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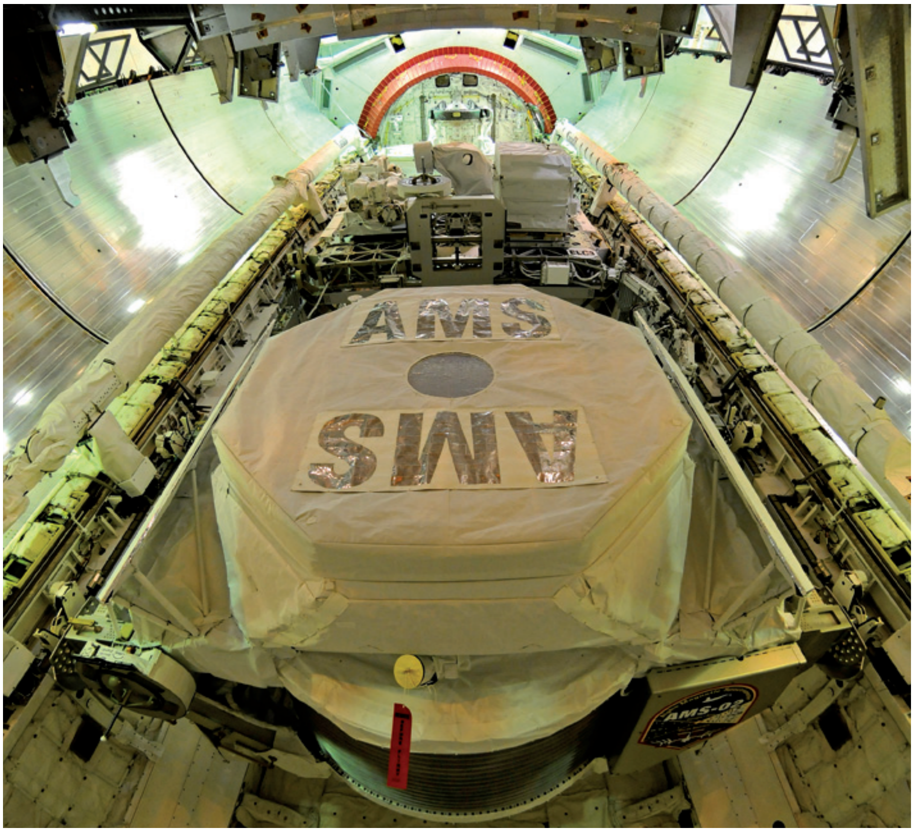

M. FAMIGLIETTI/AMS COLLABORATION

The Alpha Magnetic Spectrometer will ride to orbit in the space shuttle *Endeavour*'s cargo bay.

ASTROPHYSICS

Antiuniverse here we come

A controversial cosmic-ray detector destined for the International Space Station will soon get to prove its worth.

BY EUGENIE SAMUEL REICH

The next space-shuttle launch will inaugurate a quest for a realm of the Universe that few believe exists.

Nothing in the laws of physics rules out the possibility that vast regions of the cosmos consist mainly of antimatter, with antigalaxies, antistars, even antiplanets populated with antilife. "If there's matter, there must be antimatter. The question is, where's the Universe made of antimatter?" says Samuel Ting, a Nobel-prizewinning physicist at the Massachusetts Institute of Technology in Cambridge, Massachusetts. But most physicists reason that if such antimatter regions existed, we would have seen the light emitted when the particles annihilated each other along the boundaries between the antimatter and the matter realms.

No wonder, then, that Ting's brainchild, a US$2-billion space mission sold partly on the promise of looking for particles emanating from antigalaxies, is fraught with controversy. But the project has other, more mainstream scientific goals. So most critics held their tongues last week as the space shuttle *Endeavour* prepared to deliver the Alpha Magnetic Spectrometer (AMS) to the International Space Station, in a flight delayed by shuttle problems until later this month.

PUSHING THE BOUNDARIES

Seventeen years in the making, the AMS is the product of former NASA administrator Dan Goldin's quest to find remarkable science projects for the space station and of Ting's fascination with antimatter. Funded by NASA, the US Department of Energy and a consortium of partners from 16 countries, it has prevailed despite delays and technical problems, and the doubts of many high-energy and particle physicists.

"Physics is not about doubt," says Roberto Battiston, deputy spokesman for the AMS and a physicist at the University of Perugia, Italy. "It is about precision measurement." As their experiment headed to the launch pad, he and other scientists were keen to emphasize the AMS's unprecedented sensitivity to the gamut of cosmic rays that rain down on Earth. That should allow it not just to detect errant chunks of antimatter from the far Universe, but also to measure the properties of cosmic rays, the high-energy, charged particles flung from sources ranging from the Sun to distant supernovae and γ-ray bursts.

On Earth, cosmic rays can only be detected indirectly, from the showers of secondary particles they produce when they slam into molecules of air high above the ground. From space, the AMS will get an undistorted view. "We'll be able to measure cosmic-ray fluxes very precisely," says collaboration member physicist Fernando Barão of the Laboratory of Instrumentation and Experimental Particle Physics in Lisbon. "The best place to be is space because you don't have Earth's atmosphere ▶

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For more on Samuel Ting and the AMS, see: go.nature.com/m9unz8

that is going to destroy those cosmic rays." No matter what happens with the more speculative search for antimatter, the AMS should produce a definitive map of the cosmic-ray sky, helping to build a kind of astronomy that doesn't depend on light.

The AMS consists of a powerful permanent magnet surrounded by a suite of particle detectors. Over the ten or so years that the experiment will run, the magnet will bend the paths of cosmic rays by an amount that reveals their energy and charge, and therefore their identity. Some will turn out to be heavy atomic nuclei, and any made from antimatter will reveal themselves by bending in the opposite direction from their matter counterparts (see 'Looking for cosmic curveballs').

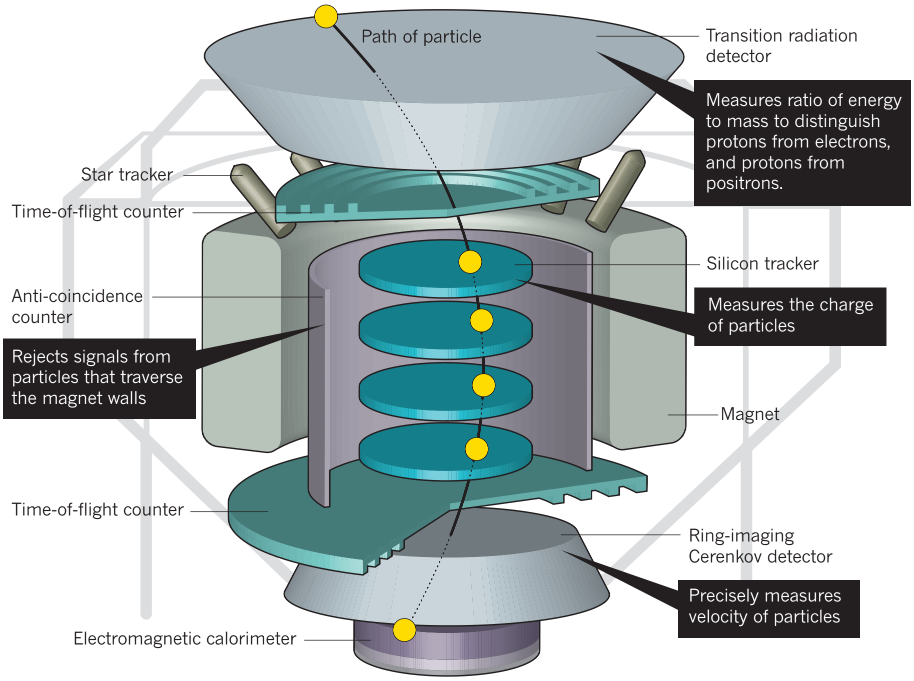
By counting positrons — antimatter electrons — the AMS could also chase a tentative signal of dark matter, the so-far-undetected stuff that is thought to account for much of the mass of the Universe. In 2009, researchers with the Russian–Italian Payload for Antimatter Matter Exploration and Light-nuclei Astrophysics, flying on a Russian satellite, published evidence of an excess of positrons in the space environment surrounding Earth (O. Adriani *et al. Nature* **458,** 607–609; 2009). One potential source is the annihilation of dark-matter particles in the halo that envelops the Galaxy.

Another speculative quest is to follow up on hints of 'strange' matter, a hypothetical substance, perhaps found in some collapsed stars, that contains strange quarks along with the up and down quarks in ordinary nuclei. NASA's AMS programme manager, Mark Sistilli, says that hints of strange matter were seen in a pilot flight of the AMS aboard the shuttle in 1998, but that the results were too tentative to publish.

Thanks to its status as an exploration mission, the AMS did not need to go through the peer review that NASA would normally require of a science mission. But Sistilli emphasizes that it earned flying colours from committees convened by the energy department, which is supplying $50 million of the funding. Now their confidence will be put to the test. ■

LOOKING FOR COSMIC CURVEBALLS

The toroidal magnet at the heart of the Alpha Magnetic Spectrometer bends the path of charged, high-speed particles, helping researchers to identify them.



SPACE FLIGHT

China unveils its space station

Plans for modest outpost solidify 'go it alone' approach.

BY DAVID CYRANOSKI

The International Space Station (ISS) is just one space-shuttle flight away from completion, but the construction boom in low-Earth orbit looks set to continue for at least another decade. Last week, China offered the most revealing glimpse yet of its plans to deploy its own station by 2020. The project seems to be overcoming delays and internal resistance and is emerging as a key part of the nation's fledgling human space-flight programme. At a press briefing in Beijing, officials with the China Manned Space Engineering Office even announced a contest to name the station, a public-relations gesture more characteristic of space programmes in the United States, Europe and Japan.

China first said it would build a space station in 1992. But the need for a manned outpost "has been continually contested by Chinese space professionals who, like their counterparts in the United States, question the scientific utility and expense of human space flight", says Gregory Kulacki, China project manager at the Union of Concerned Scientists, headquartered in Cambridge, Massachusetts. "That battle is effectively over now, however, and the funds for the space station seem to have been allocated, which is why more concrete details are finally beginning to emerge."

Significantly smaller in mass than the ISS and Russia's Mir space station (see 'Rooms with a view'), which was deorbited in 2001, the station will consist of an 18.1-metre-long core module and two 14.4-metre experimental modules, plus a manned spaceship and a cargo craft. The three-person station will host scientific experiments, but Kulacki says it also shares the broader goals of China's human space programme, including boosting national pride and China's international standing.

The space-station project will unfold in a series of planned launches over the next ten years. Last Friday, official state media confirmed that the Tiangong 1 and Shenzhou 8 unmanned space modules will attempt a docking in orbit later this year, a manoeuvre that will be crucial for assembling a station in orbit. If that goes well, two manned Shenzhou craft will dock with Tiangong 1 in 2012. China will then move on to proving its space laboratory capabilities, launching Tiangong 2 and Tiangong 3, which are designed for 20-day and 40-day missions, respectively, over the next 3 years. Finally, it will launch the modules that make up the station.