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The status of the High-Dynamic DCM-Lite for LNLS/Sirius

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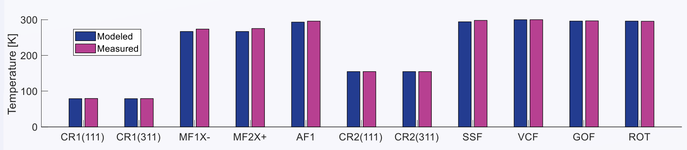
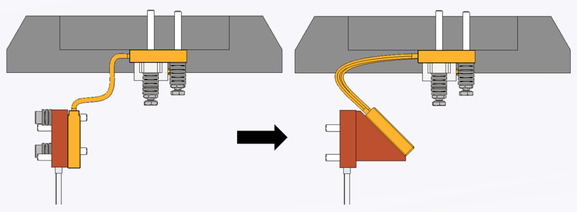
Abstract

Two new High-Dynamic Double Crystal Monochromators (HD-DCM-Lite) are under installation for QUATI (superbend) and SAPUCAIA (undulator) beamlines at Sirius. The HD-DCM-Lite portrays an updated version of Sirius LNLS HD-DCMs not only in terms of being a lighter equipment for sinusoidal scans speeds with even higher stability goals, but also bringing forward greater robustness for Sirius monochromators projects. It takes advantage of the experience gained from assembly and operation of the previous versions during the last years considering several work fronts, from the mechanics of the bench and cooling systems to FMEA, alignment procedures and control upgrades. In this work those challenges are depicted, and first offline results regarding thermal and dynamical aspects are presented

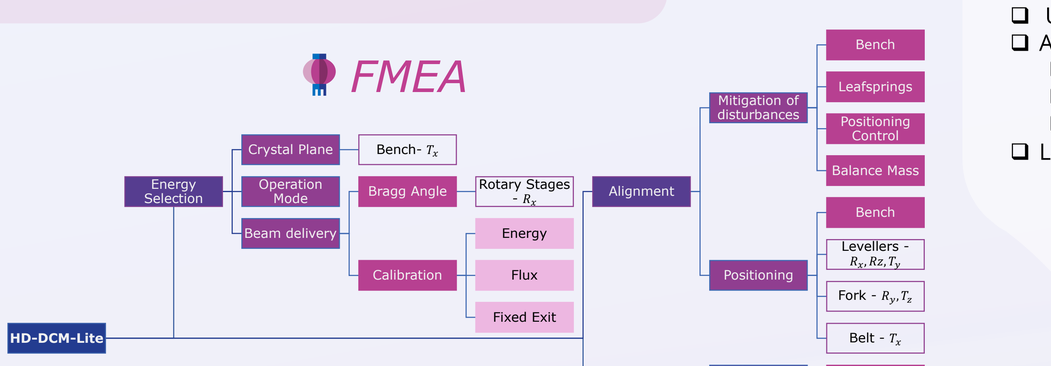
Thermal Management





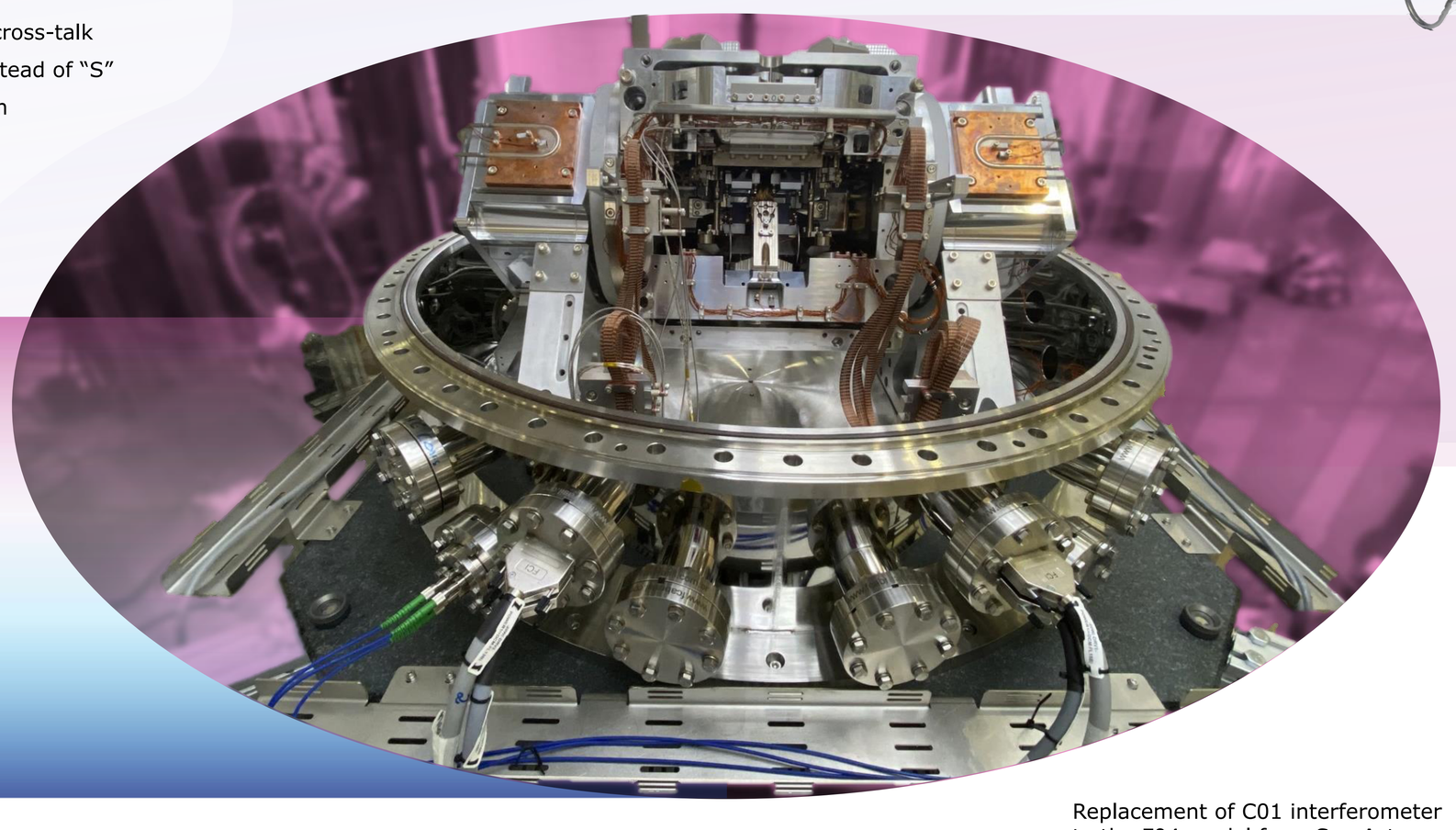
- Braid stiffness was causing cross-talk
  - C-shape was adopted instead of "S"
  - Longer braids was chosen
- Thermal model validated

FMEA



A FMEA was conducted from a Functional Product Breakdown. It contributed to:

- Systematic assessment of design fitness
- Knowledge sharing across teams
- Design of detection signals
- Preventive control
- Documentation

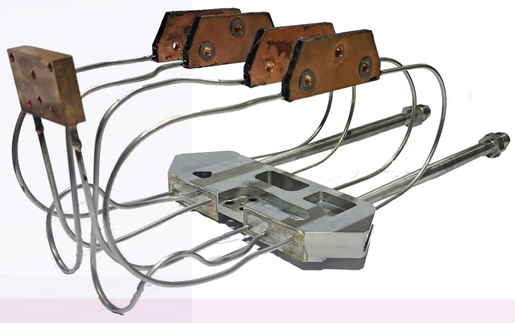


Key Design Modifications

The design updates drawing upon the insights gleaned from the design, assembly, and commissioning of previous HD-DCMs have proven highly effective for enhancing performance, streamlining the production process, and facilitating the assembly phase. These updates includes:

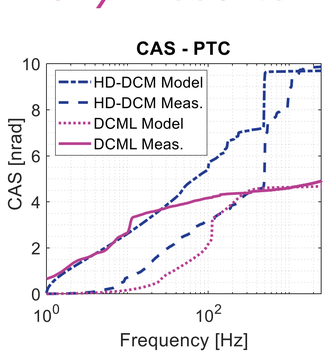
- Use of two parallel rotary actuators,
- Advancements in the granite bench
  - New rooting parts,
  - Equipment protection
  - Enhanced features for foot placement during assembly
- Large range interferometer with serial reading

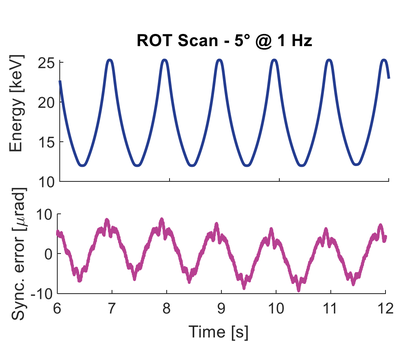
Additionally, modifications to the manufacturing process of the LN2 cooling manifold, along with the implementation of laser welding as the final step, have resulted in fewer unit losses due to leaks or clogging.

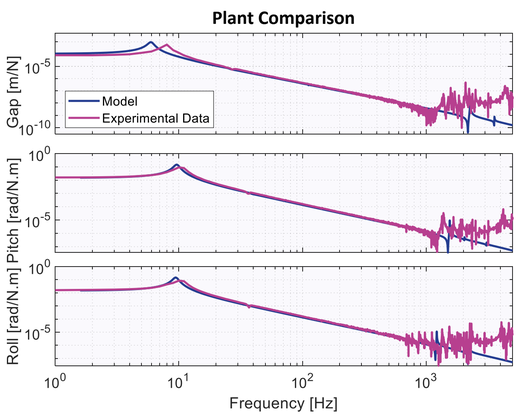


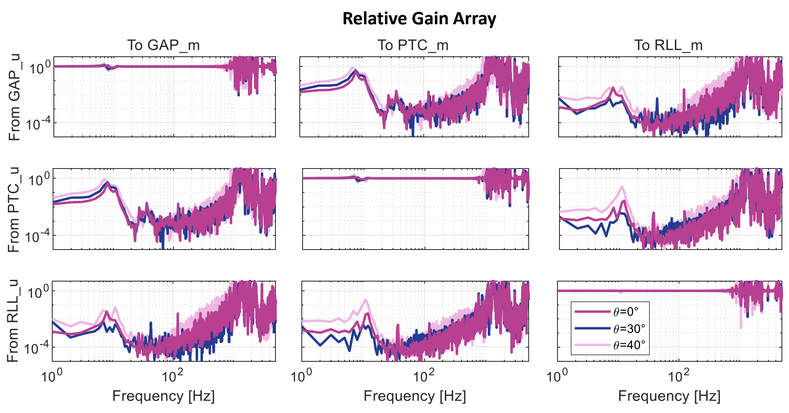
Preliminary Results

The system's identified plant closely mirrors the model, displaying minimal cross-talk, thus simplifying the development of an appropriate controller. In-position stability results meet all specified criteria, with particular emphasis on pitch parallelism, surpassing the performance of previous state-of-the-art HD-DCM units. While fly-scan results remain preliminary, high amplitude in mid-frequencies and high frequencies with low amplitudes have been reached. Torque optimization studies show promise.

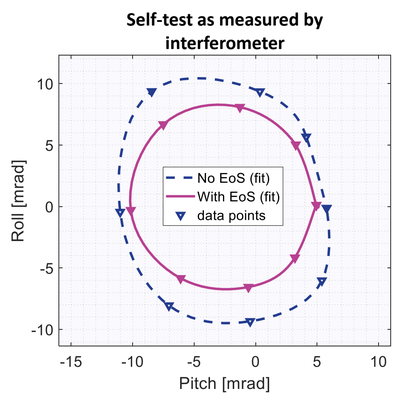








Alignment



Replacement of C01 interferometer to the F04 model from SmaAct extended the reading range to the full 15 mrad of operation, also enable an End of Stroke (EoS) self-test.

Beamline	Crystal pair Orientation	Before [μrad] μ_{pitch}	Before [μrad] μ_{roll}	After [μrad] μ_{pitch}	After [μrad] μ_{roll}
SPU	Si(111)	-1185	374	-43	-207
SPU	Si(311)	1849	-875	99	93
QUA	Si(111)	-171	1032	-210	58
QUA	Si(311)	456	56	-206	2

To ensure beam quality and streamline the commissioning procedure, the crystals mounting pads were machined to correct crystalline plane mismatch, achieving parallelism better than 250 μrad.

Conclusion

Key design modifications have streamlined assembly and boosted performance. In-position and scanning results meet specifications, showing great promise for fly-scan capabilities. Effective thermal management has been achieved, and FMEA has enhanced system reliability. These advancements demonstrate LNLS's commitment to advancing synchrotron technology.

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