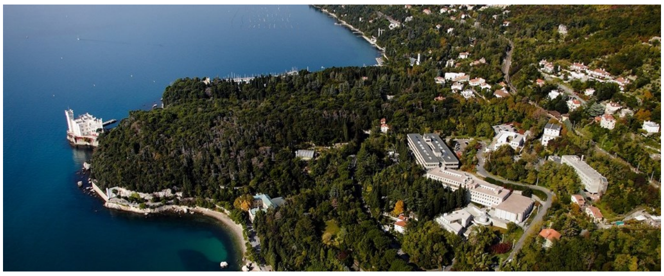

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The mystery of the massive galaxy without dark matter

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According to the LambdaCDM cosmology, present-day galaxies with stellar masses M>10^11 M_sun should contain a sizable fraction of dark matter within their stellar body. Models indicate that in massive early-type galaxies (ETGs) with M~1.5x10^11 Msun dark matter should account for ~15% of the dynamical mass within one effective radius (1 Re) and for ~60% within 5 Re. Most massive ETGs have been shaped through a two-phase process: the rapid growth of a compact core was followed by the accretion of an extended envelope through mergers. The exceedingly rare galaxies that have avoided the second phase, the so-called relic galaxies, are thought to be the frozen remains of the massive ETG population at z~2. The best relic galaxy candidate discovered to date is NGC 1277, in the Perseus cluster. We used deep integral field data to revisit NGC 1277 out to an unprecedented radius of 5 Re. By using Jeans modelling we recovered the dark matter fraction of NGC 1277 within 5 Re, and found it to be negligible (<5%; two-sigma confidence level), which is in strong tension with the LambdaCDM expectation. Since the lack of an extended halo would reduce dynamical friction and prevent the accretion of an envelope, we propose that NGC 1277 lost its dark matter very early or that it was dark matter deficient ab initio. We discuss our discovery in the framework of recent proposals suggesting that some relic galaxies may result from dark matter stripping as they fell in and interacted within galaxy clusters. Alternatively, NGC 1277 might have been born in a high-velocity collision of gas-rich proto-galactic fragments, where dark matter left behind a disc of dissipative baryons. We speculate that the relative velocities of ~2000 km/s required for the latter process to happen were possible in the progenitors of the present-day rich galaxy clusters.

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