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Dark Matter, Galactic Dynamics, and Gaia

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We are in an age of large precision astrometric datasets, most recently thanks to ESA's Gaia mission, which has already measured the full 6-dimensional phase space of over 7 million stars. One of the many exciting physics outcomes of Gaia is the ability to measure the Milky Way's gravitational potential, as inferred from stellar kinematics. This can be leveraged to make precise statements about the underlying fundamental theory that governs the dynamics of our galaxy. In this talk, I will discuss how Gaia can be used to strongly test models of collisionless dark matter against alternative theories such as low-acceleration modifications to gravity and emergent long-range forces. I will also discuss recent efforts to reconcile measurements of the local dark matter density via the Jeans equation with the recent observations in the Gaia dataset indicating that stars in the Milky Way's disk are not in equilibrium.

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