Understanding the Flattening of galaxies' Rotation-Curves without Dark-Matter and MOND

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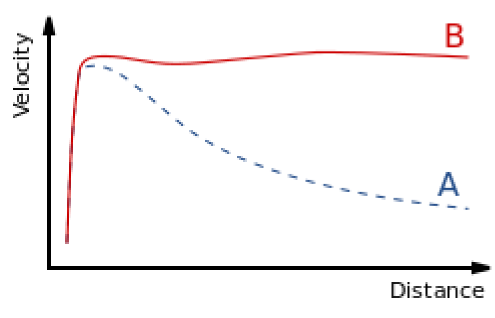
Abstract:

This letter attempts to understand the observed flattening of galaxies' rotation-curves in terms of gravitational-pull of fast-rotating interior-stars on the slow-rotating stars at out-skirts of the galaxy. Due to fast rotation of the interior-stars, the relative-position of the stars vary at different times, adding a sinusoidal-component to the tangential-velocity of the stars at the out-skirts. These sinusoidal-components, caused by different stars in the interior, are of different frequencies, depending upon the tangential-speed of the star. The resultant sum of these sinusoidal components of different frequencies mutually nullify up to a certain radial distance, but then start adding coherently at the out-skirts; causing significant increase in the rotational velocity of the star at the out-skirts. Thus, it may not be necessary to invoke Dark-Matter, or to modify Newtonian Dynamics, as proposed in MOND or scalar-vector-theory of John Moffat.

Introduction:

In the late 1960s, Vera Rubin, an astronomer at the Carnegie Institution of Washington worked with a new sensitive spectrograph that could measure the velocity curve of edge-on spiral galaxies to a greater degree of accuracy than had ever before been achieved. She announced at a 1975 meeting of the American Astronomical Society the discovery that most stars at the out-skirts of spiral galaxies orbit at roughly the same speed as shown in the figure below. These were the first robust results to suggest that either Newtonian gravity does not apply universally or that, conservatively, upwards of 50% of the mass of galaxies was contained in the relatively dark galactic halo. This letter attempts to explain these rotation-curves in terms of well-established laws, without invoking Dark-Matter of MOND.



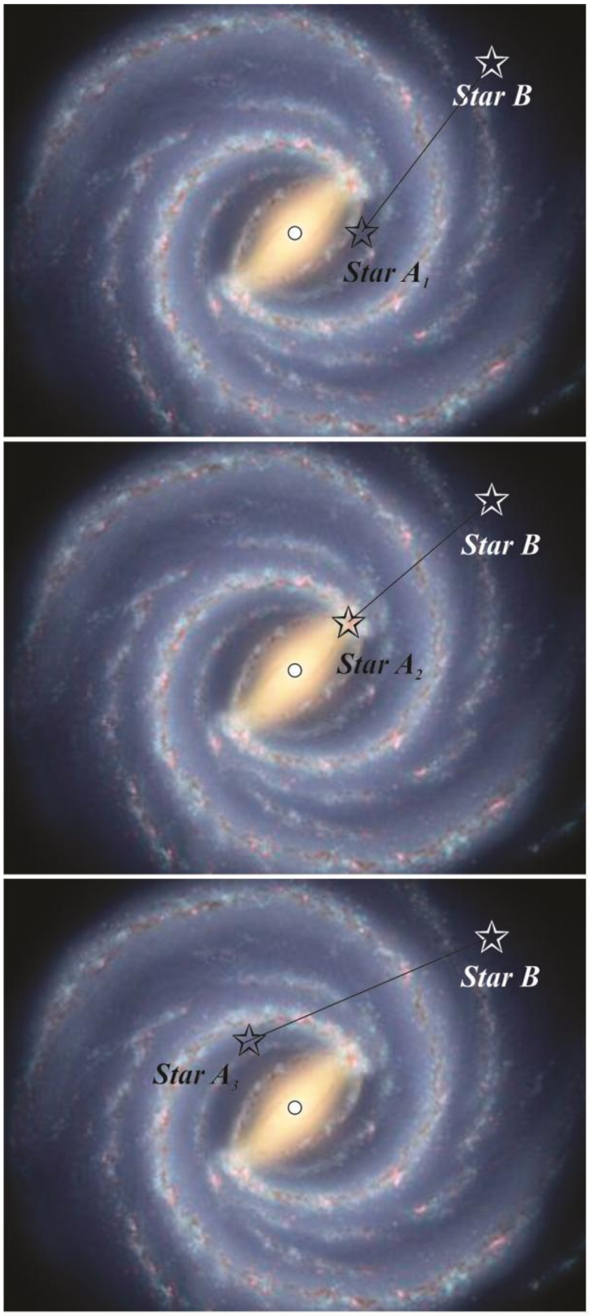


Fig. A1 : Relative positions of interior-star-A and exterior-star-B at different times.

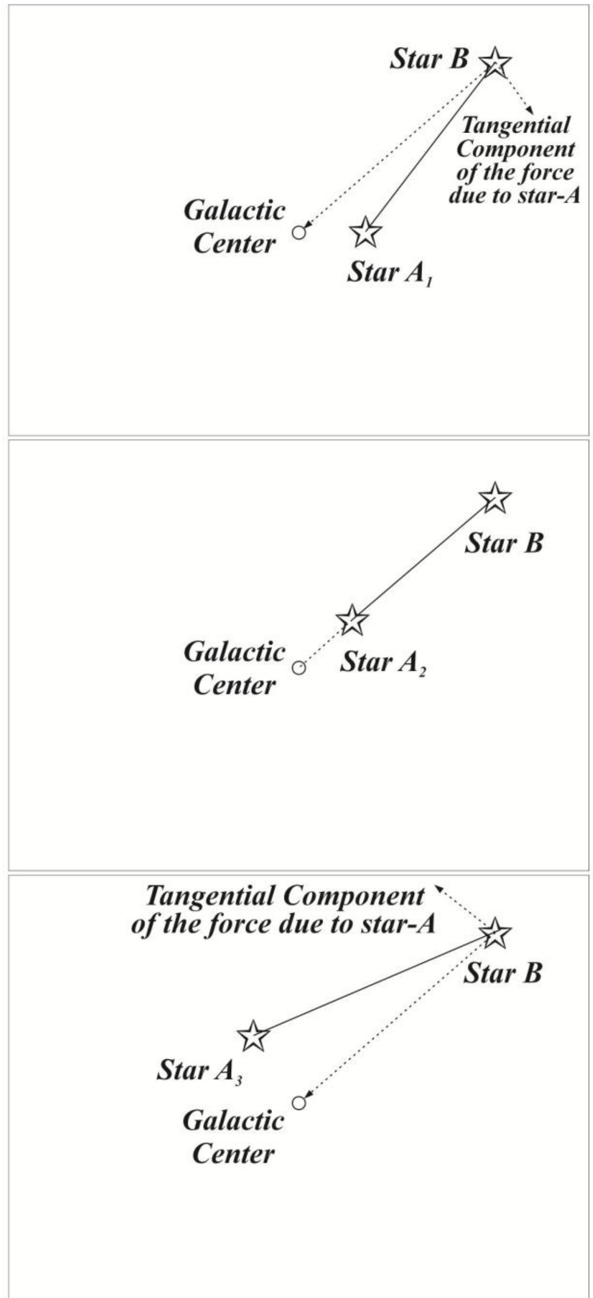


Fig. A2 : Vector components of force due to interior-star-A on the exterior-star-B at different times.

The Explanation:

The fig.-1 shows positions of two stars within a spiral galaxy. The star-A at the interior of galaxy has much higher tangential-velocity than that of star-B at the out-skirts. So the gravitational-pull due to the star-A either adds or subtracts a small component from the tangential-velocity of the star-B, causing sinusoidal variations in the velocity of the star-B. Similarly all the stars at the interior of the galaxy add a sinusoidal component of different frequencies to the tangential-velocity of the star-B. The fig.2 shows how the sinusoidal waves of a wide band of frequencies mutually nullify at most of the radial distances, and add coherently at certain radial distance.

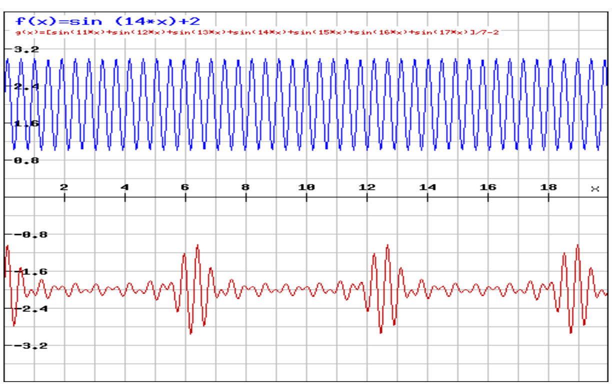


Fig.2: (i) The blue-colored graph at the top shows central spectral-component of the actual band of waves, sin (14*x). (ii) The red-colored graph at the bottom shows superimposition of a wide band of waves: sin (11*x) + sin (12*x) +sin(13*x)+sin(14*x)+sin(15*x)+sin(16*x) + sin(17*x)/7, and we find that constructive superimposition of all the spectral components takes place only at certain radial distances from the center. In our case of galaxies' rotation-curves, only the first occurrence of constructive superimposition is observable.

This is how we can understand the observed flattening of galaxies' rotation-curves without invoking any dark-matter or MOND.

References:

1. V. Rubin, W. K. Ford, Jr (1970). "Rotation of the Andromeda Nebula from a Spectroscopic Survey of Emission Regions". *Astrophysical Journal* **159**:379.
2. V. Rubin, N. Thonnard, W. K. Ford, Jr, (1980). "Rotational Properties of 21 Sc Galaxies with a Large Range of Luminosities and Radii from NGC 4605 (R=4kpc) to UGC 2885 (R=122kpc)". *Astrophysical Journal* **238**:471