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## First measurements of quantum diffusion in an undulator

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Plasma and beam physics are usually considered as classical physics disciplines with quantum effects featuring only rarely. In particular, free electron lasers (FELs) even in the Angstrom regime (developed recently and being upgraded towards even shorter wavelengths) are well described by classical mechanics and electrodynamics. There is, however, a quantum effect that can influence the operation of these devices and limit the shortest achievable wavelength, namely energy diffusion in an electron beam due to quantum fluctuations in undulator radiation. Although this effect has been calculated theoretically, it has never been measured. In this work we present measurements of quantum diffusion effect at the European X-Ray Free-Electron Laser. The method uses a recently installed wakefield structure, which enables measurements of the longitudinal phase space after the hard X-ray undulator. The effect of quantum diffusion in the undulator is measured for the first time, and the results are in good agreement with theoretical predictions.

### Footnotes

### Funding Agency

**Author:** TOMIN, Sergey (Deutsches Elektronen-Synchrotron)

**Presenter:** TOMIN, Sergey (Deutsches Elektronen-Synchrotron)

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