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Revisiting particle acceleration at ultra-relativistic shocks

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Relativistic shocks are thought to drive the non-thermal gamma-ray emission in many astrophysical phenomena, such as GRBs and AGNs. The details of the mechanisms by which particles are accelerated to the energies required to emit gamma rays is not fully understood. Fermi acceleration at relativistic shocks relies on the the particles' ability to repeatedly cross the shock. As argued in previous studies, for acceleration to proceed, the isotropization rate in downstream must exceed the gyro-frequency. This provides an upper limit on the maximum energy, commonly referred to as the magnetized limit.

In this work, we demonstrate that the magnetization limit is in fact a weak condition, and that the maximum energy achievable at a relativistic shock can in fact exceed this limit. We discuss the implications in light of recent TeV detection of GRBs.

Primary authors: HUANG, Zhi-Qiu (Max-Planck-Institut für Kernphysik); REVILLE, Brian (Max-Planck-Institut für Kernphysik); KIRK, John (Max-Planck-Institut für Kernphysik); GIACINTI, Gwenael (Max-Planck-Institut für Kernphysik/Tsung-Dao Lee Institute, Shanghai Jiao Tong University)

Presenter: HUANG, Zhi-Qiu (Max-Planck-Institut für Kernphysik)

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