Galactic Rotation

Revised Expressions using Measurement Quantization (MQ)

In MQ Form

Standard Deviation: 1.39 km/s
For 84 star velocities describing the Milky Way evenly selected from 0 to 84,000 light-years.

\[ v_e = 2 \theta_s \left( \frac{2 \frac{v_o}{\sqrt{2m_f}} - c \theta_s}{1/2} \right) \]

Discussion

What is referred to as the dark matter phenomenon combines two unexplained observations. One, the velocity of stars orbiting a galaxy is faster than what we would expect. Secondly, we consider stars further from the galactic core we would expect a decreasing velocity curve that follows Newton’s expression for gravitation. This is also not observed.

Using new disciplines resolved with observations of Heisenberg’s uncertainty principle \(^{(4, \text{Eq. 6-10})}\), we may present an expression that describes galactic orbital dynamics. In this case when used to describe the Milky way we find star velocities that correspond with measurement data with a standard deviation of 1.39 km/s for the first 84,000 light-years.

The expressions are from use of a nomenclature \(^{(3, \text{Sec. 2.3})}\) called Measurement Quantization (MQ) that separate the fundamental measures \(^{(4, \text{Eq. 67-79})}\) from those fundamental measures. For example, length would be described as \(l = n_f t_f\). Applying MQ to the uncertainty principle \(^{(4, \text{Eq. 6-10})}\) we find that all the measure terms cancel out. This allows us to resolve the values of the count terms and then the values of the measures \(^{(4, \text{Sec. II})}\). The predicted measures match the 2014 CODATA to six significant digits.

Further support is provided by the measure of quantum entangled X-rays \(^{(4, \text{Eq. 56, Tab II})}\), in the prediction of polarization angles with respect to the plane. In those experiments we find a match to six significant digits. Further physical support can be found with the MQ description of quantum gravity \(^{(4, \text{Eq. 29-33})}\) and in further analysis of the gravitational constant \(^{(1, \text{Eq. 24})}\) and Planck’s reduced constants \(^{(1, \text{Eq. 36})}\). Collectively, there are some 15 separate experiments that all provide support for the physical significance of fundamental units of measure \(^{(4, \text{Sec. II})}\) and it is on this foundation that we present a description of galactic orbital dynamics.

A description of star velocity may be resolved by incorporating two effects; one, the effect of dark energy \(^{(1, \text{Sec. 3.8})}\) with respect to the expansion of the universe and two, the effect of an upper count bound to mass measures \(^{(3, \text{Eq. 15-17})}\) \(m_f\). There are several bounds to measure, notably the speed of light being just one example. Written in MQ form this is expressed as \(c = n_f / n_f t_f\). We call this the length frequency in that the most important part of this expression are the count terms \(n_f / n_f t_f\) which identify the upper count bound of length measures per count of time measures. Another important bound in MQ is called mass frequency, the upper count bound of mass measures \(m_f\) with respect to a count of time.
count of time measures. Another important bound in MQ is called mass frequency, the upper count bound of mass measures \( m_f \) with respect to a count of time measures \( t_f \). For completeness, the last fundamental bound of the frequency counts is \( m_f / l_f \). This bound we have not assigned a name. And finally there are combinations of these bounds; one well-known composite bound being the gravitational constant \[^{[3, Eq. 31]}\] \( G=(l_f / t_f)^3/(m_f / t_f) \).

With this nomenclature \(^{[3, Sec. 2.3]}\) at hand and an understanding of the physical significance of fundamental units of measure \(^{[4, Sec. 8]}\), we can then approach a description of galactic orbital dynamics. We begin, first by resolving the bound velocity \(^{[3, Eq. 54]}\). The bound velocity is a calculation of the mass frequency bound which takes into account universal expansion \(^{[1, Sec. 3.8]}\) but does not account for any other factors, notably the mass distribution profile of a galaxy. The expression is \(^{[3, Eq. 54]}\) (right)

\[ v_b = \theta \cdot c \sqrt{2m_f} = 204.054 \text{ km s}^{-1} \]

The expansion of the universe \(^{[1, Sec. 3.8]}\) is described by the value \( \theta \cdot c \). The upper bound to countable mass measures \( m_f \) is described by square root of two \( m_f \). Collectively, the expression describes the upper count bound to orbital velocity as a function of discernible mass \( m_f \).

The challenge with this description is that it does not take into account the mass distribution profile of a galaxy. We wish to understand the effects of mass frequency relatively in terms of the radial distance from a center of mass and with respect to the mass distribution profile of the observed galaxy. To accomplish this, we may perform a translation to relative measure using the percent difference change of the bound velocity with respect to the observed velocity \(^{[3, Eq. 61]}\). The relation between effective mass \( M_{\text{eff}(R)} \) and bound mass \( M_{\text{b}(R)} \) is then the bound mass times the percent difference change \(^{[3, Eq. 63]}\), (right)

\[ M_{\text{eff}(R)} = M_{\text{b}(R)} \left( \frac{v_{\text{eff}}}{v_{\text{b}}} - 1 \right) \]

Finally, with an understanding of the approach and the physical significance of the model we may now plot both the bound (purple) and effective (red) mass. Notably, the point where the effective mass rises above the bound is where the count of mass measures exceeds the bound and likewise, the point where classical behavior ceases and the new behavior begins ... approximately 9.32848 \( 10^8 \) light-years. We call this the Newtonian Crossover.

And when we integrate the mass density profile for the Milky Way into the expression, entering the bound velocity \(^{[3, Eq. 54]}\) (which is a fixed value), we produce the effective mass frequency bound velocity \(^{[3, Eq. 66]}\) (red).

The blue curve represents Newton’s expression which does not integrate universal expansion \(^{[1, Sec. 3.8]}\) or the mass frequency bound \(^{[3, Eqs. 15-17]}\). Only by applying the principles of MQ can galactic orbital motion be properly described.

We should note that this is not a relation \(^{[2, Sec. 3.9]}\), as is Newton’s expression. The expression is a constraining function. That is, where \( v_{\text{eff}} = v_{\text{b}} \), then we may identify the corresponding effective mass \(^{[3, Eq. 63]}\) \( M_{\text{eff}(R)} \) in relation to the bound mass \(^{[3, Eq. 56]}\) \( M_{\text{b}(R)} \). The observed velocity can come from any data source (i.e. velocity MOND models, mass, luminosity, etc.) and must accurately reflect the mass distribution profile of the considered galaxy.

Notably, one might contend that feeding in something that looks like a velocity profile to get a velocity is a physically inappropriate means of assessing the mass density profile. This does not apply to constraining functions for a specific reason. Because this is a constraining function, entering a dataset that corresponds to values where \( v_{\text{eff}} \neq v_{\text{b}} \) will cause a skew between the two such that the effective \(^{[3, Eq. 66]}\) and observed \(^{[3, Eq. 67]}\) velocity curves separate. This is actually the case at the peak of the graph above and is due to discrepancies in the MOND mass models that were assembled to produce the entire dataset.

Please find the remainder of this article online at [www.informativity.org/galacticrotation](http://www.informativity.org/galacticrotation).

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4 Physically Significant Units of Measure

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2 Quantum Model of Gravity Unifies Relativistic Effects, Describes Inflation/Expansion Transition, Matches CMB Data

3 Measurement Quantization Accounts for Galactic Rotational Velocities and Obviates Dark Matter