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Gamma-ray flares in strongly radiative magnetic reconnection

KEVIN SCHOEFFLER, THOMAS GRISMAYER, Instituto Superior Tecnico (GoLP), DMITRI UZDENSKY, University of Boulder Colorado, LUIS SILVA, Instituto Superior Tecnico (GoLP) — The time evolution of radiation generated in reconnecting relativistic pair plasma is investigated comparing 3D and 2D particle-in-cell simulations in strong magnetic fields. The compression of plasma, magnetic fields, and increased heating at the center of magnetic islands during reconnection leads to a sudden flaring of emission. Although radiative cooling weakens these flares, it also leads to further compression of the islands, which amplifies fields and plasma density (1), and mitigates this effect. Measured increases in density n and magnetic fields B due to compression are visible in n-B space. The quantum electrodynamic (QED) module (2) of the OSIRIS framework models radiation as either classical radiation reaction or QED emission of discrete photons by non-linear Compton scattering, as well as single-photon decay into pairs (non-linear Breit-Wheeler). These QED effects are important for the field strengths close to the critical (Schwinger) field occurring in magnetar magnetospheres, where gamma-ray flares occur. We show that the sudden enhancement of radiation is expected to occur in regions with strong fields, leading to both gamma-ray emission and pair production.

(1) K. Schoeffler et al., ApJ, 870, 1 (2019)
(2) T. Grismayer et al., Phys. Plasmas 23, 056706 (2016)

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