

A BRIEF NOTE ON THE MAGNETIC EFFECTS OF THE ELECTRON

B.G. Sidharth*

Centre for Applicable Mathematics & Computer Sciences
B.M. Birla Science Centre, Hyderabad 500 063 (India)

Abstract

In this paper it is shown that a recent formulation of the electron in terms of a Kerr-Newman type metric, exhibits a short range magnetic effect, as indeed has been observed at Cornell, and also an Aharonov-Bohm type of an effect.

In a recent model[1, 2, 3] it was shown how an electron could be described as a Kerr-Newman type black hole with Quantum Mechanical inputs. Such a scheme lead to a cosmology consistent with all so called large number relations and which predicted that the universe would continue to expand for ever[4, 5], as indeed has been subsequently observed[6, 7]. Moreover this scheme also gives a description of the quark picture including such features as the characteristic fractional charge, handedness, confinement and an order of magnitude estimate of the masses[8, 9, 10].

We would now like to point out two additional consequences of the above model, one an extra magnetic effect in the electromagnetic vacuum and the other an Aharonov-Bohm type effect[11].

We first observe that the magnetic component of the field of a static electron as a Kerr-Newman black hole is given in the familiar spherical polar coordinates by (Cf.refs.[1, 2])

$$B_{\hat{r}} = \frac{2ea}{r^3} \cos\Theta + o\left(\frac{1}{r^4}\right), B_{\hat{\Theta}} = \frac{e \sin\Theta}{r^3} + o\left(\frac{1}{r^4}\right), B_{\hat{\phi}} = 0, \quad (1)$$

⁰E-mail:birlasc@hd1.vsnl.net.in

whereas the electrical part is given by

$$E_{\hat{r}} = \frac{e}{r^2} + 0(\frac{1}{r^3}), E_{\hat{\theta}} = 0(\frac{1}{r^4}), E_{\hat{\phi}} = 0, \quad (2)$$

A comparison of (1) and (2) shows that there is a magnetic component of shorter range apart from the dipole which is given by the first term on the right in equation (1)– infact this model also exhibits the anomalous gyro magnetic ratio $g = 2$ of the electron. We would like to point out that a short range force the $B^{(3)}$ force mediated by massive photons has indeed been observed at Cornell and studied over the past few years[12].

On the other hand as the Kerr-Newman charged black hole can be approximated by a solinoid, we have as in the Aharonov-Bohm effect, a negligible magnetic field outside, but at the same time a real vector potential \vec{A} which would contribute to a shift in phase. Infact this shift in phase is given by

$$\Delta\delta_{\hat{B}} = \frac{e}{\hbar} \oint \vec{A} \cdot d\vec{s} \quad (3)$$

There is also a similar effect due to the electric charge given by

$$\Delta\delta_{\hat{E}} = -\frac{e}{\hbar} \int A_0 dt \quad (4)$$

where A_0 is the usual electro static potential given in (2). In the above Kerr-Newman formulation, (\vec{A}, A_0) of (3) and (4) are given by (Cf.refs.[1, 2])

$$A_\sigma = \frac{1}{2}(\eta^{\mu\nu} h_{\mu\nu}), \sigma, \quad (5)$$

From (5) it can be seen that

$$\vec{A} \sim \frac{1}{c} A_0 \quad (6)$$

Substitution of (6) in (3) then gives us the contribution of the shift in phase due to the magnetic field.

References

- [1] B.G. Sidharth, Int.J.Mod.Phys.A, (1998) 13 (15), p.2599ff.

- [2] B.G. Sidharth, Ind.J. of Pure and Applied Phys., 35, 1997, pp456-471.
- [3] B.G. Sidharth, Gravitation & Cosmology, Vol.4, No.2, 1998, pp158-162.
- [4] B.G. Sidharth, International Journal of Theoretical Physics, 37 (4), 1998, pp1307-1312.
- [5] B.G. Sidharth, Chaos Solitons & Fractals, 11 (8), 2000, pp1269-1278.
- [6] S. Perlmutter, et. al., Nature, 391 (6662), 1998.
- [7] R.P. Kirshner, Proc. Natl. Acad. Sci. Vol.96, 1999, pp.4224-4227.
- [8] B.G. Sidharth, Mod.Phys. Lett. A., Vol. 12 No.32, 1997, pp2469-2471.
- [9] B.G. Sidharth, Mod.Phys. Lett. A., Vol. 14 No. 5, 1999, pp387-389.
- [10] B.G. Sidharth, in Instantaneous Action at a Distance in Modern Physics: "Pro and Contra" , Eds., A.E. Chubykalo et. al., Nova Science Publishing, New York, 1999.
- [11] Y. Aharonov, "Non-Local Phenomena and the Aharonov-Bohm Effect" in Quantum Concepts in Space and Time (Eds.) R. Penrose, C.J. Isham, Clarendon Press, Oxford, 1986, pp.41ff.
- [12] M.W. Evans "Origin, Observation and Consequences of the $B^{(3)}$ Field" in The Present Status of the Quantum Theory of Light, S. Jeffers et al. (eds), Kluwer Academic Publishers, Netherlands, 1997, pp.117-125 and several other references therein.