

DISCRETE COSMOLOGY APPLICATION CONCERNING DARK MATTER HALOS

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ABSTRACT. We applied discrete cosmology for investigation of the density profiles of dark matter (DM) halos of clusters of galaxies. Comparing the derived velocity dispersion with the experimental data for the Coma cluster, we found the effective radius for the mass distribution inside this galaxy cluster. Our estimates give an opportunity to restrict the parameters of the Navarro-Frenk-White profile for considered cluster.

Keywords: dark matter, clusters of galaxies.

It is generally known, our Universe is dark: dark energy and dark matter contribute approximately 69% and 26% into total mass-energy balance in the Universe, respectively.

We found potentials, which satisfy the Poisson equation and give us an opportunity to consider motion of test massive bodies and light taking into account gravitational attraction to inhomogeneities inside the galaxies, groups and clusters of galaxies and cosmological expansion of the Universe:

$$\Delta\Phi = \frac{1}{R} \frac{d^2}{dR^2}(R\Phi) = 4\pi G_N \rho_{\text{ph}},$$

where G_N is the Newtonian gravitational constant and ρ_{ph} is the physical rest mass density of the bound system.

After that we introduce the distance radius of zero acceleration surface (at which the gravitational attraction and cosmological expansion compensate each other):

$$R_H = \left[\frac{G_N M}{\ddot{a}/a} \right]^{1/3}$$

Using the NFW density profile of DM halo of clusters of galaxies as the most commonly used profile:

$$\rho_{\text{ph}}(R) = \frac{4\rho_s}{\frac{R}{R_s} \left(1 + \frac{R}{R_s}\right)^2}, \quad R_s = \text{const}, \quad \rho_s = \rho(R_s)$$

we obtain, with the help of the observable data, the preferable profile parameters for the Coma cluster: $R_{200} \approx 1.77 h^{-1} \text{ Mpc} = 2.61 \text{ Mpc}$ and the concentration parameter $c = 3 \div 4$

The most galaxies are concentrated inside a sphere of effective radius $R_{\text{eff}} \sim 3.7 \text{ Mpc}$ for the Coma cluster (Abell 1656).

We also found line-of-sight velocity dispersion 1004 km s^{-1} . The observations give very close value 1008 km s^{-1} for this cluster.

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References

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