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Two-photon undulator radiation

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We report on experimental investigations of a single electron, circulating in the Fermilab IOTA storage ring, focusing on two-photon undulator emissions. We employ a Mach-Zehnder (MZ) interferometer for the undulator radiation to determine the photon coherence length as well as to measure its statistical properties. In this experiment, the pulse of radiation in one arm of the interferometer is delayed by a certain optical delay. The optical delay can be adjusted with a step as small as 25 nm. We show that when the optical delay is varied, we observe oscillations of photon count rates in the two outputs of the interferometer. This interference pattern contains information about the temporal shape of the undulator radiation pulse, also known as the radiation coherence length. It may also contain information on non-classical two-photon statistics. In this paper, we present and discuss our measurements of this coherence length and statistical properties in both multi-electron and single-electron regimes.

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Footnotes

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