HiLumi WP4 – Crab Cavities

Tuning frame – Modal analysis

Joanna Swieszek, Kurt Artoos

25.09.2016

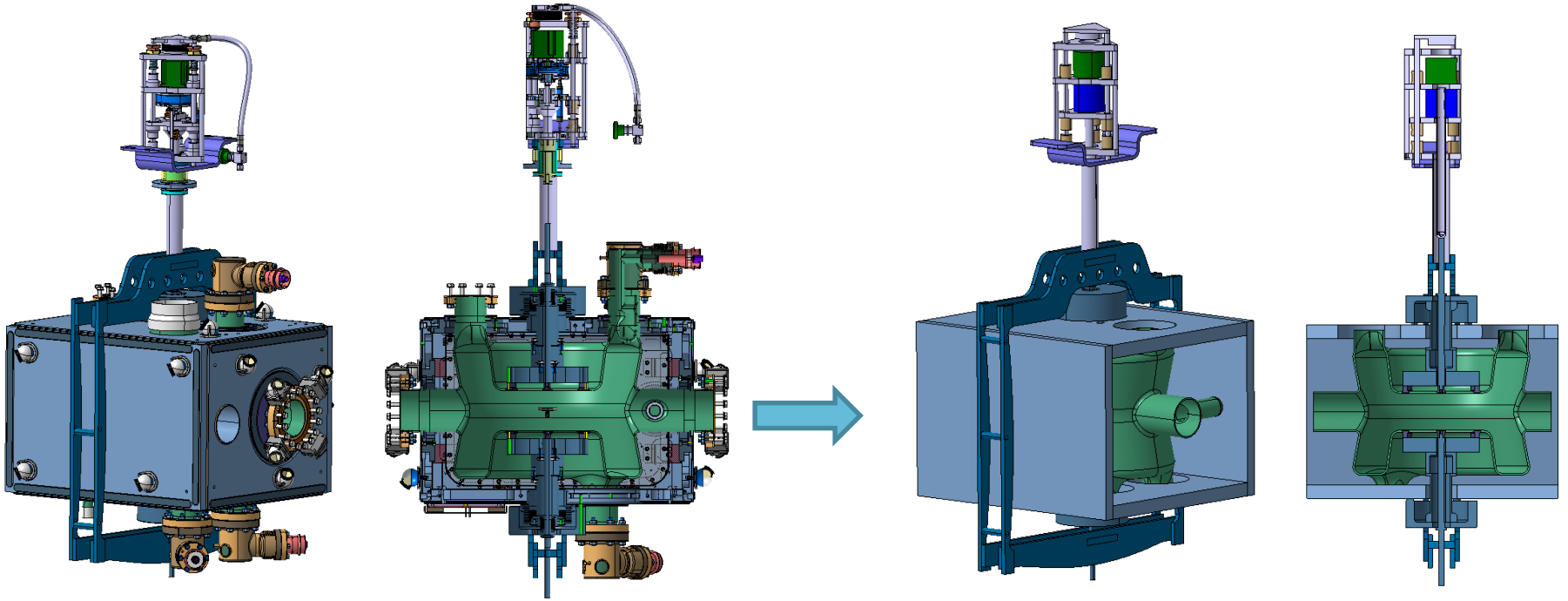
Purpose

- Evaluation of the harmonic modes of the tuner frame
- Looking into improvements
- Simplification of the model for the analysis purpose

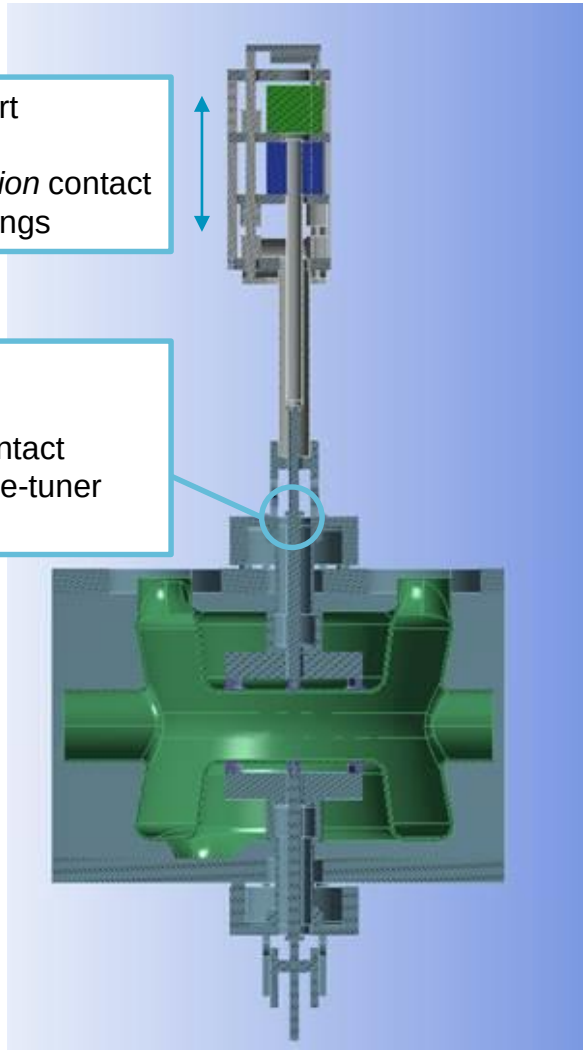
Simplified model

From cryomodule model
ST0711598

Simplified model



Model

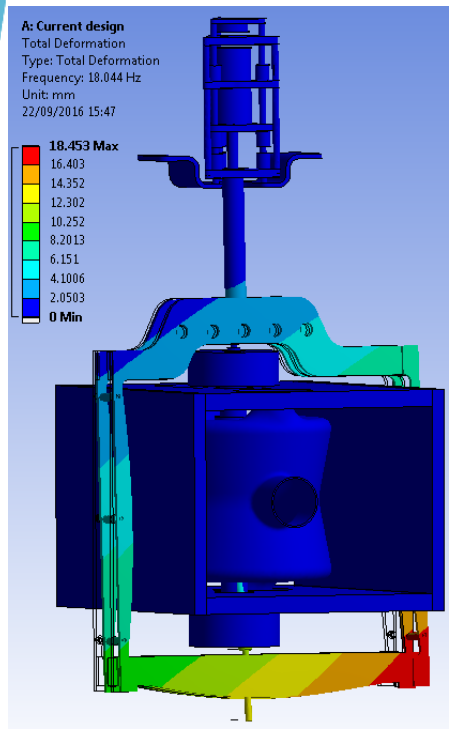


A: Fixed support on the tuner supporting plate
B: Fixed support on all cavity extremities
C: Fixed support on helium vessel

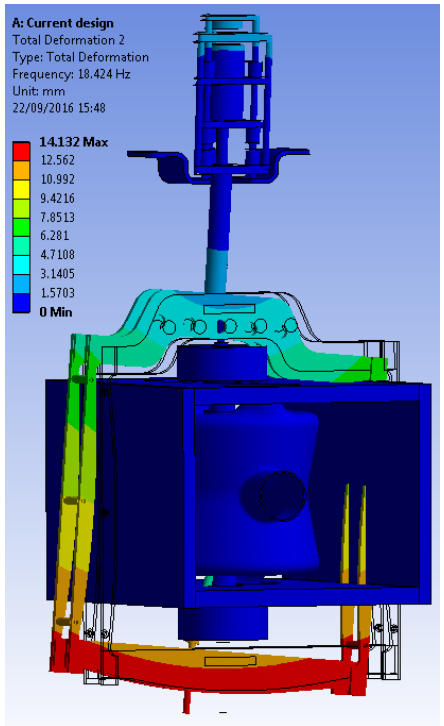
Results

- Modes:

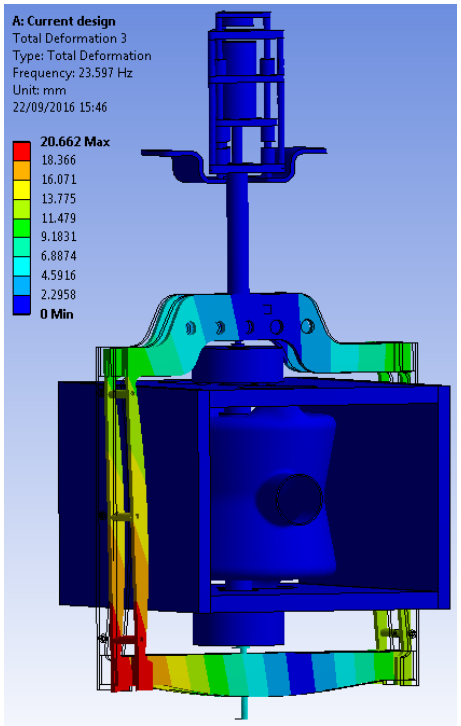
1



2



3

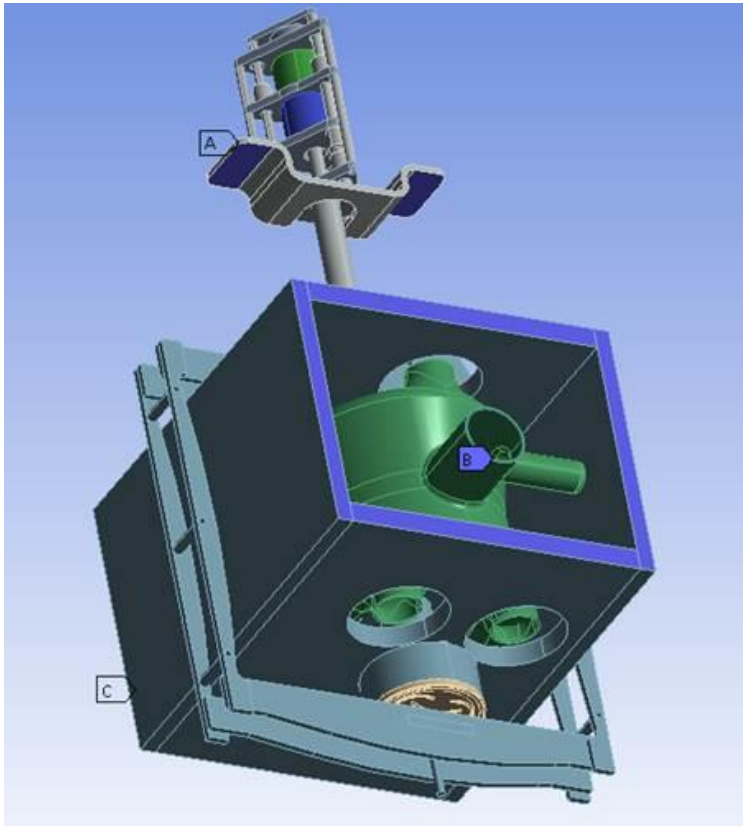


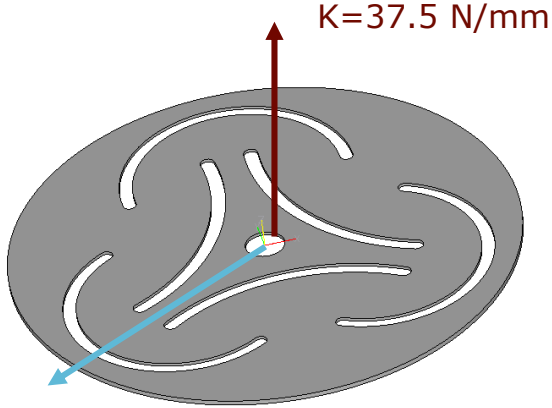
Mode	Frequency [Hz]
1.	18.044
2.	18.424
3.	23.597
4.	51.232
5.	68.15
6.	68.658

Modal_analysis_Tuner_frame.wbpj

Flexural diaphragm

- Adding a flexural diaphragm on bottom

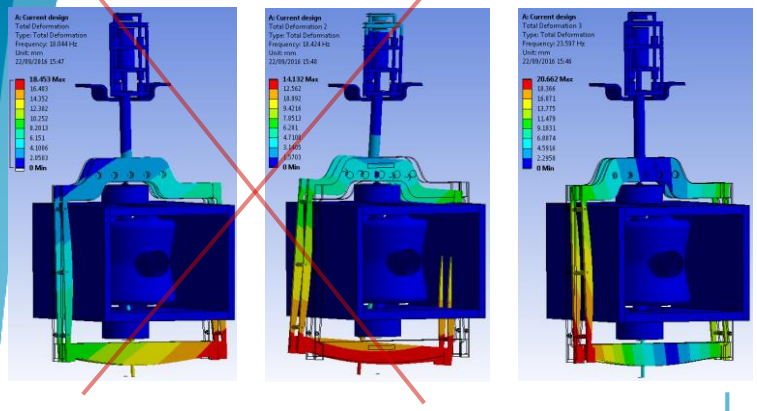




Longitudinal stiffness:
K=20680 N/mm

Results

1 2 3



Eliminate two first modes

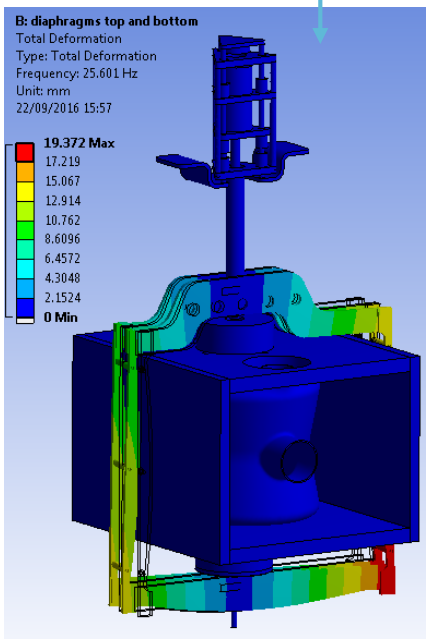
Current design

Mode	Frequency [Hz]
1.	18.044
2.	18.424
3.	23.597
4.	51.232
5.	68.15
6.	68.658

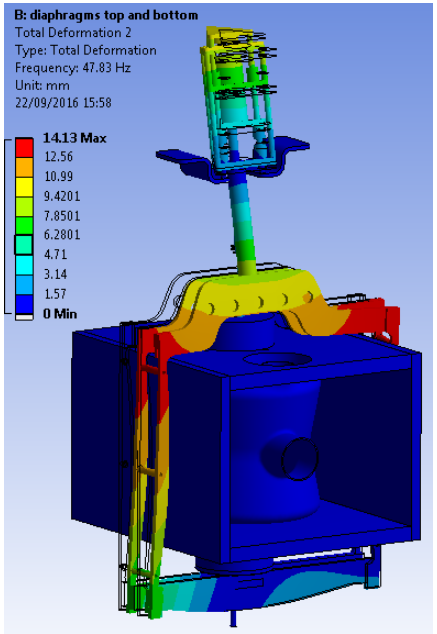
Flexure diaphragm

Mode	Frequency [Hz]
1.	**25.601**
2.	47.83
3.	60.952
4.	67.776
5.	81.561
6.	85.893

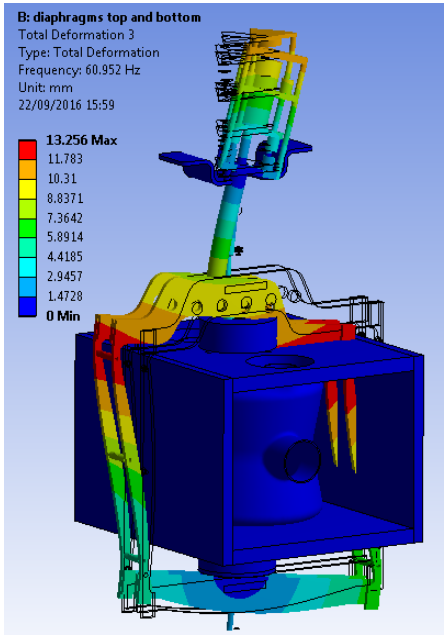
1



2



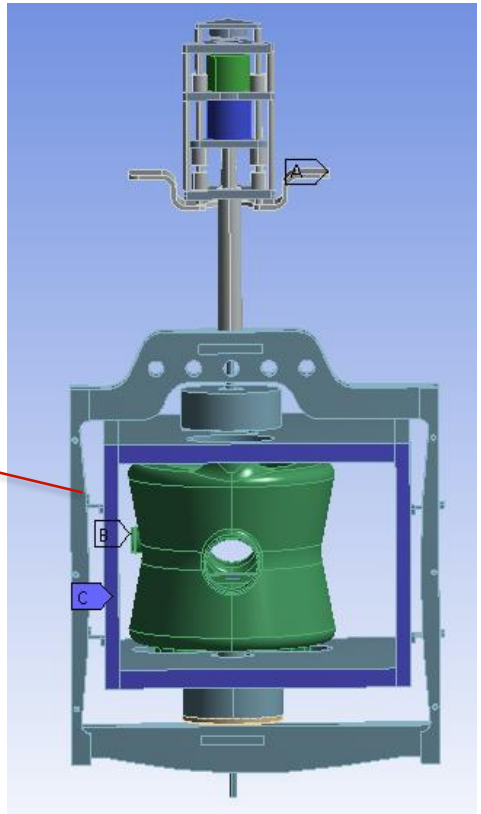
3

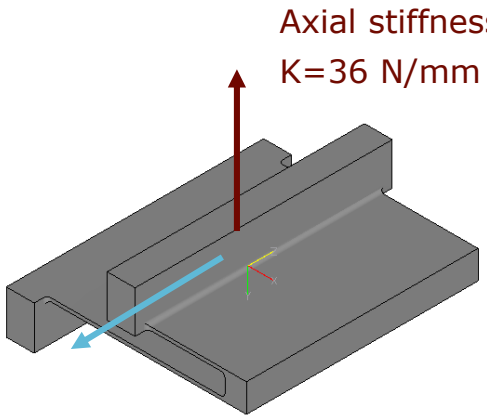


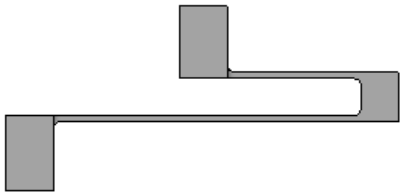
Modal_analysis_Tuner_frame.wbpj

Flexure guidance

- Elements connecting helium vessel with a tuner frame, (Thomas Jones recommendation)



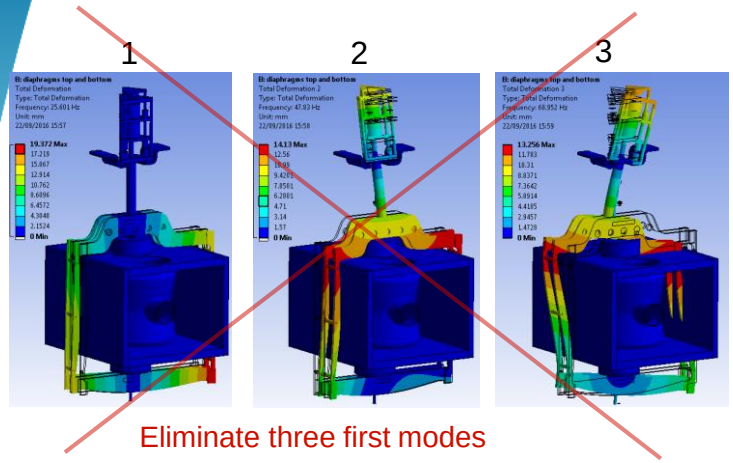




Longitudinal stiffness:
K=3477 N/mm

This shape needs to be optimized!

Results



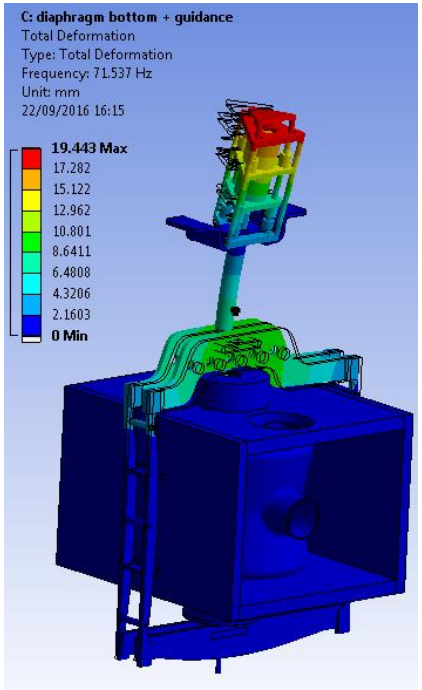
Flexure diaphragm

Mode	Frequency [Hz]
1.	25.601
2.	47.83
3.	60.952
4.	67.776
5.	81.561
6.	85.893

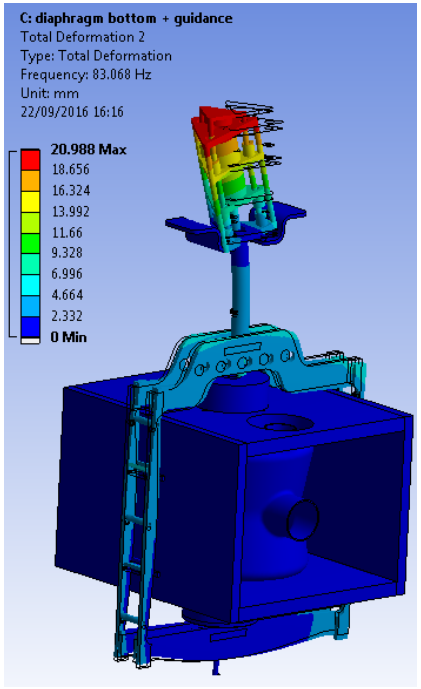
Flexure diaphragm + side guidance

Mode	Frequency [Hz]
1.	**71.537**
2.	83.068
3.	122.44
4.	127.12
5.	139.89
6.	146.29

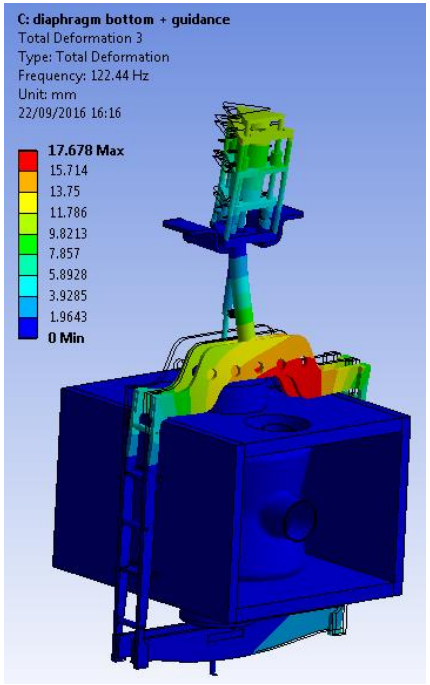
1



2



3



Option with only side guidance has been checked as well. It gives similar results (69 Hz first mode).
It means the flexure diaphragm is not needed for this purpose.

Conclusion

- Flexure diaphragm, connecting bottom the part of tuner frame with the helium vessel, prevents frame from swing on low frequency mode but it doesn't eliminate frame twist around z axis

- Using flexural guidance seems to be a better solution for increasing first natural mode, for this purpose diaphragm are not necessary, but they can be significant for a buckling analysis (under investigation)

- Guiding elements connecting helium vessel and frame need to be optimized according to the expected displacement range.

Thank you for your attention!