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Universal accelerations and the Tully-Fisher relation for spiral galaxies in conformal gravity

In a recent paper McGaugh, Lelli, and Schombert showed that in an empirical plot of the observed centripetal accelerations in spiral galaxies against those predicted by the Newtonian gravity of the luminous matter in those galaxies the data points occupied a remarkably narrow band. While one could summarize the mean properties of the band by drawing a single mean curve through it, by fitting the band with the illustrative conformal gravity theory with fits that fill out the width of the band we show here that the width of the band is just as physically significant. We show that at very low luminous Newtonian accelerations the plot can become independent of the luminous Newtonian contribution altogether, but still be non-trivial due to the contribution of matter outside of the galaxies (viz. the rest of the visible universe). We present a new empirical plot of the difference between the observed centripetal accelerations and the luminous Newtonian expectations as a function of distance from the centers of galaxies, and show that at distances greater than 10 kpc the plot also occupies a remarkably narrow band, one even close to constant. Using the conformal gravity theory we provide a first principles derivation of the empirical Tully-Fisher relation. The idea for this talk was first prompted in a conversation during IWARA 2016, and all relevant conclusions will be explored.

Primary authors: O'BRIEN, James (Wentworth Institute of Technology); CHIARELLI, Thomas (Wentworth Institute of Technology); MANNHEIM, Philip (University of Connecticut)

Presenter: O'BRIEN, James (Wentworth Institute of Technology)