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Black holes as boson stars

K. D. W. J Katugampala[1*] and L. N. K. de Silva[2]

[1]Department of Mathematics, Faculty of Science
University of Kelaniya, Sri Lanka
[2]109/1, Railway Avenue, Maharagama, Sri Lanka
Email: wasantha@kln.ac.lk

Kaup (1968) had shown that spin zero bosons could form stable stars. However, there had been no interest in these stars until the Higgs boson was discovered in 2012. Now there is renewed interest in boson stars.

Clark (2017) in an article "holy moley" published in the New Scientist (15th July) considers boson stars and black holes as two different types of objects. As far as black holes are considered it can only be said that the matter collapses in to a singularity. Boson stars on the other hand are made of bosons. The above article considers black holes and boson stars to be two different kinds leading to same observations with respect to certain objects. However, they could be the same with black holes constituting bosons of zero mass.

In this paper it is suggested that some stars, may be most stars, constitute ordinary matter, some may constitute fermions and bosons, while some others are boson stars. It is not ruled out that some stars could be made of bosons of zero mass such as gluons and/or gravitons. Some stars could be made of bosons including photons, as stars with photons only have been ruled out.

de Silva (1970) had considered time like geodesics in the Schwarzschild metric

$$ds^2 = \left(1 - \frac{2M}{r}\right)(c^2 dt^2) - \frac{dr^2}{1-\frac{2M}{r}} - r^2(d\theta^2 + sin^2\theta d\varphi^2)$$

and found that the energy of a particle of rest mass m_0 at a coordinate distance r can be written as m_0kc^2 where $k = \frac{\sqrt{1-\frac{2M}{r}}}{\sqrt{1-\frac{u^2}{c^2}}}$ and u being the velocity of the particle in the local frame at rest with respect to the frame at infinity.

In recent research we have found that the rest mass of a particle in a rest frame, called the local rest frame at coordinate distance r could be considered as $m_0(1-2M/r)^{1/2}$ in a Schwarzschild metric, where m_0 is the rest mass of the particle at infinity and M is the Schwarzschild mass of the central object. The rest mass of the particle in the local rest frame decreases, and ends up as zero as the particle enters the singularity with velocity c. It implies that black holes in a Schwarzschild metric could be considered as objects made of bosons with zero mass and observed at large distances with non zero Schwarzschild mass M.

Keywords: Black holes, Boson stars, Zero mass