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119(7) : Gravitomagnetic Estimate of the Properties of the Milky Way Galaxy.

According to the website :

www.physicsforums.com/blog.php?b=21

The sun orbits the galactic centre at 220 km s^{-1} towards Cygnus, taking 220 million years per orbit. The local standard of rest (LSR) is a reference frame in circular orbit around the galactic centre. The sun is also influenced by the gravity of near stars so moves at 20 km s^{-1} w.r.t. respect to the LSR.

The gravitomagnetic velocity calculated for:

$$\Omega = - \underline{v} \times \underline{g} / c^2 \quad (1)$$

is

$$\underline{v} = 70.4 \text{ km s}^{-1} \quad (2)$$

assuming for simplicity that $\underline{v} \perp \underline{g}$.

The various estimates of v (solar motion) vary from 220 to 600 km s^{-1} . For example

in: S. Courteau and S. van der Burg,
Astron. J., 118, 337 (1999)

The sun's velocity is $306 \pm 18 \text{ km s}^{-1}$ towards an apex at $l = 99 \pm 5^\circ$ and $b = -4^\circ \pm 4^\circ$. There are also various estimates of the mass of the local group of galaxies, with respect to which the sun is moving.

Using simple Newtonian dynamics it is possible to estimate Milky Way galactic properties from eq. (2). The time taken for the sun to complete one rotation about the galactic centre is:

$$\tau = 220 \text{ million years} = 6.95 \times 10^{15} \text{ secs.}$$

Its angular frequency is therefore:

$$\omega = \frac{2\pi}{\tau} \quad - (3)$$

If the orbit is approximately circular:

$$r = \frac{v}{\omega} = 2\pi v \tau \quad - (4)$$

$$= 3.08 \times 10^{21} \text{ metres}$$

$$= 320,000 \text{ light years}$$

The mass at the centre of the galaxy is given by Kepler's third law:

$$M = \frac{4\pi^2 a^3}{G\tau^2} \quad - (5)$$

$$= 6.55 \times 10^{44} \text{ kg}$$

$$M (\text{Milky Way}) = 1.8 \times 10^{12} \text{ Sun masses}$$

This is consistent with the estimate of the mass of the local cluster as:

$$\text{Mass local cluster} = (1 \text{ to } 2.3) \times 10^{12} \text{ Sun masses.}$$

Conclusion

The earth's equinoctial precession is a gravitomagnetic effect caused by the sun's orbital velocity around the centre of the Milky Way. The gravitomagnetic equation (1) gives plausible properties for the Milky Way.