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Switchable X-ray OAM from a Free-Electron Laser Oscillator

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X-ray vortices carrying tunable Orbital Angular Momentum (OAM) are an emerging tool for X-ray characterization technology. However, in contrast to the generation of vortex beams in the visible wavelength region, the generation of X-ray vortices in a controlled manner has proved challenging. Here, we demonstrate an X-ray free-electron laser oscillator (XFELO) can adjust only the kinetic energy of the electron beam to produce vortex beams that can be programmed to dynamically change between different OAM modes, without the need for additional optical elements. With the nominal parameters of currently constructing 1 MHz repetition rate facility (i.e. SHINE), the active formation of the OAM modes of $l = \pm 1$ and $l = \pm 2$ and the rapid switching between them by detuning the electron beam energy of the XFELO are numerically illustrated. The real-time switching can be achieved within 200 μ s, while the output pulse energy can reach the 100 μ J level. This result extends the capabilities of XFELOs, and paves the way for advanced at-source applications using X-ray vortex beams.

I plan to submit also conference proceedings

Yes

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