Mem. S.A.It. Vol. 74, 480

Memorie della

Universe outline by the expansion center model according to Dirac

L. Lorenzi

Former astronomer at Osservatorio Astronomico di Torino, Pino Torinese, Italy

Abstract. The expansion center model (Lorenzi 2000a,b), as expressively referred to the Milky Way position within the framework of a spherical homogeneous and isotropic inner Universe radially decelerated towards the expansion center, allows to picture a local Universe outline according to Dirac's theory (1937), the so-called large numbers hypothesis (LNH), which is based on possible simple relations between cosmological and microphysical quantities. Among the most significant results are to cite: $t_0 = 1/(3H_0)$ and $G \propto t^{-1} + \ldots$.

Key words. cosmology: theory

1. Our epoch t_0

Let us consider two fundamental relations carried out by the expansion center model (ECM hereafter, Lorenzi 2000a) as expressively referred to the Galaxy Hubble function (H_{MW}) and to the Galaxy radial distance (R_{MW}) from the huge void center. They are

$$H_{\mathrm{MW}} = H_0 \left(1 - \frac{3H_0 r}{c}\right)^{-1}, \tag{1}$$

$$R_{\mathrm{MW}} = R_0 \left(1 - \frac{3H_0 r}{c}\right)^{1/3}. \tag{2}$$

Remember that $r \leq c/(3H_0)$ is the light-space run with speed c by light to reach us from the source; by expressing r in Mpc and t in seconds it is

$$\frac{dr}{dt} = -c = -\frac{1}{N}, \tag{3}$$

this means

$$r = -c \int_{t_0}^{t} dt = -c(t - t_0) = \frac{t_0 - t}{N} \tag{4}$$

where N ($\equiv 1.029 \times 10^{14}$ s Mpc^{-1}) is the number of light seconds corresponding to 1 Mpc.

At the same time, Eq. 2 in Hubble units gives immediately our epoch (just the one of Dirac's theory (1937), cf. Coles & Lucchin 1995), as

$$R_{\mathrm{MW}} = 0 \;\Rightarrow\; r = \frac{c}{3H_0}. \tag{5}$$

Such a r, once taken $H_0 = 70 \pm 3$ km s^{-1} Mpc^{-1} (Lorenzi 2000b), based on data by Sandage & Tammann (1975), gives the

Send offprint requests to: L. Lorenzi
Correspondence to: Via Beccaria 21, I-12084 Mondovì (CN), Italy

following age of the Universe expressed in time

$$t_0 = N\frac{c}{3H_0} \tag{6}$$

corresponding to $t_0 = (4.65 \pm 0.20) \times 10^9$ yr.

2. Main formulas according to Dirac

At first one can show the following dimensionless equality

$$1 - \frac{3H_0 r}{c} \equiv \frac{t}{t_0}. \tag{7}$$

that results through the introduction of the Eqs. 4 and 6 as it follows

$$1 - \frac{3H_0}{c}\left(\frac{t_0 - t}{N}\right) = 1 - \frac{t_0 - t}{t_0} = \frac{t}{t_0}. \tag{8}$$

Then Eqs. 1 and 2 become directly

$$H = H_0\left(\frac{t_0}{t}\right) \text{ in s}^{-1}, \tag{9}$$

$$R = R_0\left(\frac{t}{t_0}\right)^{1/3} \text{ in cm.} \tag{10}$$

The previous different formulations of $H_{\rm MW}$ and $R_{\rm MW}$ have to be inserted into the velocity and deceleration formulas of our Galaxy, the ones derived (Lorenzi 2000a) as

$$\dot{R} = HR \text{ in cm s}^{-1}, \tag{11}$$

$$\ddot{R} = -2H^2R \text{ in cm s}^{-2}. \tag{12}$$

So the above formulas take the following formulations as functions of time

$$\dot{R} = H_0R_0\left(\frac{t}{t_0}\right)^{-2/3} \text{ in cm s}^{-1}, \tag{13}$$

$$\ddot{R} = -2H_0^2R_0\left(\frac{t}{t_0}\right)^{-5/3} \text{ in cm s}^{-2}. \tag{14}$$

Eq. 10, holding the conservative law that mass does not change with time, furnishes the density law

$$\rho(t) = \rho_0\frac{t_0}{t} \text{ in g cm}^{-3}. \tag{15}$$

that, with Eq. 9, when inserted into the ECM density formula

$$\rho \geq \frac{3H^2}{2\pi G} \tag{16}$$

together finally confirm the controversial Dirac result $G \propto t^{-1}$ (cf. Coles & Lucchin, 1995) if it is the equality sign in Eq. 16 to be held. In fact we obtain

$$G \geq \frac{3H_0^2}{2\pi\rho_0}\frac{t_0}{t} \tag{17}$$

where the lower limit value for G is referring to the ECM with only radial expansion, without any rotation.

Indeed all the previous results, in particular those represented by Eqs. 6, 10, 13, and 17 agree with Dirac's theory (1937, 1938), the so-called large number hypothesis (LNH), which is based on possible simple relations between cosmological and microphysical quantities.

Acknowledgements. The author wishes friendly to thank Alberto Masani and Attilio Ferrari for the past precious discussions and constant encouragment; he also thanks the Editors A. Rifatto and E. M. Corsini for all their help.

References

Coles, P., & Lucchin, F. 1995, Cosmology. The Origin and Evolution of Cosmic Structure (Chichester: Wiley)
Dirac, P. A. M. 1937, Nature 139, 323
Dirac, P. A. M. 1938, RSPSA, 165, 199
Lorenzi, L. 2000a, MemSAIt, 71, 1163 (reprinted in 2003, MemSAIt, 74)
Lorenzi, L. 2000b, MemSAIt, 71, 1183 (reprinted in 2003, MemSAIt, 74)
Sandage, A., & Tammann, G. A. 1975, ApJ, 196, 313