

## Motion, Celestial and Local

***Goal:*** a mathematical representation specifying the location of a body versus time along a trajectory, known or unknown

***Status as of 1638:***

By adopting Kepler's proposed horizontal parallax of 1', Horrocks had reduced his eccentricity for the Earth-Sun orbit from 0.0180 to 0.0173, and that in turn had led to an increase in the eccentricity of Venus's orbit from 0.00692 to 0.00750 and in the length of its semi-major axis from 0.74413 to 0.7233 a.u.; the revised value of the semi-major axis eliminated the prior 0.11% discrepancy between its cube and the square of its period, leading him then to take Kepler's  $3/2$  power rule to be exact and inferring from its period a further revision of the length of the semi-major axis to 0.72333 a.u.; these revisions turned out to reduce discrepancies between observation and the Rudolphine Tables as large as 5' to less than 2'.

The sole "natural" local motion – that is, near the surface of the Earth – is vertical fall. Galileo had originally concluded that bodies have a characteristic, natural constant speed of descent that depends on their density and the density of the medium. He was now instead proposing that, in the absence of any resisting medium, all bodies are uniformly accelerated as they descend, the rate at which they gain speed is the same for all bodies regardless of their weight and shape, and any observed departure from this results from an effect induced by the motion, and hence a "second-order" consequence of it, namely a resistance to it impressed on the moving bodies by the medium through which they are descending.