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DM halos from the maximum entropy principle and its link to particle physics

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We discuss the problem of formation of dark matter (DM) halos from the principle of maximum (coarse-grained) entropy, when including for the quantum nature of the DM particles. In the case of DM fermions, such a formation mechanism involves for (long-range) particle-particle interactions, and can lead to a most-likely phase-space distribution accounting for the Pauli-principle as well as particle escape effects. We show the full family of DM profiles which can be built out of the above mechanism for self-gravitating fermions, and analyze which solutions are stable, long-lived and of astrophysical interest. We emphasize on a novel kind of ‘core – halo’ DM profiles, where the compact and dense core of DM can work as an alternative to the supermassive BH scenario, while the extended halo can explain the “flatness” of the rotation curves. Finally, we show the possibility to model such DM fermions within minimal extensions of the SM of particle physics which include for right handed (keV-ish) neutrinos.

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