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Testing of a W-band Corrugated Waveguide for High-Gradient High-Efficiency Wakefield Acceleration

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Because of their ability to produce high gradients, radiofrequency (RF) structures in the sub-terahertz (sub-THz) regime are of considerable interest in structure wakefield acceleration. These structures can be used to generate a high gradient and high efficiency wakefield, allowing for a low physical footprint. In the pursuit of a structure with these properties, we have designed and built a metallic corrugated W-band structure based on the available electron beams at the Argonne Wakefield Accelerator (AWA) with the emittance exchange (EEX) beamline. The EEX beamline offers the possibility to perform longitudinal bunch shaping to optimize the gradient and the transformer ratio (defined as the accelerating gradient at the witness bunch over the decelerating gradient at the drive bunch in the two-beam acceleration regime). This talk will present the testing results of the W-band structure when excited by 42 MeV bunches sent through the EEX beamline. Two cases were studied: (1) demonstration of a high gradient from a single drive electron bunch with a charge of 10 nC and a short bunch length of about 150 microns; (2) demonstration of a high transformer ratio using a two-bunch train, where the drive bunch with about 2 nC of charge was shaped with a transverse mask, and a small witness bunch trailed behind to measure the wakefield. Detailed results will be presented in this talk, showcasing the promise of sub-THz wakefield acceleration with longitudinal bunch shaping.

Working group

WG4 : Novel structure acceleration

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