Testing the Accuracy of the Tangent Point Method for Determining the Milky Way's Rotation Curve

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The motions of stars and gas contain valuable clues about the distribution of matter inside of their host galaxy. A rotation curve plots the rotational speed of interstellar gas and stars as a function of their distance to the galactic center, and has provided substantial evidence for the existence of dark matter. Since 1954, the tangent point method (TPM) has been used to calculate the rotation curve of the inner portion of the Milky Way, relying on the assumption that the observed radial velocity will be an extremum at the tangent point. A computer simulation of the Milky Way by Chemin et al. (2015) found that the TPM yields a much steeper rotation curve than expected when applied to a simulated Milky Way, which would imply that the tangent point assumption is incorrect. My work tests this prediction by creating and comparing rotation curves using two independent data sets and methods: the HI4PI radio telescope survey, used to create a rotation curve with the TPM, and the Gaia satellite, used to create a rotation curve with stellar positions and velocities. I found a statistically significant difference between the two rotation curves. Additionally, along one line of sight, I found the location of the radial velocity extremum to be statistically significantly different than the location of the tangent point. These results support the hypothesis by Chemin et al. (2015) and suggest that there is less dark matter in the inner regions of the Milky Way than previously thought.

Awards Won:

NASA: Honorable Mention