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Opportunities for Bright-Beam Generation at the Argonne Wakefield Accelerator (AWA)

Bright electron beams have played a critical role in many recent advancements in accelerator technology, including free electron lasers and ultrafast electron diffraction/microscopy. Producing such beams via photoemission is ultimately limited by the maximum accelerating field that can be applied to a photocathode surface without degrading the beam brightness and the minimum achievable mean transverse energy of the electrons emitted from a photocathode. Moreover, photocathodes must operate under high laser fluences required to produce bright electron beams for high-current applications. This paper discusses the opportunity to generate bright electron beams using an upgraded version of the Argonne Wakefield Accelerator (AWA) photoinjector. The focus of this study is to examine optimal configurations of the photoinjector to produce 100-pC with 100-nm transverse emittance (corresponding to a brightness $\geq 10^{15} A.m^{-2}$). Optimizations of the AWA photoinjector including realistic electromagnetic-field maps are presented for the different photocathodes under consideration.

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