PSF20-2020-000016

Abstract for an Invited Paper
for the PSF20 Meeting of
the American Physical Society

Metamaterial Structures for High-Gradient Wakefield Acceleration[1]

XUEYING LU, Northern Illinois University / Argonne National Laboratory

This talk will present the recent advances in novel metamaterial (MTM) structures for structure-based wakefield acceleration (SWFA). SWFA is a promising approach to make compact high-energy particle colliders by achieving high accelerating gradient. The MTM structure designed for SWFA is a wagon wheel periodic structure with a negative group velocity, and it can interact strongly with relativistic electron bunches by reversed-Cherenkov radiation. The period of the structure is much smaller than the wavelength. In this way, the MTM structure performs almost as a continuous medium. Two wagon wheel MTM structures have been tested at the Argonne Wakefield Accelerator (AWA). The reversed-Cherenkov radiation was verified experimentally. The highest power generated was 380 MW in a 10 ns long pulse at 11.7 GHz from a train of eight electron bunches with an energy of 65 MeV and a total charge of 224 nC. These results demonstrate the unique features of MTM structures that are attractive for future wakefield accelerators. Advantages include the high shunt impedance, the simple and rugged structure, and a large parameter space for optimization.

In Collaboration With: Julian Picard, Michael Shapiro, Ivan Mastovsky, Richard Temkin; Massachusetts Institute of Technology. Manoel Conde, John Power, Jiahang Shao, Eric Wisniewsk, Maomao Peng, Gwanghui Ha, Jimin Seok, Scott Doran; Argonne National Laboratory. Chunguang Jing, Euclid Techlabs LLC

[1]U.S. Department of Energy, Office of Science under Award No. DE-SC0015566 and No. DE-AC02-06CH11357