SPACE SCIENCE

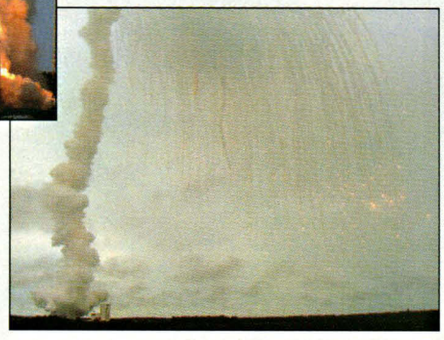
Ariane Failure Casts Shadow Over ESA's Science Program

BRUSSELS—As the Ariane 5 rocket blasted off from the Kourou space center in French Guyana for its maiden flight on 4 June, hundreds of space scientists held their collective breath. Atop Europe's newest launcher was a collection of four identical satellites designed to study Earth's magnetosphere in exquisite detail (*Science*, 24 May, p. 1095). The mission, called Cluster, was to be part of the first large "cornerstone" mission of the European Space Agency's (ESA's) ambitious Horizon 2000 program, and teams of researchers across the world had spent the best part of a decade preparing for this day.

Ariane 5 rose flawlessly in a blast of orange fire. But 37 seconds into the flight, something went terribly wrong. The nozzles on both solid boosters swiveled sideways, causing the launcher to tilt sharply. It was then streaking through the atmosphere at close to the speed of sound, and the abrupt change of course subjected it to stresses that the vehicle wasn't designed to withstand. It was automatically destroyed in a huge explosion followed by a rain of debris. "At first, I couldn't believe it," says Rudolf Schmidt, Cluster's project scientist at the European Space Research and Technology Centre in Noordwijk, the Netherlands. "I associated each item of debris with things we have done for the mission, the instruments, our new data system, our new science operations concept ... all these jobs for these young scientists."

It wasn't just the hopes of participants in the Cluster mission that were riding on Ariane 5 last week. The new launcher, designed for lifting up to 5.9 tons into a geostationary orbit—1.1 tons more than Ariane 4—is planned to be the main vehicle for Europe's commercial space efforts and the workhorse of ESA's space science program. It is scheduled to carry the X-ray Multi-Mirror Mission in 1999; the Far Infrared and Submillimeter Space Telescope in 2005; and Rosetta, which is scheduled to rendezvous with the comet Schwassmann-Wachmann, in 2010. And it is also expected to launch the Automated Transfer Vehicle, the "space tug" for transporting modules to the International Space Station. Whether last week's disaster will affect the timing of these missions will depend on what caused the malfunction, how soon Ariane 5's launch schedule can be resumed, and whether ESA succeeds in resurrecting all or part of the Cluster mission for a later launch.

A board of inquiry set up by ESA and CNES, the French space agency, is conducting an investigation into the disaster and is scheduled to report by 15 July. Preliminary indications, based on the simultaneous deflection of both nozzles, point to a fault in the control system rather than mechanical failure in the propulsion systems. Many believe the culprit will turn out to be a software error.



PHOTOS BY PATRICK H. ERTZOG/AFP

Shattered dreams. Years of planning for the Cluster mission ended in a fiery explosion 37 seconds into Ariane 5's first flight.

While the engineers are trying to figure out what happened, the Cluster scientists are looking for ways to pick up some of the pieces of their project. "We have spent 10 years—even more—on this project," says Jean Michel Bosqued of the CNRS Laboratory for the Study of Radiation in Space at Toulouse, France, and co-investigator on the Cluster Ion Spectrometer. "But it is also the future of our project that has disappeared in the fireworks at Kourou."

Schmidt, who along with seven of the 11 principal investigators (PIs) of the project was in Kourou to witness the launch, says "a few minutes later, after the shock, we started thinking how to recover from this." Even before they left Kourou, Schmidt and his colleagues started meeting with ESA's scientific director, Roger Bonnet, to discuss possible options.

When Bonnet returned to ESA's headquarters in Paris last week, he told *Science* that difficult choices will have to be made if even a small part of the Cluster project is to be revived. Given the painstaking planning that has already gone into the Horizon 2000 program, Bonnet says it is unlikely that one of the upcoming missions could be replaced by a Cluster-type mission: "A large part of the research community would not go for this. On the other hand," he adds, "if we can find a way to develop a scaled-down but still interesting Cluster-type mission, requiring little funding, then we could think of postponing slightly some of the future missions."

Schmidt says a single Cluster spacecraft could be built within a year: "We have spare parts, spare assemblies, and spare instruments. But we do not have everything; we need to order a few things." One Cluster spacecraft would be great, agrees PI André Balogh of Imperial College in London: "Flying a single Cluster in almost any orbit will give good data, because the instruments are very much the state of the art."

But, says Balogh, such a mission would lack the element that would have made Cluster unique: the use of four spacecraft flying in formation and taking identical readings from different positions. This multiple imaging would have made it possible to map Earth's magnetic field in three dimensions. "We discussed a multispacecraft mission that would have the same objectives as we have defined for Cluster," says Schmidt. They concluded that there may be a chance of getting such a mission off the ground if ESA puts together one spacecraft from the spare parts of Cluster and national space programs can build the additional spacecraft.

The PIs are now sounding out the prospects for funding from their national programs to create a fleet of spacecraft, says Schmidt. He notes that such a " 'composite Cluster' would have different instruments, but we would take care to calibrate these instruments carefully." Most national space budgets are already under severe financial pressure, however, and it will take a hard sell—involving trade-offs with other space science programs—to squeeze out additional funding for Cluster. "Four satellites is a big expense. And the economic situation today is not what it was in 1985," says Bosqued.

The eleven PIs and Schmidt will meet in Paris with Roger Bonnet during the week of 17 June to prepare their input for a meeting of ESA's Science Program Committee and the Space Science Advisory Committee, to be held on 21 June. "We will present our conclusions to these two bodies and see what of sort of recommendations we get out of them," says Schmidt.

–Alexander Hellemans

Alexander Hellemans is a science writer in Brussels.