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Superradiant Amplification to Produce Attosecond Pulses in Soft X-Ray Regime via Linear Reverse Taper within Undulator Section

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Laser pulses of sub-femtosecond duration can be used to track the motion of electrons in the inner shell, which is needed in a variety of advanced experiments. Although this has been accomplished in XUV and hard X-rays in a free-electron-laser facility, it remains a challenge in the soft X-ray region due to the relatively high photon energies and large slippage in the undulator. In this contribution, we present a method to achieve a pulse sequence of ~ 120 attosecond each in average at 293.8 eV photon energy (4 nm wavelength), which covers the K-shell absorption of Carbon. The key is to create a linear undulator taper within each undulator module by rotating a transverse gradient undulator (TGU) at a small angle. The TGU technique is usually referred to minimise the energy spread effect in Laser-driven plasma accelerator, while in this paper we demonstrate that it can also be used to generate short pulses.

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