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Statistical and interferometric beam diagnostics in IOTA at Fermilab

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At the Fermilab Integrable Optics Test Accelerator (IOTA), we are carrying out a research program on the statistical and quantum-optical properties of undulator radiation from electron bunches down to single electrons [1]. As a result of this program, novel beam diagnostic techniques have been developed. From the intensity fluctuations of undulator radiation, it is possible to infer very small beam sizes, which would otherwise be very challenging to observe [2]. In addition, we applied interferometric methods to observe vibrations of the apparatus at the nanometer scale [3]. A review of these methods is given, with an outlook on possible developments.

[1] https://doi.org/10.18429/JACoW-IPAC2024-MOPG06
[2] https://doi.org/10.1103/PhysRevLett.126.134802
[3] https://rpubs.com/gist/clara-vibration-studies https://doi.org/10.5281/zenodo.14897587

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