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Attosecond Single-Cycle Undulator Light

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Modern light sources continue to improve our knowledge of the natural world, from the subtle workings of life to matter under extreme conditions. Free-electron lasers, for instance, have enabled the characterization of biomolecular structures with sub-ångström spatial resolution, and paved the way to controlling the molecular functions. However, to broaden our scope of the ultrafast world, we need new light sources that would enable the observation of electronic processes at a time scale as short as a few attoseconds. To this end, we review and compare three recently proposed methods to generate attosecond x-ray pulses in undulators. These novel methods utilize the coherent radiation of microbunched electrons in undulators and the tailoring of the emitted wavefronts. The resulting pulse energy can potentially outperform pre-existing technologies by three orders of magnitude.

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