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The interaction of a high-power sub-nanosecond microwave pulse with preliminarily formed plasma in a waveguide

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We present the results of analytical modeling and numerical particle-in-cell simulations showing that the propagation of a high-power sub-nanosecond microwave pulse through a plasma-filled cylindrical waveguide[1] should lead to the formation of a wakefield with significant periodic plasma density modulation. The latter can be controlled by varying the waveguide radius, the plasma density, and the microwave power. To study this phenomenon, two backward wave oscillators (BWO), operating in the super-radiant mode at frequencies of 9.6 GHz[2] and 28.6 GHz[3], were designed and tested. These BWOs were driven by an electron beam (~280 keV, ~1.5 kA, ~5 ns) generated in a magnetically insulated foilless diode and propagating through a slow-wave-structure guided by an axial magnetic field. Microwave pulses of ~0.4 ns width, up to ~500 MW peak power at 9.6 GHz and up to ~1.2 GW at 28.6 GHz were obtained. A cylindrical wire-array waveguide is placed at the exit of the BWO and filled with plasma produced by an array of flashboards. The high power microwave pulses traverse this plasma interacting with it in a non-linear parameter range never studied before. First experimental results at 9.6 GHz will be presented.
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[1] Phys of Plasmas, 24, 063112 (2017).
[2] J. Appl. Phys. 121, 033301 (2017).
[3] Phys. Plasmas 26, 023102 (2019).

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