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A Bayesian estimation of the Milky Way's circular velocity curve using Gaia DR3

The Milky Way is an excellent laboratory for studying dark matter as its spatial distribution can be inferred by tracing the dance of luminous celestial bodies. We use the Jeans equation to model the rotational velocities of stars measured by the Gaia satellite to constrain the Galactic circular velocity curve. In particular, we exploit the increase of volume and precision in data brought about by ongoing large-scale stellar surveys and use approximately 0.7 million Red Giant Branch stars from Gaia DR3. With the increasing precision of astrometry, a more careful accounting of the systematic uncertainties is required as they are propagated into the determination of the DM density profile and thus affect how we interpret results from searches of physics beyond the standard model. Motivated by this, we present a novel Bayesian inference approach to estimate the circular velocity curve of the Milky Way along with uncertainties that account for various sources of systematic uncertainty. Our methodology provides a self-consistent way to quantify uncertainties in the Sun' s Galactocentric distance and the spatial-kinematic morphology of the tracer stars. Using this method, we estimate the circular velocity curve within a range of 5 to 14 kpc and we also infer the DM mass within 14 kpc and predict the local DM density.

Type of contribution

Talk

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