GALACTIC MASS DENSITY IN THE VICINITY OF THE SUN

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It is possible to estimate the galactic mass density in the solar neighbourhood either directly by summing up the mass densities of individual subsystems of stars and interstellar matter or indirectly from dynamical considerations.

Observational data on the number density of visible stars lead to mutually consistent results on the stellar component of the mass density. The mean of different estimates is $\rho_{stars}=0.052\pm0.010\ M_\odot pc^{-3}$. By adding the probable contributions of intrinsically faint undetected objects and of interstellar matter the value $\rho=0.09\pm0.02\ M_\odot pc^{-3}$ has been obtained for the total mass density.

Dynamical estimations have given rather discrepant results ($\rho_{dyn}=0.05\div0.30\ M_\odot pc^{-3}$). The authors who obtained $\rho_{dyn}\gtrsim0.15\ M_\odot pc^{-3}$ have often interpreted their results as an indication of the presence of a population of unknown objects (missing mass) in the solar vicinity.

More probable explanation of the discrepancy between the direct and dynamical density determinations lies in the fact that the dynamical determinations are subject to large systematical and accidental errors. In the first approximation $\rho_{dyn}\propto(\sigma_z/\sigma_z)^2$, where σ_z is the mean dispersion of the galactovertical velocities and σ_z is the dispersion of the distances z from the galactic plane in a flat steady-state subsystem. The values of ρ_{dyn} are very sensitive to any errors in the accepted values of both dispersions, σ_z and σ_z. The inclusion of few halo or old disk population stars into statistical sample of young stars may significantly increase the velocity dispersion in the sample whereas the space distribution remains practically the same. Hence inhomogeneous statistical samples based on HD or MK spectral classifications lead to exaggerated values of ρ_{dyn}. Among the available determinations of ρ_{dyn} the lowest values are the most trustworthy. These values are in agreement with direct density estimates. Thus so far there is no real dynamical evidence for the presence of significant amount of missing mass in the solar vicinity.

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