Highlights of Astronomy, Volume 16
XXVIIIth IAU General Assembly, August 2012
T. Montmerle, ed.
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doi:10.1017/S1743921314011430

The influence of halo evolution on galaxy structure

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Abstract. If Einstein-Newton gravity holds on galactic and larger scales, then current observations demonstrate that the stars and interstellar gas of a typical bright galaxy account for only a few percent of its total nonlinear mass. Dark matter makes up the rest and cannot be faint stars or any other baryonic form because it was already present and decoupled from the radiation plasma at z = 1000, long before any nonlinear object formed. The weak gravito-sonic waves so precisely measured by CMB observations are detected again at z = 4 as order unity fluctuations in intergalactic matter. These subsequently collapse to form today's galaxy/halo systems, whose mean mass profiles can be accurately determined through gravitational lensing. High-resolution simulations link the observed dark matter structures seen at all these epochs, demonstrating that they are consistent and providing detailed predictions for all aspects of halo structure and growth. Requiring consistency with the abundance and clustering of real galaxies strongly constrains the galaxy-halo relation, both today and at high redshift. This results in detailed predictions for galaxy assembly histories and for the gravitational arena in which galaxies live. Dark halos are not expected to be passive or symmetric but to have a rich and continually evolving structure which will drive evolution in the central galaxy over its full life, exciting warps, spiral patterns and tidal arms, thickening disks, producing rings, bars and bulges. Their growth is closely related to the provision of new gas for galaxy building.

https://doi.org/10.1017/S1743921314011430 Published online by Cambridge University Press