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PIC and Hybrid Simulations of SRF Cavity Plasmas using VSim¹ JARROD LEDDY, BEN COWAN, PETER STOLTZ, ILYA ZILBERTER, Tech-X Corporation, JOHN CARY, Tech-X Corporation and University of Colorado Boulder — Superconducting radio frequency (SRF) cavities are utilized for acceleration in particle accelerators, but impurities on the surface of the cavity can cause arcing and therefore lower the maximum obtainable fields inside the cavity. Plasmas can be used to remove these impurities, but their formation and behavior is not well understood. We have performed electromagnetic particle-in-cell simulations using VSim to investigate the plasma formation via ionization cascade using a Monte Carlo collision framework. These simulations explore the EM power threshold for plasma ignition at experimentally relevant background gas pressures, and we compare them with experimental data. In addition to plasma formation, the behavior of the plasma at long time scales is also of interest. PIC simulations are too expensive for any time scale longer than hundreds of nanoseconds, so a GPU capable hybrid model was implemented in VSim. Such a model treats the ions as kinetic species and approximates the electrons as a fluid with source terms determined by the previously conducted PIC simulations of the plasma formation. We will describe the model implementation, show benchmarks, and present preliminary results for the simulations in the cavity geometry.

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