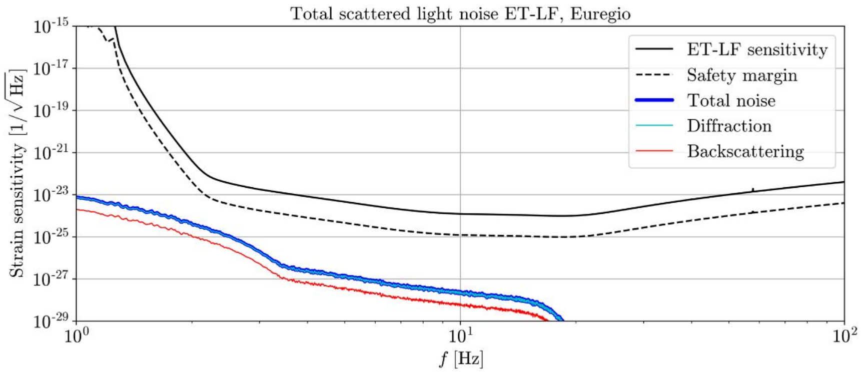
STRAY LIGHT NOISE SIMULATIONS

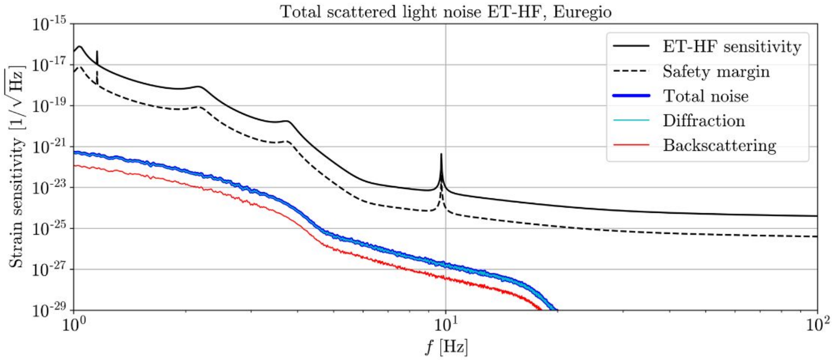
Preliminary noise estimation



STRAY LIGHT NOISE SIMULATIONS

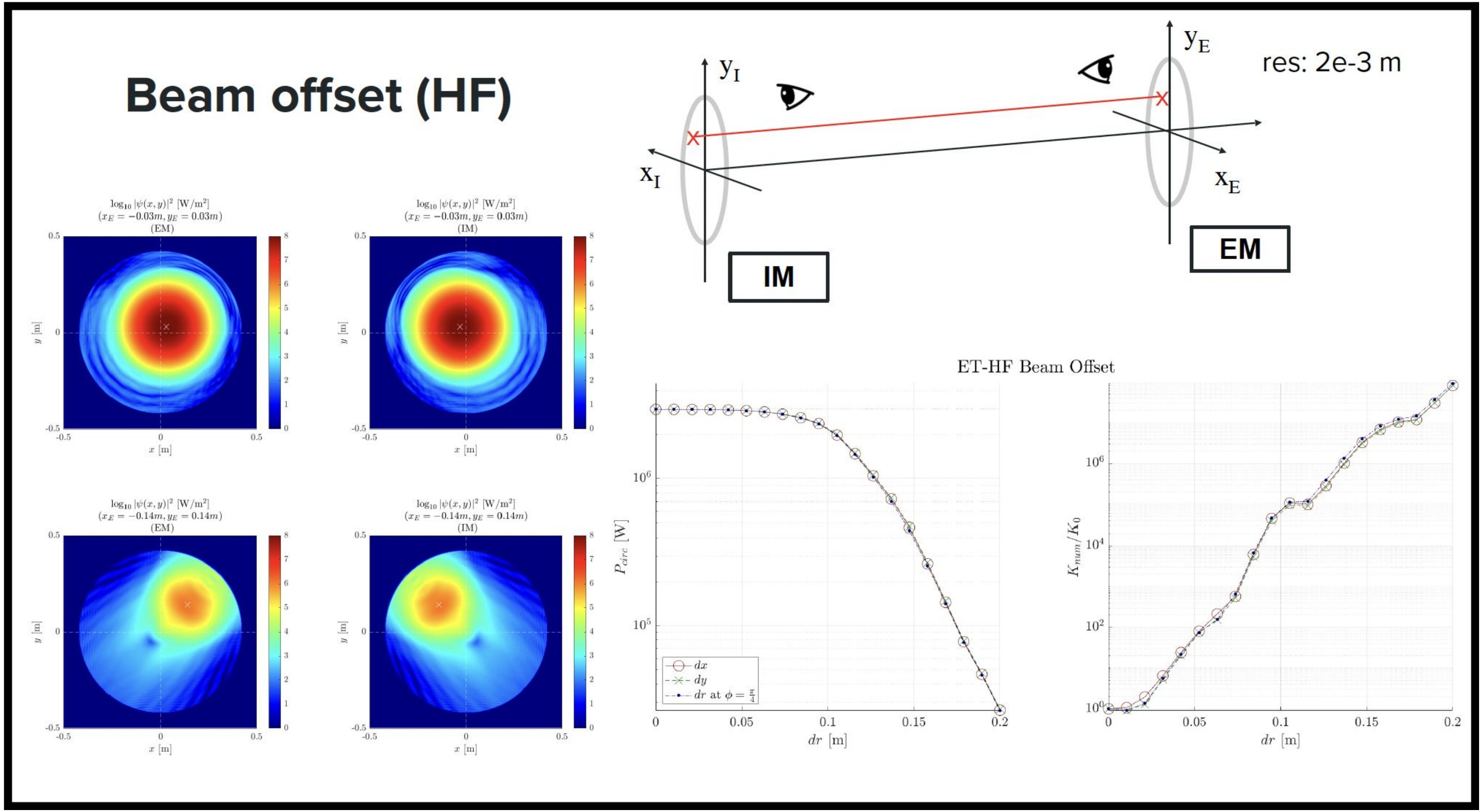
Preliminary noise estimation





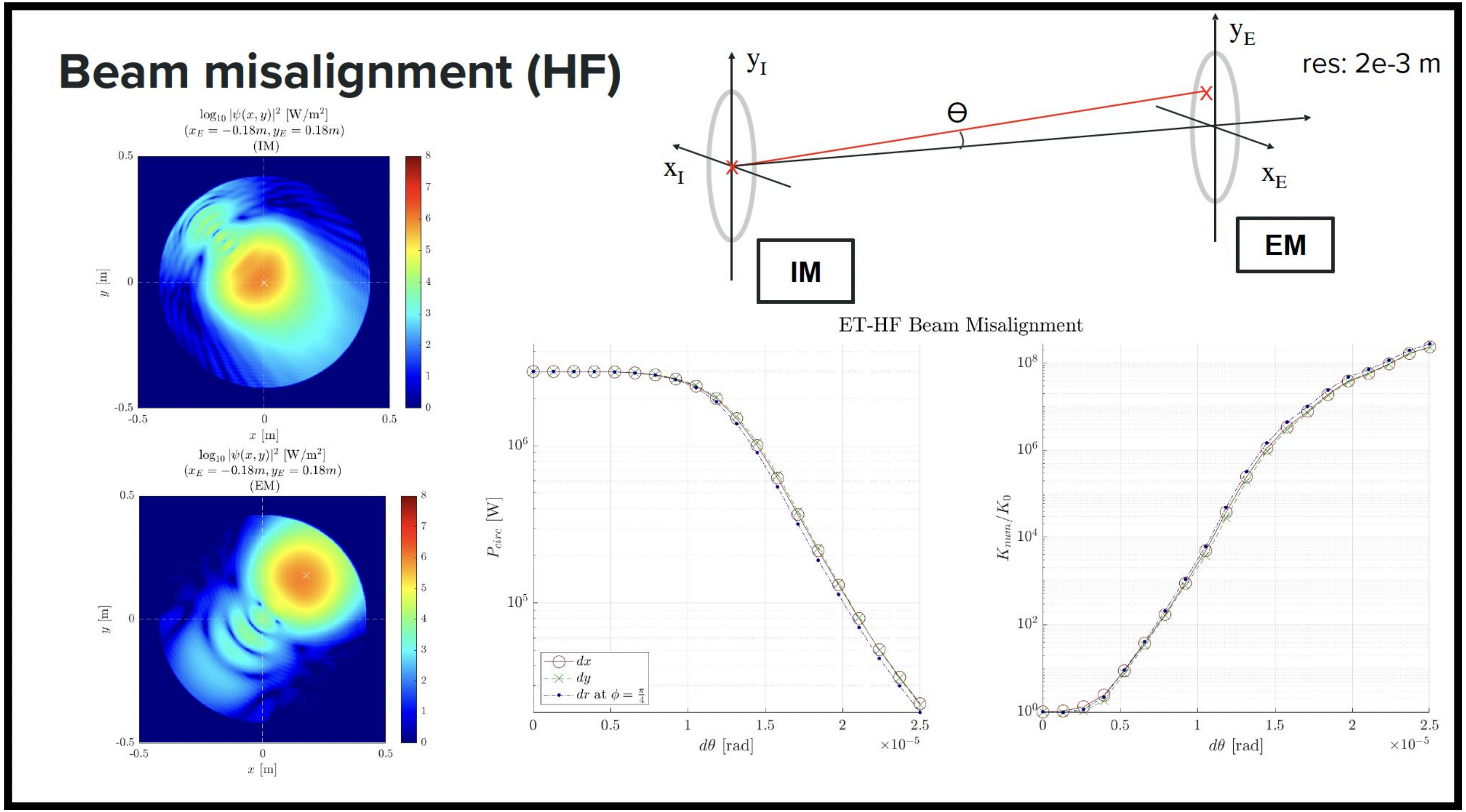
NEW STUDIES

Non-ideal cavities



NEW STUDIES

Non-ideal cavities



NEW STUDIES

Vibration analysis

Institut de Física d'Altes Energies

EXCELENCIA SEVERO OCHOA

BIST Barcelona Institute of Science and Technology

1. Overview

The **objective** consists on **presenting** the **results** of the **dynamic analyses** carried out on **Baffle** which is **Bolted To** a **Welded Ring** on the Beampipe (**BTWR**)

R_{flange} = 515.0 mm

t_{flange} = 6.0 mm (flange thickness)

R= 500.0 mm

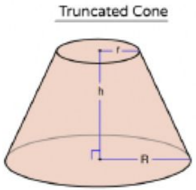
r = 420. mm

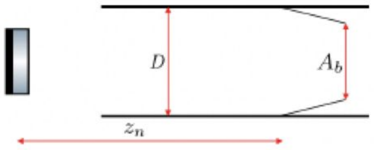
h = 114.3 mm

t = 1.5 mm (thickness)

m_{Baffle} = 7.11 kg

m_{ring} = 3.1 kg





The ring welded to the Beampipe has 6 mm thickness.

The Baffle flange has 6 mm thickness.

The Baffle is fixed to the Welded Ring through x6 M6 bolts.

NEW STUDIES

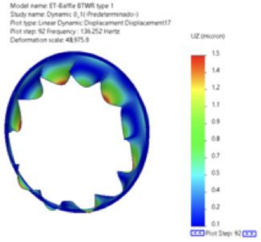
Vibration analysis

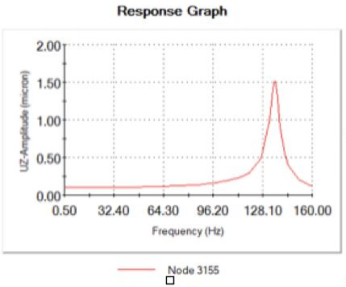
Institut de Física d'Altes Energies

EXCELENCIA SEVERO OCHOA

Barcelona Institute of Science and Technology

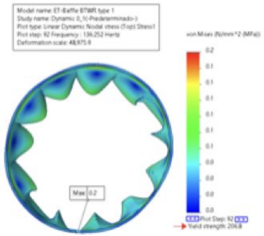
Frequency response @ 0.1 µm in Z

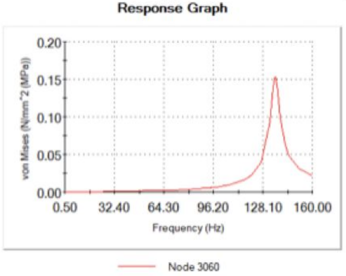




Amplitude

A = 1.51 microns/0.1 microns = 15.1



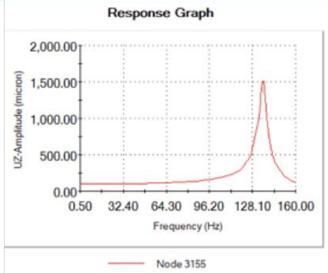


Safety Margin

SF = 206.8 MPa / 0.2 MPa = 1034.9

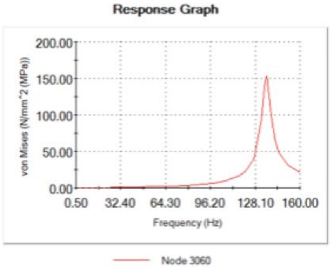
SST yield strength = 206.8 MPa

Frequency response @ 100 µm in Z



Amplitude

A = 1506 microns/100 microns = 15.06



Safety Margin

SF = 206.8 MPa / 152.7 MPa = 1.35

SST yield strength = 206.8 MPa