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The galaxy center with scalar field dark matter (ultra-light boson) haloes

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Recent analysis of the rotation curves of a large sample of galaxies with very diverse stellar properties reveal a relation between the radial acceleration purely due to the baryonic matter and the one inferred directly from the observed rotation curves. Assuming the dark matter (DM) exists, this acceleration relation is tantamount to an acceleration relation between DM and baryons. This leads us to a universal maximum acceleration for all halos. Using the latter in DM profiles that predict inner cores implies that the central surface density $\mu_{DM} = \rho_s r_s$ must be a universal constant, as suggested by previous studies in selected galaxies, revealing a strong correlation between the density ρ_s and scale r_s parameters in each profile. We then explore the consequences of the constancy of μ_{DM} in the context of the ultra-light scalar field dark matter model (SFDM). We find that for this model $\mu_{DM} = 648 M_\odot/\mathrm{pc}^2$, and that the so-called WaveDM soliton profile should be an universal feature of the DM halos. Comparing with data from the Milky Way and Andromeda satellites, we find that they are consistent with a boson mass of the scalar field particle of the order of 10^{-21} eV/c^2, which puts the SFDM model in agreement with recent cosmological constraints.

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