

EQUATIONS OF MOTION OF THE UNIVERSE : A SINGLE GALAXY

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Understanding the movements of matter and space in the exponentially expanding (XPXP) universe requires using exponential mathematics. It is an important premise of this theory that an XPXP universe cannot be described using common Euclidian math. Laws derived on the surface of the Earth do not necessarily apply to the cosmos.

On the largest scale, galaxies participate in the proper cosmic expansion, the “Hubble flow”, and obey the Hubble-LeMaitre Law: $dR/dt = H_0 R$, leading to an exponential expression: $R = R_0 e^{H_0 t}$ (see H/L Law). Instantaneous position, velocity, and acceleration are derived from this simple relationship. An exploration of the XPXP motions of the universe is necessary to fully grasp its importance.

Figure 30-1. THE DISPLACEMENT OF A PROPER GALAXY IN XPXP:

ORIGINAL POSITION

$$R_A = R_0 e^{H_0 t_A}$$

$$v_A = \frac{dR_A}{dt} = H_0 R_0 e^{H_0 t_A}$$

$$a_A = \frac{d^2 R_A}{dt^2} = H_0^2 R_0 e^{H_0 t_A}$$

POSITION AFTER Δt

$t_A' = t_A + \Delta t$

$$R_A' = R_0 e^{H_0 (t_A + \Delta t)}$$

$$= R_0 e^{H_0 t_A} \cdot e^{H_0 \Delta t}$$

$$v_A' = \frac{dR_A'}{dt} = H_0 R_0 e^{H_0 t_A'} = v_A \cdot e^{H_0 \Delta t}$$

$$a_A' = \frac{d^2 R_A'}{dt^2} = H_0^2 R_0 e^{H_0 t_A'}$$

- Note that a Maclaurin expansion of the exponential terms in Figure 1 yields approximate values of $R \sim (H_0 R_0)t \sim C_0 t$, and $v \sim (H_0^2 R_0)t \sim H_0 C_0 t$. (see Maclaurin expansion) These approximations correspond to distance = light speed x time, and velocity = acceleration x time in the standard model.

- Multiplication by an expansion factor of $e^{H_0 t}$ provides expressions for position, velocity and acceleration. Also, because $H_0 t$ is minuscule and $e^{H_0 t} \sim e^0 = 1$, in “normal” situations, the exponential nature of the universe goes unnoticed.

- XPXP is ongoing and continuing, thereby producing an accelerating universe. This was a surprise to many when discovered in the late 20th century. No need for “dark energy”. The proper universal acceleration is $(H_0^2 R_0) e^{H_0 t} = (H_0 C_0) e^{H_0 t}$. This is proposed to be value of the universal acceleration discovered in the late 20th century.