VOLUME 08 ISSUE 03
OCTOBER 11

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Mission control CERN: Inside the AMS-02 command center

October 7, 2011 | 1:58 pm

Inside the AMS control center. Image: CERN

Physicist Mike Capell pointed to a display screen showing images of a semi-cylindrical detector. Every few seconds one or two straight lines appeared, seeming to slice the detector lengthwise.

“That’s particles going through right now,” he said.

The event display, located in the control room for the Alpha Magnetic Spectrometer, or AMS-02, shows cosmic rays passing through the experiment’s particle detector as they fly through space. At the control center, located at CERN’s site in Prevessin, France, Capell is in charge of operations for a team of scientists who rotate in eight-hour shifts, 24 hours a day. They plan to do this for 20 years.

Right now, though, they’ve only just begun. The center opened in June. It still smells like fresh paint.

For most people, CERN probably brings to mind the 27 kilometers of tunnels and magnets that make up the Large Hadron Collider. However, not all the detectors at the European center lie underground. AMS-02, by far the largest fundamental particle physics experiment in space, orbits the Earth as an appendage of the International Space Station. There it detects charged cosmic rays, searching for antimatter and hoping to measure the mass of dark matter in a way impossible to do from beneath our planet’s 60 miles of particle-scattering atmosphere. AMS-01, the experiment’s precursor, flew for 10 days in 1998 on the shuttle Discovery.

The control center at CERN is serene and hushed. Most of the eight people working wear headsets connecting them to Marshall Space Flight Center. If they aren’t directly speaking with the Marshall crew, they are listening in on a constant chatter including communications with the ISS astronauts. “That means we don’t like a lot of ruckus,” Capell said.

The workroom is spacious with a two-story ceiling and tall windows on the sides. Large framed photos of AMS-02 construction and shots of the launch and shuttle make up the decor. At the far end, a live feed from NASA dominates the wall, showing the current position of the ISS over a day/night map of the world. This indicates when the station will lose radio contact with researchers on the ground, which happens periodically due to both its relative location to communication satellites and its position in Earth's nonuniform magnetic field, a potential signal-jam.

Losing radio contact is not the only complication of running the AMS-02 experiment. The detector includes modifications that keep the experiment running through radiation and extreme temperature fluctuations in space. Dealing with the latter condition is so important to the mission that one person working in the control room is dedicated full-time to monitoring and adjusting the detector's thermal equipment.

The scientists on shift work at computer stations arranged in a U shape around the room. They are physicists, grad students and postdocs. Most come from LHC experiments, and those who do not are likely to join such experiments, should they leave AMS-02 in the future.

Thirteen people were simultaneously on duty at the control center when post-launch operations first moved from Johnson Space Center to the new site at CERN. Soon Capell realized this was unnecessary. "Everything's been going just like a clock," he said. He cut the shifts to five people, with one person often monitoring multiple sub-detectors alone. "It's not as frantic as I expected it to be."

One operator in the control center watched a feed from a webcam on the ISS in the corner of her busy computer screen. In the hours when the astronauts sleep, the webcam points Earthward, away from the dreamers. The view of oceans rolling slowly past made for a small window of Zen among a chaotic collection of code.

The AMS-02 team uses these hours to download data in order to avoid excess competition for bandwidth with the other experiments on board the ISS. Keeping up with the data flow is one of the critical functions of the control center, said AMS-02 project manager Trent Martin from his NASA office in Houston. "At times we take as much as one third the bandwidth coming down from the space station."

Since AMS-02 docked with ISS in May, it has been collecting data on billions of events. "This is laughable by LHC standards," Capell said, "but in terms of cosmic rays, this is absolutely groundbreaking." The experiment is the biggest and will be the longest running of its kind, observing particles at the highest energies and masses in history as they naturally occur.

The U.S. Department of Energy provides most of the U.S. scientific funding for AMS-02, covering about 5 percent of the experiment's costs. Universities and institutes in 16 different countries provide the rest of the funding, as well as more than 600 physicists and engineers led by Nobel Laureate Professor Sam Ting of the Massachusetts Institute of Technology. CERN built the control center as part of its contribution to the experiment. NASA provided shuttle transport and continues to provide technical and safety support for the mission.

"This is by far the largest [collaboration] we've worked on at NASA," Martin said. So many people were involved with AMS-02, he said, that, through rough times over the 17 years of preparation for launch, the project never collapsed. "They still believed in the science."

Amy Dusto

Posted in astrophysics |
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One Response to “Mission control CERN: Inside the AMS-02 command center”

1. *kfir blum* Says:
   October 22nd, 2011 at 2:10 pm

   Nice article. Does anyone know when we should expect data release?

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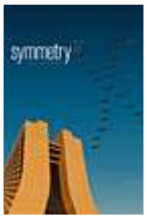
• *symmetry* magazine

volume 08 | issue 03 | october 11



On the cover:
As *symmetry* celebrates its 50th issue, big changes are afoot at Fermilab. The lab's Tevatron Collider, once the most powerful particle collider in the world, is shutting down, and a new project is on the horizon: Project X. This proposed $1.8 billion accelerator complex would keep Fermilab at the forefront of high-energy physics, this time at the Intensity Frontier—a realm in which scientists bring incredible numbers of particles into collision to search for extremely rare processes with a big physics impact. It's exactly the kind of place where discoveries may lie. See "Solving for X". *Photo illustrations: Reidar Hahn, Fermilab and Sandbox Studio*

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