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Dark matter fermions: from linear to non-linear structure formation

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Relaxation mechanisms of collisionless self-gravitating systems of fermions in cosmology, can lead to equilibrium states which are stable, long-lived, and able to explain the dark matter (DM) halos in galaxies. The most general fermionic DM profile out of such a mechanism, develops a degenerate compact core which is surrounded by an extended halo. When applied to the Milky Way, it is demonstrated that the outer halo can explain the rotation curve of our Galaxy, while the central DM-core explains the dynamics of all the best resolved S-cluster stars orbiting SgrA *, without assuming a central black hole (BH). When such novel core-halo DM profiles are applied to larger galaxies, the dense DM core can reach the critical mass for gravitational collapse into a BH of ~ 10^8 Mo. This result provides a new mechanism for supermassive BH formation in active galaxies directly from DM, leading to a paradigm shift in the understanding of galactic cores.

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