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The extreme dark matter haloes of gas-rich ultra-diffuse galaxies

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The formation of ultra-diffuse galaxies is one of the most actively discussed subjects in extra-galactic astronomy during the last years. Yet, no clear consensus has been reached regarding their evolutionary pathways, with a number of simulations producing UDG-like galaxies using very different feedback prescriptions and even with different dark matter haloes properties. In order to test such simulations it is necessary to improve the current observational constraints on UDGs; obtaining resolved kinematic measurements can be a powerful tool to such end. I will present results regarding recent HI interferometric observations on a sample of isolated gas-rich UDGs. Robust kinematic modelling shows that the galaxies have very low circular speeds for their baryonic mass, making them outliers of the baryonic Tully-Fisher relation and seemingly have very high baryon fractions relative to the cosmological average. Through the rotation curve decomposition of the galaxies, we find that their dark matter fractions are very low in scales as large as 10 kpc. Within the context of CDM, the only way to explain our observations is if UDGs have extremely low concentration parameters. Interestingly, we find that a tail of low-concentration haloes exists in the IllustrisTNG-50 simulations. Moreover, those haloes host significant gas reservoirs and have high baryon fractions, in resemblance to our observed gas-rich UDGs. Such haloes have on average higher spin parameters and later assembly times than haloes with normal concentrations, which could explain some of the observed properties of UDGs. However, while the simulated haloes have comparable densities to the observations within 8 kpc, they are systematically overdense within the inner 2 kpc. Potential solutions to reduce this problem include strong feedback (which might however be at odds with the high baryon fractions and late assembly times) or invoking self-interacting dark matter particles.

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