THE DESIGN OF HIGH STABILITY DOUBLE CRYSTAL MONOCHROMATOR FOR HALF

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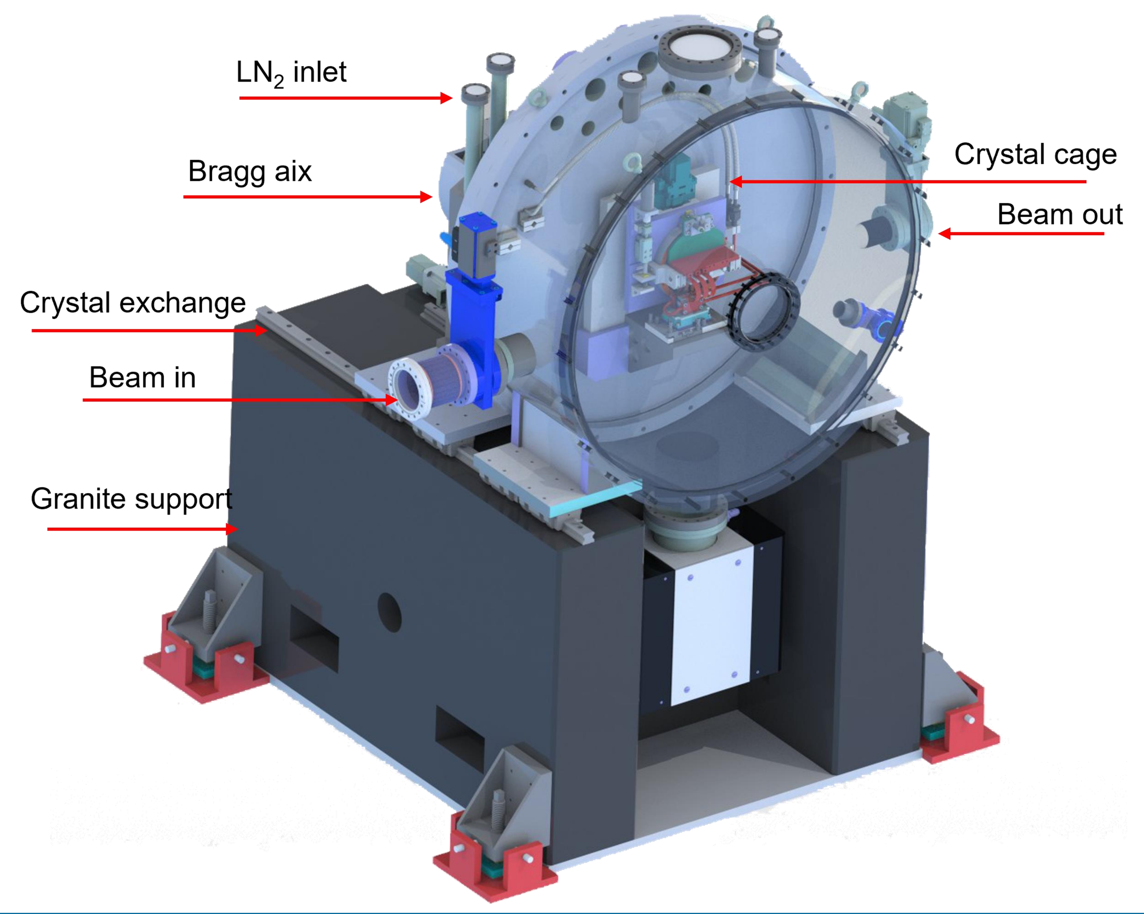
Abstract

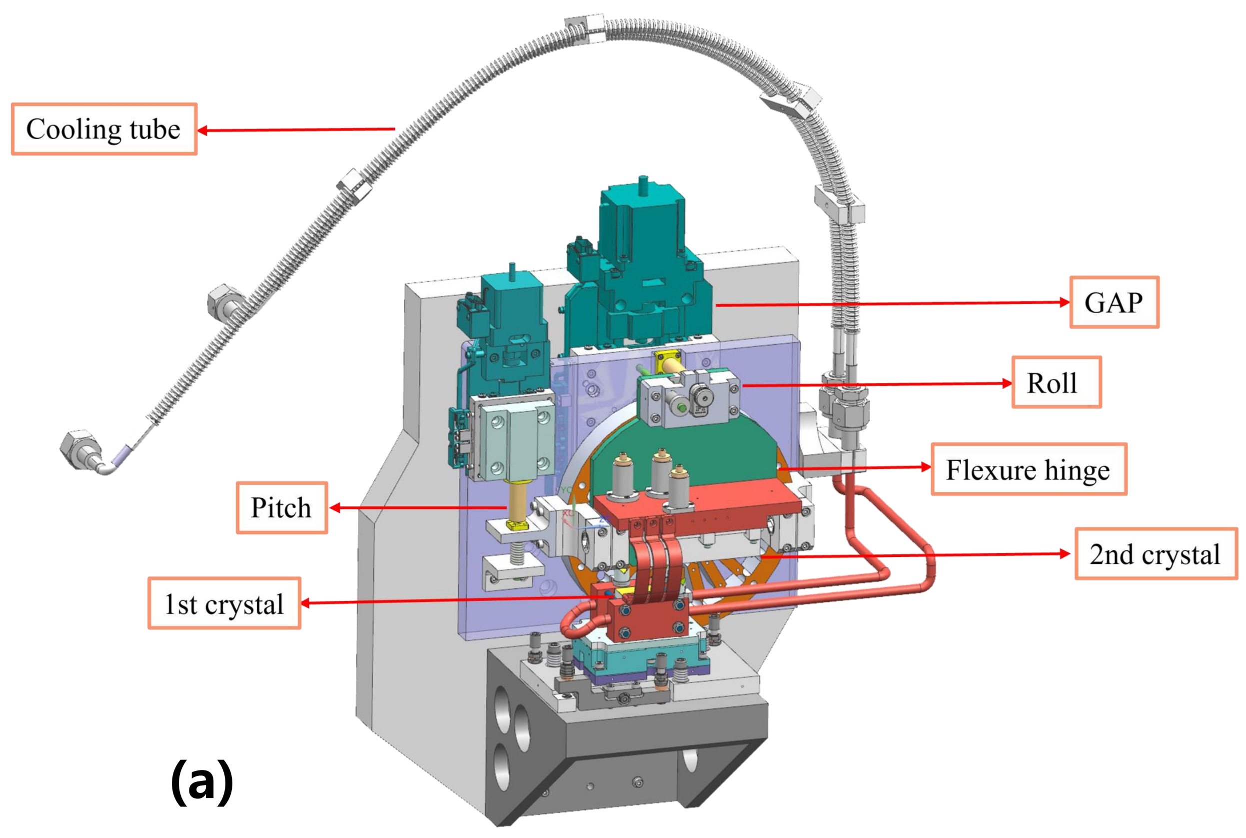
The monochromator is known to be one of the most critical optical elements of a synchrotron beamline, since it directly affects the beam quality with respect to energy and position. Naturally, the new 4th generation machines, with emittances in the range of order of 100 pm rad, require even higher stability performances. A high stability DCM (Double Crystal Monochromator) is under development at the HALF, the new 4th generation synchrotron . In order to achieve high stability of tens of nano radians, as well as to prevent unpredicted mounting and clamping distortions, simulation are proposed for crystal angular vibration and thermal management.

Main Functional Specs for the DCM Prototype

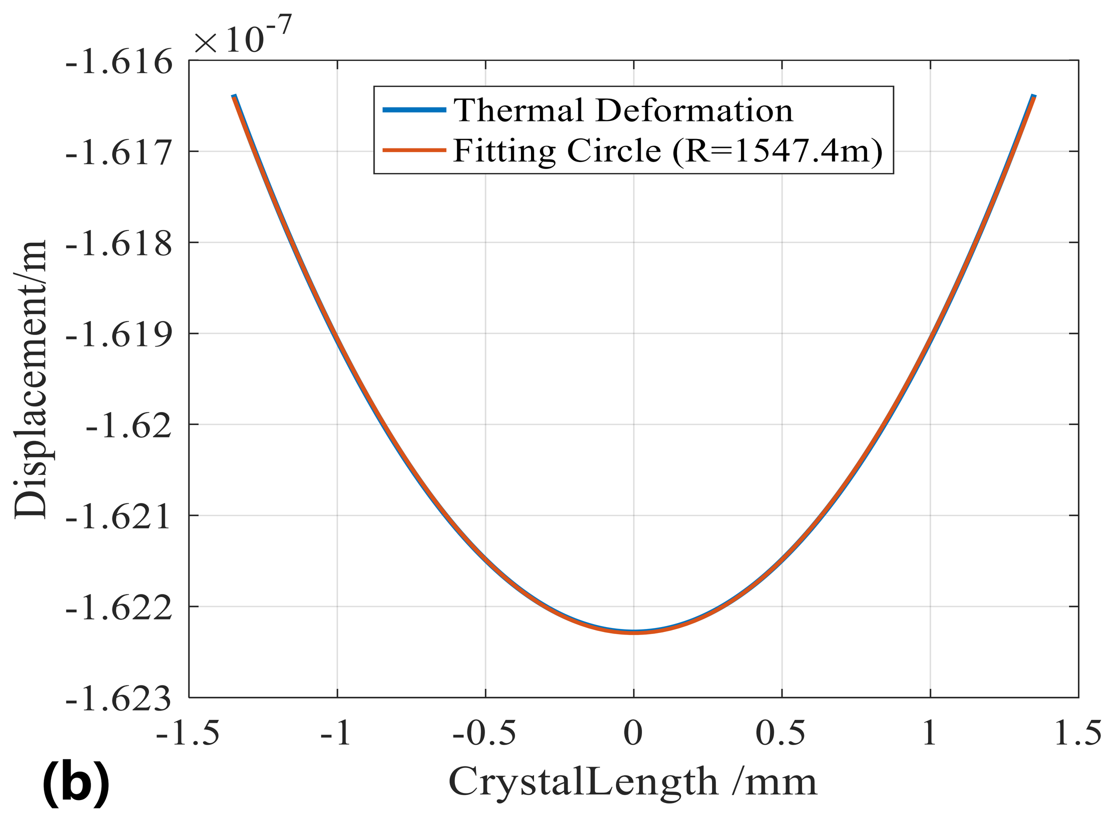
Parameter	Description
type	Vertical DCM
Beam offset	20 mm
Angular range	14° - 81°
Angular resolution	0.5 μrad
Crystal	Si(111): 2 to 8 keV
Crystal Cooling	1st crystal: Indirect LN2
	2nd crystal: Copper straps
Beam size	4×3.3 mm2
Input power	38.9 W



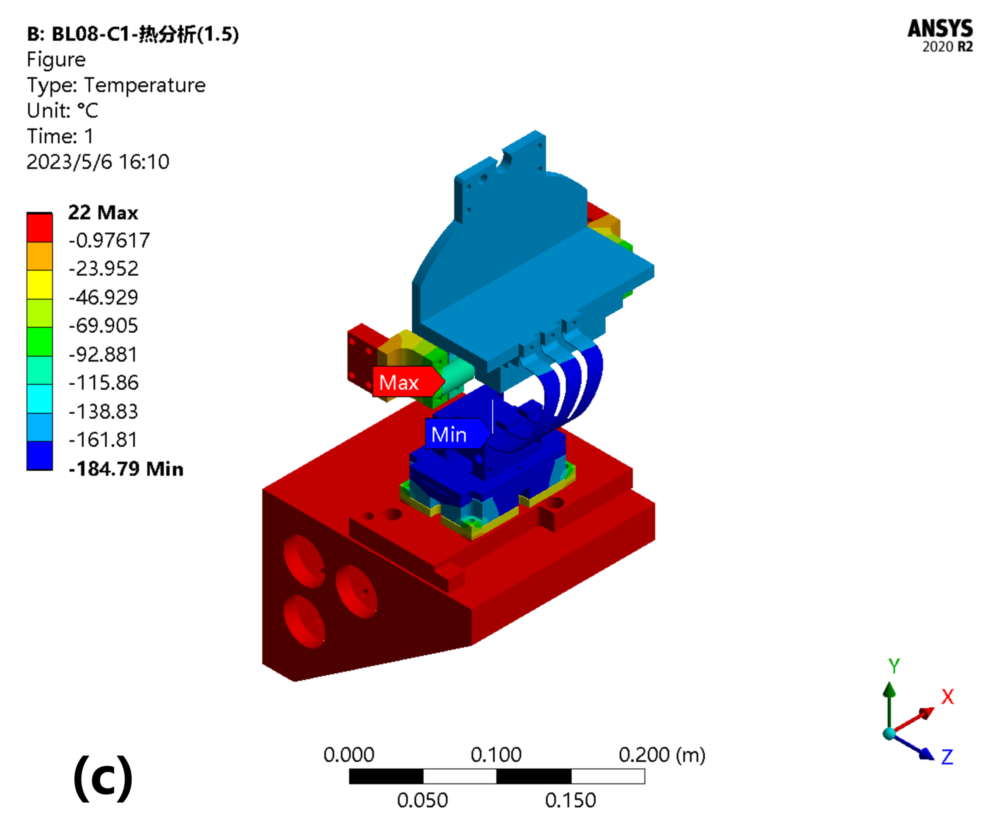
Crystal cage and Thermal Management



(a)



(b)

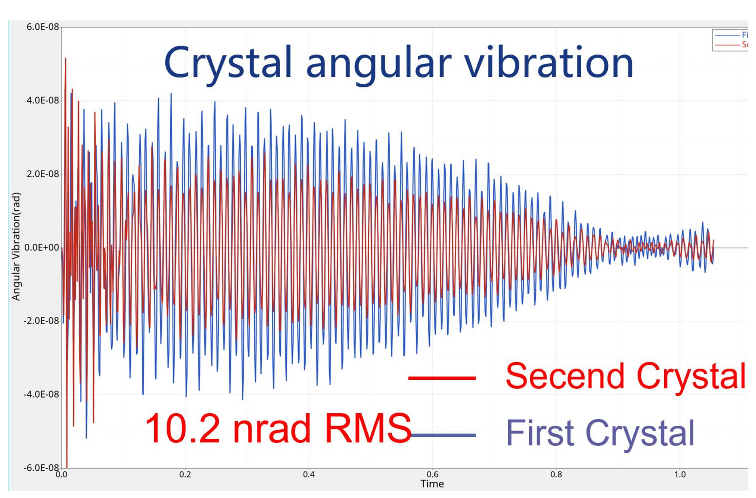


(c)

The design of the crystal cage of the DCM is illustrated in fig. a. To guarantee a good thermal insulation and cooling efficiency, the FEA, referring to the heat leakage from thermal conduction and radiation, was performed, so that the structure of the cryo-area was optimized. The result shows that under the clamping cooling method, the residual slope error has reduced down to 0.01μrad whose thermal deformation is shown in fig.b. The temperature distribution of the core area of the DCM is as Fig c.

Crystal angular vibration

After vibration simulation analysis, the vibration data from the HALF ground was used as input to obtain the absolute angular vibration in the pitch direction of the first crystal as 17.8 nrad, the absolute angular vibration of the second crystal as 11.5 nrad, and the relative angular vibration of the crystal as 10.2 nrad.



Conclusion

This poster briefly described the DCM design and thermal management for the DCM for HALF. Several analytical and numerical tools have been used in order to design them with specific targets regarding slope errors, thermal response, and crystal vibration.

Reference

[1]Kristiansen, Horbach, Dohrmann and Heuer.(2015) extension.22.879-85.

[2]L Zhang, M Sanchez Del Rio, G Monaco, C Detlefs, T Roth, A I Chumakov and P Glatzel. [J].J Synchrotron Radiat.2013.20.567-80