Contribution ID: **200** Contribution code: **THP12** Type: **Poster Presentation**

Can stepper motors replace the piezos in a high-resolution monochromator?

Thursday 18 September 2025 16:40 (1 hour)

The IXS High Resolution Monochromator (HRM) on the Petra III Beamline P01 is used for the medium X-ray range from 2.5keV to 3.5keV. The core piece is a disk that carries the crystals. An encoder ring is attached to the circumference. A radial and axial runout of less than 1µm during rotation of maximum +-20° is ensured by a high-precision spindle bearing. Rotation is performed by a PiezoLEG with a 110 mm long ceramic rod, which is coupled to the disk and offers an angular resolution of 100nrad at best. The HRM has been in operation since mid-2017 with four independent superstructures - two for the inline arrangement, two for the nested arrangement. Unfortunately, the PiezoLEGs stop from time to time because cold welding occurs between the piezo legs and the ceramic rod in a high vacuum, which is probably due to the very long ceramic rods and the imperfect coupling to the structure. As the currently required angular resolution is 1700nrad +-500nrad, the idea arose to replace the PiezoLEGs with a pusher, driven by a stepper motor. Initial tests with a commercially available pusher show promising results in closed-loop operation.

Footnotes

Funding Agency

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Session Classification: Thursday Poster Session

Track Classification: PRECISION MECHANICS: Nano-positioning