

## Particle heating, injection, and acceleration in collisionless shocks: the role of nonlinearities

Anatoly Spitkovsky<sup>1,†</sup>

<sup>1</sup> *Princeton University*

<sup>†</sup> anatoly@astro.princeton.edu

Nonlinear magnetic structures can be generated in the vicinity of collisionless shocks by streaming of accelerated particles and as part of the shock structure evolution. I will discuss the effects of these nonlinearities on electron heating and on particle injection into the shock acceleration process. Such fluctuations present one way for a shock to continuously adjust the level of injection to a nonlinear steady state. I will present the results of test particle, particle-in-cell, and MHD-PIC simulations that allow to probe these effects on different spatial and temporal scales, and will discuss the prospects of detecting the signatures of these nonlinearities in laboratory experiments.