

Electron Spin

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Quantum theory attributes the electron with the properties of angular momentum and magnetic moment, both of which are physically impossible.

The argument in favour of electron spin is based on the Stern-Gerlach experiment in which a beam of atoms is split in two by a magnetic field which varies in flux density across the path of the beam. The experiment was originally designed to test whether or not the ground state solution of the hydrogen atom predicted by quantum mechanics to have zero angular momentum was correct. When the experiment showed that atoms with a hydrogen like single outer electron flipped into either parallel or anti-parallel alignment confirming angular momentum, the defenders of quantum mechanics invented electron spin.

An electron is an elementary charged particle. It has an electric field which possesses energy. Its motion generates a magnetic field which contains its kinetic energy. From its mass and charge, we can calculate its radius.

$$\frac{1}{2} m v^2 = \frac{\mu_0 e^2 v^2}{12\pi r} \quad \Rightarrow \quad r = \frac{\mu_0 e^2}{6\pi m} = 1.879 \times 10^{-15}$$

Suppose the electron is spinning with angular frequency ν then a strip of width $\delta\theta$ at an angle θ to the axis will have an area of $2\pi r^2 \sin\theta \delta\theta$ and charge $\frac{2\pi r^2 \sin\theta \delta\theta}{4\pi r^2} e$. The area of the current loop formed by this strip is $\pi(r \sin\theta)^2$ giving it a magnetic moment of $\frac{1}{2} e \nu r^2 \sin^3\theta \delta\theta$. The magnetic moment of the electron would be:

$$\int_0^\pi \frac{1}{2} e \nu r^2 \sin^3\theta d\theta = \frac{2}{3} e \nu r^2$$

Setting this equal to the observed magnetic moment gives a required frequency of rotation of:

$$\nu = 2.463 \times 10^{45}$$

This would require an equatorial circumferential velocity 970 times the speed of light! It is obvious that electrons would need supernatural powers to possess such large magnetic moments. Exactly the same argument applies to angular momentum. We have actually been quite kind in allowing the electron a finite radius. The standard model gives the electron a zero radius requiring an infinite equatorial circumferential velocity!

One of the more exotic theories from the fringe world of alternative physics supposes electrons to be toroids of charge rotating at the speed of light!