



Contribution ID: 220 Contribution code: THO15

Type: Contributed Oral Presentation

The X-ray free-electron laser oscillator at the European XFEL: design and status

Thursday 18 September 2025 15:40 (20 minutes)

This contribution provides an insight into the X-ray Free Electron Laser Oscillator (XFEL), an R&D project currently under commissioning at the European XFEL. XFEL aims to be the first demonstrator of a cavity-based free electron laser, promising significantly enhanced beam properties. The layout of the optical cavity and its integration into the SASE1 undulator section present unique challenges, particularly regarding the optomechanics to align the individual optical elements. These requirements include two angular and two linear degrees of freedom (DoF) with nanoradian-level angular stability and resolution, long travel ranges of up to 40 mrad, ultra-high vacuum compatibility, non-magnetic materials, and radiation resistance. To meet these demands, high-precision mechanics were developed that are based on flexures and combine parallel kinematics for high-resolution angular alignment with integrated serial kinematics for linear positioning. We will provide an overview of the XFEL setup, followed by a detailed look at the design and implementation of the precision mechanics. Finally, we will present a brief summary of the current status of commissioning and performance.

Footnotes

Funding Agency

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Session Classification: Precision Mechanics

Track Classification: PRECISION MECHANICS: Nano-positioning