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**Non-adiabatic electron heating in supernova remnant shocks**

VASILEIOS TSIOLIS, PATRICK CRUMLEY, ANATOLY SPITKOVSKY, Princeton University — We investigate electron heating in collisionless, non-relativistic, perpendicular electron-ion shocks from first principles. We employ numerical, fully kinetic, two-dimensional particle-in-cell simulations to follow the shock formation until the downstream steady-state in electron-ion temperature ratio $T_e/T_i$ is reached. Our simulations are performed in a range of Alfvenic, $M_A$, and sonic Mach numbers, $M_s$, ranging from 2 to 68. We find that for low sonic Mach numbers, the electron-ion temperature ratio shows weak dependence on $M_A$ and the two species are closer to equipartition. At higher $M_s$, the temperature ratio is primarily determined by $M_A$, showing a minimum value of $T_e/T_i \approx 0.1$ at $M_A \approx 10$ and reaching an asymptotic value of $T_e/T_i \approx 0.3$ at higher Mach numbers. At high $M_A$ the shock structure becomes filamentary because of the Weibel instability. The presence of the filaments in density and magnetic field at the shock foot and ramp is responsible for the non-adiabatic heating of electrons, as these filaments provide channels of acceleration along the field lines due to fast electrostatic oscillations associated with the cross-shock potential. The physical picture described here is relevant in supernova remnant shocks.

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