
Magnetic monopole

High energy physics is obviously a very attractive subject these days — when we are not writing about charm we are writing about magnetism. A Berkeley/Houston group (P.B. Price, E.K. Shirk, W.Z. Osborne, L.S. Pinsky) maintain that they have detected a monopole, the basic unit of magnetism, and E.K. Shirk described their evidence in a lecture at CERN at the end of August.

Two years ago the team dangled a balloon over Iowa loaded with a stack of plastic (Lexan) plates, nuclear emulsion layers and a Cherenkov counter. They were looking for very heavy nuclei in cosmic rays and particularly for 'super-heavy' nuclei which might exist around atomic number 114.

Their first information on the possible existence of the monopole came from the nuclear emulsion which was scanned at Houston. A black core surrounded by a halo suggested the passage of a very heavy particle with atomic number around 80. The diameter of the halo gave an estimate of the velocity of the particle as about half that of light, 0.5 c.

This data was passed to Berkeley and guided the chemical etching of the Lexan sheets in the region where the particle passed. The depth to which the etching occurs and the rate at which the etching takes place gives more precise estimates of particle charge and velocity.

The etching indicated that the particle passed through the sheets giving almost constant ionization regardless of depth in the stack. The best estimate was for a particle of charge around 137 and velocity about equal to that of light, in contradiction to the nuclear emulsion data.

Attention then turned to the fast film of the Cherenkov counter. A particle of high velocity should have recorded a black core with a ring around it where the Cherenkov light emerging at an angle to the particle

direction intercepted the film plane. No evidence of Cherenkov light was found which said that the particle velocity was not higher than 0.7 c. This was in line with the data from the nuclear emulsion that a low velocity particle was involved. How then was it possible to explain the data from the etching of the Lexan sheets which indicated a highly ionizing, high velocity particle?

A magnetic monopole is predicted to cause ionization at a rate proportional to its strength, g , and its velocity. The etch rate seemed consistent with the interpretation that a monopole with $g = 137$ and a velocity which was sufficient to penetrate all the plates, was responsible for the track through the detectors. To have passed through all the plates it must have had an energy of over 32 GeV which means that its mass must be greater than 200 times that of the proton.

Some checks on the detectors were, of course, carried out. For example, the tracks left by iron nuclei were used for calibration. The film from the Cherenkov counter was examined in the region of the possible monopole track to ensure that fast particles were giving the ring signal of Cherenkov light. And so on. Other interpretations were tried, particularly the possibility that a couple of nuclear interactions took place along the track, giving changes in particle identity which could fit the data. The Berkeley/Houston team believe this possibility to be very remote (1 in 10^5 level).

Monopoles were first suggested by P.A.M. Dirac in 1931 as the magnetic counterpart to the role played by the electron as the basic unit of electricity. He predicted that its charge would be at least 68.5 times that of the electron.

It was perhaps the estimate of the detected particle charge at 137, twice the Dirac prediction, which lent extra weight to the monopole interpretation

of what was seen in the balloon detector. Since the result was first announced there has been a recalibration which has taken the charge to 121 and at the same time taken a lot of credulity with it.

To catch one monopole in the duration of the flight with the area of the balloon detector gives a figure for the number of monopoles possibly flying around in the upper atmosphere. It comes out much higher than that emerging from other unfruitful searches for the monopole, though just one track makes statistics very dodgy. A few more are obviously needed before the monopole interpretation receives acceptance.

Nevertheless it is an intriguing observation which has served to give the high energy physics world another stir and to bring magnetic monopoles onto the front pages of the newspapers.