An Expected Revolution of the Galaxy Around the Expansion Center

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Abstract. After accepting, within the expansion center model (ECM), only the radial acceleration formula for an escaping splinter-galaxy, a fac-simile Hubble law for the Galaxy revolution is derived. Hence, by another simulation, an angular velocity formula and its finite difference at the observed distance \( r \) follow, expecting to be confirmed by observation. In conclusion two components of the matter density are presented, as responsible for a decelerated rotating Universe running away from the expansion center.

Key words. Cosmology

1. A fac-simile Hubble law for the Galaxy cosmic revolution

In the context of the expansion center model (ECM), the study of the \( G \) variation (Lorenzi, 2002), based on the Galaxy radial deceleration, in c.g.s. units,

\[
\ddot{R} = -2H^2 R = -\frac{4}{3}\pi\rho GR + R\dot{\theta}^2
\]

after the introduction of the formulae \( H = H_0 \cdot t_0/t \) and \( \rho = \rho_0 \cdot t_0/t \), leads to

\[
G(t) = \frac{3H_0^2}{2\pi\rho_0} \left( \frac{t_0}{t} + \frac{\dot{\theta}^2}{2H_0^2} \frac{t}{t_0} \right)
\]

which, after deriving with respect to time, becomes

\[
\dot{G}(t) = \frac{3H_0^2}{2\pi\rho_0} \left( -\frac{t_0}{t^2} + \frac{\ddot{\theta}}{2H_0^2t_0} + \frac{\dot{\theta}\ddot{\theta}}{H_0^2 t_0} \right)
\]

The ratio \( \dot{G}/G \), applied to the Galaxy at our epoch \( t = t_0 \), gives the angular velocity equation

\[
\dot{\theta}_0 = 2H_0^2 \left( \frac{1 + \varepsilon_0}{1 - \varepsilon_0} \right) - \frac{2\dot{t}_0\dot{\theta}_0 - \dot{t}_0}{1 - \varepsilon_0}
\]

whose solution may be written as

\[
\dot{\theta}_0 = y_0 H_0
\]

and

\[
\ddot{\theta}_0 = \xi_0 \frac{\dot{\theta}_0}{y_0 t_0}
\]

with

\[
\xi_0 = y_0^{-1}(1 + \varepsilon_0) - 0.5y_0(1 - \varepsilon_0)
\]
\[ \varepsilon_0 = \dot{G}_0 C_0^{-1} t_0 \] (8)

The Galaxy angular acceleration \( \varepsilon_0 \) at our epoch \( t_0 \) (note both \( \xi_0 \) and \( y_0 \) are dimensionless) can be easily processed in Hubble units as follows:

\[ \frac{d \dot{\theta}_{(r^{-1})}}{\dot{\theta}_{(r^{-1})}} = \frac{\xi_0 \ t_0}{y_0} \Rightarrow \frac{\delta \dot{\theta}_{(r^{-1})}}{\dot{\theta}_{(r^{-1})}} = - \frac{\xi_0}{y_0} \frac{3H_0}{c} \delta r \] (9)

remembering

\[ 1 - \frac{3H_0 r}{c} = \frac{t}{t_0} \Rightarrow \frac{dt}{t_0} = - \frac{3H_0}{c} \delta r \] (10)

Then, from eq. (9) it is possible to get a fac-simile Hubble law for the angular acceleration of the Galaxy cosmic revolution around the expansion center.

In fact, after putting

\[ W_0 = -3H_0 \frac{\xi_0}{y_0} \] (11)

we obtain

\[ \left( \frac{\delta \dot{\theta}}{\delta r} \right) = \dot{\theta}_0 W_0 \] (12)

where \( W \) and \( \dot{\theta} \) take the place of \( H \) and \( R \) in the Galaxy Hubble law, respectively.

### 2. Galaxy angular velocity \( \dot{\theta}_{MW} \) by another simulation

Working in the same way as the simulation carried out on the radial Galaxy Hubble law (Lorenzi, 1995bc, 1999a), always in Hubble units, after putting

\[ \frac{d \dot{\theta}}{\delta r} = \frac{\dot{W}}{c} \] (13)

and

\[ c \int_0^{\xi_0} \dot{\theta} = \] \[ \dot{\theta}_0 \int_{-\frac{W_0}{c}}^{0} (W_0 + \left( \frac{\delta W}{\delta r} \right)_0 \cdot r)(1 + \frac{W_0}{c} \cdot r) \cdot \delta r \]

\[ = \dot{\theta}_0 \int_{-\frac{W_0}{c}}^{0} (W_0 + \left( \frac{\delta W}{\delta r} \right)_0 \cdot r)(1 + \frac{W_0}{c} \cdot r) \cdot \delta r \] (14)

with the assumption

\[ \dot{\theta}_{MW} = \dot{\theta}_0 \rightarrow r = 0 \rightarrow t = t_0 \] (15)

\[ \dot{\theta}_{MW} = 0 \rightarrow r = - \frac{c}{W_0} \] (16)

one obtains

\[ \left( \frac{\delta W}{\delta r} \right)_{r=0} = \left( -\frac{3W_0^2}{c} \right)_{r=0} \] (17)

from which it follows

\[ W = W_0 \left( 1 + \frac{3W_0 r}{c} \right)^{-1} \] (18)

that inserted in eq. (13), after the logarithmic reduction, gives finally

\[ \dot{\theta} = \dot{\theta}_0 \left| 1 + \frac{3W_0 r}{c} \right|^\frac{1}{2} \] (19)

as the angular velocity formula of the Galaxy revolution.

### 3. An expected \( \Delta \dot{\theta}_{MW} \) from observations

As it is plausible to imagine some angular acceleration \( \left( \xi_0 \neq 0 \right) \) in the presence of some cosmic revolution \( \left( y_0 \neq 0 \right) \), the expected variation of the Milky Way angular velocity, \( \Delta \dot{\theta}_{MW} = \dot{\theta} - \dot{\theta}_0 \), occurred in the time measured by the observed light-space \( r \), results to be

\[ \Delta \dot{\theta}_{MW} = \dot{\theta}_0 \left( \left| 1 + \frac{3W_0 r}{c} \right|^\frac{1}{2} - 1 \right) \] (20)

that, at first order and at the observed distances \( r \) with \( \left( 1 + \frac{3W_0 r}{c} \right) > 0 \), gives the following simple formula (21), that must be confirmed by observation.

\[ \Delta \dot{\theta}_{MW} \approx -\xi_0 \frac{3H_0^2}{c} r = -\xi_0 K_0 r \] (21)
4. A new density formula

After fixing the position \( \xi_0 \), from eq. (1) the matter density at our epoch results to be

\[
\rho_0 = \frac{3H_0^2(2 + y_0^2)}{4\pi G_0} \tag{22}
\]

Being \( \varepsilon_0 \simeq 0 \) (Lorenzi, 2002), after accepting \( \dot{\theta} < 0 \) (that is \( \xi_0 < 0 \)), eq. (7) leads to

\[
\varepsilon_0 \simeq 0 \text{ and } \xi_0 < 0 \Rightarrow y_0 > \sqrt{2} \tag{23}
\]

Consequently eq. (22), if we put \( y_0 \simeq 2 \) as a first approximation, can be rewritten as the addition of two components, the following

\[
\rho_0 = \rho_0' + \rho_0'' \simeq \frac{3H_0^2}{2\pi G_0} + \frac{3H_0^2}{\pi G_0} \tag{24}
\]

which, in terms of relative ratios, lead to

\[
\frac{\rho_0'}{\rho_0} \simeq 0.3 \quad \frac{\rho_0''}{\rho_0} \simeq 0.7 \quad \tag{25}
\]

The numerical values in eq. (25) seem to agree with the results recently found for dark matter and dark energy (Bennett et al., 2003); however the ECM excludes dark energy. Consequently the results here proposed in (25) represent an alternative Universe dominated by dark matter, where a non canonical rotation (see parallel paper) finds its "reason d’etre" in the matter density component \( \rho_0' \).

References

Lorenzi, L. 2003b, The expansion center model as a challenge to cosmology, based on data, results, and 3 historical models.