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Ab Initio vs Reduced Pair Production Models for Pair Discharges in Pulsar Magnetospheres FABIO CRUZ, THOMAS GRISMAYER, LUIS O SILVA, GoLP/IPFN, Instituto Superior Tecnico, Lisbon, Portugal, ALEXANDER Y CHEN, ANATOLY SPITKOVSKY, Department of Astrophysical Sciences, Princeton University, Princeton, NJ — Pulsar magnetospheres are thought to be filled with pair plasma generated in strong discharges. The driving mechanism of these discharges is the consecutive emission of gamma-ray curvature radiation, its reabsorption in the extreme magnetic field of these objects, and the subsequent production of pairs via Quantum Electrodynamics (QED) processes. Modelling pair discharges from first principles in this setting is challenging, and has only been possible using one dimensional simulations. However, the field structure in the regions where these discharges develop is intrinsically multi-dimensional. In this work, we present 2D cylindrical particle-in-cell simulations of pair discharges in pulsar polar caps with realistic magnetic field geometry and including the QED processes from first principles. We show that electrostatic plasma waves are generated during the periodic pair discharges, and convert to an electromagnetic mode that is highly collimated along the pulsar magnetic axis. Furthermore, we propose a reduced model for the pair production process that qualitatively reproduces the *ab initio* results. Using this model, we analytically describe the development of the pair cascade, demonstrate that the final plasma configuration is unstable and show that it determines the final amplitude of the generated plasma waves.

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