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Cold collisionless dark matter halos are consistent with observations of galaxies

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Observations of intermediate mass and dwarf galaxies are hard to reconcile with the results of numerical simulations of cold collisionless dark matter (CDM). The most notable problems are (i) the core-cusp problem, or the inability of DM-only simulations to reproduce flat density profiles, i.e., cores, in the centers of dwarf galaxies, (ii) the diversity of the central density profile slopes, and the corresponding rotation curves of intermediate mass galaxies, and (iii) the too-big-to-fail problem. Other challenges, such as missing satellites, and planes of satellites, seem to be either resolved, or in limbo. The proposed solutions for (i) and (ii) range from stellar feedback, to alternative DM particle models, such as self-interacting or ultra-light. Instead of using simulations, I will describe a theory of self-gravitating cold collisionless systems, based on statistical mechanics. The theory, DARKexp, has one shape parameter, and naturally reproduces cored density profiles, as well as the diversity of profile slopes. I will briefly comment on the apparent disagreement between DARKexp and numerical simulations.

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