RFD transport:
Shock and random excitation response of the cavity components

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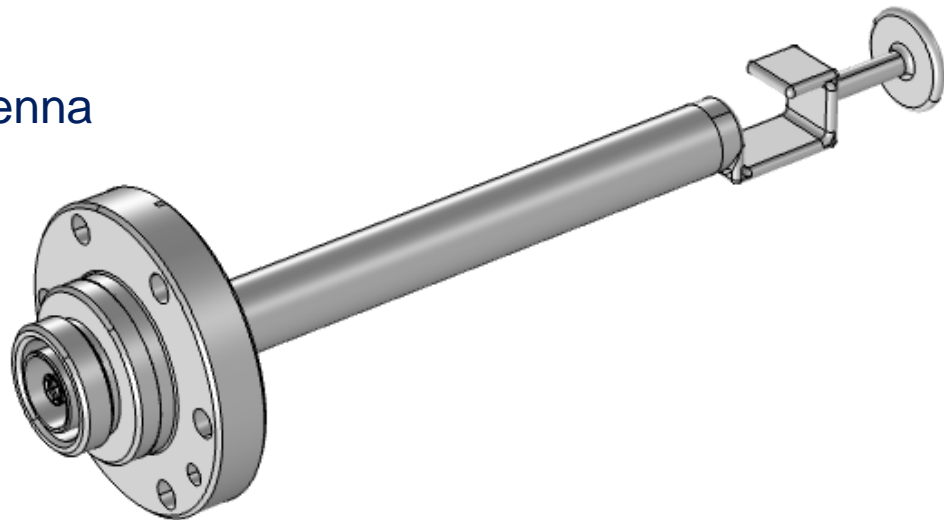
CERN, EN-MME

CERN – 05/06/2019

Introduction

- **Shock** – Represented as half sine wave. Two ways to evaluate it:

    1. Transient response to the half-sine wave.
        - Long
        - Computationally expensive
        - Need of a very small time step

    2. Response spectrum analysis
        - Much faster
        - Needs spectrum of the shock

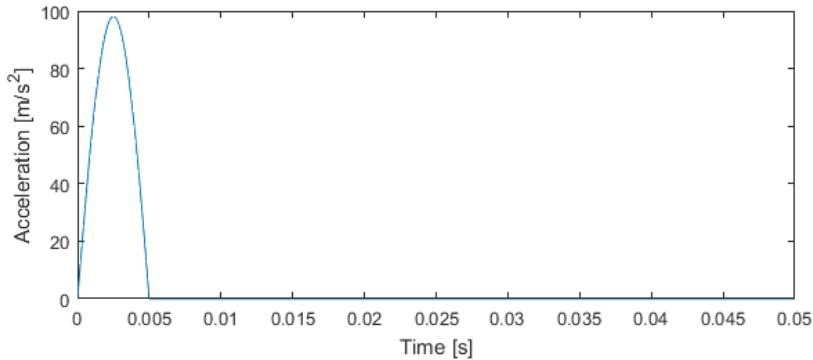- **Random vibration** – Response Power Spectral Density (RPSD)
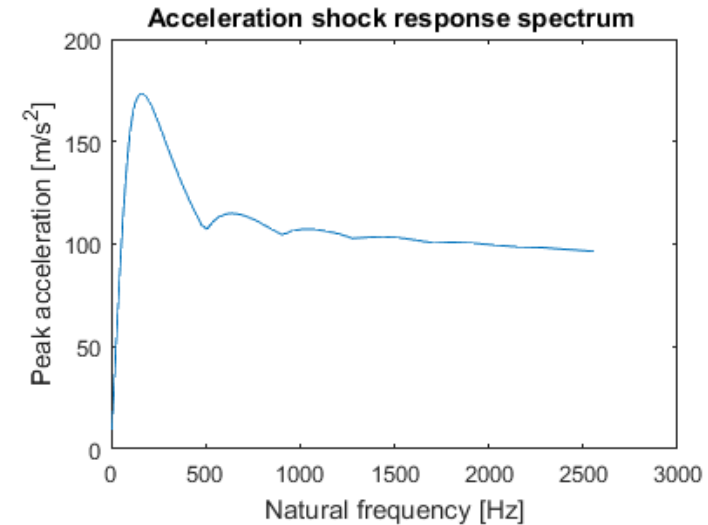
    Example: DQW pickup antenna

Shock analysis

2. Response spectrum analysis

- Input curve transformed into spectrum
- Analysis of the response of the model
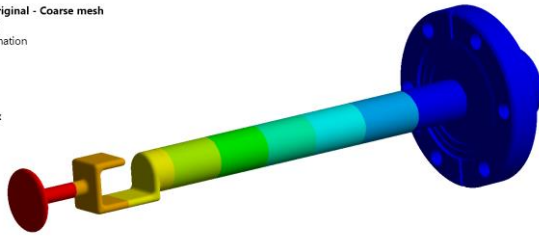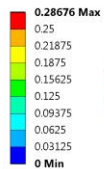
Matlab

Acceleration shock response spectrum

O: Transient of original - Coarse mesh
Total Deformation
Type: Total Deformation
Unit: mm
Time: 7.2e-003
06/03/2019 16:40

0.28676 Max
0.25
0.21875
0.1875
0.15625
0.125
0.09375
0.0625
0.03125
0 Min
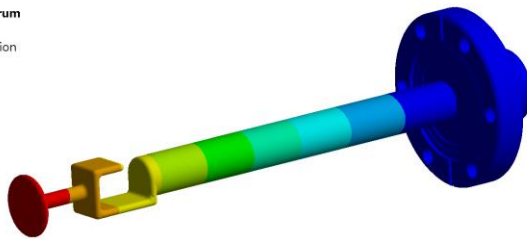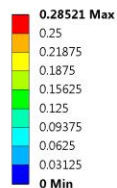
O: Transient of original - Coarse mesh
Equivalent Stress
Type: Equivalent (von-Mises) Stress
Unit: MPa
Time: 7.2e-003
13/03/2019 14:35

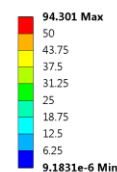99.165 Max
50
43.75
37.5
31.25
25
18.75
12.5
6.2501
9.0014e-5 Min
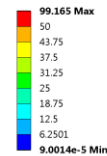
AE: Response Spectrum
Total Deformation
Type: Total Deformation
Unit: mm
Time: 0
13/03/2019 14:38

0.28521 Max
0.25
0.21875
0.1875
0.15625
0.125
0.09375
0.0625
0.03125
0 Min

AE: Response Spectrum
Equivalent Stress
Type: Equivalent Stress
Unit: MPa
Time: 0
13/03/2019 14:35

94.301 Max
50
43.75
37.5
31.25
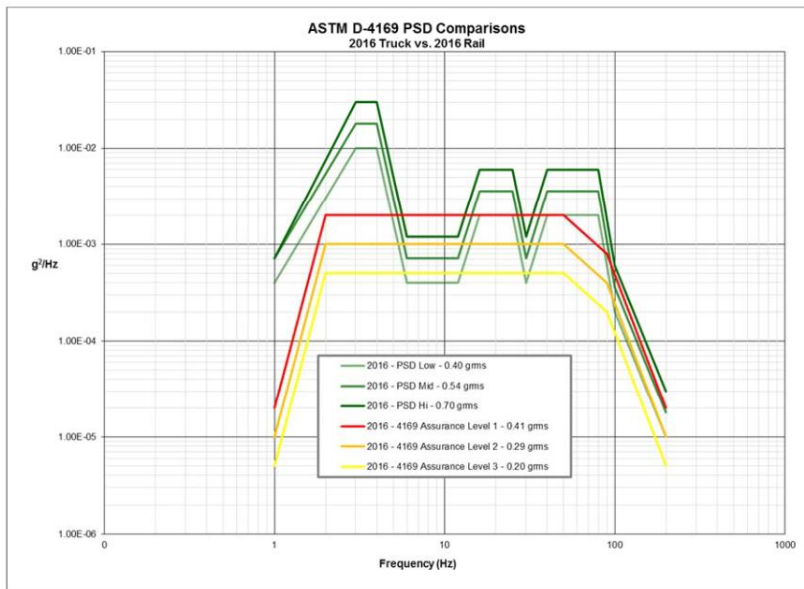25
18.75
12.5
6.25
9.1831e-6 Min

Random vibration

3. Response spectrum analysis

- PSD of the random signal
- Analysis of the response of the model
- A Response PSD is calculated for every node at each frequency.
- A RMS value (1,2 or 3 sigma) for the entire frequency range is calculated for every node
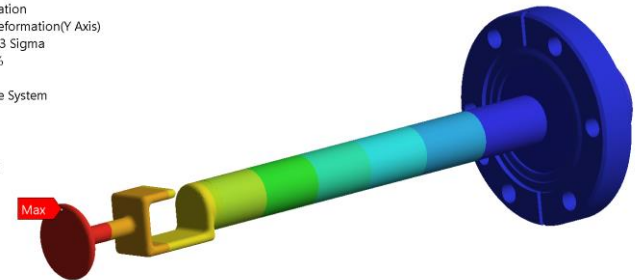
Displacement, 3 sigma

INPUT – ASTM 4169 – Truck PSD

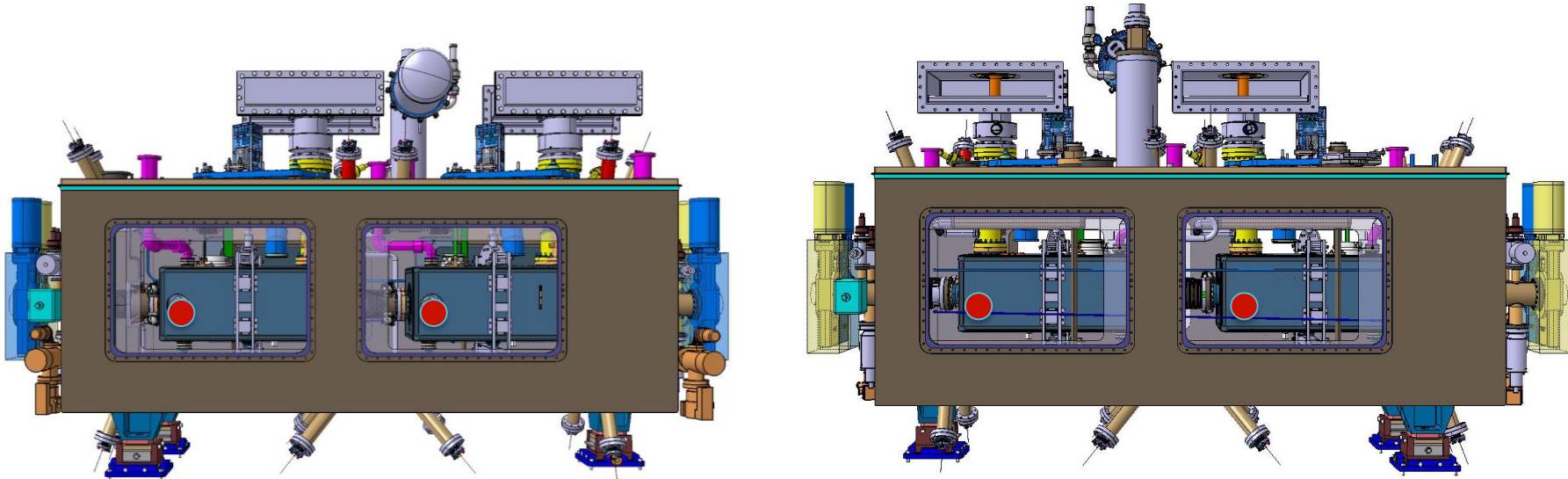### Stress, 3 sigma
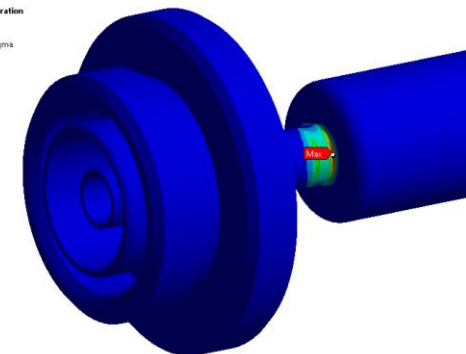
Restrains on the cavity displacement

- RFD Transport restraints design
- Modal
- Shock and Random
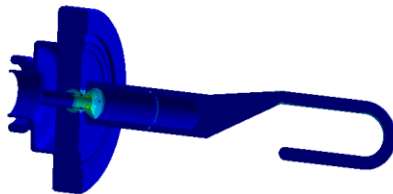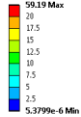- Mesh improvements made (Flexural guides)

Preliminary, in work…
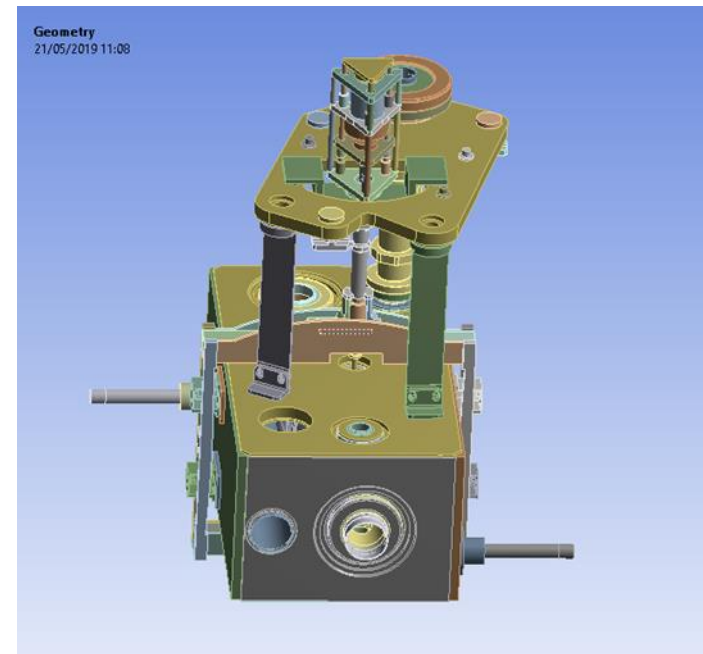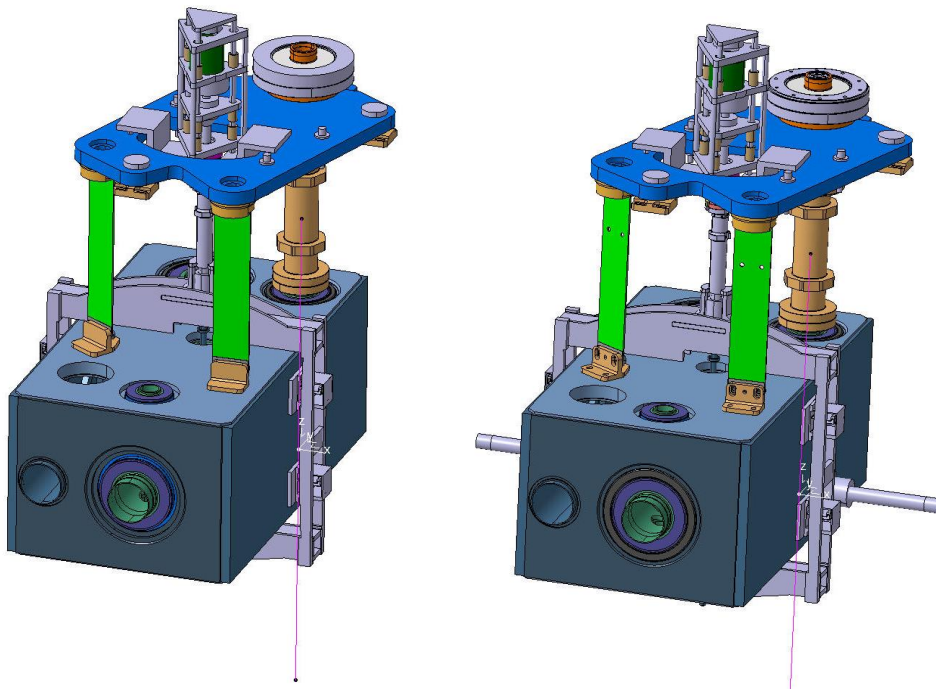
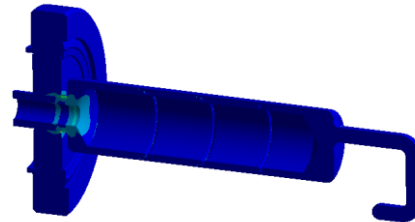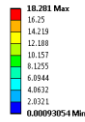# Restrains on the cavity displacement

- RFD position of the restraints.

- Calculations ongoing for RFD antennae, tuning system, he vessel, etc.
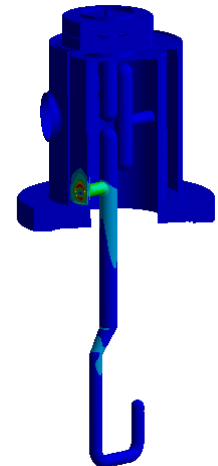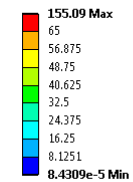
Benchmark

- Experimental campaign to compare the simulations with an actual model.

- Shaker with capability of reproducing PSD signal and shocks.

- Pickup model + benchmark design optimized through FEA calculations

- Instrumented with accelerometers & strain gauges.
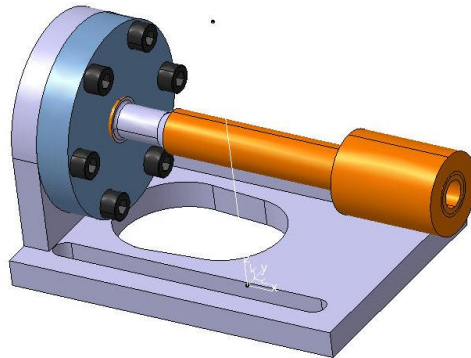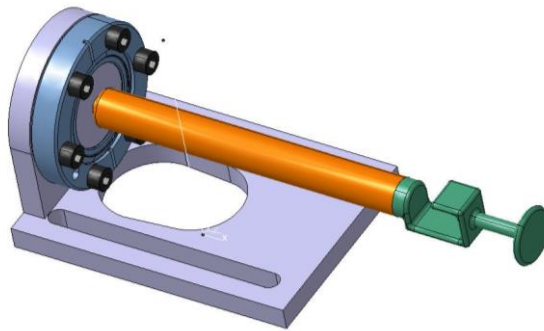
Thank you for your attention!