

Dark Matter Problem in the Local Supercluster

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Abstract. The Local Supercluster is an ideal laboratory to study distribution of luminous and dark matter in the nearby Universe. The 1100 small groups have been selected using algorithm based on assumption that a total energy of physical pair of galaxies must be negative. The properties of the groups have been considered.

Keywords. dark matter

1. Algorithm

We used an selection algorithm based on assumption that a total energy of physical pair of galaxies must be negative (Makarov & Karachentsev 2000). Individual mass of the galaxies are estimated from their K-luminosity using appropriate value of M/L. It is chosen to reproduce the well known nearby groups of galaxies, like the Centaurus A, M 81, M 83 and IC 342.

2. Parameters of the groups

The 5687 galaxies of 10571 (about 54%) with $V_{LG} < 3500$ and $|b| > 15^\circ$ have been gathered in 1127 groups. The median velocity dispersion in groups with ≥ 5 members is 88 km s^{-1} , and the median harmonic radius is 222 kpc. We find the median mass-to-K-luminosity ratio for the groups to be 26 in solar units using a projected mass estimator (Heisler *et al.* 1985). That shows presence of moderate amount of dark matter in the considered groups.

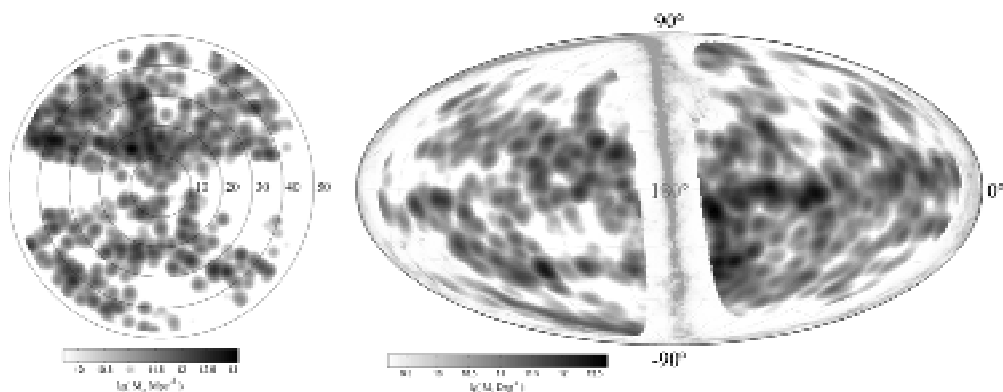


Figure 1. The mass distribution in the Local Supercluster. The left panel presents distribution of surface mass density in the Local Supercluster plane. The right panel shows an all sky map of surface mass density in the Supergalactic coordinates.

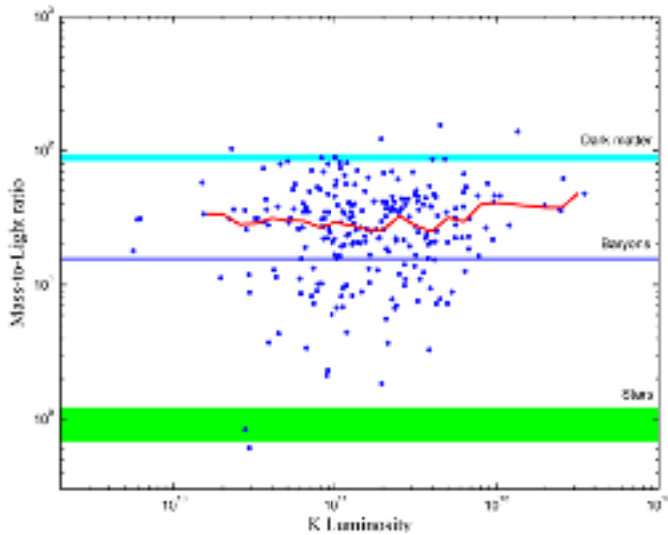


Figure 2. The mass-to-light ratio versus K-band luminosity. The dots show the individual groups. The winding line represents the running median of M/L . The horizontal lines show the mean value for stars $M/L = 0.95 \pm 0.27$ (Bell *et al.* 2003), expected M/L ratio for baryonic $\Omega_b h^2 = 0.02229$ and dark $\Omega_m h^2 = 0.1277$ matter in standard cosmology (Spergel *et al.* 2007).

3. Dark matter in the Local Supercluster

Based on our algorithm for group selection we derived the median mass-to-light ratio of groups $M/L_K \sim 26$ that was used to trace the distribution of mass via light distribution in the Local Supercluster (LSC). The mean K-band luminosity density within the considered volume is $j_K = 3.96 \times 10^8 L_\odot \text{ Mpc}^{-3}$, being in good agreement with the global luminosity density $4.19 \pm 0.63 \times 10^8 L_\odot \text{ Mpc}^{-3}$ from 2dF survey (Cole *et al.* 2001) and $4.24 \times 10^8 L_\odot \text{ Mpc}^{-3}$ from 2MASS and SDSS surveys (Bell *et al.* 2003). Thus, the mean total mass density inside the LSC volume is $1.0 \times 10^{10} M_\odot \text{ Mpc}^{-3}$ that corresponds to $\Omega_m = 0.07$. This value amounts only a quarter of the global density $\Omega_m = 0.27$ in standard cosmology (Spergel *et al.* 2007). Even the total mass-to-light ratio of the Virgo cluster ($M/L_K \sim 62$) is not enough to reach the global value $M/L_K \sim 90$ expected for $\Omega_m = 0.27$. To adjust the ensemble averaged value $\Omega_m = 0.07$ with the global density one needs to suppose that a significant part of the dark matter on the LSC scale is not associated with system of galaxies.

Acknowledgements

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References

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