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2P05 - Fast-Wave and Slow-Wave Interactions in the Rippled-Field Magnetron

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The rippled-field magnetron is a compact millimeter wave source developed by Bekefi [1]. This source is driven by a rotating electron stream. The electron stream moves through an azimuthally periodic wiggler magnetic field oriented transversely to the flow and a uniform axial magnetic field. The advantages of this circular device compared to linear devices is that the beam circulates continuously, resulting in a long effective interaction. The anode-cathode gap is part of the magnetic wiggler interaction region.

The rippled magnetic field can be achieved by permanent magnet or wires carrying current (electromagnet). The rippled-field magnetron uses samarium-cobalt bar magnets positioned behind grounded stainless steel cylinders and held in place using a grooved aluminum holder. In this work, the magnet bars are replaced by azimuthally periodic longitudinal strips carrying high current. A combination of strips connected to the cathode and anode are considered. They carry currents in opposite directions in order to form the desired magnetic wiggler fields. This setup is similar to the inter-digital magnetron (Mitron) which raises the possibility of electrons interacting with Hartree harmonics. The slow-wave growth is similar to magnetron interaction which can be achieved even for a moderate relativistic beam. On the other hand, the fast-wave growth is a free-electron laser type of instability which requires MeV or higher electron beam energies.

1. G. Bekefi, "Rippled-Field Magnetron,"Appl. Phys. Lett., vol. 40, 578, 1982.

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Authors: ELFRGANI, Ahmed (University of New Mexico); ANDREEV, Andrey; KUSKOV, Artem; Mr ANDREEV, Dmitrii (University of New Mexico); SCHAMILOGLU, Edl (University of New Mexico); Mr SMITH, Samuel (University of New Mexico); Ms HERNANDEZ, Stacie (University of New Mexico)

Presenters: KUSKOV, Artem; Ms HERNANDEZ, Stacie (University of New Mexico)

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