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Novel constraints on the phase space of fermionic dark matter in dwarf galaxies

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Since the pioneering work of Tremaine & Gun to the present, many approaches has been presented to constrain the dark matter (DM) particle mass from its phase-space density (PSD) evolution until the virialization of DM halos today. In particular, in the context of recent numerical simulations of fermionic DM particles, developed to investigate the effects of primordial thermal velocities of fermionic DM particles on the PSD of sub-halos, an strong tension arises between the particle mass required to produce the expected core size of dwarf spheroidal (dSph) halos and the corresponding lower mass limit set by observations of Lyman-α forest. We propose in this work an alternative first principle physics approach, based on quantum statistics and gravity, to describe the fermionic phase-space density of dSph galaxies. In particular, we consider a semi-degenerate model of keV fermions which describes the distribution of DM in galaxies. We show then that this novel semi-degenerate configuration of fermions successfully describes dSph observables with a particle mass in agreement with constraints of Lyman-α forest, alleviating thus former inconsistencies. Furthermore, the DM configurations presented in such an analysis also provide a good fit for the projected velocity dispersion profile of nearby dSph galaxies which permits us to establish a reliable lower bound for the fermion mass in accordance with the aforementioned astrophysical and cosmological constraints

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