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Designing the High-Dynamic Double Crystal Monochromators (HD-DCM-Lite) control system for fast energy scans and beam sub-nanometer stability at SIRIUS

Wednesday 24 September 2025 15:39 (3 minutes)

Two new High-Dynamic Double Crystal Monochromators (HD-DCM-Lite) have been successfully deployed on the SAPUCAIA (SAXS) and QUATI (quick-EXAFS) beamlines at SIRIUS. Building on previous work, that introduced the dynamic modeling and initial stabilization control strategies*, this paper details the mechatronic architecture, commutation schemes, and control strategies that enabled these systems to meet stringent operational requirements during online beamline validation. The contributions of this work can be summarized in three key areas: (i) the development of commutation rules that enable closed-loop motion control of the 3-phase brushless rotary stages; (ii) the control approach for coordinated motion of two goniometers to achieve single-degree-of-freedom movement; and (iii) the design of controllers for the high-bandwidth Short-Stroke system. At SAPUCAIA, the HD-DCM-Lite achieved sub-5 nrad RMS parallelism stability in the pitch direction, essential for ultra-low-noise scattering experiments. At QUATI, the system was able to reach high-speed energy scanning while maintaining the beam in fixed-exit condition, crucial for quality assurance in time-resolved spectroscopy. These results highlight the HD-DCM-Lite as a state-of-the-art mechatronic platform. Experimental data on crystal and beam stabilities during online operation confirm the effectiveness of the designed control system and commutation strategies.

Footnotes

T. R. S. Soares, J. P. S. Furtado, G. S. de Albuquerque, M. Saveri Silva, R. R. Geraldes, "Dynamical modelling validation and control development for the new High-Dynamic Double-Crystal Monochromator (HD-DCM-Lite) for Sirius/LNLS", In: 19th Int. Conf. on Acc. and Large Exp. Phys. Control Systems (ICALEPCS'23)'

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