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Shock structure and particle acceleration in electron-position and electron-ion plasmas ANATOLY SPITKOVSKY, KIPAC/Stanford University — I discuss 3D simulations of relativistic collisionless shocks in electron-positron and electron-ion plasmas performed using the particle-in-cell (PIC) method. The shock structure is mainly controlled by the magnetization of the upstream flow ("sigma" parameter). I will demonstrate how the structure of the shock varies as a function of sigma for both perpendicular and oblique shocks. At low magnetizations the shock is mediated mainly by the Weibel instability which generates transient magnetic fields that can exceed the initial field. At larger magnetizations the shock is dominated by magnetic reflections. I demonstrate where the transition occurs and argue that it is impossible to have very low magnetization collisionless shocks in nature (in more than one spatial dimension). I further discuss the acceleration properties of these shocks, and show that higher magnetization perpendicular shocks do not efficiently accelerate nonthermal particles in 3D. Among other astrophysical applications, this poses a restriction on the structure and composition of gamma-ray bursts and pulsar wind outflows.

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