METHODS OF DETECTION OF MAGNETIC FIELDS ON THE SUN

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Introduction

One hundred years ago, astronomers, such as Young, thought that the black spots on the sun were meteorological phenomena, storm centers with whirling masses of gases, caused by cyclonic circulations in the solar atmosphere. About 1908, Hale at Mt. Wilson, California, made a hydrogen-alpha spectroheliogram, with only recently available red-sensitive plates. He noted the fibril configurations which suggested motion and magnetism. He had noted the broadening of some spectral lines, when the image of sunspots were positioned on the entrance slit.

Zeeman had observed the effect when atoms emitting spectral lines were subjected to a magnetic field. It gradually became clear that atoms have their own magnetic field. In fact the hydrogen electron, in its innermost orbit, produces a magnetic field of a half million gauss. Orbital angular moments of electrons in an atom couple together to form a resultant orbital moment, labelled L and spin moments couple together to form a resultant spin moment, labelled S. Then the L and the S couple to form a resultant total angular momentum, which is labelled J. These electronic configurations have their magnetic moments, which will determine how they line up in a magnetic field.

The magnetic moment is the current times the area of the electrical circuit. For hydrogen the current is e/c (the charge) times the frequency, n. The area is, for the lowest orbit πr^2. This current times area can be recast into a form which includes the angular momentum. Angular momentum is quantized in units of $h/(2\pi)$, where h is Plank's constant. The resulting magnetic moment for hydrogen is $\frac{eh}{4\pi mc}$. It is called the magneton.

To obtain the magnetic moment of an electronic configuration, with the L-S coupling mentioned above, we have to obtain the component of L along J, plus the component of S along J, and this from geometry is clearly J. But it has been found that S has a double dose of magnetic