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X-ray Radiation and Electron Injection from Beam Envelope Oscillations in Plasma Wakefield Accelerator Experiments at FACET[1] K.A. MARSH, W. AN, C.E. CLAYTON, C. JOSHI, W. LU, W.B. MORI, N. VAFAEI-NAJAFABADI, UCLA, C. CLARKE, S. CORDE, J.P. DELAHAYE, J. ENGLAND, A. FISHER, J. FREDERICO, S. GESSNER, M.J. HOGAN, S. LI, M. LITOS, D. WALZ, Z. WU, E. ADLI, SLAC — PWFA experiments at FACET at the SLAC National Accelerator Laboratory have shown a correlation between ionization-injected electrons and the betatron x-ray yield. The PWFA experiments were carried out using a rubidium vapor heat pipe oven. The vapor density was 2.5x10^{17} cm^{-3} and was ionized by the 20 GeV electron beam via tunneling ionization. The injected charge and x-ray yield are attributed to the beam envelope oscillations where at the oscillation minima, the field of the beam is strong enough to ionize RbII, and at the electron oscillation maxima, the beam electrons radiate x-rays. In general the x-ray yield scales as $r^2n^2\gamma^2$, but for a matched beam the x-ray yield is reduced and scales as $r^{3/2}n^{3/2}\varepsilon$. The FACET x-ray diagnostic can be used to tune the drive beam parameters for matched propagation by minimizing the x-ray yield. For a matched beam, there is no beam envelope oscillation, thus the x-ray yield and unwanted beam loading are greatly reduced. Injection of plasma electrons into the wake can limit the wake amplitude and deplete the accelerating gradient. Minimizing the x-ray yield should reduce unwanted beam loading.

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