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2P13 - Hybrid Kinetic-Fluid Simulations of a Ku-band MILO

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There has been tremendous progress in the modeling and simulation of high-power microwave devices, especially in the lower frequencies, such as L-band (1-2GHz) and S-band (2-4GHz). Here we look at significantly higher frequency, 14GHz, while still studying a tube with GW-class power levels [Tao Jiang et. al. Phys. Plasmas 2015]. The choice of this Ku-band allows both high frequency and high power density (due to the smaller dimensions of the slow wave structure) to be investigated. Additionally, the tube under study is a magnetically insulated line oscillator, where the self-magnetic field from the intense relativistic electron beam population is sufficient to insulate the transmission of current across the vacuum gap. In this way, the Ku-band MILO offers physics and power densities approaching those seen in magnetically insulated transmission lines (MITL), a critical pulsed power technology for high-energy density physics (HEDP). We report on the application of fully electromagnetic particle-in-cell (VSim) and fluid models (USim) in modeling electron flow in the device. Additionally, due to the intense power loading experienced in this device, we also investigate various plasma production models that introduce ion space charge into the device. We use the combination of both kinetic and fluid simulations to study the interaction of electron and ion populations in a fully electromagnetic environment, as well as use the Ku-band MILO as a test bed for active and automated transition between PIC and fluid models during individual run to produce a hybrid model of the plasma physics in this device.

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