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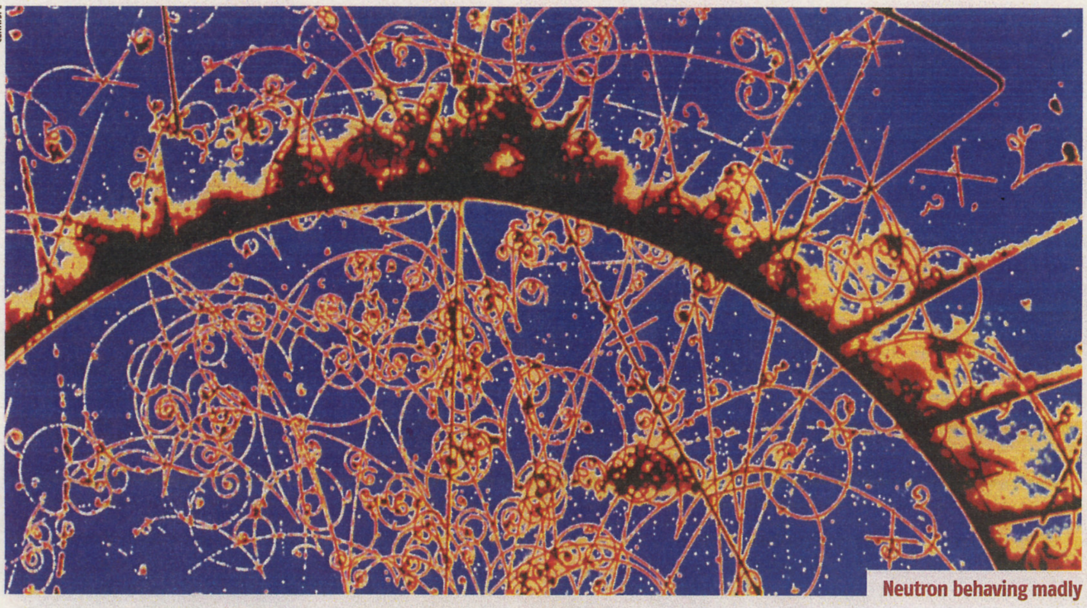

Neutron behaving madly

Why neutrons die young

SEVENTY-TWO years after James Chadwick discovered the neutron, physicists believe they have made the most precise measurement ever of the particle's lifetime – and the new figure is ruffling feathers. It differs enough from the accepted lifetime to have an impact on our understanding of the composition of the universe.

Neutrons are made of three fundamental particles called quarks and decay into protons when a "down" quark turns into an "up" quark. The rate at which neutrons turn into protons determined how much of each was created in the first seconds after the big bang and it also dictates the amount of helium in the universe today.

To find out the precise decay rate, Anatoly Serebrov from the Petersburg Nuclear Physics Institute in Russia and colleagues trapped cold neutrons in a large metal bottle and then counted them after fixed periods of time. From these observations they estimated that it took 878.5 seconds for half the neutrons to decay, 7.2 seconds less than the half-life that is the accepted standard.

"This result is wildly discrepant," says Scott Dewey, a member of another group that measures neutron lifetimes using a different technique at the National Institute of Standards and Technology in Gaithersburg, Maryland. Both the new measurement and the world standard have an estimated error of less than 1 second.

If the new measurement is correct, it could help explain why astronomers have found less helium in the universe than expected. Grant Mathews, a cosmologist at the University of Notre Dame in Indiana, has found that the new neutron lifetime cuts the predicted abundance of helium by about 0.15 per cent to 24.61 per cent (*Physical Review D*, in press). Although it's a small shift, the new prediction is closer to the estimate of abundance that astronomers have come up with from observations of young galaxies.

The measurement also affects our estimates of the strength of the weak nuclear force, making it fit better with the predictions of the standard model of particle physics. "There is a big probability that our result is correct," says Serebrov.

But some astronomers believe that there is enough uncertainty in the measurements of the helium abundance for them to be compatible with predictions made using the standard neutron lifetime.

Dewey adds, "People who have been in this game for a while are very suspicious." But after carefully studying Serebrov's four-page paper, which will be published in the journal *Physics Letters B*, Dewey has found no flaws in the work. "It's very hard to poke a hole in it." **Jenny Hogan**

Primordial rock boosts case for life's early start

THE first detailed study of a rare isotope of iron in some of the oldest rocks on Earth has boosted the case for the presence of life very early in our planet's history.

Rocky outcrops found on Akilia Island off the southwest coast of Greenland are thought to be about 3.85 billion years old. Like most of the oldest known rocks, these were once buried deep underground and subjected to enormous heat and pressure. Geologists have argued over whether they are igneous (volcanic) or sedimentary in origin and whether they contain any traces of life.

In 1996, some researchers claimed to have found graphite in the rocks, and the isotopic signature of carbon suggested it was biological in origin. But recent studies have knocked down that idea.

Nicolas Dauphas of the University of Chicago in Illinois argued that the graphite was the result of contamination from later biological activity. And Christopher Fedo of George Washington University in Washington DC has found no graphite at all in the rocks. His study will appear in a future issue of the journal *Geology*.

Now the argument has taken a new turn. Dauphas and colleagues from the Field Museum in Chicago analysed the rocks for isotopes of iron and found that the levels of iron-57 in the rocks are greater than those in igneous rocks found anywhere on Earth (*Science*, vol 306, p 2077). Where did the iron-57 come from?

Dauphas believes that oxygen emitted by ancient photosynthetic bacteria oxidised some of the dissolved ferrous iron in the oceans to produce the minerals containing the iron-57 isotope. The minerals were laid down as sediments but were eventually compacted, heated and metamorphosed to such an extent that they no longer resemble sedimentary rocks.

"Ancient bacteria may have oxidised oceanic iron, which was laid down as sediments, then compacted and heated"

But Fedo, whose earlier study of rare-earth elements in the Akilia Island rocks had suggested that they were igneous in origin, now says that it's impossible to conclusively tell the nature of the rocks, given the extreme conditions to which they have been subjected over billions of years. "What is present is a profoundly deformed and metamorphosed rock," he says. Jeff Hecht