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Ultrahigh 6D-brightness electron beams for the light sources of the next generation FAHIM HABIB, GRACE G. MANAHAN, PAUL SCHERKL, THOMAS HEINEMANN, Z.M. SHENG, University of Strathclyde, The Cockcroft Institute, D.L. BRUHWILER, RadiaSoft LLC, J.R. CARY, University of Colorado Boulder, Tech-X Corporation, J.B. ROSENZWEIG, UCLA, BERNHARD HIDDING, University of Strathclyde, The Cockcroft Institute — The plasma photocathode mechanism (aka Trojan Horse) enables a path towards electron beams with nm-level normalized emittance and kA range peak currents, hence ultrahigh 5D-brightness. This ultrahigh 5D-brightness beams hold great prospects to realize laboratory scale free-electron-lasers. However, the GV/m-accelerating gradient in plasma accelerators leads to substantial energy chirp and spread. The large energy spread is a major show-stopper towards key application such as the free-electron-laser. Here we present a novel method for energy chirp compensation which takes advantage of tailored beam loading due to a second "escort" bunch released via plasma photocathode. The escort bunch reverses the accelerating field locally at the trapping position of the ultrahigh 5D-brightness beam. This induces a counter-clockwise rotation within the longitudinal phase space and allows to compensate the chirp completely. Analytical scaling predicts energy spread values below 0.01 percentage level. Ultrahigh 5D-brightness combined with minimized energy spread opens a path towards witness beams with unprecedented ultrahigh 6D-brightness [1]. [1] Manahan*, G.G. and Habib*, A.F. et al. Nat. Commun.8,15705 (2017) (* equal contribution)

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