Europhysics Notes

Compiled from correspondents' reports.
Contributions should be sent to the Editor.

● ITER Agreement

The four delegations (US, Japan, Soviet Union and the European Community) to the ITER negotiation meeting in Washington D.C., USA, on 8-9 July have reached agreement on the terms of the cooperation for a six-year Engineering Design Activity for the International Thermonuclear Experimental Reactor. The design will be conducted by a multinational team based in San Diego, CA, USA (project integration), Garching, Germany (in-vessel components) and Naka, Japan (out-of-vessel components). ITER is to be overseen by a Council chaired by the Soviet Union with its formal seat in Moscow. Professor P.H. Rebut, Director of the European Community's JET Joint Untertaking experimental reactor facility in the UK, believes the agreement improves the prospects for fusion and offers continuation of the work beyond JET.

● CERN Council

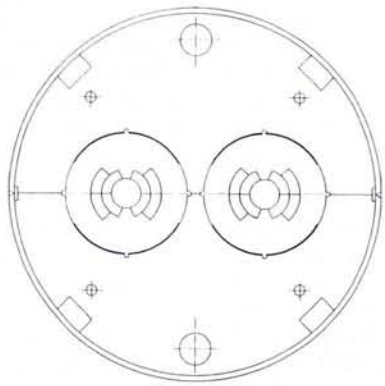
CERN Council last month was the occasion, marked by a flag raising ceremony (see photo), for **Poland** to formally become the Organization's 16th Member State and the first from central Europe.

Raising the Polish flag at CERN: from the left – Professor C. Rubbia, CERN Director-General, Professor R. Zelazny, the Polish representative and President of the Polish National Atomic Energy Agency, Sir William Mitchell, CERN's President of Council, and other members of the Polish delegation.

The Soviet Union and Israel were accorded Observer status at the meeting, the former in the wake of specific collaboration agreements, thus joining the present Observers (Turkey and Yugoslavia) in an essentially symbolic gesture.

● LHC Review

Also discussed at CERN Council were the recommendations of an external **Review Committee** set up by CERN'S Science Policy Committee to examine the proposed LHC collider in preparation for a request to Council for authorization to start the project maybe next year. Chaired by B. Wiik, the Project Leader of DESY Hamburg's HERA proton ring, the Review Committee appreciated that LHC represented an ambitious project aiming at an unprecedented high luminosity and based on a large extrapolation of existing technology. However, it considered the present design proposal as a sound base line and the design luminosity of roughly ten times that of the SSC in Texas (to allow comparable physics in spite of the lower energy) as realistic.



A schematic of a cross section through the LHC twin-bore dipole magnet showing the modified design with separate collars for the superconducting coils.

A recommendation to modify the design of the beam line dipole magnets will have the most important immediate impact. A novel, superfluid helium cooled, 10 tesla, twin-bore design was envisaged (see *Europhysics News* **21** (1991) 90) but two of the four 1 m long model dipoles delivered to date by industry have only reached approximately 90% of the 10 T short sample design limit. The Committee thus recommended a simpler design based on separate collars for the superconducting coils. G. Brianti, the LHC Project Leader, indicates that the modification should result in a 7-10 cm increase in the overall size of the dipoles (they will still be able to be accommodated in the confined space above the existing LEP beam line) without a significant increase in cost. The modified, more forgiving, design resembles that of the two LHC quadrupole prototypes being constructed at CEN Saclay, except that the iron yoke must provide support in the high field dipole.

CERN aims to understand why the two-in-one concept appears to exhibit a generic effect of premature quenching, perhaps due to coupling and mechanical constraints between the pair of coil/collar assemblies. It will also probably assemble and test a separate-collar model dipole along with models to be ordered from industry. Model development will proceed until the end of 1992 in parallel with the testing of a complete LHC cell based on the 10 full length dipoles, with the original LHC twin bore design, ordered from industry late last year. CERN will then be able to specify the final design.

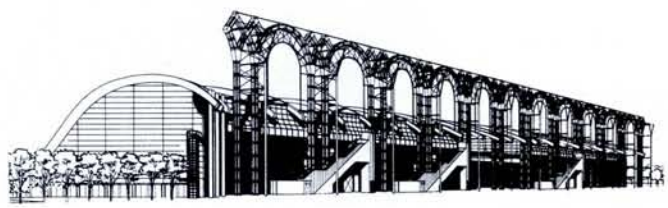
Details of the background to the Committee's recommendations and to future development work will be presented shortly. In brief, the Committee indicated satisfaction with the designs of the proposed injector scheme and of the beam cleaning system comprising "bottleneck" collimators to intercept inelastically scattered particles in the beam halo from depositing on the chamber wall and quenching out the magnets (the beam cleaner must be 99.5% efficient owing to the high luminosity). Increasing the coil aperture by 10% to ensure retaining the exceptional luminosity was considered wise. The effect of the ensuing 2-3% reduction in magnetic field may possibly be recuperated by increasing the length of the dipoles.

The Committee also agreed with CERN's conclusion that further detailed work will be needed in order to exploit the cryopumping effect of the 2 K vacuum chamber wall. A perforated bimetallic tube, with a 1-2% coverage of roughly 1 mm holes and kept at 5-10 K, will be placed around the beam. The perforations will suppress an avalanche of synchrotron radiation and ion bombardment induced desorbed hydrogen moving to the 2 K vacuum chamber wall once a single monolayer of adsorbed gas on the beam screen is exceeded.

● Space Science

The European Space Agency (ESA) is to team up with major European laboratories in an "Elements of the Universe" exhibit in a Pavilion of the Future at the **World Fair** next year in Sevilla. One dramatic display by CERN will be a cosmic arch to visualize natural high energy particles. It is planned to start monitoring such particles in 1993 using a new and truly large three-dimensional detector array called DURAND II (see below) and visitors to another joint ESA-CERN astrophysics exhibit, this time in CERN's permanent Microcosm display hall, will soon be able to inspect one of 17 inch glass spheres packed with electronics that constitutes a DURAND II detector module.

Professor R.M. Bonnet, Director of ESA's science programmes, speaking at CERN



A sketch of the Pavilion of the Future at the Seville 1992 World Fair.

Professor R.M. Bonnet (left), Director of Science Programmes, ESA, Paris, and P. Darriulat, Director of Research at CERN, inaugurating the ESA exhibit at CERN's Microcosm.

after inaugurating the special exhibit on July 8 (see photo), hoped the exhibit would help redress the recent impression conveyed by reports in several journals that ESA was not NASA's **equal partner** in space science. ESA's science budget of about 280 MECU (some 10% of the total ESA budget) combined with national spending on space science gives a total of 400 MECU which is modest compared to the NASA equivalent of 1200 MECU, and as little as 15-20% of the NASA figure if one includes launch costs.

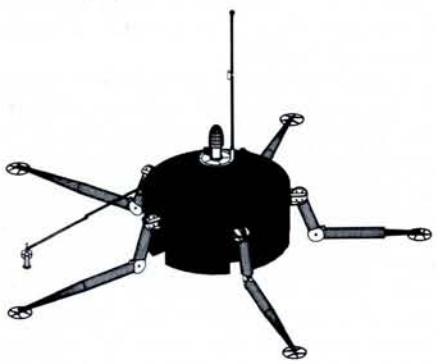
Professor Bonnet argued however that careful targetting had bred imaginative spacecraft missions and a list of notable successes, including close-up pictures by **Giotto**, one of ESA's five operational satellites, of Halley's Comet in late-1986 (the dust blasted, 1.5 kg lighter Giotto satellite has now been redirected to encounter another comet — Greg-Skjellerup — in June 1992). The five satellites also include NASA's **Hubble** Space Telescope with a 18% ESA observing allocation. It has recently been decided that a shuttle space walk will take place in late-1993 to introduce aberration correcting optics for the "perfectly imperfect" primary mirror and to change the solar panels which introduce thermally induced vibrations.

Similar vibrations have also now been confirmed for a 7 m long data taking boom on the **Ulysses** spacecraft launched last October and due to commence measurements above one of the Sun's pole in May to September 1994, followed by the other pole a year later. *In situ* remedies are available, but in general the experience with the effect of temperature variations indicates that spacecrafts for scientific work must be increasingly better designed and tested. Meanwhile, the **Hipparcos** satellite launched in 1989 is starting to provide yardstick data on stellar positions in spite of a distorted orbit owing to problems encountered during positioning in orbit.

ESA space scientists have mapped out a "Horizon 2000" research programme stretching into the next century, fully aware that ensuring continuity between literally different generations of scientists requires proper management to avoid some of the recent mistakes. Horizon 2000 envisages a balance between large- and medium-sized projects and Professor Bonnet felt planning was fairly well insulated from the current debate within ESA of its role in environment and earth monitoring (ESA's first earth observation satellite — ERS-1 — was successfully launched this month), and from US Congress decisions affecting NASA's space station project which has an important ESA contribution.

The first of the medium-scale missions is the **Huygens** probe to land on Titan in 2002 from NASA's Cassini spacecraft which will be launched in 1995. Meanwhile, preparations for a second medium-scale mission began in June 1989 with a call for mission proposals. Of the 22 received, four have been selected for in-depth analysis prior to final selection next year. They are a γ-ray observatory, a satellite to monitor stellar activity and to perform astroseismology, a network of three landers to study the Martian surface (see illustration), and a satellite test of the weak equivalence principle — an experiment that dates back to Galileo.

The Marsnet lander, one of ESA's second-generation medium-scale space science mission proposals.



● DUMAND Stage II

Professor Peter Grieder of Bern University, the coordinator of the DURAND II project, reports that the Swiss National Science Foundation has agreed to fund a Swiss participation. DURAND II comprising nine 230 m long vertical strings, 40 m apart and each with 24 of the spherical detector modules (see photo and illustration) anchored in 5 km deep ocean 37 km offshore from the "Big Island" of Hawaii will serve as a deep underwater muon and neutrino detector (DUMAND). The Swiss commitment follows approval by the lead agency, the US Department of Energy, in 1990. **Construction** of the modules can now begin with data taking by the first three strings foreseen for early 1993. Regular observation of the universe with the complete array using "neutrino light" (detection is based on Cherenkov radiation produced by relativistic muons in the ocean) is planned for late 1993.

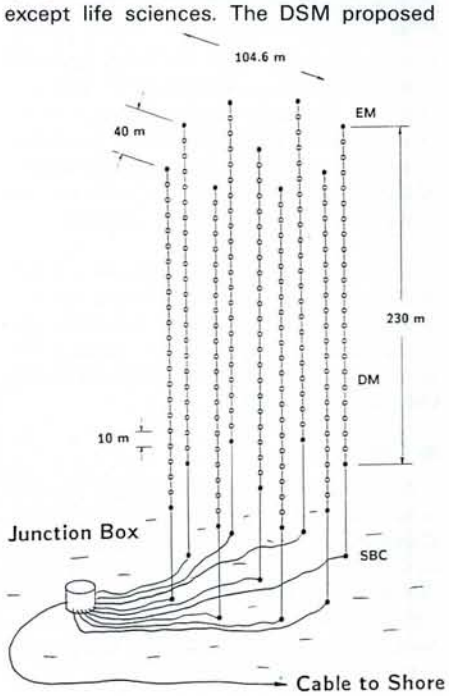
A 17 in diameter DUMAND detector module (left) and the DUMAND Stage II array (right) with 216 ocean-bottom moored modules.

DURAND Stage I involving a ship-deployed string of seven detector modules verified in 1987 the basic technique in one of the most sophisticated experiments ever performed in the deep ocean. Stage II extends this work in opening up high energy neutrino astronomy which has hitherto been plagued by poor signal to noise ratios whereby faint extraterrestrial effects are obscured by a terrestrial background.

Among the 17 or so major underground/underwater detector installations now operating or under construction, only an experiment in Lake Baikal employing significantly less sophisticated detector technology exceeds the scale of DURAND II with its (signal limited) calculated angular resolution of 1° for muon direction reconstruction, and a point source sensitivity sufficient to investigate most known candidates for discrete galactic neutrino sources. This and other scientific goals in cosmic ray physics, high energy muon and neutrino physics and γ-ray astronomy will be reviewed in detail shortly.

● France's CEA Restructures

The Direction des Sciences de la Matière (DSM) of the **Commissariat à l'Energie Atomique** (CEA), the French Atomic Energy Commission, is responsible for the organization's basic research activities in all fields except life sciences. The DSM proposed



last October a new organization for nuclear physics, particle physics and astrophysics, based largely at the Centre d'Etudes Nucléaires site at Saclay outside Paris, as they have many themes in common. It was felt that improved coordination between the three areas, each historically organized as separate departments with their own technical and scientific resources, would improve efficiency, both in experimental programmes and with respect to instrumentation and technical capabilities.

The CEA management, after a fair amount of discussion and consultation leading to approval by the DSM staff, has finally decided that that a single department within DSM and involving some 900 people will be responsible for these three fields of science. The new department will comprise the three physics services as well as five technical services which also carry out R. and D. programmes.

● CNRS Decentralizes

National research organizations tend to reflect local structures, not least the French **CNRS** which in 1989 had 53.3% of its scientific staff based in and around Paris in the Ile-de-France region. The organization, with an annual budget close to one-fifth of the national R. & D. budget of 49000 MFF in 1990, adopted a vigorous ''déconcentration'' policy in its 1989 modernization plan. The strategic plan for 1990-92 envisaged boosting deconcentration and partnerships (*e.g.* the creation of regional delegations with three new centres, regionalisation of the scientific departments' plans of action) and the definition of redeployment policies.

The result for 1989/90 of mainly limiting growth in the Ile-de-France fell slightly short of the targetted 1% p.a. decrease (for three years) in the number of research staff in the region. In a positive next step aimed at making up the shortfall, funds have recently been made available to both individual scientists and research groups to facilitate mobility.

To fully exploit regional strengths in science, the Director-General of the CNRS will be generating, in consultation with heads of scientific departments, a list of activities eligible for mobility grants and special services. Appropriate funds will be incorporated in the 1992 budget and regional centres of excellence identified. The departments are also being called upon to plan and coordinate regional involvement, with the results of pilot schemes available by the autumn.

● Swedish Neutron Research

Rebuilding of the horizontal beam tubes for neutron scattering work was recently completed at Sweden's main research reactor, bringing the number to eight. In an unrelated move, ownership of the reactor, the 50 MW R2 unit at **Studsvik** (see photo), was transferred in May to the newly privatised Swedish State Power Board, the main power generating utility company. This restructuring is essentially financially motivated and is itself not connected to the

Sweden's Studsvik nuclear centre situated 90 km south-west of Stockholm

Government's proposal, now before Parliament, to rescind the three-year old decision to start phasing out nuclear power by 1995. The proposal is to close reactors only if a 700 M$US programme to develop non-nuclear energy sources leads to viable alternatives.

The restructuring of Studsvik began in the mid-1970's when government support began to be reduced. The national R. & D. centre for nuclear technology evolved into a diversified group of commercial companies which include Studsvik Nuclear, the operators of R2.

User charges for neutron beam time will continue to be funded by the national research authorities and the plan is to expand Studvik's Neutron Research Laboratory to perhaps a staff of 8-10 to match the increased capacity. The Laboratory is organized as a Department of Uppsala University but serves users from all over Sweden and elsewhere.

● Nuclear Structure Review

Professor Brian Fender, Vice-Chancellor of Keele University, UK, and Chairman of the SERC Review Panel set up to examine future support for **UK nuclear structure research** following the government's (SERC's) decision to close the Nuclear Structure Facility at Daresbury Laboratory (see *Europhysics News* **22** (1991) 50) has indicated that the Committee submitted its final report this month for consideration by the SERC Council at its meeting on 19 July. The Review Panel concluded that UK nuclear structure work was of high quality and it was impressed by the performance of the relatively small UK nuclear structure community which had contributed greatly to a limited number of carefully selected areas. The Panel could foresee a positive future for UK nuclear physics in the European context and hoped that suitable arrangements could be made so that the UK could play an appropriate role in existing and future European partnerships. As the Panel recommended a programme of £ 6 M, some £ 3.7 M in excess of current provisions, the SERC Nuclear Physics Board has been asked by Council to work out by early autumn how increased spending on nuclear structure research can be accommodated.

● ILL Proposes Refurbishing

The ILL has confirmed that it will replace both the lower and upper grills that suppress turbulence in the Institute's water cooled reactor. This follows the discovery of unusual defects (see *Europhysics News* **22** (1991) 91) on the upper surface of the upper grill that arose owing to a transfer of movement from the incorrectly mounted lower grill. Pieces of a guide roll of a security bar have also been found around the periphery of the upper grill so all the rolls will also be replaced.

The Management Committee meeting on 3 July proposed an intervention plan that would effectively refurbish the reactor by 1994, ready for a second phase of operations. The plan may eventually involve changing components other than the grills, possibly even the reactor vessel and its associated structures if this is thought necessary. It seems increasingly unlikely that the reactor will be operated for experimental cycles during the 12 months or so in which the intervention is being planned.

The shutdown comes at a difficult time as the UK SERC's ''forward plans'' call for a total of £ 17 M a year from 1993-94 for neutron research whereas the ILL and the ISIS spallation facility at the Rutherford Appleton Laboratory each receive £ 11 M a year at present from the SERC Science Board budget (£ 129 M in 1989/90). A Review Panel chaired by Dr. M. Lomer, a former Director of UKAEA's Culham Laboratory, was set up in February to make recommendations on the future of neutron research in the light of SERC's reduced funding. The Review Panel's report to SERC Council has praised the science programmes at both ISIS and the ILL and noted the topics which can only be pursued at one or the other. Council decided that it wished to make an unambiguous commitment not to close ISIS until at least 1997 and that it would renegotiate, as a matter of urgency, the ILL agreement owing to the shutdown of the ILL reactor until 1994.

The reactor shutdown will also probably have implications for ILL's five year development plan 1993-97. The 237 MFF sought in the original plan submitted to the ILL Steering Committee last November was considered too large. The Committee recommended instead no increase in the volume of activities (staffing, experiments, operating budget) with possible funding levels of 4 or 8% of the present annual expenditure — 315 MFF in 1991 — for five years, giving 63 or 125 MFF, respectively. The Institute argued in its revised proposal submitted in May that only the 8% option offered real development to maintain a leading position. The bulk of the 125 MFF is allocated to new developments, mainly instruments, and for replacing and upgrading infrastructure and equipment, and only 21% for increased staff and operating costs. A priority aim is to boost the R. and D. spending to 6.6% of annual budget for five years from an inadequate 2.6% spent in 1989-91. A total of seven instruments would be taken out of the schedule and replaced by five new proposed instruments and the three others which would have come into operation at the horizontal cold source in the coming years.