electrolytic cells to produce pure aluminum.

Uncertain US landscape

How the US will respond to Merkel's entreaty this June to join the EU pact or whether it will enact more stringent legislation in the future is unclear. Representatives from the US State Department did not return telephone calls, but environmental experts were less than optimistic.

"The US would be likely to veto a cap [on emissions] if a bill came forward," predicted Matt Banks, senior program officer with WWF's climate change program in Washington, DC. "The administration is in a very different place than the American people are on the issue. It's clear the country is ready to act—the majority of Americans realize climate change is here and want federal action."

A new international poll conducted by the BBC found that 57% of Americans are concerned about global warming. The percentage is higher in most other countries. Two-thirds of all respondents "blame the US before any other country" for climate change, the poll found.

Global warming models paint a less-than-rosy picture. In the first installment of a report released in February, the IPCC warned that temperatures might rise far more than 2 °C, the level to which the EU pact seeks to limit global warming. The IPCC's second installment, released in April, predicted that almost one-third of the world's plant and animal species could be eradicated and said that alteration of the world's weather systems could change rainfall patterns, unleash more violent storms, and increase the risk of drought, flooding, and water shortages. The third installment, due in May, will address how the worst consequences might be prevented.

Yet change may be afoot in the US with a Democratic Congress in place. In a surprise move, the US Supreme Court ruled in early April that the Environmental Protection Agency violated the Clean Air Act by declining to regulate new-vehicle emissions standards to control the pollutants that scientists say contribute to global warming.

The high court's ruling could lend weight to attempts by states to force the federal government to cut greenhouse gas emissions or to be allowed to do it themselves. According to the Pew Center for Climate Change, 15 states have set targets for emissions reductions and a 16th is expected to do the same later this year while Washington, DC, and 23 states have set standards specifying that electric utilities generate a certain amount of electricity from renewable sources. In the meantime, House Democrats have said they expect to pass global warming legislation by early July, and Senate leaders are working on a similar bill. **Karen H. Kaplan**

New chief vows to reinvigorate Italian space activities

As president of Italy's space agency, Giovanni Bignami aims to revive the country's satellite program and strengthen ties to other space agencies.

"I don't think the international community realizes how bad it's been for science in Italy," says University of Florence astrophysicist Franco Pacini, former president of the International Astronomical Union. "In the last three or four years, there has been a systematic hostility to science. If you add to that the economic crisis, it's a general scenario which is very difficult."

The demise of Silvio Berlusconi's government last year has sparked hopes that science will become a higher priority, although it's too early to be sure. One bright spot is the appointment of Giovanni (Nanni) Bignami to head the Italian Space Agency (ASI). The high-energy astrophysicist is the first scientist to head the agency. Indeed, says Pacini, who served on the search committee, it was a good sign that all three finalists for the job were scientists. In recent years, he adds, "there has been a poverty of scientific programming [at ASI]. We need people like Nanni who have lots of energy—sometimes he has too much! We need someone who will shake up the system."

Bignami, who at press time was expected to be installed as president in late April, served as ASI's director of science from 1997 to 2002. After that, he became director of the Centre d'Étude Spatiale des Rayonnements in Toulouse, France, and also chaired the space science advisory committee of the European Space Agency (ESA). He is on leave from the University of Pavia.

Bignami's appointment "marks a real change in attitude, which is good for science," says Luciano Maiani, a particle physicist at the University of Rome I ("La Sapienza") and former director general of CERN. "First of all, I am sure he will put in shape the collaboration with the European Space Agency, which has been wrongly tuned down in the past years—it's as if in particle physics Italy would try to become independent of CERN, a real nonsense." Italy's previous government played down European collaborations in general, Maiani adds. "I considered it a mistake."

Shortly after his nomination, Bignami spoke to PHYSICS TODAY about his plans for ASI.

PT: What is ASI known for?

Bignami: Italy has launched about 20 satellites—many since ASI was formed [in 1988]. The first one was launched in 1964—we were the third nation, after the USSR and the US, to launch a satellite. ASI has accomplished some significant scientific results. The most spectacular was the *BeppoSAX* mission, which discovered the origin of gamma-ray bursts.

Another achievement was the *Lageos* [*Laser Geodynamics Satellite 2*] mission, a collaboration with NASA. It's a passive satellite, a sphere covered with mirrors, orbiting the Earth at 12 000 kilometers. With a laser beam, you hit it, and the laser beam bounces back, and you measure very accurately the time propagation delay of the signal, out of which you measure all sorts of interesting general relativity effects.

And currently in collaboration with the US [and others], there is the *Swift* gamma-ray burst mission. A significant part of the payload, namely the x-ray telescopes, is from Italy, supported by ASI. And a significant fraction of the data collection goes through the Italian ground station at Malindi in Kenya.

There you have the past and the present. In the immediate future, there will be the launch of the *AGILE* mission, which is dedicated to gamma-ray astronomy.

PT: What are your priorities at ASI?

Bignami: On the one hand, it's inevitably more of the same, in that priorities of space are always science, always applications for the good of citizens. But beyond these generalities, there are some focused activities.

I want to reconsider the position of Italy within ESA. For various reasons, Italy's presence in ESA has been eroded in the last years. The scientists and Italian industry have not been financed or supported to do what they could for ESA. This doesn't sound sexy from a


Giovanni Bignami

journalistic point of view, but it's of big relevance in the European context.

Within ESA, we now face the fact that easy access to the space station is coming to an end—the shuttle program ends in 2010. So I shall focus on a program with a vision to follow it. This will probably be an exploratory program for the planetary system.

The other all-important point is to reestablish a serious relationship with NASA as a sister or mother agency, and in general with US collaborators. Here, there is a lot of work to be done. One major issue is the AMS [Alpha Magnetic Spectrometer; see the story on page 30]. Italy put about 20% into it. The goal is to discover primordial antimatter, if there is any. And if [AMS] doesn't go into orbit, it's of no use. The other collaborations that have to be revived are the planetary exploration program and the astronomy exploration program, in which Italian astronomers have fallen a bit behind.

And it's equally important to revive a series of small scientific satellites.

PT: Revive?

Bignami: Yes. In the last five years, ASI has not launched any satellites. None. The business of a space agency is to fly satellites. I want to revive the small scientific satellites, in the class of *AGILE*—that is, missions that have a cost smaller than €100 million [$133 million], and to launch at a rate of maybe one satellite every two years.

PT: Given that NASA has let down its collaborators on the AMS and other projects, and that it is so focused on building a station on the Moon and on manned visits to Mars, would you trust NASA at this point to keep to the collaborations it commits to?

Bignami: Yes. Many people in Europe consider the fact that NASA is not doing many parts of science they used to as freeing a niche of activities. So we can decide for once to take the initiative, and the US community can join in. There is splendid potential for collaborations, in terms of dark matter explorers, in terms of gravitational-wave projects—all things that realistically can hardly be done by NASA alone in the context you mention.

PT: What's your view of the US's Moon–Mars vision?

Bignami: I honestly have difficulties understanding the situation. Seen from the outside, it's confusing because it's changing so rapidly. I will fly to Washington to get a good feeling.

PT: What about collaborations with other space agencies?

Bignami: With France we now have in mind the first-ever formation flying of two satellites. One satellite will host the optics for x rays, and the other one the focal plane instrumentation. *XMM* [*X-Ray Multi-Mirror*] and *Chandra* have focal lengths of just a few meters, which is a lot if you need a rigid structure. But if you abandon the idea of a rigid structure and you can keep the two satellites positioned accurately in controlled formation flying, then you can put the focal length at 40 meters, and this allows you to reach much higher energies of x rays. We are just kicking this off. We will possibly launch it five or six years from now.

I'd like to establish similar bilateral arrangements with both Germany and Britain. I'm sure we will also collaborate more and more with the Chinese, who are coming up strong in space. It's much easier to start collaborations through scientific projects—they're not political, they're not commercial, they're not military. It's a clean, straightforward interface between scientists.

PT: What is ASI's budget, and how is it divided?

Bignami: Roughly speaking, ASI's budget is about €800 million a year; €400 million or so goes to ESA. The rest is for the national effort, which is divided into several branches. Italy has a vigorous launcher development

program with ESA around the Vega rocket. There is a big Earth observation program. Then, of course, there is the effort in the space station. In a few months, another Italian astronaut will go to the station.

PT: What do you see as the greatest challenges facing you?

Bignami: Flying missions. We need a vision at ASI, immediately, and we need to start implementing it. We need to redefine Italy's role in ESA. And, thinking ahead to the next meeting of ESA at the ministerial level, which will be in 2008—coinciding with the 20th anniversary of ASI—I will lobby for Russia to join ESA.

Toni Feder

NASA cancels science flight, ditches international partners

A 12-year project to build a billion-dollar particle-physics lab in space is grounded unless someone comes up with at least $380 million.

Sam Ting walked into a meeting with PHYSICS TODAY last month with an entourage of high-powered scientists from nuclear physics labs across Europe and Asia. They were there to go to bat for the Alpha Magnetic Spectrometer (AMS), the experiment spearheaded by Ting, an MIT particle physicist. Despite the AMS being NASA's main science justification for completing the International Space Station (ISS), the agency announced in February that it has put the experiment's flight on the chopping block.

By detecting high-energy charged cosmic rays in space, the AMS might discover unknown pulsars and x-ray sources and observe dark matter (see PHYSICS TODAY, February 2003, page 30). Above all, it might solve the *CP* violation problem: Where is the universe's antimatter? "No one has ever measured primordial antimatter. . . . It would be another Nobel Prize for Sam Ting," says Giovanni Bignami, the newly nominated president of the Italian Space Agency (see the story on page 28). "No matter how large an accelerator you make, you are never going to reach the same high energies as you get with cosmic rays," says Ting, adding that it's impossible to know what the AMS might discover. "Nearly every major science experiment, such as the *Hubble Space Telescope* [*HST*] or the Tevatron at Fermilab, found major unexpected discoveries that the machines were not originally designed to study."

A long campaign

Ting first proposed the AMS in the early 1990s, when the US physics community was still reeling from the cancellation of the Superconducting Super Collider. He persuaded the Department of Energy's Office of Science to support the experiment, and NASA to ferry the AMS to the ISS and to provide power and communications. CERN agreed to provide free assembly space and logistics support. Some 16 countries—including both China and Taiwan—signed on, and 95% of the experiment's $1.5 billion construction costs were paid by space agencies, national funding agencies, and universities from across Europe and Asia. The DOE provided $30 million. So far NASA has invested $55 million, mainly toward building a transport cradle for the space shuttle.

In 1998 a 10-day flight of a prototype proved that one could isolate the powerful magnets in the detector from interference of Earth's magnetic field, which is vital for detecting charged cosmic rays. The test flight also discovered helium fluxes in the magnetosphere that behave in ways not predicted by cosmic-ray models, says Ting. The prototype used permanent ferromagnets; the final version has liquid-helium-cooled superconducting magnets. Once assembled, the AMS will also have four times as many detectors as the prototype and incorporate recent advances to shrink the detector—with its more than 300 000 detection channels—to only a 3-meter cube. "The detector is complex even by terrestrial standards," says Switzerland's AMS team leader, Maurice Bourquin, former rector of the University of Geneva.

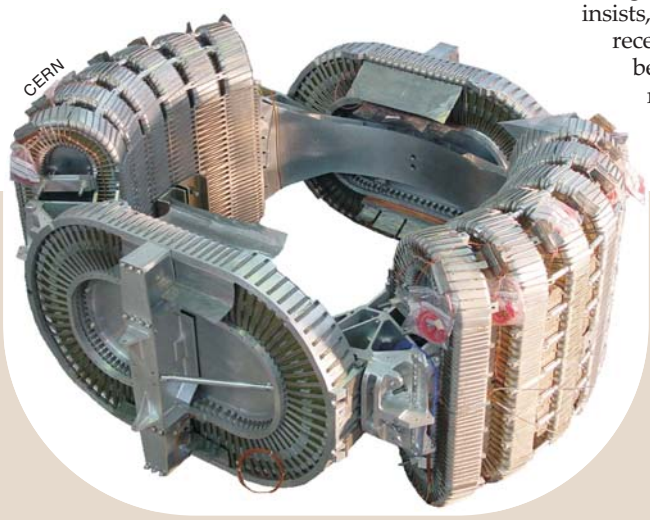
A DOE review last year concluded that the justification for continuing with the project was undeniable. "Plans should be made to place [the AMS] onto the space station, in order for it to carry out its promising science," the review says. "I recognize that NASA has shifted priority to Moon–Mars, but that doesn't justify walking away from flying this already built, expensive, and beautiful device," says Caltech's Barry Barish, who chaired the review. "I know of no other missions that are proposed to do this science."

Not giving up

NASA first warned in September 2005 that it might not fly the AMS. Following the *Columbia* accident in January 2003, the number of shuttle flights was curtailed. The shuttle is scheduled for retirement in 2010, and NASA has tagged the remaining flights for completing the ISS and sending a service mission to the *HST* (see PHYSICS TODAY, December 2006, page 33).

Late in 2005, NASA started feasibility studies for alternatives to sending the AMS to the ISS by shuttle. One possibility would be to use a US or Japanese rocket to launch the AMS in parallel with a shuttle launch. After dropping supplies off at the ISS, the shuttle would pick up the AMS and deliver it to the station. This proposal, however, is running against the clock. NASA would have to start work immediately to be able to launch the AMS at the time of the last two shuttle flights, and it hasn't got the money, says Mark Sistilli, the NASA AMS project manager. Nonetheless, he insists, "We fully expect to receive AMS in December 2008 and get it ready for flight."

Another option would be to fly



At the heart of the Alpha Magnetic Spectrometer is a superconducting magnet that will produce a field 20 000 times stronger than Earth's.