358(6): Spacetime Current of the Whirlpool Galaxy.

This is defined as:

$$\underline{J}_F = a_0^2 \underline{\nabla} \times (\underline{\nabla} \times \underline{v}_F) - \frac{\partial}{\partial t}\left((\underline{v}_F \cdot \underline{\nabla}) \underline{v}_F \right) \quad -(1)$$

where

$$\underline{v}_F = \frac{L_{FZ}}{m r_F^2} \left(-Y \underline{i} + X \underline{j} \right) \quad -(2)$$

is the velocity field of spacetime associated with a whirlpool galaxy.

As in previous notes:

$$\underline{g}\,(\text{matter}) = (\underline{v}_F \cdot \underline{\nabla}) \underline{v}_F \quad -(3)$$

$$= -\frac{L_{FZ}^2}{m^2 r_F^3} \underline{e}_r$$

so if r_F is independent of time:

$$\frac{\partial}{\partial t}\left((\underline{v}_F \cdot \underline{\nabla}) \underline{v}_F \right) = \underline{0} \quad -(4)$$

As in previous work: $\quad -(5)$

$$\underline{w} = \underline{\nabla} \times \underline{v}_F = \frac{2 L_{FZ}}{m r_F^2} \underline{k} = \frac{2 L_{FZ}}{m (X^2 + Y^2)} \underline{k}$$

Therefore:

$$\underline{\nabla} \times (\underline{\nabla} \times \underline{v}_F) = \frac{2 L_{FZ}}{m} \begin{vmatrix} \underline{i} & \underline{j} & \underline{k} \\ \partial/\partial X & \partial/\partial Y & \partial/\partial Z \\ 0 & 0 & \frac{1}{(X^2+Y^2)} \end{vmatrix} \quad -(6)$$

2)

So:

$$\underline{J}_F = \frac{4a_0^2 L_{FZ}}{m r_F^4}\left(-Y\underline{i} + X\underline{j}\right) \quad -(7)$$

$$= \frac{4a_0^2}{r_F^2}\underline{v}_F$$

where

$$r_F^2 = X^2 + Y^2 \quad -(8)$$

This is the spacetime current that gives rise to the whirlpool galaxy.