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From Bar Formation to Dark Matter Detection: Implications of Inner Halo Spin Distribution

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Several studies have shown that dark matter halo properties like concentration, triaxiality, and spin play an important role in bar instability dynamics. Building on these insights, we investigated the role of the inner (within the disk region) halo angular momentum distribution on bar formation and evolution processes. We conducted a series of high-resolution N-body simulations of Milky Way-type disk galaxies. These models began with similar disks but with progressively increasing inner halo angular momentum in the surrounding dark matter halo. The bar formed earlier in the model with higher inner halo angular momentum compared to those with lower values, similar to studies suggesting the influence of halo spin. However, the bar's secular evolution, which refers to its long-term development, exhibited growth in all models regardless of inner halo angular momentum. This contradicts earlier claims that high halo spin dampens the bar's secular evolution. The model with the highest inner angular momentum displayed more pronounced box/peanut/x-shaped bulges compared to the model with the lowest. Finally, using multiple approaches, we show that dynamical friction exerted by the dark matter halo on bars reduces when most of the dark matter particles are rotating in the same direction as the disk (net prograde rotation). This finding can potentially explain the short bars with high pattern speeds observed in Low Surface Brightness galaxies with larger halo angular momentum. Additionally, the dark matter wakes in the Milky Way, caused by strong dynamical friction, enhance the density of dark matter along the bar region. This potentially creates observable line-of-sight signatures for dark matter detection experiments.

Track type

Dark Matter

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