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Generation of 1 GW of 11.7 GHz Power using a Metamaterial-based Power Extractor for Structure-based Wakefield Acceleration JULIAN PICARD, MICHAEL SHAPIRO, IVAN MASTOVSKY, RICHARD TEMKIN, Massachusetts Institute of Technology (MIT), XUEYING LU, JIAHANG SHAO, MANOEL CONDE, JOHN POWER, ERIC WISNIEWSKI, MAOMAO PENG, GWANGHUI HA, SCOTT DORAN, Argonne National Lab (ANL), CHUN-GUANG JING, Euclid Techlabs, LLC — We present our recent experimental efforts toward producing one gigawatt of power at 11.7 GHz with a metallic metamaterial-based power extractor for use in structure-based wakefield acceleration (SWFA). SWFA is a novel acceleration scheme in which high-charge electron bunches are passed through a power extractor structure to produce a high-intensity wakefield. The resulting wakefield can either be used to accelerate a witness bunch in the same beamline or passed through a waveguide to a secondary acceleration beamline. Our approach uses a specifically-tailored metamaterial for the power extractor structure. The properties of the metamaterial allow us to overcome some of the difficulties encountered by other SWFA techniques. Here, we present the Stage 3 experimental design. The Stages 1 and 2 experiments generated 80 MW and 380 MW RF pulses, respectively, with several-nanosecond duration using the 65 MeV beam at the Argonne Wakefield Accelerator. The Stage 3 design includes significant design improvements, including an all-copper structure, fully-symmetric coupler design, and treatment to reduce breakdown risk. With these improvements, simulations predict over 1.1 GW of output power. The experimental run is scheduled for February 2021.

Julian Picard
Massachusetts Institute of Technology (MIT)

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