NEWS

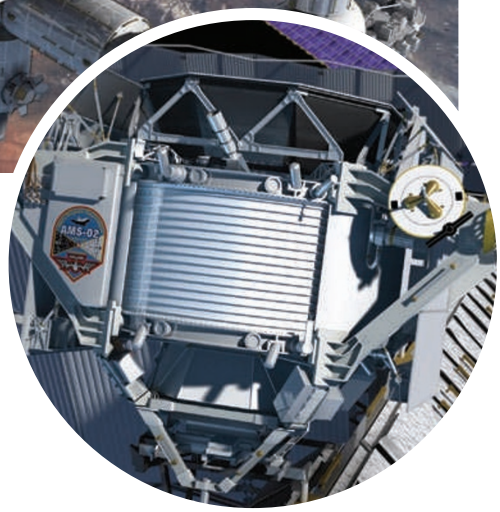
Hasty switch for space magnet

Longer-lasting part could make cosmic-ray detector less sensitive.

Fifteen years into the development of a US$2-billion experiment to detect cosmic rays, its designers have abruptly changed course. Less than six months before the Alpha Magnetic Spectrometer (AMS) is due to fly out to the International Space Station, they swapped the superconducting magnet at the heart of the seven-tonne particle detector for a weaker, permanent magnet. AMS researchers say the swap will preserve the sensitivity of the experiment and extend its lifetime. But some physicists say that problems with the superconducting magnet forced the swap, and fear that it could hamper the ability of the AMS to find evidence of dark matter, thought to make up 85% of the Universe's mass.

Designed to measure the properties of cosmic rays — high-energy particles reaching Earth from space — the AMS is the brainchild of Nobel-prizewinning physicist Samuel Ting of the Massachusetts Institute of Technology in Cambridge (*Nature* **455,** 854–857; 2008). Such cosmic rays might be produced by collisions between dark-matter particles. The project, an international collaboration led by the US Department of Energy, won the support of NASA administrator Dan Goldin in 1995, but looked as if it might be dropped after the Space Shuttle Columbia disaster in 2003. The administration of former US president George W. Bush reinstated it two years ago, but it will now miss its scheduled July shuttle flight and is instead likely to take off in the autumn.

According to Ting, the decision to switch the magnets, which are needed to discriminate between different kinds of cosmic-ray particle according to their charge and momentum, was taken after the present US administration said it would like to extend the life of the space station from 2015 to 2020, or perhaps even 2028.



NASA

The Alpha Magnetic Spectrometer (circled) will perch on the International Space Station.

Poor resolution?

The liquid-helium coolant required to keep the superconducting magnet at its operating temperature of 2 °C above absolute zero would run out after no more than three years. Ting's team have calculated that the weaker permanent magnet will require more data to identify particles with the same level of precision as its superconducting counterpart. But, they say, the permanent magnet's longer running time will more than make up for this loss of resolution.

In reality, Ting and his colleagues may have had little choice. In February, while testing the detector with particle beams at CERN, Europe's particle-physics laboratory near Geneva, Switzerland, the collaboration observed the magnet warming up unexpectedly during operation. Ting says that space-readiness tests of the detector subsequently made at the European Space Research and Technology Centre in Noordwijk, the Netherlands, showed that in the lower pressure and gravity of orbit warming would be reduced and would not be a problem.

But collaboration member Martin Pohl, a physicist at the University of Geneva, says that although one of the models used to test the detector at Earth-orbit conditions showed that there would be no significant warming, another showed that consumption of helium coolant would increase, shortening the lifetime of the experiment to less than two years.

The AMS team plans to carry out more beam tests in August at CERN with the permanent magnet, which was originally used in a pilot flight aboard a US shuttle in 1998. Some warn that making the switch to the magnet this late on could compromise the detector. "Testing and verification is a very exacting process and you really shouldn't be rushing it," says Bob O'Dell, the first project scientist of NASA's Hubble Space Telescope, now at now at Vanderbilt University in Nashville, Tennessee. "The risk is that they fail to find everything that could go wrong or, more seriously, things that have gone wrong."

Even assuming that the magnet does work as planned, Gregory Tarlé, an astrophysicist at the University of Michigan at Ann Arbor, says that the collaboration has overstated the scientific capability of the new configuration.

In 2008, the Italian-led PAMELA satellite provided tentative evidence of dark matter in the Milky Way, when it observed what looked like an excess of positrons (anti-electrons) at high energies — which would be given off when two dark-matter particles collide. Ting's team says that, over the 18 years that the space station might now fly, changes that they have made to silicon trackers inside the detector will increase the chances of detecting such positrons by four to six times, depending on the energy of the particles. The PAMELA data extended up to about 150 gigaelectronvolts, whereas the AMS, says Ting's team, will be able to go all the way up to 1 teraelectronvolt (TeV), so extending the search considerably. But Tarlé disagrees. "Ting's claim that he will still be able to identify positrons up to 1 TeV with the weaker permanent magnet is laughable," he says.

But would the team have gone to the trouble and expense of developing the superconducting magnet if they had the idea with the silicon trackers earlier? "That is hard to say," says Ting. "I try to look forward and not to look back." ■

Edwin Cartlidge