Possible Reasons for Differences in the Velocity Measurements
of
Orbiting Celestial Bodies

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Abstract
The anomalous galaxy rotation curve is a well known problem in physics today and has given rise to speculation that some form of gravitating dark matter might exist within galaxies, thereby providing the additional force required to explain a flat non Keplerian rotation curve. In this paper an alternative explanation for a flat rotation curve is proposed, where the anomaly is caused by comparing incompatible measurement techniques.

Prograde vs. Retrograde Motion
In the time of Johannes Kepler and Tycho Brahe the modern understanding of celestial orbital motion was being developed, the velocities of celestial bodies were carefully measured with respect to the fixed background stars and methodically recorded. At that time the Universe was believed to be static, i.e neither contracting nor expanding, so one might presume that Kepler and Tyco Brahe considered orbiting bodies to have a positive velocity. Kepler famously showed that the velocity of orbiting bodies follow a $1/r^2$ rule and declared the velocity vector to be positive.

Today we understand the Universe is expanding, and how space is expanding equally in all directions. This gives rise to ambiguity in respect of velocity direction. If we define positive velocity as observer directed, and negative velocity as moving away from the observer, then an orbiting body where the radius is increasing can only be negative with respect to the observer, and positive with respect to the distant fixed stars. Herein arises the apparent problem with galaxy rotation curves, Keplerian rotation curves come from positive velocity vectors, i.e. measurements based on the fixed background stars, however the technique used to measure velocities in the discs of distant galaxies is the doppler shift of the light spectra of the distant stars, which has the observer at the origin, and should therefore be assigned negative velocities.

It can now be shown that by changing the sign of the velocity vector, the sum of negative velocities does indeed produce a flat rotation curve as seen in observations.
Using existing data from current observations it should be possible to confirm or deny the proposed explanation, and if so confirmed may set a different limit to the amount of dark matter that should exist.

Summary
When measuring orbital velocity with respect to the past, orbital motion should be considered to as prograde, but when measuring orbital motion with respect to the present the motion should be considered to as retrograde.