



Contribution ID: 3 Contribution code: WEP60

Type: **Contributed Poster**

Millimeter-Wave Undulators for Compact X-Ray Free-Electron Lasers

Wednesday, 24 August 2022 17:10 (20 minutes)

Electromagnetic wave undulators have the advantage of a shorter period compared with the permanent magnet undulators when operating at high frequency, therefore producing FEL radiation at the same wavelength with less electron energy. This paper investigates the properties of a Ka-band microwave undulator, and the factors that affect the choice of the high-power drive sources, through the design and beam dynamic study of a 36GHz cavity-type microwave undulator proposed for the CompactLight X-ray FEL. The future research is to prototype a millimeter-wave undulator operating at ~100GHz, which will have an undulator period of about 1/10 of the state-of-the-art permanent magnet undulators. The millimeter-wave undulator will allow the generation of soft X-ray radiation at much lower beam energy, such as hundreds of MeV, enabling a reduction in the cost of a compact XFEL facility.

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Session Classification: Wednesday posters

Track Classification: Photon beamline instrumentation & undulators