DWARF GALAXIES

Simulating the absence of dark matter

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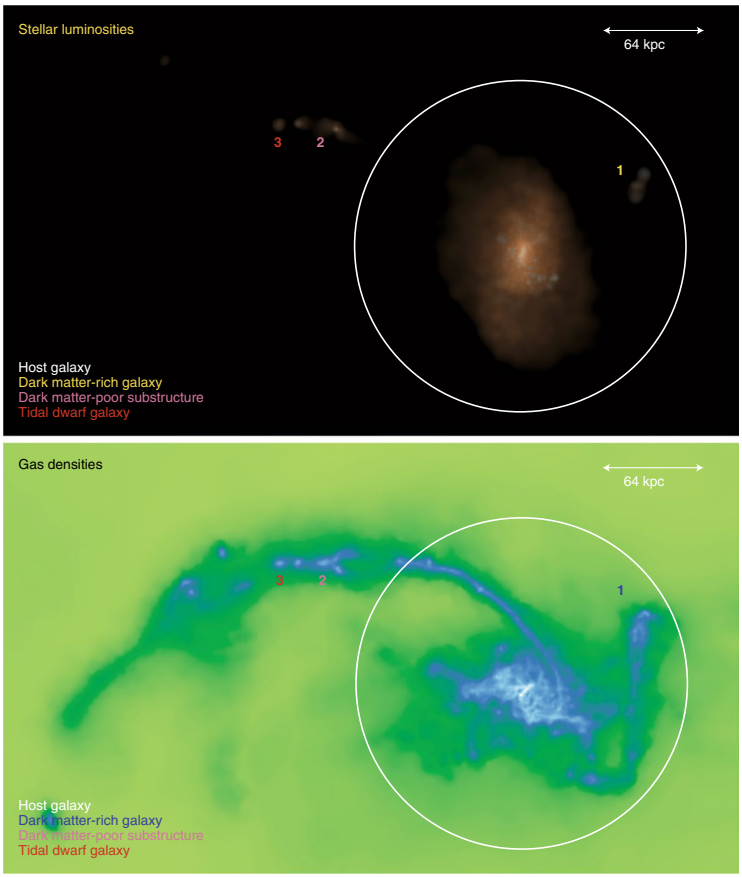

Credit: ESO / Illustris Simulation

Dwarf galaxies (DGs) have come to the forefront of astronomical research as potential relics of the primordial Universe and as probes of galaxy evolution. It has been suggested that DGs can form through the collapse of primordial matter within dark matter haloes or through galaxy encounters due to tidal forces removing gas and stars from the merging system (pictured). Moritz Haslbauer and collaborators show that two populations of DGs, corresponding to these two formation pathways, naturally arise in cosmological simulations but find that dark-matter-free tidal DGs should be very rare in the local Universe.

The authors use the Illustris simulation to identify large samples of both primordial and tidal DGs and study their stellar and dynamical properties. Haslbauer et al. find that tidal DGs have higher metallicities and younger stellar populations compared to primordial DGs, indicating a later formation. Moreover, tidal DGs have preferred orbits around their, usually massive, host galaxies, an additional confirmation of their tidal origin. The two populations of DGs populate different regions on the stellar mass versus radius diagram — tidal DGs are more compact — further confirming their different formation histories.

A recently reported tidal DG candidate, NGC 1052-DF2 was shown to contain no gas and 400 times less dark matter than expected from its stellar mass. Based on their Illustris study, the authors however conclude that there is zero probability to observe such a system at redshift zero. Nonetheless, given the observational uncertainties and the limitations of the simulations, the authors cannot draw definite conclusions about the nature of this source.

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