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TITLE FORMATION OF GALACTIC HALOS IN THE COLD DARK MATTER UNIVERSE:
COMPUTER SIMULATION.

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Formation of Galactic Halos in the Cold Dark Matter Universe : Computer Simulations.

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We simulate the formation of structure on the galactic scale in the cold dark matter, $\Omega=1$ universe.

Numerical calculations are initiated at $z=24$ in a cube with a volume of 10^3 Mpc^3 . Such large redshifts are necessary to capture galactic scale perturbations in the linear regime. Initial conditions are imprinted by deforming a 64^3 cubic lattice of particles so that the Fourier transform of its density has the power spectrum :

$$P(k) = A k (1 + \alpha k + \beta k^{3/2} + \gamma k^2)^{-2}$$

where k is the wavenumber, $\alpha = 1.71 h^{-2} \text{ Mpc.}$, $\beta = 9.0 (h^{-2} \text{ Mpc.})^{3/2}$, $\gamma = 1.0 (h^{-2} \text{ Mpc.})^2$ and $A = 4.63 \times 10^{-2} h^3 \text{ Mpc.}$ (Peebles 1982, Blumenthal et al 1984, Davis et al 1985). Dynamical evolution is then followed with an FFT cloud-in-cell code on a 64^3 mesh.

N-body simulations of spheres (radius = 5 Mpc.) cut out from the FFT cube are used to follow the nonlinear development of structure on galactic scales. The change over from the FFT code (resolution $\sim 250 \text{ kpc.}$) to the more accurate N-body code (softening radius $\sim 10 \text{ kpc.}$, ~ 6000 bodies) takes place at $z=5.25$. Their evolution is followed until $z=-0.2$ ($t=1$).

The particle distribution at $z=0$ exhibits a number of compact clumps. Their masses ($\sim 10^{12} M_{\odot}$) and their density ($\sim 0.01 \text{ Mpc}^{-3}$) are consistent with the inferred masses and number densities of galactic halos. When one selects only collapsed portions of these objects (relative density ~ 160), they appear to be relatively compact (sizes $\sim 100-200 \text{ kpc.}$) and have rotation parameters (λ) in the range 0.01-0.15. When these clumps are identified with galactic halos, one concludes that about 80% of the matter remains outside. This result -- if confirmed by further simulations -- would be of importance for biased galaxy formation but it should be treated with caution at this stage.

Fig: 1 The distribution of N-body particles at $z=0$.

Fig: 2 The regions of figure 1 that have overdensity >160 .

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