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Plasma undulator excited by high-order mode lasers.[1] JINGWEI WANG, SERGEY RYKOVANOV, Helmholtz Institute Jena — A laser-created plasma undulator together with a laser-plasma accelerator makes it possible to construct an economical and extremely compact XFEL. However, the spectrum spread of the radiation from the current plasma undulators is too large for XFELs, because of the different values of strength parameters. The phase slippage between the electrons and the wakefield also limits the number of the electron oscillation cycles, thus reduces the performance of XFEL. Here we proposed a phase-locked plasma undulator created by high-order mode lasers. The modulating field is uniform along the transverse direction by choosing appropriate laser intensities of the modes, which enables all the electrons oscillate with the same strength parameter. The plasma density is tapered to lock the phase between the electrons and the wakefield, which signally increases the oscillation cycles. As a result, X-ray radiation with high brightness and narrow bandwidth is generated by injecting a high-energy electron beam into the novel plasma undulator. The beam loading limit indicates that the current of the electron beam could be hundreds of Ampere. These properties imply that such a plasma undulator may have great potential in compact XFELs.

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