

## Contents

Coherent Radiation from Free-Electron Lasers by P.W. van Amersfoort, M.J. van der Wiel	211
The THEMIS Telescope	214
<b>9th EPS GENERAL CONFERENCE</b>	
Opening Ceremony	215
Scientific Programme	215
Parallel Sessions	222
1993 Europhysics High Energy Physics Conference	224
1993 European Quantum Electronics Conference	226
<hr/>	
Executive Committee Report	228
Honorary Members Elected	229
Amendments to the <i>Constitution and By-laws</i>	230
One of the First to Move	232
<hr/>	
Letter to the Editor	227
● <i>Europhysics Notes</i>	231

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*A view of the Free-Electron Laser for Infrared eXperiments (FELIX) facility at the FOM-Institute for Plasma Physics in Nieuwegein, The Netherlands. The undulator is in the foreground and the vacuum vessel to the right houses the output mirror.*

## Signs of the Times

Deciding what to do in space is made difficult by the need for international missions when "history has shown one cannot depend on decisions made in the US". R.M. Bonnet, Director of the European Space Agency's Science Programme, says one must thus be more "subtle" by defining missions based on European capabilities to minimize risks; international contributions are then added. Foremost is a possible delay, owing to US budget pressure, in launching the Huygens probe aboard NASA's Cassini to explore Saturn's moon Titan (ESA's first Medium-Sized Mission: M1; 1997 launch).

The thinking is reflected in ESA's major Cornerstone missions in its 10-year Horizon 2000 space science programme. The "over-ambitious" 1983 proposal of sample return in the Rosetta mission was abandoned when the US stepped out; a redefined, completely European mission received the green light on 5 November as the third Cornerstone (C3). It takes preference to FIRST (high-throughput sub-mm astronomy) partly because Rosetta involves a long flight (the Rosetta Rider will accompany a comet for six months in 2010). The US is strongly interested in participating, perhaps as part of its deep-space network, and there are proposals from the US, Japan and Russia for the lander.

FIRST, now C4, has also been scaled down (telescope diameter reduced from 8 m to 3 m; fixed antenna) and more is needed to bring Rosetta and FIRST from 610 M Accounting Units (AU) to closer to the 544 AU agreed by the ESA Council in 1992. Dr. Bonnet nonetheless believes that "dreams can be realized with a realistic budget".

The redefined strategy and the fact that

science is perhaps "safe from the torment" surrounding Hermes and the Columbus module (Germany only decided this month to keep its 38% participation) do not imply that international collaboration is being played down. For example, the International Mars Working Group has agreed to "a flexible exploration strategy involving complimentary projects defined according to constraints". The US and Europe are working on the basis of having 550 M\$US on a 50/50 basis so MARSNET (a network of meteorological and seismological stations on Mars), which was one of the four M2 candidates but was not selected in June 1993 since the collaboration was "immature", has thus become one of the seven M3 proposals short-listed in November for further study.

The other M3 selections by the Space Science Advisory Committee (SPAC) from 53 submissions were: a Mercury orbiter (now limited to 300 MAU to retain control); a Moon orbiter MORO; a follow-on of NASA's COBE; STARS (a scaled-down version of M2's PRISMA for seismology of the Sun); STEP (test of the equivalence principle proposed for M2 and scaled down to meet European capabilities); and a gravity wave experiment. Solar physicists are disappointed that a satellite close to the Sun was rejected on the largely unfounded basis of being too expensive; with no sample return for Rosetta, solid-rock paleontologists are upset that a planetary sample mission is out since the last was the 1972 Apollo 19 lunar mission.

The effects of internationalisation also show up in on-going missions, notably INTEGRAL (a large,  $\gamma$ -ray observatory using the same platform as XMM, the C2 high-throughput observatory for x-rays) selected in June as M2. A 2001 launch using a Proton rocket is planned following a 1989 Russian offer that

was confirmed recently; difficulties would mean using an Ariane 5 with a smaller payload and reduced scientific capabilities (the final decision is due in 1995).

Regarding the SOHO solar observatory, the status of the US's Atlas launcher is unconfirmed and NASA decided only this summer to change the microchannel plate detectors used by complimentary experiments (SUMER and UVACS) for the two largest collaborations. Delivery using a different design is set for October 1994 so much rests on accelerated testing procedures. Cluster, the other part of C1 and involving four satellites in a pyramidal arrangement to study space plasma, will use the first Ariane 5 flight. This is slightly worrying as the budget does not include storage charges in the event of a delay.

So in spite of considerable turbulence, Dr. Bonnet was able to announce no changes to the dates announced a year ago for launches. He was also positive for the future where a large "inertia" means ESA must look now beyond Horizon 2000. An outline by 1995 of a follow-on Horizon 2010 was asked for by ESA Council in 1992 and a call for ideas in June netted 108 replies, some 30 more than for Horizon 2000 indicating the growing interest (solar physics, astronomy and fundamental physics figured strongly with 40, 30 and 25 concepts, respectively); an enlarged working group of the SPAC will carry out an evaluation by June 1994.

Planning a lunar base continues following publication of the first-phase report *Mission to the Moon*. A more technical study of what can be done, and how and why is now underway, and it is no surprise that today's trends called for the OECD to be involved.

P.G. Boswell