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Dark matter at all scales: from the Galactic center to the entire halo

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Relaxation mechanisms of collisionless self-gravitating systems of fermions in cosmology, can lead to spherical equilibrium states which are stable, long-lived, and able to explain the dark matter (DM) halos in galaxies. We show that 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 while the outer halo can explain the rotation curve of the Galaxy, the central DM-core explain the dynamics of all the best resolved S-cluster stars orbiting SgrA *, without the need of assuming a central black hole (BH). In particular it is shown how this dense DM-core alternative to the BH can pass the test of General Relativistic effects including the gravitational redshift and the periapsis precession of the S2 star. On halo scales, and independently of rotation curve tracers, it is further shown the ability of the fermionic DM profile to explain the kinematics of recently detected stellar streams by the GAIA mission. Finally, this fermionic DM model can provide a mechanism of supermassive BH formation from the core-collapse of the central core, leading to a paradigm shift in the understanding of galactic halos in terms of quantum fermionic particles.

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