COSMOLOGY

Magnet Experiment Appears to Drain Life From Stars

It's an unassuming experiment: to see how a magnetic field affects polarized laser light. And the rotation the researchers saw was tiny, a mere 100,000th of a degree. If the result is true, however, the implications are huge. According to researchers in Italy who conducted the experiment, this slight twist in the beam—the result of disappearing photons—suggests the existence of a small, never-before-seen neutral particle, which, if made in stars, would siphon off all their energy.

Even theorists who find that scenario far-fetched are struggling to explain the disappearance of the photons. "I'm skeptical of the particle interpretation," says theoretical physicist Georg Raffelt of the Max Planck Institute for Physics in Munich, Germany. "But there are no other obvious explanations."

Standard physics predicts a very small rotation in a beam's polarization in a magnetic field due to ordinary particles popping in and out of the vacuum. But when researchers at the PVLAS experiment at Legnaro National Laboratory of Italy's National Institute for Nuclear Physics turned on their 5-tesla magnet in 2000, they immediately saw a rotation 10,000 times larger than expected, says PVLAS member Giovanni Cantatore of the University of Trieste. The rotation is caused by the loss of a small number of photons whose electric fields line up with the magnetic field. This selective disappearance is what physicists would see if the missing photons were converting into neutral particles about 1 billionth of the mass of electrons.

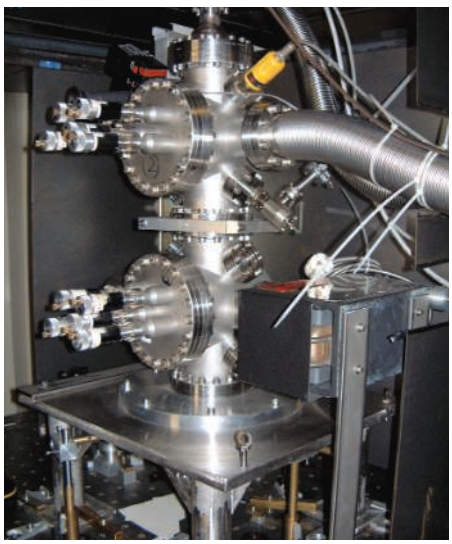
"If you believe the signal is real, then the interpretation is a new particle," says theoretical physicist Andreas Ringwald of DESY, Germany's particle physics center near Hamburg. But Ringwald thinks most physicists believe the rotation comes from some subtle artifact of the instruments. The PVLAS team has spent 5 years looking for such systematic effects: They have rotated and reduced the magnetic field, added air to their vacuum system, and changed the frequency of the laser. "All this time we have tried to make the signal go away," Cantatore says. It hasn't. The PVLAS team doesn't claim to have discovered a new particle. "It is important to be careful," Cantatore says. A paper in *Physical Review Letters* is due this month.

"These are very serious, very competent people," says Pierre Sikivie of the University of Florida, Gainesville, who also looks for novel particles with magnetic fields. Still, he has a "wait-and-see attitude," because the implications would be "revolutionary."

The PVLAS particle, if it exists, has the makings of an axion, a hypothetical particle that some cosmologists propose is the invisible missing dark matter that makes up a large chunk of the mass of the universe. However, the particle suggested by the PVLAS experiment is not what the theorists ordered. It couples so strongly to photons that the axion-search experiments currently scattered around the globe should have seen loads of them coming from the sun (*Science*, 15 April 2005, p. 339). Such a stream of invisible particles out into space would drain a star of its energy in a few thousand years. But we know stars, including our sun, last for billions of years. Raffelt says the PVLAS particle would need "crazy properties" to match astrophysical constraints, but there is no fundamental reason they can't behave that way.

The PVLAS collaboration plans to settle the question with an experiment involving two magnets separated by a wall. On one side, part of a laser beam would be converted into a flux of PVLAS particles, which would fly straight through the wall. On the other side, the second magnet would reconvert some of the particles back into photons, at a rate of one every 2 seconds, Cantatore predicts. Ringwald is proposing a similar experiment at DESY, and CERN, the European particle physics lab near Geneva, Switzerland, is also considering one.

Although most physicists doubt the reality of this particle, they are curious to see what comes of it. "People want to give the idea a fair hearing," Sikivie says. "If it turns out to be true, it will be a theoretical challenge to explain, but also an opportunity." **–MICHAEL SCHIRBER**



CREDIT: THE PVLAS COLLABORATION

A twist in the tale. By rotating a laser beam with magnets, this experiment may have found never-before-seen particles.

Turtles Imperiled, Biologists Say

Despite a letter of protest signed by more than 100 scientists, a regional fisheries council has moved to open a protected area of the U.S. Pacific coast to drift gillnet fishing, a practice that kills many marine species. Since 2001, this type of fishing has been seasonally banned along most of the Oregon and California coast to protect critically endangered leatherback turtles. But the Pacific Fishery Management Council says that regulations on fishing vessels, including closing all fishing if two turtles are caught during the leatherback annual migration, are sufficient to protect the species while increasing commercial access to fishing grounds during their most productive season.

Conservation scientists fear that the turtles will be pushed even closer to the brink of extinction. "There is not a lot of leeway with this species," says David Ehrenfeld, a biologist at Rutgers University in New Brunswick, New Jersey, who signed the protest letter. In April, the council also will consider whether to allow longline fishing, which often catches turtles and other marine species as well. Both decisions must be approved by the National Marine Fisheries Service, which is expected to make a decision on the proposal by the end of July.

–JENNIFER CUTRARO

UK Biobank Taking Deposits

This week, U.K. officials launched what may be the largest-ever population study. The goal of the project, dubbed UK Biobank, is to track 500,000 adult volunteers for up to 30 years seeking to link their genes, lifestyle, and common diseases.

Proposed in 1999, the $106 million effort has been criticized for its size and for the possibility of turning up spurious associations between genes and disease. Principal investigator Rory Collins of the University of Oxford says these are "misconceptions" and that the study's large size will make false associations unlikely. But organizers now emphasize that UK Biobank is a broad medical study and that biological markers such as blood protein levels may yield as much information as genes.

Manchester citizens aged 40 to 69 are receiving invitations to join in a 3000-subject pilot project; national enrollment begins later this year and will continue for 5 years. The study is funded by government agencies and the Wellcome Trust charity.

–JOCELYN KAISER

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