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4D Transverse phase space characterization at PITZ via virtual pepper pot

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Due to the space-charge dominated nature of the electron beams at high brightness photoinjectors, a slit scan technique is utilized as a standard tool for quantifying horizontal and vertical emittance and reconstructing corresponding phase spaces. A novel method for 4-dimensional transverse phase space diagnostics is proposed at the Photo Injector Test facility at DESY in Zeuthen (PITZ), the so-called Virtual Pepper Pot (VPP) technique, that can give insight to the transverse beam phase space coupling. Also, since it is virtual, there is no mechanical design consideration, rather VPP utilizes the horizontal and vertical single slit scan data to form pepper-pot like beamlets and mask. By post processing of this data, all elements of the 4D transverse beam matrix are calculated and used to obtain the 4D transverse emittance and coupling factor. Additionally, the signal loss due to low SNR in the beamlets is estimated and the systematic error resulting from the crossing of beamlets is also explored. The VPP technique has been applied to ASTRA simulated beams as well as specially designed experiments with rotated beams (generated by a pair of normal and skew gun quadrupoles installed near the gun) to demonstrate the diagnostic capability.

Summary

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