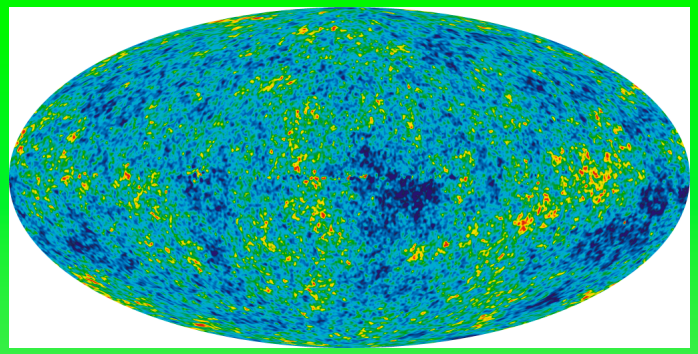
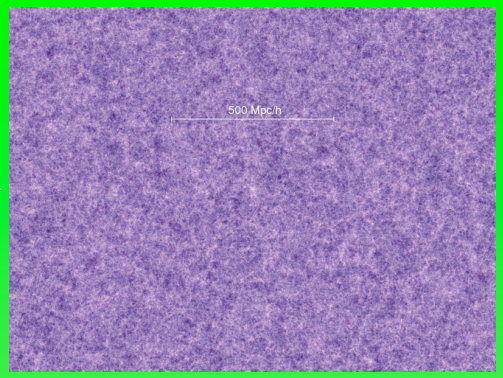
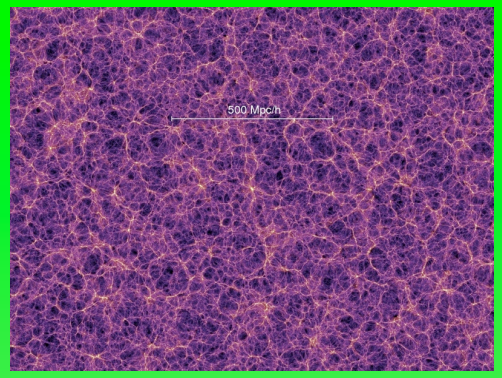
Dark matter and structure formation in the Universe?







Precision cosmology

Combining measurements of the CMB (Spergel et al., 2006, astro-ph/0603449), large-scale galaxy clustering (Tegmark, 2004, PhRvD, 69, 3501) and high redshift supernovae (Riess et al., 2004, ApJ, 607, 665) constrains the cosmological model to a high precision.

Initial conditions

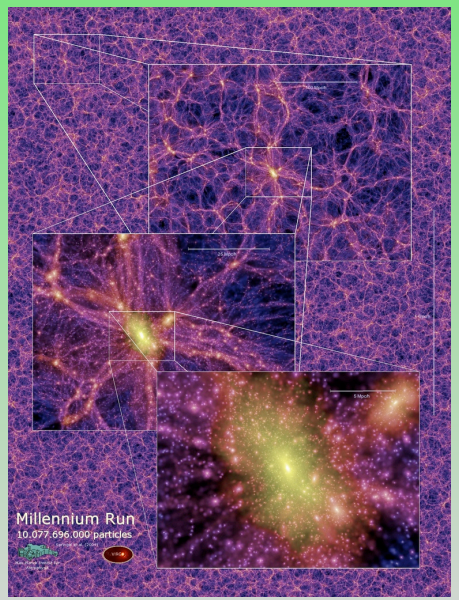
With a known cosmology we can generate initial conditions (ICs) that trace the matter distribution of the Universe at high redshifts (z~100) (Efstathiou, 1985, ApJS, 57 , 241; Bertschinger, 2001, ApJS, 137, 1).

Simulation of dark matter evolution

The ICs can be evolved in super-computers using N-body codes (Springel, 2005, MNRAS, 364, 1105). The simulation results in a model Universe that can be used to study the formation and evolution of galaxies (Springel, 2005, Nat, 435, 629).

Global properties of dark matter haloes

1. What is the mass function of dark matter (DM) haloes? (Jenkins et al., 2001, MNRAS, 321, 372)
2. What is the spin distribution of DM haloes? (Bullock et al., 2001, ApJ, 555, 240)
3. What is the clustering properties of DM haloes and DM substructure, is the number of DM haloes consistent with observations? (Moore et al., 1999, ApJ, 524, 19; Klypin et al., 1999, ApJ, 522, 82)



Detailed properties of dark matter haloes

1. What are the density profiles of dark matter haloes? (Ghigna et al., 2000, ApJ, 544, 616)
2. Are the centres of dark matter haloes cusped or cored? (Diemand et al., 2005, MNRAS, 364, 665)
3. What is the nature of the dark matter, cold/warm/hot and what would the observable differences be? (Bode et al, 2001, ApJ, 556, 93)

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