Panorama

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NASA's costly quest for the heart of the cosmos

By Dennis Overbye

After 16 years and $1.5 billion of other people's money, it is almost showtime for NASA and Sam Ting.

Sitting and being fussed over by technicians in a clean room at the Kennedy Space Centre in preparation for a February launching – and looking like a giant corrugated rain barrel for all the world – is an eight-ton assemblage of magnets, wires, iron, aluminum, silicon and electronics that is one of the most ambitious and complicated experiments ever to set out for space.

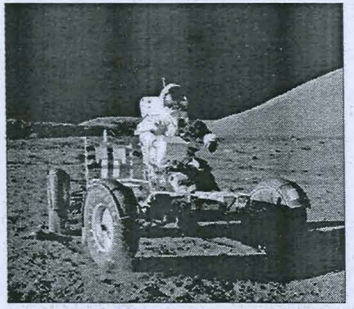
The experiment, if it succeeds, could help NASA take a giant step toward answering the question of what the universe is made of. It could also confer scientific glory on both the International Space Station and a celebrated physicist reaching one last time, literally, for the stars. If it fails, it will validate critics who think it a scandal the experiment was ever approved.

The device, named the Alpha Magnetic Spectrometer, is designed to sift the high-energy particles flying through space known as cosmic rays. On Feb 27, the space shuttle Endeavour will ferry the spectrometer to a permanent berth on the space station. But the real destination is the shadow universe.

You might think that the universe is made of atoms and molecules, protons and electrons, stars and galaxies – something you learned in high school. That notion has been turned on its head over the past few decades as astronomers have concluded – not happily – that all this is just a scrim overlying a much vaster shadowy realm of invisible 'dark matter' whose gravity determines the architecture of the cosmos.

If they are lucky, scientists say, the spectrometer could confirm that mysterious signals recorded by other satellites and balloons in recent years are emanations from that dark matter, revealing evidence of particles and forces that have only been theoretical dreams until now.

Even if dark matter won't ever become



the ultimate diet – eat it and disappear – knowing what nature is made of could be useful someday in ways nobody can dream. Einstein's curved spacetime, equally elusive to the senses, proved crucial to the function of GPS devices that were invented decades after his death.

Or the device could find even something weirder.

"Real discovery is outside the ring of existing knowledge," said Samuel Chao Chung Ting, a professor at the MIT and the leader of the cosmic ray project, in his laboratory at CERN outside Geneva in August.

A few yards away, the hulking spectrometer was sitting in a test frame, being pinged by a beam of protons in final tests before being shipped to Cape Canaveral.

Physics revolutionised

Dr Ting, the 74-year-old Nobel laureate and one of science's great control freaks and worrywarts, has spent his life commanding armies of physicists. In 1974 he discovered a particle that would revolutionise physics, but he took so long checking for errors and looking for more particles that another lab found it and he wound up splitting the Nobel.

In 1994, Ting told Dan Goldin, then NASA's administrator, that he could make the measurement with a space-based cosmic ray detector. Goldin was instantly smitten and agreed to put the spectrometer on the International Space Station, which was desperately lacking scientific credibility. In doing so, Goldin bypassed the agency's normal peer-review procedures and set off resentment among other cosmic-ray physicists that still lingers.

Part of the lure was that the space agency would not have to pay for it. The bulk would be paid for by Ting's army of collaborators abroad, which grew to 600 scientists from 16 countries, including Italy, Germany, Russia, China and Taiwan.

After the shuttle Columbia disintegrated in 2003, killing its crew of seven astronauts, Ting's fortunes took a turn for the worse. NASA decreed an early end to the shuttle era, and the Alpha spectrometer was dropped from the flight manifest. Ting fought back. In 2005, invited to address a Senate committee on the state of US science, he used his five minutes and nine transparencies to mount a rousing defence of basic science and of his experiment.

"They were surprised to hear that the space station can do good science," Ting recalled.

In the following years powerful senators like Ted Stevens of Alaska, Bill Nelson of Florida and Kay Bailey Hutchinson of Texas sat through Ting's PowerPoint shows or visited the project at CERN. In the end, Congress ordered NASA to provide an extra shuttle flight for the experiment. "Three days after Barack Obama's inauguration, we were back on the manifest," Ting said.

But Ting has faced a lot of criticism. "The original goal has evaporated," said Greg Tarle, a cosmic-ray physicist at the University of Michigan and longtime critic of the experiment. Instead, the heavens were crackling with intimations of dark matter. Two years ago a European satellite named Pamela registered an excess of anti-electrons, or positrons, in space – perhaps from collisions of dark matter particles.

But that satellite had no way to tell positrons, which are exotic, from protons, which are humdrum, being the nuclei of hydrogen, and everywhere. The Alpha spectrometer does. "It will tell us whether these things are there or not," said John Ellis, a CERN theorist.

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