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Simulations of Relativistic Ion Energization in Collisionless Shocks

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Collisionless shocks are a ubiquitous feature in numerous different heliospheric and astrophysical plasma systems. The dynamics of particle energization in shocks span multiple length scales, from kinetic interactions at the shock front to the much larger MHD scales that are driving the shock. Simulating ion energization requires modeling all of these length scales as well as a range of disparate ion velocities from thermal to relativistic. I present results of ion acceleration at collisionless shocks from the first hybrid simulations (kinetic ions-fluid electrons) to include relativistic ion dynamics. The high energy distribution of ions as well as the rate of energization is compared with predictions of diffusive shock acceleration theory. The modifications to the shock associated with relativistic ion dynamics are addressed.

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