

## **First-Principles Simulations of Particle Acceleration at Astrophysical Shocks**

Particle-in-cell simulations are providing us unprecedented insights into the microphysics of collisionless shocks, also attesting to their ability to accelerate particles and generate magnetic fields.

I present state-of-the-art 2D and 3D kinetic simulations of non-relativistic shocks, discussing under which conditions (shock strength and inclination) ions and electrons are injected and energized via diffusive shock acceleration. I also outline how the initial magnetic field is amplified by different plasma instabilities induced by energetic particles, which has both observational and theoretical implications. Finally, I discuss the relevance of these findings for cosmic ray acceleration in astrophysical sources, such as supernova remnants and galaxy clusters.