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Dark matter halos in central and isolated galaxies

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Chapter 1

Introduction

Amanece
se abre el poema
GONZALO MILLÁN

1.1 The need for dark matter

The first evidence of a hidden, non luminous component of the Universe came from the large discrepancy between optical and dynamical masses found in the Coma cluster by Zwicky (1933). But this finding did not produce a significant echo in the astronomical community. The alarms only turned on in the mid-70's with studies of the dynamics of pairs of galaxies and groups that revived the stunning discrepancy between dynamical and optical masses (Einasto et al. 1974; Ostriker et al. 1974), although perhaps the most convincing piece of evidence came from the fact that the rotation curves of late-type galaxies remain flat to large radii which indicates an enclosed mass growing linearly with radius (Rubin et al. 1978; Bosma 1978).

What is the nature of this dark component? At that time no known stellar population was thought to produce very high mass-to-light ratios; neither hot gas was a good candidate (e.g. Thorstensen & Partridge 1975). The case against dark matter composed by baryons was supported by cosmology: the early Universe was hot and dense, radiation pressure was high which damps the primordial density fluctuations. Once the Universe expands, radiation pressure becomes less important and the hot plasma can cool and recombine. Neutral gas has now the ability to fall into the density fluctuations and start forming structure. These fluctuations leave an imprint on the temperature of the cosmic microwave background (CMB). Theoretical considerations showed that these fluctuations should be of the order of 10^{-3} of the density itself, but early measurements of the CMB gave upper limits of much smaller amplitude. Although there was room for several forms of baryonic dark matter, these candidates were unable to explain by themselves the cosmological and observational phenomenology (see Carr 1994, for a review).