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The density model of the Milky Way from the tangent-point measurements of the rotation curve

Oleksiy Golubov and Andreas Just

Astronomisches Rechen-Institut, Zentrum für Astronomie der Universität Heidelberg, Mönchhofstraße 12-14, 69120 Heidelberg, Germany,
email: golubov@ari.uni-heidelberg.de

Abstract. We use measurements of the rotation curve of the Milky Way by the tangent point method to reconstruct the density model of the Milky Way. The observed inner rotation curve is fitted by a theoretical density model, consisting of a Dehnen bulge, an exponential disc with a hole, and a flattened dark matter halo with a cored isothermal or NFW density profile. The density model is also set to be consistent with the local density constraints in the solar neighborhood.

Keywords. Galaxy: kinematics and dynamics — solar neighborhood

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We use observational data for the inner rotation curve of the Milky Way determined by the tangent point method and compiled by Sofue *et al.* (2009). We fit the data with a 3-component density model consisting of a Dehnen bulge, an exponential disc with a hole, and a flattened dark matter halo with either cored isothermal or NFW profile. When adjusting free parameters of the density model, we constrain ourselves to the local surface density of the disc $\Sigma_{\rm disc} = 45.2 \pm 4\mathrm{M}_\odot/\mathrm{pc}^2$ and the local volume density of the dark matter halo $\rho_{h,0} = 0.014\mathrm{M}_\odot/\mathrm{pc}^3$, as they are determined by Just & Jahreiß (2010).

We also analyze the SDSS stellar sample of dwarf stars by Lee *et al.* (2011), calculate mean rotation velocity of stars, correct for asymmetric drift, and thus trace the rotation curve in the extended solar neighborhood. The flatness of the resulting rotation curve at the solar radius is used as an additional constraint in our fitting procedure.

For the resulting best fit model the density of the bulge is given by the Dehnen model with the power index $\gamma = 0.5$, the total mass $M_b = 1.8 \times 10^{10}\mathrm{M}_\odot$, and the scale radius of $a_b = 0.22\,\mathrm{kpc}$, the disc is exponential with the scalelength $R_d = 2.5\,\mathrm{kpc}$ with a hole of a twice smaller scalelength, and the central density of the hole composing 40% of the central density of the disc. Two different models of dark matter halo are considered, a spherical cored isothermal halo with core radius $a = 3.2\,\mathrm{kpc}$, and flattened NFW profile with $a = 20\,\mathrm{kpc}$. Both models succeed to reproduce the data, with a somewhat better fitness for the one with cored isothermal profile.

An advantage of our density model compared to the one proposed by Sofue *et al.* (2009) is its consistency with the local surface density and dark matter density in the solar neighborhood. Another advantage is that we do not need to include gas overdensity rings, whose drastic impact on the rotation curve is not well justified.

References

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