



Contribution ID: 252 Contribution code: WEP34

Type: Poster Presentation

## Design of an S-band parallel-coupled transverse deflecting cavity with variable polarization for multi-dimensional phase space diagnostics in photoinjectors

Wednesday, 11 September 2024 14:20 (1h 30m)

Beam quality from photoinjectors is critical for lasing in Free Electron Laser (FEL) facilities. While phase space measurement are usually limited to 2D with conventional methods, the recently-developed transverse deflecting cavities (TDCs) with variable polarization provide the capability to measure multi-dimensional phase space information. Such information could reveal coupling between 2D phase spaces and guide the improvement of beamline setup for optimal lasing performance. In this manuscript, we present the design of an S-band parallel-coupled TDC, in which two chains that deflect beam horizontally and vertically are independently fed by waveguide networks and variable polarization can be obtained by adjusting the relative amplitude and phase between the networks. This structure has several advantages, such as compactness, tunability, high shunt impedance, single-frequency operation, etc. In this manuscript, physical and mechanical design of this TDC as well as preliminary simulation study of multi-dimensional phase space diagnostics in FEL photoinjectors will be presented in detail.

### Footnotes

### Funding Agency

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Yes

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**Session Classification:** WEP: Wednesday Poster Session

**Track Classification:** MC5: Longitudinal Diagnostics and Synchronization