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O-TYPE METAMATERIAL HIGH POWER MICROWAVE SOURCE WITH 310 MW OUTPUT POWER*

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Unusual electrodynamic properties of metamaterials naturally call for investigations of their applicability as slow wave structure (SWS) elements in modern microwave vacuum electron devices [1,2]. In this work, a novel microwave oscillator based on the idea of a cylindrical metamaterial SWS (MSWS) is designed. The designed MSWS, consisting of split ring resonators (SRRs) with oppositely oriented gaps with a period that is much less than a wavelength, shows metamaterial properties such as below cutoff propagation, negative dispersion, and double negative behavior. The interaction space is coupled with the outer coaxial channel through gaps between the SRRs.

Using particle-in-cell (PIC) simulations, it was found that the electron beam in the interaction space forms a sequence of trapped electron bunches by the synchronous operating wave. The output parameters of this oscillator for an applied voltage U=400 kV, electron beam current I=4.5 kA, and guide axial magnetic field B=2 T are radiation power P=310 MW, radiation frequency f=1.4 GHz, and electronic efficiency ⍁=15% when the total SWS length L consisting of 12 split rings is 34.5 cm. High output power is achieved with a very fast risetime of about 4 ns when the voltage risetime is 2 ns with a decreased overall size compared to conventional backward wave oscillators. This presentation will present a detailed overview of the design of this high power microwave oscillator.

1. S.C. Yurt, M. Fuks, S. Prasad, and E. Schamiloglu, "Design of a Metamaterial Slow Wave Structure for an O-Type High Power Microwave Generator,"Phys. Plasmas, vol. 23, pp. 123115-1-7 (2016).
2. S.C. Yurt, A. Elfrgani, M. Fuks, K. Ilyenko, and E. Schamiloglu, "Similarity of properties of metamaterial slow wave structures and metallic periodic structure,"IEEE Trans. Plasma Sci., vol. 44, pp. 1280-1286 (2016).

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