COMMENTARY

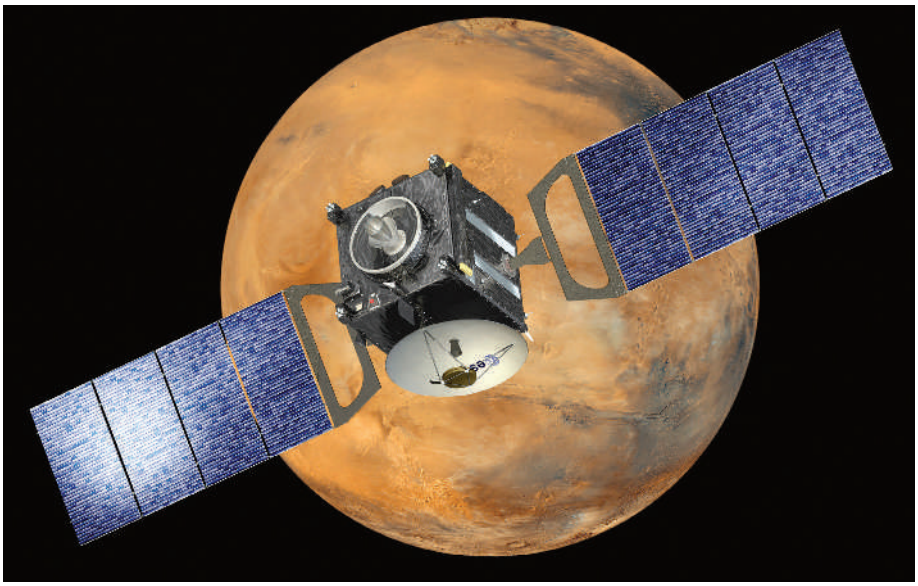
A fresh start for Europe's space agency

The European Space Agency has a strong track record and plenty of ambition to propel it into its next 30 years, says **Giovanni Bignami**. But key decisions must be made in the context of a new Europe.

Celebrations for the thirtieth birthday of the European Space Agency (ESA) began early when the Huygens probe landed on Saturn's moon Titan on 14 January. Another mark of European success in space science is that out of a fleet of 17 satellites operated by ESA, 15 are involved in scientific projects. A further satellite will soon be launched in the first European mission to Venus.

Of course, Europe has other space successes to celebrate: the 1975 COS-B gamma-ray telescope, with which ESA began; the Giotto mission sent to meet Halley's comet; the Hipparcos satellite that mapped the heavens; and much else besides[1]. The Ariane launcher, French-driven but solidly European, now dominates the world market in commercial satellite launches, and is a long way from Veronique, Blue Streak and Europa, the forgotten names of the first stages of European rocketry.

Today, ESA has a unique opportunity to explore the Solar System, especially if it can quickly shift its attentions beyond the International Space Station. And now is a good time for Europe to take the lead in a number of scientific endeavours, mostly in astronomy, that have been left open by NASA's change of direction towards exploration. Ambitions also reach well beyond space science: the Galileo programme for global positioning, and the Global Monitoring for Environment and Security Initiative are both due to be established by the end of 2008.



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Missions to Mars: building on the success of Mars Express, European scientists have set their sights on future missions to the red planet, to collect more clues about its atmosphere and surface.

Rallying support

But continued success will need continued investment. The United States has long understood the importance of investing in basic science in space. Despite the US gross national product being similar to Europe's, NASA's budget is more than five times ESA's, which today stands at €3 billion[2] (US $4 billion). Moreover, NASA's science programme accounts for 30% of its overall budget — rich by comparison with ESA's 12%.

Of the €1 million spent by ESA every day on science, more than 80% goes to industrial contracts. These are particularly cherished by Europe's aerospace industry; scientific projects generate industrial competitiveness and innovation[3].

As the European Union (EU) expands, ESA's membership grows; this year, it includes 17 nations. With the EU's science budget set to double over the next five years, we, Europe's space scientists, are conscious that the importance of our job goes beyond our community. But we also know we have to work with limited financial support. We are used to it: we don't complain, we get organized.

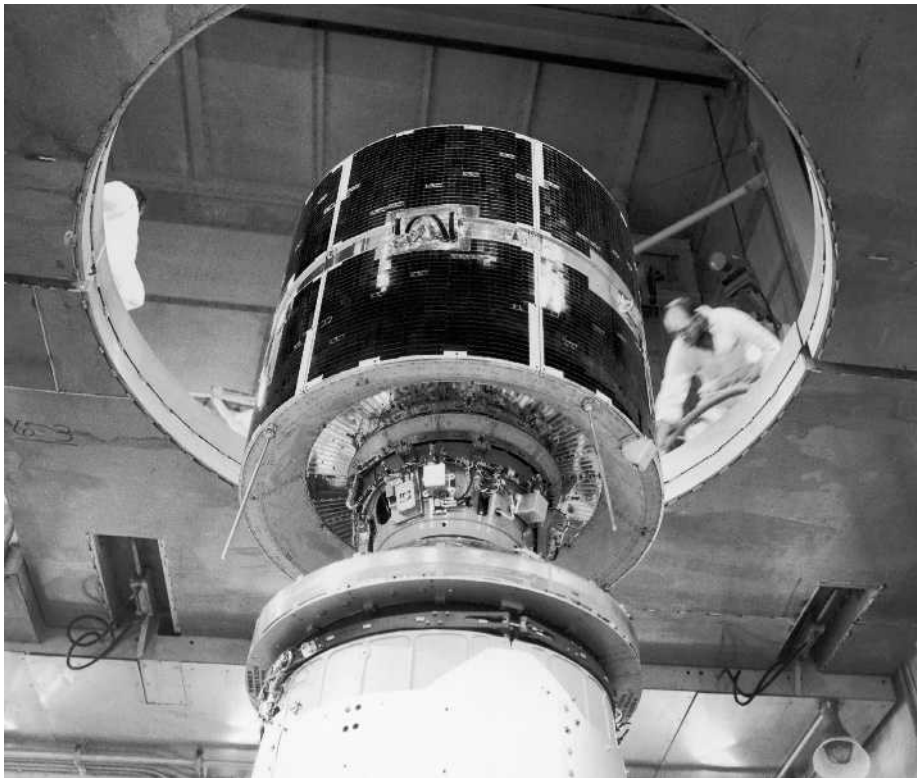
From 1984 to 2004, ESA science was guided by two ten-year plans; a third will take us to 2014. This third plan includes numerous missions whose aims range from studying Mercury to understanding the frontiers of cosmology. Like Soviet-style planners of yore, we are now building our fourth ten-year plan — Cosmic Vision 2015–2025. But unlike those of Soviet planners, this plan is built according to Abraham Lincoln's doctrine, "by the people, for the people".

In reaction to a request issued last year, 151 European groups entrusted their ideas to ESA. This is more than twice the number of groups that have responded previously, and indicates the increased number and diversity of European space scientists. Before the year is out, our Cosmic Vision plan, already discussed with the space-science community and approved by ESA's advisory structure, will be presented to ESA's council of ministers, who dictate the agency's financial portfolio. ESA's resources cover the 'mandatory science programme' as well as several optional programmes that range from Earth observation and telecommunications to the Space Station and Aurora (see below). For the mandatory programme, contributions from ESA-member states are made according to their gross national products; for the optional programmes, they are made à la carte.

Pooling efforts

What is in our 2015–2025 plan? The Cosmic Vision plan that was released in April is organized around four grand questions. These range from 'what are the conditions for planetary formation and the emergence of life?' to 'how did the early Universe originate and what is it made of?' Each of these questions prioritizes specific subjects for study, ranging from life and habitability in the Solar System to the evolving violent Universe. Starting from these objectives, strategies have been drawn up for possible space missions in astronomy, fundamental physics and solar-system sciences.

Cosmic Vision also includes a technology development plan that spells out how to get from these strategies to proto-missions — the concepts from which real missions will emerge. Examples of proto-missions include:



ESA

COS-B, one of Europe's most successful missions, and ESA's first, was used to study gamma-ray sources.

an X-ray Super Telescope; a next-generation gravity-wave explorer; and a Jupiter/Europa probe. Although ministers at December's council meeting will not be allocating funds to the Cosmic Vision plan, a broad commitment is hoped for. If all goes well, calls to the community for concrete mission proposals will start early next year.

But the European space-science programme cannot proceed in isolation, without input or overlap with other ESA programmes, such as Aurora and the Space Station.

Aurora was conceived in 2001 as a pay-as-you-go programme to explore the Solar System, and to support European aerospace. It was not originally conceived with the main purpose of doing science, and must remain true to its original mission.

Because it relies on voluntary contributions, Aurora has had a slow start. The biggest contributors so far are Italy and the United Kingdom; exact sums are now being discussed. These contributions may be matched by Germany, despite its difficulties with the Space Station (see below). France has a self-imposed cap on its overall contribution to ESA; any extra money invested into Aurora means less money spent on other ESA projects. But overall, the €100 million needed to start a serious effort seems to be within reach.

Aurora was intended to provide a way forward for Europe's aerospace industry, after the (assumed) completion of the Space Station. But progress with the Space Station has met with severe difficulties, generated by the Columbia tragedy and the subsequent hiatus in Shuttle flights: no flights have taken place for more than two years. Return to flight is expected next month (fingers crossed), but there are rumours that the number of remaining flights will be as few as 15, or half the number previously considered.

This drop in flight number suggests a lack of enthusiasm on the part of NASA for even a half-decent scientific use of the Space Station, despite the agency's earlier claims that science was the Station's *raison d'être*. It also raises questions about the value of the investment put into it by NASA, Russia, Japan, many ESA states and others.

Worse still, the slumbering Space Station is holding back other space programmes, including Aurora. For example, while the German-led Columbus module for the Space Station — so named because it was meant to be in orbit in 1992 — remains on the ground in Bremen, the German delegation has hesitated to enter the Aurora programme. A quick way forward must be found in collaboration with the new NASA, once the shuttle returns to flight.

Aurora uplifted

A potential silver lining is that any quick resolution of the Space Station problem could release new resources for a well-focused Aurora programme. ESA has wisely created a new directorate that is dedicated to both robotic exploration and human presence in space. Its funding covers both Aurora and the Space Station. So money not going into the Station could easily be transferred to Aurora, if member states agree.

At the upcoming ESA Council, we must make ministers an offer they cannot refuse, and one that does not seem to compete with the mandatory science programme. We should clearly distinguish the technology and exploration content of Aurora from the aims of the science programme, as outlined in the Cosmic Vision plan. Here are some suggestions.

As soon as possible, Aurora should supersede the Space Station as a programme that drives industry, while also satisfying taxpayers' cosmic dreams. Aurora's aim should be to use innovative technologies to explore the Solar System — with a long-term goal of putting people on Mars. New methods need to be found for nuclear-power generation and propulsion, but also for landing on Mars, such as aerocapture and aerobraking (to aid spacecraft landing in the thin martian atmosphere). The development of such techniques would revolutionize exploration and allow for more efficient payload transportation.

Furthermore, when planning robotic exploration of Mars, mission and payload selection should be delegated to the science directorate — well versed in the time-honoured peer-review approach. The same directorate could even contribute to the allocation of funding for scientific payloads.

We should also start with something credible. The Beagle 2 failure has put pressure on us to deliver. One concrete proposal emerged from an ESA workshop in Birmingham in April, in which scientists recommended starting with a rover mission to Mars that could eventually culminate in an international sample return mission. Finally, Aurora should embrace international partners but will need to maintain its own personality and independence, for example in developing key enabling technologies, such as aerocapture.

President George Bush's new Moon–Mars plan for NASA may leave more room for ESA in space science. It certainly seems the right moment for a stronger Europe–United States partnership, at least in some fields such as X-ray astronomy, or outer-planet exploration. A grave difficulty here is caused by the current US restrictions on technology exchange. Such restrictions hamper joint work and are especially hard on US industry.

ESA has other partners as well. Russian scientists are working on the gamma-ray astronomy observatory Integral. And now China is involved in the Double Star mission for studying the Earth–Sun connection. The Bepi-Colombo joint mission with Japan to Mercury is already in the making. And a very recent agreement has been reached with India, for ESA's participation in India's lunar mission.

The opportunity to give Europe a central, aggregating role in space science is now here; it augurs well for ESA's next 30 years. ■

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1. http://www.esa.int/esaSC/index.html
2. Andersen, B. *Science* **307,** 1206 (2005).
3. Coppens, Y. *et al. Le Monde* 4 April, 1 (2005).