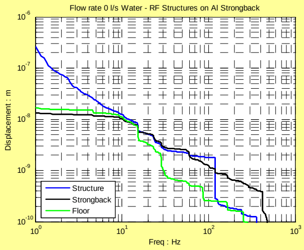
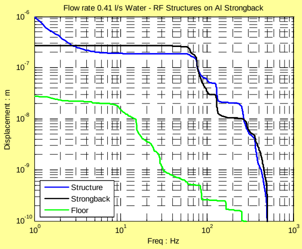
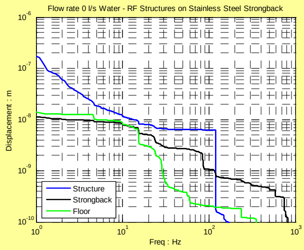
SETUP 1 RESULTS

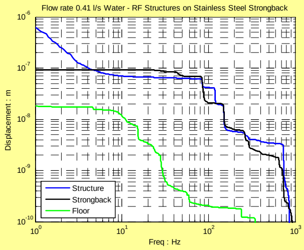




ALUMINUM STRONGBACK

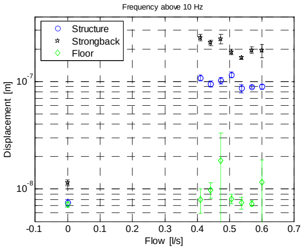
The standard strongbacks used for testing RF structures at NLCTA (NLC Test Accelerator) are made of aluminum. This material is lighter with respect to stainless steel and widely used for accelerators supports. In this case, its shape resonance are triggered by the water flow.
The average integrated displacement at 10 Hz on the structures is about 200 nm while the strongback shows an integrated displacement of almost 300 nm.





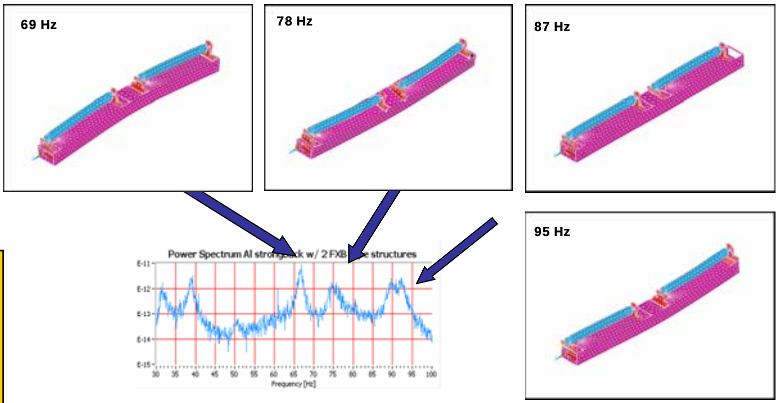
STAINLESS STEEL STRONGBACK

The configuration with the Stainless Steel strongback allows for a lower transmission of vibrations from the cooling water to the structures. The average integrated displacement at 10 Hz on the structures is ~70 nm, while the strongback presents a higher integrated displacement of about ~100 nm. The resonance frequencies of this strongback are higher with respect of the Aluminum one.



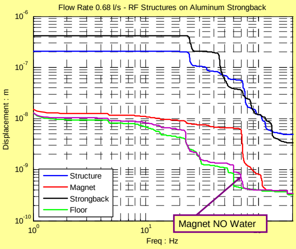
WATER FLOW RATE DEPENDENCE

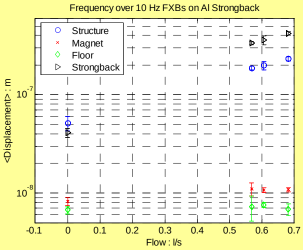
The water system allowed to perform measurements with different flow rates in a range between 0.4 and 0.6 liters/s. The dependence of the average displacement with respect to the water flow rate is shown above.
In this regime the dependence is negligible and in part the vibration amplitude is affected by the partial opening of the valves used to control the water flow.



Together with the measurements, several 3D finite element analysis were performed in order to simulate the system behavior. Shown above is the good agreement between a measured spectrum and the numerical data. This result allows focusing on simulations for the design of the NLC Girder.

SETUP 2 RESULTS



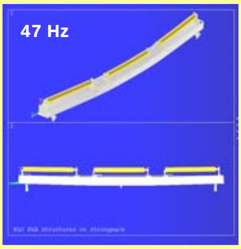


MAGNET COUPLING

The main goal for this configuration consisted in discovering the vibration coupling between the cooled structures and the adjacent quadrupole magnet. The magnet is connected to the structures by means of a bellow.
The plot on the side show in magenta the average integrated displacement for the magnet when no water is flowing, and in red the displacement during cooling at 0.68 liters/s. The displacement increase is around 3 nm which is within the specifications.

WATER FLOW RATE DEPENDENCE

This second setup allowed to analyze how the support system affects the vibration level in the structures. By connecting the 4 cooling pipes in parallel, it was possible to reach 0.68 liters/s. Again the dependence of the displacement as a function of the water flow rate is not very strong.
Since the strongback is not bolted to the floor, the displacement at zero flow is still significant.



FINITE ELEMENT ANALYSIS

As for the previous setup, several 3D models were generated in order to simulate the behavior of the experimental configuration.
In the pictures are shown the first 3 natural modes of the aluminum strongback supporting three RF structures on mockup movers.

Future developments

- Adding wave guides to the RF Structures ports in order to evaluate the effect on the overall stiffness of the system
- Test using an electromagnet instead of the permanent magnet
- If possible extend to 4 RF structures on a strongback in order to simulate the standard NLC-girder unit

Conclusions

The cooling water system plays a predominant role in the vibration budget of the RF structure – girder system. Several setups leading to a more precise simulation of the final girder design have been tested showing that the vibrations induced are within tolerances. The coupling to the adjacent PM has also been proven to be within specifications. Additional tests performed adding wave guides and adopting optimized supports for the RF structures are part of the ongoing activities.