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Simulation of a brilliant betatron gamma-ray source from a two-stage wakefield accelerator[1] X. DAVOINE, J. FERRI, CEA DAM DIF, 91297 Arpajon, France, I. ANDRIYASH, Synchrotron SOLEIL, 91192 Gif-sur-Yvette, France, S. CORDE, A. DOPP, A. DOCHE, C. THAURY, K. TA PHUOC, B. MAHIEU, V. MALKA, A. LIFSCHITZ, LOA, 91762 Palaiseau, France — Thanks to the recent progress in laser-driven plasma acceleration of electrons, the ultra-short, compact and spatially coherent X-ray betatron sources generated in a wakefield accelerator have been successfully applied to high-resolution imaging or ultra-fast probing of matter evolution in the last few years. Here, based on three-dimensional particle-in-cell simulations, we propose an original hybrid scheme in which an electron beam produced in a first stage of laser-driven wakefield, interacts in a second stage with ahigher plasma density to generate a beam-driven wakefield and undergo strong betatron oscillation.This second stage acts as an efficient plasma radiator: we show that this scheme greatly improves the energy efficiency of the source, with about 1% of the laser energy transferred to the radiation, and that the gamma-ray photon energy exceeds the MeV range when using a 15 J laser pulse. This new scheme opens the way to a wide range of applications requiring high-brilliance MeV photon source, such as photo-nuclear reaction study, radiography of dense objects, probing in nuclear physics or electron-positron pair production.

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