Gravitational monopole

Domenico Oricchio

September 11, 2021

Abstract

I prove the existence of a new exact solution of the Einstein field equation for a massless gravitoelectromagnetic monopole in the case of the linear approach for a weak gravitational field.

I prove that the metric of a gravitoelectromagnetic monopole is:

$$\boxed{ds^2 = c^2 dt^2 - \frac{q_B}{4\pi}\frac{1}{r^2} d\phi dt - dr^2 - r^2\left(\sin^2\theta d\phi^2 + d\theta^2\right)}$$

The magnetic monopole was obtained by Dirac like a termination of a line of dipole[**1**], so that a theoretical termination of an infinite solenoid with a mass flow (neutral particles and antiparticles instead of charged particles) generate a monopole field (this is true for weak and strong gravitational field), so that a gravitoelectromagnetic monopole exist like a solution of the Einstein field equation.

The monopole solution must be massless because of the gravitomagnetic field $\mathbf{B}_g$ exist, and the gravitoelectric field $\mathbf{E}_g$ is null.

In the limit of a linear approach for a weak gravitational field the metrix is[**2**]:

$$ds^2 = c^2\left(1 + \frac{2\Phi}{c^2}\right)dt^2 - \frac{4}{c}\left(\mathbf{A}\cdot d\mathbf{x}\right)dt - \left(1 - \frac{2\Phi}{c^2}\right)\delta_{ij}dx_i dx_j$$

for a magnetic monopole in spherical coordinates[**3**]:

$$\begin{array}{l}\Phi = 0\\ \mathbf{A} = \frac{q_B}{4\pi}\frac{1}{r^2}\mathbf{u}_\phi\end{array}$$

the metric of a gravitational monopole is:

$$\mathbf{A} \cdot d\mathbf{x} = A_k dx_k = A_\phi d\phi + A_\theta d\theta + A_r dr$$
$$ds^2 = c^2 dt^2 - \frac{q_B}{4\pi} \frac{1}{r^2} d\phi dt - dr^2 - r^2 \left(\sin^2 \theta d\phi^2 + d\theta^2 \right)$$

gravitational waves exist as a means of dissipating energy so that a gravitational monopole exist as a means to dissipating energy.

References

[1] John David Jackson . *Classical electrodynamics; 3rd ed.*. Wiley, New York, NY, 1991

[2] Athanasios Bakopoulos "Gravitoelectromagnetism: Basic principles, novel approaches and their application to Electromagnetism", Master thesis, 2016, p.15. arxiv: 1610.08357

[3] Wikipedia (11 feb 2011). *Monopolo magnetico* https://it.wikipedia.org/wiki/Monopolo_magnetico#Interpretazione_topologica