Collisionless relaxation of satellites after a tidal shock

Placed slightly out of dynamical equilibrium, a stellar system quickly returns towards a steady state, through a period of collisionless relaxation. This process is involved at various points in galaxy formation and evolution, as a consequence of feedback-induced gas loss, accretion of a satellite galaxy, or after a tidal shock. Based on Rozier & Errani 2024, I will show that the final state of the stellar system can be found very efficiently using linear response theory. I will then present an application of our method to the relaxation of energy-truncated Hernquist spheres, mimicking the tidal stripping of a cuspy dark matter subhalo. Comparison of our linear predictions against controlled, isolated N-body simulations shows agreement at per cent level, both in density and velocity dispersion profiles. In this model of a tidally stripped subhalo, we find that collisionless relaxation generates a tangential velocity anisotropy in the intermediate regions of the subhalo, despite the initial disequilibrium state having isotropic kinematics. We further confirm that relaxation is responsible for depleting the amplitude of the density cusp, without affecting its asymptotic slope. Finally, we compare the linear theory against a more realistic N-body simulation of tidal stripping on a radial orbit, confirming that the theory still accurately predicts density and velocity dispersion profiles for most of the system.