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Beam-Driven Dielectric Wakefield Acceleration with a plasma photocathode at the AWA

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The Trojan Horse experiment has recently demonstrated the plasma photocathode concept at SLAC FACET, with a two-gas mixture where one species is ionized for wakefield generation and the other for precision witness beam generation within the plasma bubble. In an experimentally similar approach called the 'Dielectric Trojan Horse', the plasma accelerator component is replaced with a solid-state dielectric structure for the wakefield medium. The dielectric structure is filled with a gas that is ionized by an injection laser to generate the witness beam for the plasma photocathode process. While the peak accelerating field is sacrificed compared to the plasma accelerator, the hybrid method may provide low emittance beam generation that is maintained through transport. Here, we described the design and implementation of this experimental scenario at the Argonne Wakefield Accelerator (AWA) where the concept of a bunch brightness transformer can be realized. In the AWA experiment, a bunch train resonantly excites the fundamental mode in the dielectric wakefield accelerator and a precision laser ionizes Xe-gas, filled into the structure, to generate the witness beam. Proposed experimental methods and diagnostic capabilities are discussed.

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