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An effective theory for violent relaxation in cold dark matter halos: origin of the universal halo profiles

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Cold dark matter halos are known to harbor universal density profiles such as the NFW, Einasto and prompt cusp profiles in cosmological N-body simulations. Despite decades of research, the origin of these profiles has remained elusive. I will present a first principles kinetic theory calculation based on the Vlasov-Poisson equations that, for the first time, provides a microscopic description of the emergence of universal profiles from the violent relaxation of dark matter halos. First, I will present a quasilinear theory that yields the NFW profile as a quasi-steady state attractor of collisionless relaxation of accreted matter. Next, I will present an effective theory for violent relaxation that yields both NFW and prompt cusps as quasi-steady attractors. The halo gets stuck in these quasi-steady states for a long time before Maxwellianizing into an isothermal sphere.

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