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Progress Report

SPIRAL STRUCTURE OF THE GALACTIC DISK AND ITS INFLUENCE ON THE ROTATIONAL VELOCITY CURVE

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The most spiral galaxies have a flat rotational velocity curve, according to the different observational techniques used in several wavelengths domain. Larger telescopes and improved detectors have existed for optical, radio, and mm observations; the strong emission lines of Hα and [NII] are more easily detected and measured than the weak broad H and K absorption lines; so that, the combination of high spatial and high spectral resolution digital detectors and fast computers has permitted a sophistication in the velocity analyses. However, all of them have provided almost flat curves implying the lack of mass in the outer part of galaxies. In this work, we show that non-linear terms are able to balance the dispersion, thus reviving the observed rotational curve profiles without inclusion of any other but baryonic matter concentrated in the bulge and disk, only. By using the gravitational N-body simulations with up to 10^7 particles, we test this dynamical model in the case of realistic galaxies with two different approaches. Within the direct approach, as an input condition in the simulation runs we set the spiral surface density distribution which is previously obtained as an explicit solution to non-linear Schrödinger equation (instead of a widely used exponential disk approximation). In the evolutionary approach, we initialize the runs with different initial mass and rotational velocity distributions, in order to capture the natural formation of spiral arms, and to determine their role in the disk evolution. In both cases we are able to reproduce the stable and non-expanding disk structures at the simulation end times of $\sim 10^9$ years, with no halo inclusion. These results imply that non-linear effects can significantly alter the amount of dark matter which is required to keep the galaxy in the stable dynamical configuration.