R35a The Formation of Cuspy Density Profiles through Violent Relaxation of Stellar Systems

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Recent *HubbleSpaceTelescope* observations have revealed that elliptical galaxies do not have constant density cores but have cusps, unlike the view being envisaged so far. We then show that the cuspy density distributions can be realized by dissipationless gravitational collapse. The initial models consist of power-law density spheres such as $\rho \propto r^{-1}$ with anisotropic velocity dispersions. The anisotropy is characterized by $\alpha = 2T_{\rm r}/T_{\perp}$, where $T_{\rm r}$ and $T_{\perp}$ are the kinetic energies in radial and tangential motions, respectively. We set the virial ratios to be 0.1 and $10^{-1.5}$, and α=0.2, 0.5, 1, 2, 6, and 10 for each value of the virial ratios. Collapse simulations are carried out by integrating the collisionless Boltzmann equation directly, on the assumption of spherical symmetry. From the results obtained, the extent of constant density cores, formed through violent relaxation, becomes smaller as the velocity anisotropy increases radially, and practically disappears for extremely radially anisotropic models, that is, the models with $\alpha = 10$. As a result, the relaxed density distributions can be approximated by a power-law down to sufficiently small radii. It is thus concluded that the velocity anisotropy could be a key ingredient for the formation of density cusps in a dissipationless collapse picture. The velocity dispersions increase with radius in the cores according to the power-law density distributions. The power-law index, n, of the resulting density profiles, defined as $\rho \propto r^n$, changes from $n \approx -2.1$ at intermediate radii, to a shallower power than $n \approx -2.1$ toward the center. This density bend can be explained from the conservation of phase-space density.