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I **RESEARCH DIVISIONS**

- **Theoretical Physics Division**
- **Experimental Physics Division**
- **Experimental Physics Facilities Division**
- **Data Handling Division**

THEORETICAL PHYSICS DIVISION

The May 1988 telephone list of CERN-TH had 117 names. During the first five months of 1988, 132 preprints were registered. The main lines of research remained those of the 1987 annual report, though a moderate but significant shift of interest was perceptible away from superstring theory and towards more immediately phenomenological subjects.

Much work was devoted to the understanding and explicit formulation of superstrings, along the lines of the group-theoretical approach, the operator formalism, the covariant lattice construction of supercurrents, and the analysis of the new minimal supergravity in the superstring framework. Interesting properties were (theoretically) found in the scattering of gravitational waves. Among the attempts to establish contact with the standard model, at least two distinct lines of work should be cited: a thorough analysis of Yukawa couplings (fermion masses) in degenerate orbifolds and new supersymmetric "flipped" grand unified schemes, derivable from superstrings.

Contributions to the interface between particle physics and astrophysics included an analysis of the allegedly correlated response of neutrino- and gravitational wave-detectors on the day of the 1987A supernova, studies of the detectability of dark matter and various attempts to understand the vanishing of the cosmological constant.

On the lattice gauge theory front, steady progress was reported on the theoretical and numerical understanding of weak amplitudes, the mass splittings of the baryon octet and the nuclear σ -term.

New phenomenological analyses included updates and improvements of predictions for the production of Higgs particles at the LHC, and of charmonium in heavy ion collisions, the total cross-sections for heavy flavour production in hadronic collisions at CERN's collider and at HERA, and the shape of the Z-boson peak in e^+e^- annihilation, the first crucial result expected to come out of precise high statistics measurements at LEP.

On the phenomenological frontier related to recent experimental results, considerable effort has been devoted to the analysis of rare decays, mixing and CP-violation in B physics, both within and outside the standard model, and the EMC result on the spin content of the proton. Fifth-force-inspired models of new types of pseudo-Goldstone bosons, rigorous sum rules and model-dependent results on 2ν β -decay, and negative binomial distributions in multi-particle production processes also belong to this chapter.

Accelerator-related topics have also been pursued, in particular studies of bremsstrahlung in the extreme quantum and extreme high energy regimes.

TH DIVISION - SCIENTIFIC INFORMATION SERVICE (SIS)

The objective of SIS is to provide effective information service in particle physics and related scientific and technical areas to scientists, engineers and managers at CERN and to the international HEP community. A development strategy on four main fronts has been followed as decided in autumn -87:

A modernization of the organizational structure to allow effective management of staff and material resources, and a smooth development of techniques and services. This process has involved a review of responsibilities and priorities, with an emphasis on direct user services, like retrieval from internal and external databases, with rapid backup of document delivery from own collections or by interlibrary loan. SIS now has contracts with the hosts DataStar, STN, ESA, TELESYSTEMES, ECHO and DIALOG, and with document delivery centers in UK, France, Germany, Switzerland and Scandinavia.

A study in depth of the market of integrated library management systems, with a comparative evaluation leading to a definite choice. The system selected will be installed in late summer -88, and most modules should be operational by the end of the year. This will result in considerably improved information and document delivery to users, and rationalization of internal library work, the savings being used for further service improvements.

Staff training, by seminars, courses and hands-on experience on the job, to upgrade operational knowledge about computer applications in libraries, including integrated management systems, online retrieval and ordering techniques, the use of microcomputers, and the use of certain facilities on the CERN VM system.

Marketing of SIS services by production and dissemination of manuals, guides, bibliographies, and lists of current acquisitions.

The conversion of CDS/ISIS to run under VM was finalized early in the period. A feasibility study for the optical disk project concerned with easy access to preprints, has been carried out in cooperation with DD-Division with positive conclusions. Short projects include a policy study on the development of the CERN Archive, and development of an ORACLE-based system for management of the HEP directory and similar files. A proposal on space requirements for the library has been submitted to the Site Committee.

EXPERIMENTAL PHYSICS DIVISION

UA experiments

The UA1 collaboration have continued analyzing their data taken up to 1985. The more important results comprise a limit of 44 GeV (90% c.l.) on the top quark mass; a study of low-mass dimuon pairs and their quantitative interpretation in terms of known sources (semileptonic decays of heavy quarks, Drell-Yan continuum, J/ψ decays and leptonic decays of light mesons); the observation of "direct" photons from hard $\bar{p}p$ scattering processes; and the measurement of the two-jet mass distribution as a function of the centre-of-mass scattering angle. All observations are in line with expectations from the Standard Model.

The R & D work on all aspects of the new UA1 calorimeter, which is based on depleted uranium as absorber material, and the "warm" liquid tetramethylpentane as readout medium, has made such good progress that the construction of the calorimeter modules is on the verge of being started.

The upgrade of the UA2 detector having been completed, the collaboration have embarked on the analysis of their first data taken at the end of 1987 with the newly commissioned ACOL ring in operation. Their statistics correspond to an integrated luminosity of about 40nb^{-1} . The salient features of the upgrade, 4π calorimetric coverage and a better electron identification, pave the way to significant benefits in the study of jet angular correlations, the study of events with missing transverse energy, and the low-momentum cut-off for well-identified electrons.

LEP experiments

The four LEP collaborations, ALEPH, DELPHI, L3 and OPAL, have continued to construct their detectors, and to prepare their software for data analysis. All four experiments have made tremendous efforts to stick to their schedule, and have managed to do so. So far, no major delay has been encountered. All four experiments, in line with the progress made by the LEP civil engineering, have reached the stage of installing their equipment in the underground experimental halls.

SPS fixed-target experiments

The NA31 collaboration reported on a non-zero value of $\epsilon'/\epsilon = (3.3 \pm 1.1) \cdot 10^{-3}$, which if confirmed implies "direct" CP violation in the decay of the CP-odd state K_2 into two pions, rather than supporting the "superweak model" of CP violation. A minor upgrade of the detector having been completed, the collaboration have started a new series of data taking, with a view to measuring ϵ'/ϵ with an even smaller error.

The NA2 collaboration (EMC) have measured spin asymmetry in deep inelastic scattering of longitudinally polarized muons off longitudinally polarized protons, thus determining the integral of the spin-dependent structure function of the proton to be

0.114 ± 0.029 , falling short by three standard deviations of the theoretical prediction of 0.189. This result may imply that the total quark spin constitutes only a small fraction of the spin of the proton, which is at first sight a rather intriguing result.

The NA9 collaboration (EMC) completed their analysis of muon scattering at very small values of x and Q^2 , extending the measurement of the x dependence of the ratio of the F_2 structure functions of the nucleon embedded in calcium nuclei and in deuterium (which became known as the "EMC effect"). The calcium to deuterium ratio at small x is interpreted as a shadowing effect. Since no strong Q^2 dependence is observed, the shadowing is due at least partially to parton interactions within the nucleus.

The NA10 collaboration have derived a cross-section for open beauty production of $\sigma(\bar{B}B) = 14 \pm 7$ nb/nucleon from the study of trimuon events in the interaction of 286 GeV π^- -tungsten.

Heavy ion experiments

After the successful acceleration of sulphur ions in the SPS in 1987, the analysis of recent data as well as of data from earlier runs with oxygen by various experiments is in full progress. It is fair to say that so far no unambiguous signal of a phase transition of nuclear matter into the quark-gluon plasma has been observed. However in the interactions of 200 GeV/nucleon oxygen nuclei with uranium, an interesting suppression of the J/ψ production rate with respect to the dimuon continuum production has been reported by the NA38 collaboration.

LEAR programme

The operation of LEAR resumed early in 1988 after a year of essentially no operation due to the ACOL commissioning. The analysis of data has continued, with the most interesting result coming from the PS185 collaboration who measured the difference in the $\bar{\Lambda}$ and Λ parameters of $A = 0.07 \pm 0.09$, based on a sample of 4000 events (to be compared with the prediction of the Standard Model, $A \sim 10^{-4}$).

The construction of the four new LEAR experiments (PS195 CP LEAR, PS197 Crystal Barrel, PS201 OBELIX and PS202 JETSET) is progressing well.

ISOLDE

The new ISOLDE-3 on-line isotope separator produced its first radioactive ion beams at the very end of 1987. Meanwhile, the IS150 collaboration have successfully completed their programme of laser spectroscopy of gold and platinum isotopes down to mass 183 which is far below the region of nuclear stability.

In the IS120 (NICOLE) nuclear orientation experiment, platinum isotopes produced in decay of highly unstable mercury nuclei have been cooled down to a temperature of 4mK, and a programme of measuring nuclear shapes over a wide range of nuclei has been started.

EXPERIMENTAL PHYSICS FACILITIES DIVISION

1. SPS EXPERIMENTS

1.1 UA1

The activity of the UA1 group is mainly centered around the preparation of the new uranium-TMP calorimeter.

Practically all the necessary equipment has been delivered: Uranium, TMP, mechanical structures, and data acquisition units. The main difficulty arose from the manufacturing of the stainless steel boxes, which will contain the TMP. After a delay of a whole year we had to face the fact, that the manufacturer of these boxes could not at all fulfil the contract and, therefore, the problem had to be studied all over again.

The envisaged new solution should allow to receive the first boxes in May 1988 and the delivery of 21,000 boxes is expected at the end of the year.

In parallel a complete prototype with the definite boxes is being assembled. First tests are expected to take place in June.

1.2 UA2

After the 1987 $\bar{p}p$ -run some repair and maintenance work on the different detectors have been executed. Two modules of the central calorimeter have been recalibrated in the test beam. The main detectors have now been remounted and are being recabled to start cosmic ray tests by the end of May.

The manufacturing of an additional inner silicon counter array is in good progress and is also expected to be installed for the next physics run starting in September.

1.3 Omega spectrometer

The installation of the three experiments scheduled for this year has been done. The modifications of the Omega facility for the hyperon experiment are in the planning stage.

1.4 NA31

A large wire chamber (WC-2), which was accidentally destroyed by a fire during a test run, has been rebuilt by members of the group, with the help of outside institutes. The chamber was reassembled in the beam in February and performed well.

The construction of a Transition Radiation Detector (TRD), aiming for an improved electron/pion distinction and planned since September 1987, was continued. With considerable effort of CERN staff, supported by groups of collaborators, the detector was ready for operation in time for the 1988 fixed target beam period.

In parallel, the liquid argon calorimeter was brought back into operation for data taking.

1.5 PS195 and NA34

Continuous technical support was given to these two experiments.

1.6 Preparation of LEAR Experiment PS202 - JETSET

A fast RICH detector is under development, aiming to provide a π/K separation at $\beta = 0.8$ at a very early trigger level. The UV photon detection MWPC will have their cathodes segmented into small pixels with a multiplexed analog read-out (1 MHz) using a new CMOS VLSI custom chip.

2. PREPARATION OF LEP EXPERIMENTS

2.1 ALEPH

- i) Installation - It has started by 21 March 1988 and goes on as planned so far. The iron structure (barrel part) is now completely assembled, and the muon chambers are in place. Barracks, various ancillary equipments, part of gas and water pipes have been installed. Electronics barracks are in place. The driving mechanism has been installed and tried: it works very smoothly. The refrigerator, the power supply and the controls of the coil are in place.
- ii) The TPC is under test. One side is completely equipped with detectors. The production of the sectors at MPI München continues and we hope to have all sectors installed by the end of July. All fast electronics (TPD) is delivered. The complete electronics chain, from detector to computer has been tested and works.
- iii) The production of the various components goes essentially as foreseen, and we can be confident that we will have all of them in time for installation as foreseen.
- iv) The preparation of the on-line system is well under way. All computers have been delivered and are connected together. The event builders have been produced and work satisfactorily. The production of the slow controls system is well under way.

2.2 OPAL

The OPAL coil is now ready to be installed. It has been successfully completed and tested at full power by end of 1987. All the yoke iron modules have been implemented with streamer counter and wait installation of the magnet at point 6 to start hopefully some time in the first half of June 1988. The Jet chamber has performed full laser test of the first two of 24 sectors in September 1987. At present the 24 sectors are completed and cabling of HV and signals has started. The complete electromagnetic calorimeter (barrel and end-

caps) has been fully beam calibrated to set the nominal photo-multiplier gains of its about 12000 counters. At present the final beam calibration is being carried out before installation of the detector will start towards end of 1988.

2.3 L3

Assembly of magnet in the underground area has started on 1 September 1987. To date, the 28 coil elements have been entirely mounted and connected in series inside 5/8th of the return yoke. The internal and external water cooling circuits have been laid down and tested. The two doors on the end of the hall have been completed, then opened, and structural welding between the various elements is progressing. The 30 kA power supply is nearing completion in Great Britain. Test of the magnet is now foreseen in October. Design of the vertex chamber has been completed and manufacture is progressing. The 7800 crystals of the BGO barrel detector have been delivered to CERN. The first half barrel has been calibrated in an electron beam at 2, 10 and 50 GeV, and the second half barrel is nearing completion before calibration. The hadron calorimeter barrel is mechanically assembled and is being equipped with pipes and cables. The 8 muon filters are ready at CERN. The assembly of the muon spectrometer is progressing. Today, all chambers have been completed and 12 octants out of 16 have been completely equipped with cooling racks and the on-line computer system, and connected to a provisionally installed electronic blockhouse. The complete system will be moved to the experimental area in July. The support tube which has been delivered in sections to CERN is now ready in a surface hall for trial assembly of all detectors and associated equipment. The hadron calorimeter barrel and the muon filter have already been inserted at least once for checking purposes. Preparation for the mounting of the support-tube and the assembly of the detectors in the underground hall are progressing well.

2.4 DELPHI

The solenoid test in the BEBC hall (without yoke) has been terminated successfully; the main coil was taken up to 500 A, the two compensating coils to the full 1000 A. The current in the main coil was limited by stray field interference on control equipment. The layout for the intermediate dewar, control system and power supplies was tested in the final arrangement. The TPC vessel has arrived at CERN with 10 of 12 sectors mounted. It is being tested with the final gas recirculation system and the complete read-out chain for one sector. Data from cosmics and laser beam are being analyzed. The last two sectors - so far used for various lab tests - are to be mounted end of May. The B-RICH vessel has passed its pressure tests. The first drift tube has undergone successfully extensive testing. The production is under way. About 90% of the mirrors have been accepted. The HPC production has almost reached the required high rate after long delays due to various problems. The quality and beam performance of the first assembled modules is well within specifications and still improving. All modules of the forward electromagnetic calorimeter are at CERN, more than 60% calibrated in the beam. The hadron calorimeter and inner Barrel muon layer are complete. Multi-detector DAQ configurations are being finalized for use in a test beam set-up in July. First stage reconstruction and pattern recognition software is

operating, as well as basic tools for graphics. Installation of the experiment in pit 8 has started on April 21st, 1988. All electronic huts have been descended, the yoke supports have been aligned.

2.5 Cryogenics for LEP Experiments

Acceptance tests have been completed on the main compressors and cold boxes of the refrigerators for ALEPH and DELPHI, and on the first recovery and purification system. Final installation of the refrigeration equipment needed for the underground proving tests of both solenoids in the third quarter of the year is well advanced. The liquid helium pumps with their associated transfer line and control equipment were commissioned during the surface test of the DELPHI solenoid at the BEBC refrigerator.

ALEPH and DELPHI: On both sites, surface installation of main compressor, purifier, storage equipment and pipework was done. The pre-assemblies of the refrigerator cold boxes to be moved to the underground sites very soon are under completion.

OPAL and L3: 2 refrigerators of the North Area He plants, foreseen for cooling of the low beta quadrupoles, were upgraded for computer control and are now being prepared for installation on the sites.

2.6 Experimental Areas

The main effort has been put, together with the LEP Division, on the preparation of the caverns and their access.

Several technical services could not be finished in time, and work will proceed in parallel with the installation of the experiments. However, it has been possible to start installation of two more experiments (ALEPH and DELPHI), while OPAL should start in June. Since L3 had started already in August 1987, by the middle of 1988 all four experiments will be actively in the assembly phase.

3. TECHNICAL SUPPORT FOR THE CONSTRUCTION OF THE LEP MACHINE

RF-superconductivity

A SC LEP-type cavity has been installed in the SPS for a long-term test. It is operated with a 100 W refrigerator and has reached (again) its design acceleration field of 5 MV/m. Operation with the full intensity proton beam and acceleration of positrons for a later injection into LEP has been achieved. This cavity is equipped with all LEP-type auxiliaries, like couplers, frequency tuners and cryostats. Four more LEP cavities with their auxiliaries are presently under construction, two at industry and two at CERN. The development programme for Cu cavities sputtered with a thin layer of Nb is proceeding.

4. DETECTOR DEVELOPMENT

Three groups have been set-up in EF and started to work on the R & D development programme on detectors for a future multi-TeV Hadron Collider in the framework of the LAA project. The EF groups concentrate on the development of High Precision Tracking devices (scintillating fibers), on Calorimetry (lead-fiber calorimeters) and on silicon pixel detectors and ASIC (Application Specific Integrated Circuit) electronic chips design.

DATA HANDLING DIVISION

Computer Centre

- *CRAY*

The installation of the Cray X-MP/48 computer was successfully completed, the hardware acceptance tests concluded early in April, and an initial service put in place. Some 90% of the available processing capacity was immediately used by Theory Division, but a number of collaborations are actively converting their work, building up the load from experimental physics. Work on a vectorized version of relevant parts of the Program Library is underway, and assistance is provided to users.

The access control system for building 513 and 31 was in operation well before the Cray was delivered.

- *IBM*

The major activity in the IBM area in the last 6 months has been linked to the Joint Project between CERN and the IBM European Supercomputing Initiative. This project involves the upgrade of the CERN 3090 model 200E to a model 600E with 6 vector facilities, which will form the basis for an IIEP centre of competence for studies of vectorization and parallelization of IIEP codes. The first part of the upgrade, to a model 400E, and the addition of 60 GBytes of disk space were both completed successfully. After careful planning, the actual work was performed in two and a half days during the long Ascension weekend.

The CERNVM service has continued to grow such that the number of users per week has increased by 50% from 1400 to 2100 in the 7 months since October 1987. This has required careful attention and numerous changes to the overall system in order to accommodate the above increase without degradation of the user service. The ISF Integrated Systems Facility software has been introduced in order to make 3 separate VM systems appear as one to the users, and a solid state disk has been added to improve the user's response time. We began planning the end of MVS, and how this and the end of the MSS support are to be implemented.

- *DEC*

The capacity of the LEP Engineering database service was doubled, with the introduction of a second large VAX 8700 computer. The increasing load on the Computer Centre VAX/VMS services has led to a number of performance problems, which were eventually largely understood with the help of locally developed diagnostic tools. Action taken to resolve these problems has included modification of the VMS scheduler. Work has begun on preparing tools for a straight-forward batch service to be introduced on the central VAXes during the autumn.

In the frame of the CERN-DEC collaboration a number of joint projects are proposed, including Automatic Data Centre, IBM-VAX Interconnect, Vectorization, Computer Security, Parallel Processing, Migration to OSI, and others. Most of them are expected to start by the autumn this year.

- *RELATED ACTIVITIES*

The air conditioning and electrical infrastructure of the "Barn" was upgraded at the start of the year and was available to users in mid-February. The LEPICS computing facility for the L3 experiment is installed in part of the space made available.

A CERN-wide tape services committee has been set up to better coordinate all tape/cassette activities and services in view of the LEP demands as of 1989.

The direct support to users through the User Consultancy Office (UCO) is one of the pillars of our activities, through which relations with the large user community are maintained and improved.

- *DATABASES*

The whole area of user registration, accounting and budgeting, has been implemented around an ORACLE data base, and the formal reregistration of all existing users begun. New versions of the Oracle Relational Database Management System have been installed, providing interconnection of the databases installed on the main VAX and IBM services, and remote access to these databases from a variety of different workstations and personal computers. Facilities have been developed to enable the central databases to be accessed from within the LEP control system.

Communications

In the data communications area, the established pattern of growth of all services has continued. The cabling of the site with the CERN standard local area network, Ethernet, has continued. Additional external leased data circuits have been installed, most notably a satellite link to Fermilab. Accompanying this growth in infrastructure, the number of devices attached to the network continues to rise dramatically, particularly concerning personal computers and terminal concentrators. Traditional methods of connection involving point-to-point connections have begun to decline.

In the area of standard telecommunications, a trend away from telex and towards telefax has started. Contract negotiations for CERN's future digital telephone system have begun.

Support Activities

- *PHYSICS SUPPORT*

The design of the CERN Host Interface (CII) for the connection of computers from the VAX range to FASTBUS and VMEbus was completed. First examples were delivered to the L3 and DELPHI collaborations and the commercialisation of the FASTBUS version was started. Tests were started on commercial production examples of the VMEbus version. A high priority programme was initiated to allow CII optical fibre links to be delivered to experiments this year. Software includes VMS drivers (written in collaboration with Digital Equipment Corporation) and corresponding software for the M68k. Facilities are available for both efficient data transport between front-end and host, and transparent FASTBUS operation from the host using remote procedure call.

Physics groups and others continue to make heavy use of all the on-line computing services; an overview of these services is now available. Major new versions of several modules of the MODEL software for LEP data-acquisition have been released and are in use by the Collaborations; they include the Buffer Manager, Human Interface, and Process Control subsystems. A version of the VALET-Plus microcomputer software for the M68020 microprocessor has been released; over 140 VALET-Plus systems are now in service. Work has started on integrating the software for embedded microprocessors and VAX hosts, in collaboration with the new LEAR experiments: successful tests have already been made on control of embedded data-acquisition systems, and on the integration of the data flow and human interface for the combined systems. The remote procedure call system has been extended to a wider range of operating systems, including OS-9 and MS-DOS; it has also been further integrated into the rest of the on-line software. Substantial progress has been made in the rationalisation of the minicomputer pool; older equipment has been phased out to save maintenance costs and take advantage of modern technology. The

new small microVAX pool is now operational, and five allocations to experiments or projects were made during this period.

The continued development of the various components of the Program Library, especially of the PAW and GEANT packages, remained a vital activity, as was implementation of the GTS-GRAL graphics software. Off-line programming support to physicists directly in experiments operates at a bare minimum.

The construction of a further XOP fast trigger processor for L3 collaboration was started and support for the XOPs in the field continued. Investigations continued into the use of novel processor architectures for triggering and an evaluation of the AMT Distributed Array Processor (DAP) was completed using a simulator.

- *ENGINEERING SUPPORT*

Support of analogue circuit analysis programs, especially I-SPICE, was continued, working towards a stabilised version of I-SPICE. A first evaluation was completed of SABER, a package which is a likely candidate for replacing the others presently used at CERN. There was ongoing support for digital electronic CAE/CAD systems, concentrating on the interfacing of the DAISY CAE system to the VISULA system for circuit board layout and routing. Component library development also received attention. Central licence administration and information distribution was set up for the development software of Logic Cell Arrays, a new kind of programmable logic chip. A network connection to the printed circuit board prototype workshop was established.

For the mechanical CAD system, 10 storage tube work stations were replaced by PdT 50 stations (colour raster) and 10 PC work stations installed for development work, all equipped with hard-copy devices. The future system configuration has been clarified: Distributed computing on VAXstations whilst maintaining a central data base and central management. The upgrade is planned to go through several steps, starting with PdT 50 emulation on VAXstations.

The PRIAM project was reorganized with the transfer of all remaining staff into a single group. At the same time PRIAM's area of responsibility was enlarged to cover at least minimal support for the OS-9 real time operating system for the M68000 family of micros. Improved Fortran and C compilers were installed and the CERN written Fortran and C frontends for the common code generator of PRIAM's cross software suite were released to users. The RMS68K-based suite of programming tools was updated and now offers debug support for the MC68881 floating point coprocessor and allows the use of memory mapping hardware for intertask protection.

- *MANAGEMENT INFORMATION SYSTEMS*

In the area of Office Computing Systems, the year started with the difficult but successful tendering and adjudication of a contract for IBM-compatible personal computers from a European supplier in consultation with different divisions. Two rooms were equipped for use by the general CERN public: one with two desk-top publishing centres, another one containing standard Olivetti microcomputer configurations and the "PC Shop" where anyone interested can obtain information, can try out hardware and software, and can buy equipment for the Organization. Significant progress was made in the sensitive area of text processing and future office systems. A Text Processing Help Desk is operational and a TEX service is being introduced alongside transparent repackaging of SGML and work on the document storage system CERNDOC.

Easter saw the publication of the loose-leaf MIS Reference Book, originally 200 pages targeted at 300 MIS users in CERN, now distributed to over 500 subscribers, with an estimated 450 pages of information when it will be completed. Courses on the use of VM/CMS specially packaged by topic were extremely successful.

II TECHNICAL DIVISIONS

- **LEP Main Ring Division**
- **Proton Synchrotron Division**
- **Super Proton Synchrotron Division**
- **Technical Support Division**

LEP MAIN RING DIVISION

INTRODUCTION

While completion of the LEP civil engineering, services and installation of the machine equipment around the Main Ring tunnel continues to schedule, most attention is presently focused on the first beam injection tests scheduled for July this year. A beam of positrons at 18 GeV, and an average intensity of 4×10^{10} particles per second will be injected via the beam transfer channel TI 18 into octant 1-2, all equipment involved being controlled from the Prévessin Control Room. The octant is rapidly nearing completion, its beam chamber already being at the specified vacuum pressure while all other systems are presently being commissioned. The following paragraphs give further details of the work leading to the injection tests and to the remainder of the LEP construction project.

THE LEP PROJECT

Fifty-two months from the start of the underground excavation work, the Plaine and Jura sections of the tunnel came together on 8 February this year, so completing the 26.6 km of the Main Ring tunnel. By June almost all of the civil engineering had been handed over to the beam equipment installation teams and it was possible to start assembly of equipment in the experimental halls. Even in the Jura section of the tunnel where karstic phenomena caused so much disruption to excavating in 1987, concreting is progressing well and installation work gradually taking over. As to the surface buildings, all those at Points 1 and 2 have been finished while the remainder are 70% complete.

Breakthrough of the Jura section of the tunnel into the Plaine section occurred with an error of only 3 mm, a great success for the survey teams. Alignment of equipment in the transfer lines TI 12 and TI 18 was completed. Other controls on the injection chain have led to re-align parts of LIL, EPA and SPS. Equipment installed in the first two octants to become available was aligned promptly and without particular difficulties. As for the LEP experiments, measurement of their components and infrastructure proved to be satisfactory while in the underground experimental areas the survey reference network was completed and the final assembly of magnets and detectors monitored.

For the injection tests in July, injection adjustments and effects of errors were analyzed, the main application programs were specified, and the LEP description was transferred into the database. Work on polarization in LEP included dedicated wigglers, spin rotators, and simulation of the effects of realistic orbit errors. Configurations with smaller beam sizes - and hence higher luminosities - at experimental interaction points were studied, as well as configurations for beam energies up to 100 GeV. Version 7 of the beam-optics program MAD was released with graphics in the GKS standard. Synchro-betatron resonances in e^+e^- storage rings were analyzed in the presence of both dispersion and wakefields and the amplitude growth was calculated. The calculation of wakefields was refined and an improved impedance model developed which should yield better

agreement between theory and experiments on bunch lengthening. The bunched-beam transfer function was calculated and its application to LEP is being prepared.

On 16.11.87 installation of the vacuum equipment in the tunnel started. Installation of octant 1-2 was finished according to schedule by April with a total length of 2.6 km including the injection sector for e^+ . Commissioning was completed by mid June, i.e. bakeout of all sectors (except injection) to 150°C for 24 hours, followed by activation of the getter pumps. All sectors reached the low 10^{-11} Torr range within 24 hours after activation. At present vacuum readings range from $5 \cdot 10^{-12}$ Torr to $1 \cdot 10^{-11}$ Torr. The number of leaks, either at installation or during and after bakeout was much less than 1% which confirms the sound design of the system and the careful work of the installation and commissioning teams. Work on acceptance tests of components continued as before in parallel to the tunnel work.

The installation of the first two RF units (one quarter of the total RF system) adjacent to intersection point 2 was completed early this year, followed immediately by tests with RF power. Although each cavity was conditioned with RF power as part of the initial testing procedure, a slow build-up of power into the cavities is still required after installation in the LEP tunnel. In May, however, the design value of 4 MW into the 32 cavities was reached. Remote control of the installed equipment over the controls network from the PCR has also been performed. The installation of the next two units - adjacent to intersection point 6 - started in April and is progressing as planned. Power testing of these units is expected to start by the end of September. All the components for the RF system, including the cavities, klystrons and high-power circulators, have now been delivered to CERN.

Practically all the remaining magnets and associated components, including the last three wiggler magnets and six superconducting quadrupoles, have been delivered and measured. The installation of magnet system continued at an increased rate. By the end of June, the installation of the magnets will be nearly complete in the second sector, from interaction point 1 to point 8, and will start in sector 4 to 5. The first complex string of quadrupoles and orbit correctors for the high-luminosity insertions is being pre-assembled into the central tube of experiment L3. In the first sector, from the positron injection point to interaction point 2, all magnets have been electrically and hydraulically interconnected and then powered at maximum current. The main dipole field has been calibrated using the field-display and in situ flux-loop measuring systems.

Half of the injection monitors together with one beam transformer are installed in the main ring ready for first injection tests. A complete chain of electronics for data acquisition from 14 beam positron monitors located in the tunnel has been installed and tested in the underground chamber RE18. Tendering is underway for series production of the beam orbit monitor electronics. An operating system for driving the central processing units in the equipment crates, has been fully tested and is ready for operation with its various servers. A detailed design of the Q-measuring system has been completed and progress made on the various other instruments.

Effort on power converters was concentrated on the injection tests for which about 60 magnet circuits have to be powered. All the final hardware was first tested in our test area and then installed in either SR 1 or SR 2. The setting up and tests were carried out successfully. These included operation, at a minimum level, through the LEP control system from the Prévessin Control Room (PCR). Out of the ten power converters (100 kV, 40 A) for the RF klystrons, two are in regular operation for testing the 32 accelerating cavities fed by four klystrons. Another two converters are installed and are under test.

On the machine controls front, the digital communications infrastructure has been completed in five LEP sites (out of 8), to permit computer networking and telephone traffic. The networks were then made operational, connecting LEP sites 1 and 2 to the Prévessin Control Room, as well as to the computer centre in Meyrin. After cancelling in March the contract for the supply of process computers on grounds of non delivery, ten replacement computers are now used to acquire data in octant 1 - 2. Workstations for operator interaction with the machine were also commissioned in the control room and in sites 1 and 2. Meanwhile preparations for the injection test are proceeding according to schedule.

The electrical network has been completed at Point 1 and in six of the tunnel octants whilst cabling of three octants has also been finished. At Points 2 and 6 the large electrical compensators have been commissioned and computer control of the network is now operational for two of the octants as well as Points 1 and 2.

Fluid and air treatment installation work has continued. In particular the fluid distribution networks have been completed at Points 2 and 4 and almost 50 % completed at the other points, demineralized water mains have been fitted in four octants and the cooling sub-station and cooling towers handed over to CERN at Points 1, 2 and 4. Provisional ventilation is now operational at the four even points, air conditioning for the underground equipment galleries has been 50 % completed, while the air treatment and chilled water production plant at Point 2 is nearing completion. The remaining cooling and ventilation installation work is progressing well.

The installation and testing of the radiation protection monitoring system in LEP Point 2 and the injection area has been completed. The infrastructure for the monitoring system in the even LEP points is being installed, the monitors are arriving on schedule. Tests on production samples of material to be used in LEP continued and the involvement in operational radiation protection tasks was enhanced due to the increased pace of radiographic tests, RF installation and testing, and of the experimental equipment containing radioactive material (uranium). The pre-operational measurements around LEP also continued.

CLIC

Studies on a possible e^+e^- linear collider, CLIC, have continued. This has included modelling work on the RF accelerating structures and an investigation of the feasibility of a miniature, ultra-high gradient quadrupole for use in the final focus.

PROTON SYNCHROTRON DIVISION

After last year's considerable construction program, which included the ACOI project, the LEP Pre-Injector, the new PS vacuum chamber and the new LEAR experimental area, the Division has now entered an important period of running-in and consolidation.

This year's long winter shutdown covered the first two months of the year, and was followed by a very intense running period, which saw antiprotons produced and sent to the LEAR physicists, high intensity 14 GeV proton transfer to the SPS for the fixed target program, as well as East Hall operation, and lepton studies for the LEP injection tests scheduled for this July.

In addition to the usual maintenance programs it is interesting to highlight some of the major machine modifications, which took place during the January/February shutdown.

In the Proton Synchrotron (PS) the renovation of the ring continues, this time octant 1 was refurbished. The PS ring itself was also equipped with the new "CERN standard" access control system at the beginning of the year, and the improvements to the initial version, which have been implemented in order to speed up the access procedure and make it more reliable, have proved very satisfactory. One of the normal Pick-up electrodes was adapted for low frequency, high sensitivity betatron oscillation measurements.

In the South Hall, the LEAR experimental area, a new beam line (S5) has been installed for one of the antiproton trapping experiments, and a complete new gas detection system has been commissioned.

On the Hadron Injector front no major changes were carried out for either of the two LINACS, however all the BOOSTER/PS transfer elements have been upgraded for 15% higher deflection capability, following the successful endurance test with two BOOSTER rings at 1 GeV last year. The aim is to operate all 4 BOOSTER rings at 1 GeV from the middle of this year, when 1 GeV will become the standard PS injection energy for all users, thus decreasing transfer losses and increasing the available accelerated beam intensity.

Although the Antiproton Accumulator Complex (AAC) was the scene of a major upgrade last year, several important projects remain very active at the antiproton source. The third band of the Antiproton Collector Ring (AC) stochastic cooling system was completed and installed, to cover the full frequency cooling range. Cryogenic preamplifiers were installed for all the AC cooling systems. The second 9.5 Mhz antiproton debunching RF cavity was installed in the AC ring and its commissioning has continued during the spring. In the AAC target area several modifications were made in order to install the 400 kAmp pulsed magnetic Horn, which was used for antiproton production until the end of May.

In order to make even better use of the antiprotons produced by the AAC, the PS/LEAR transfer line was fully equipped with seven sets of horizontal and vertical beam position pick-ups. At the same time, in the LEAR machine itself, the new circulating beam current monitor was installed, unfortunately this has since had to be replaced, as one of the ceramic rings developed a vacuum leak. The electron collector of the electron cooling device was rebuilt, to reduce the losses during the recuperation of the 2.5 Amp electron beam. The power supplies and controls for the magnetic elements of the electron cooler are also being modified to enable the cooler to be incorporated into a normal low-energy LEAR cycle.

By March the PS was ready to deliver 24 GeV beam to the proton test areas in the EAST hall and 14 GeV protons to the SPS for fixed target physics. However the start-up for the LEAR and the AAC machines was not without problems. due to lack of resources and the increasing complexity of the various ultra-high vacuum systems concerned, it is no longer possible to perform the delicate vacuum bake-out procedure for both machines at the same time. The bake-out process is essential

to restore the ultra-high vacuum conditions (around $5 \cdot 10^{-12}$ Torr) in these low energy storage rings, after the interventions during the shutdown. This meant that there was a one week delay in the start-up for the antiproton machines. The effects of the delay were minimized for the waiting physicists by sacrificing part of the machine physics program. There was still time, however, to complete at least part of the foreseen machine development work. In the AAC a lot of effort went into improving the transverse acceptances of both the collector and the accumulator rings, as well as measuring the phase response of all the stochastic cooling systems. In LEAR, apart from some electron cooling studies at 309 and 138 MeV/c, the machine experimental program was restricted to preparing for the first antiproton physics run at 1.9 GeV/c, and protons were successfully ejected at this momentum, although attempts to eject protons at 2.0 GeV/c were not rewarded with the same success, due to insufficient deflection power at extraction. In the LEAR experimental area a slow extracted proton beam was successfully focussed into the 4.5 kGauss solenoid installed on the S1 line for PS195.

At the PS, machine studies time was used for detailed transverse emittance measurements with both protons and leptons. The high intensity lepton beams, in particular the electrons, which now circulate regularly in the PS, have given rise to another interesting and important area of machine physics, which can be studied in the PS. The electron beam can "trap" ions, which are formed from beam collisions with the residual gas inside the vacuum chamber, and the presence of these ions causes transverse beam instabilities, which have been observed in the PS. Until now such phenomena had only been seen at CERN in the AAC and LPI machines.

The period since Easter has been devoted to continuing the East hall and SPS proton operation and beginning antiproton physics for the LEAR users. The continuous 14 GeV transfer to the SPS, although initially plagued by teething problems from the new PS 9.5 Mhz RF installations, has reached very good performance levels, allowing more than $2 \cdot 10^{13}$ protons per pulse to be transferred on a regular basis. The antiproton production beam intensity was typically around $7 \cdot 10^{12}$ protons in five bunches from one BOOSTER ring.

The antiproton production was restarted using an Iridium target and a 400 kAmp magnetic focussing horn instead of the Lithium lens used last year. This test proved very successful and although the horn will be replaced this summer with the improved lithium lens, it will be kept as a replacement in case of problems. The AC RF bunch rotation cavities and the AC stochastic cooling systems have not yet reached the performance levels required for antiproton production using the full PS 2.4 second repetition rate, and only one cycle out of every two available has been used for antiproton production. Even so the increased yields that have been obtained are impressive, and have made it possible to produce and stack $1.45 \cdot 10^{10}$ antiprotons per hour using 3 PS production cycles per supercycle or almost $1.0 \cdot 10^{10}$ antiprotons per hour using only two out of six possible production cycles.

The LEAR users have taken full advantage of the higher available antiproton fluxes, and LEAR physics operation has been very stable, after some early problems with the antiproton deceleration in the PS. Beam has been ejected for three separate experiments, PS185, PS170 and PS198, at 1900 MeV/c and 700 MeV/c, with over $5 \cdot 10^9$ antiprotons per hour delivered at the experimental targets. During May transfer efficiencies from AAC to LEAR of 100% were regularly obtained for antiproton pulse intensities ranging from $2 \cdot 10^9$ to well over $1 \cdot 10^{10}$ particles. This improvement is due to better transverse cooling in the AA ring, which means that the smaller emittance beam is easier to decelerate in the PS, and the improved diagnostics in the LEAR/PS transfer line.

The LEP Pre-Injector machines are covered in the LEP report, however both electrons and positrons have been injected into the PS and subsequently delivered to the SPS on "pulse-to-pulse modulation" basis. This means that lepton studies in either the PS or the SPS can now be incorporated into any PS supercycle, and can continue without disturbing other PS users.

SUPER PROTON SYNCHROTRON DIVISION

In addition to the usual hectic activity of maintenance on all machine components, the winter shutdown during the first two months of the year saw again an intensive installation effort for the preparation of SPS as injector for LEP. The most significant items were:

- i) Installation and commissioning of a further 16 single cell cavities for lepton acceleration. All 24 installed cavities are by now operational and the remaining 8 cavities are ready for installation at the beginning of 1989.
- ii) Completion of the installation of tungsten and lead shielding against synchrotron radiation. This includes the plunging tungsten shutters which shield the electrostatic septa for proton extraction against the synchrotron radiation from the positrons, which causes excessive sparking during the interleaved proton and lepton acceleration cycles.
- iii) Installation of all elements in those parts of the lepton transfer lines from SPS to LEP, which are not accessible during SPS operation. By now the entire positron transfer line and the LEP injection system for positrons have been installed and are ready for the first LEP injection tests.

The last two weeks before Easter had been set aside to start up the SPS without physics. This approach has proved to be very beneficial and enabled the SPS to reach a satisfactory operational performance from the very beginning of the physics period which started after Easter. Simultaneously with the operation for physics, a series of machine development sessions have been carried out, using interleaved proton and positron acceleration cycles, with a minimal perturbation to the proton cycles. With the new, not yet complete, single cell cavity system positrons have been accelerated to 18 GeV, which gives confidence that next year the complete system will enable positrons to be accelerated to the design energy of 20 GeV for LEP injection. The positrons have also been extracted and were dumped after passing through the first monitors of the transfer line. The TT70 + TT60 beam transfer lines from PS to SPS have been commissioned with electrons at 3.5 GeV and electron injection tests in the SPS have started.

During these first 3 months, the operational efficiency of the SPS has been only 65%. Nevertheless, thanks to the good beam intensity of about 3×10^{13} protons accelerated per pulse, the average flux of protons delivered to all targets combined was about 1.1×10^{17} protons per day, i.e. slightly higher than the standard number of 10^{17} protons per day on which the scheduling of experiments is based.

There were mainly two reasons for the above mentioned operational efficiency:

- i) After more than 10 years of operation, the internal beam dump and parts of the extraction channels show an increased failure rate because of fatigue and radiation damage. The construction of new elements of improved design has started.
- ii) Teething troubles of newly installed hardware for lepton acceleration, which should be a very temporary phenomenon.

TECHNICAL SUPPORT DIVISION

La Division ST poursuit au cours de ce premier trimestre 1988 la rationalisation de ses activités pour faire face à des tâches de plus en plus importantes relatives notamment aux expériences LEP et au programme LAA. Les contributions essentielles de chaque groupe sont reprises ci-après.

GROUPE SUPPORT MECANIQUE

Plus de 60% du potentiel de l'Atelier Principal a été employé pour des travaux de mécanique pour la machine LEP et 30% environ pour les expériences LEP. On peut citer en particulier:

- Collimateurs "BIMO", stoppeurs de faisceau circulaires et elliptiques (BCSC et BCSE), nombreuses chambres à vide et pompes, grands composants pour DELPHI et ALEPH, nombreuses actions de contrôle dimensionnel (métrologie) pour DELPHI notamment (en Atelier CERN et dans les entreprises).
- Les transports lourds sur le site et les activités de manutention connaissent une grande intensité, avec des effectifs d'appui extérieur de l'ordre de 180 personnes dont 50% pour l'installation des éléments de la machine LEP et 20% pour l'installation des grandes expériences: en particulier, mise en place des bobines ALEPH et DELPHI (Point 4 et 8), transport de différents modules et "baraques". On peut encore noter les manutentions pour UA1, UA2, pour des installations de transformations au SPS, et au PS. La zone ouest demande aussi de nombreuses manutentions pour la préparation des éléments des expériences.
- L'activité d'entretien des véhicules routiers et d'engins divers (1100) est aussi en augmentation. Actuellement un cahier des charges est en préparation pour un appel d'offres visant à transférer cette activité à l'extérieur du site du CERN.

GROUPE TECHNOLOGIES SPECIALES

Le groupe contribue de plus en plus aux développements et mises au point de divers éléments liés aux expériences de physique. On peut citer en particulier:

- Développement d'une lentille au lithium O/36 avec connections électriques, développement de cibles pulsées, maquette pour aimant supra et banc de mesure du conducteur pour études préliminaires de LHC.
- Chambres à vide spéciales à parois minces pour LEP.
- Assistance pour nettoyage chimique des cavités supraconductrices RF.

- Divers éléments sophistiqués ont été réalisés pour les expériences LEP et on peut ajouter la soudure par bombardement électronique des "BIMO" et stoppeurs de faisceaux, ainsi que des traitements thermiques en assistance pour HERA (DESY) dans le cadre de la nouvelle politique de collaboration avec les laboratoires et entreprises extérieurs.

GROUPE INSTALLATIONS ELECTRIQUES

La réunification des activités déployées sur les sites Prévessin et Meyrin, et concernant les réseaux et les détections feu et gaz, a permis de réaliser une homogénéité des systèmes. Le projet de remplacement des équipements à huiles polychlorées est en cours et plusieurs installations ont déjà été remplacées; le programme s'étale jusqu'en 1992 compte tenu de son ampleur technique et financière. Un contrat a été conclu pour la destruction des huiles.

Les études et travaux sont importants dans les domaines relatifs au LEP et aux expériences, ainsi que pour les communications, les systèmes de détection et l'alimentation électrique du Centre de Calcul.

GROUPE CHAUFFAGE, VENTILATION, CLIMATISATION

Le groupe a consolidé son organisation pour faire face à des tâches de plus en plus répandues sur tous les sites du CERN, en particulier pour les installations liées aux expériences LEP et à la machine, ainsi que dans le domaine de la maintenance pour les bâtiments de surface LEP et même pour le début de maintenance des installations souterraines.

Les projets d'installations de climatisation pour le Centre de Calcul (CRAY, IBM), pour ACOL, pour PS et SPS, y compris pour les installations de cryogénie, ont demandé de gros efforts pour des réussites techniques obtenues dans les délais.

GROUPE GESTION DU SITE

Des efforts particuliers sont apportés, malgré les problèmes budgétaires, aux travaux de maintenance des bâtiments (réparations de toitures notamment) et pour le nettoyage des sites et installations, lesquels connaissent une grande extension avec les tâches effectuées pour la machine LEP et les expériences.

La gestion informatisée de l'espace construit pour une amélioration de l'affectation des locaux se poursuit avec succès. Cette même base de données permet une meilleure approche pour déterminer un programme de rénovation de l'infrastructure génie civil. Le groupe conduit en outre la construction du bâtiment pour LAA.

GROUPE LOGISTIQUE

La rationalisation et l'informatisation des principales tâches de ce groupe (distribution, expédition des marchandises et gestion des stocks) se poursuivent. En particulier, le projet concernant l'intégration de fournisseurs extérieurs dans le système de livraison pour diminuer le volume des stocks internes a été élaboré et testé. Ce système devrait permettre un élargissement de la disponibilité des composants techniques tout en évitant un accroissement des moyens de gestion et distribution.

REMARQUES: Ces activités intenses s'inscrivent dans le cadre d'une diminution du budget et des effectifs. En effet, le budget de 1988 a été réduit de 1 MFS ce qui porte à 5 MFS la réduction par rapport à 1985. Cela conformément aux engagements pris lors de la création de la Division ST. Vingt nouveaux départs du personnel (retraites, retraites anticipées, décès) ont été enregistrés en un an, soit 40 dans les deux dernières années (ou 10%) qui s'ajoutent à la centaine de personnes déployées vers le LEP et les expériences depuis le 1er janvier 1986.

ST DIVISION - TIS COMMISSION

There have been no serious accidents or incidents at CERN during the first half of 1988 and this in spite of the very intensive effort going into the installation of the LEP machine and experiments. The main activity in TIS has continued to be accident prevention and improved safety information transfer to CERN staff.

Training and preparation in the Rescue and Medical Services is aimed at dealing as rapidly and effectively as possible with any accidents on the greatly increased site, now that most of the LEP construction sites are included. Because of the very extensive underground installations, great emphasis has been put on the control and use of breathing apparatus, including the self-rescuers given to all LEP installation staff. The definition and purchase of photoluminescent safety signs and their installation, together with more than a thousand fire extinguishers, is just one example of the continual support given by TIS to the LEP project. The auxiliary firemen of one of the CERN contractors train regularly with the CERN Fire and Rescue Service, and a special effort has been made by our Medical staff to train more CERN staff in first aid, particularly those working on the more remote LEP sites.

Safety inspections on all LEP sites have continued with emphasis being put on a maximum presence on the work sites so as to encourage the use of safe working methods, and of personal protection such as safety helmets. The Mechanical Engineering Group have notably been present and provided help for the numerous special transport and lifting problems involved in lowering the large and often exceptionally heavy components of the LEP experiments to the experimental caverns. As the LEP experiments start to be assembled underground, work continues to analyse and apply in practice the results of risk analyses carried out in the TIS specialist groups or notably by a consultant in EF Division. All to ensure that the extremely large and very densely packed experiments on LEP and also the SPS collider (UA1 and UA2) can be operated as safely as possible.

Environmental monitoring for all sites continues with considerable administrative work being necessary for transport and control of dangerous materials, such as radioactive sources or PCB oils being sent for destruction. The Radiation Protection Group have completed the first evaluation of a new ventilation system for the neutrino beam target cave, which indicates that the release of Be has been greatly reduced. Radiation monitoring at LEP has started with the testing of the radio-frequency cavities and klystrons at Point 2, and the first complete radiation monitoring and data-collection system is in place and ready for the LEP injection tests in July.

A new version of the CERN Safety Policy document (SAPOCO/42) has been signed by the Director-General, thus completing several years of effort. Three revisions of safety codes have also been signed in the first half of this year.

III ADMINISTRATION

- **Direction of Administration**
- **Finance Division**
- **Personnel Division**

DIRECTION DE L'ADMINISTRATION

Bureau du Directeur de l'Administration

Au titre des relations avec les Etats-hôtes, l'Administration a poursuivi sa mission de représentation de l'Organisation auprès des Services publics français et suisses. Elle s'est occupée plus particulièrement des questions suivantes : séjour et emploi des familles des membres du personnel, transports (circulation, cartes de carburant détaxé, facilités administratives), entreprises contractantes (situation juridique, personnel, hygiène et sécurité du travail, contacts réguliers avec les Directions du travail de Genève et du Département de l'Ain).

Une partie des activités du Bureau a également été consacrée à la révision ou à l'établissement de nouvelles procédures en matière d'accès, de vols/disparitions, de véhicules etc. et à la gestion de la partie française du domaine laissée à l'agriculture (réunions avec les Administrations, les élus et les Organisations professionnelles).

General Services Group

The rate of occupation of the CERN hostels and flats has now reached maximum levels during the busy summer months. Many customers are being forced to find accommodation on the local market in difficult circumstances. Solutions for this unsatisfactory situation are being actively examined. We hope that Host States will be able to help in this aspect. A computerized reservation and billing system for the hostels will soon be implemented.

Automatic barriers have been installed at the Prévessin entrance. This will produce savings in the cost of guarding the site and is the first phase in the introduction of access-control facilities to operate from the Reception building on the Meyrin site. Plans are about to be implemented for the automation of gate A, to the Meyrin site; use of the standard access cards will be extended to cater for access outside normal hours.

Composition and Printing Group

The replacement of the last ND 100 by a small ND 5000 has been successfully completed. ND's Computer Aided Publishing products have been installed for evaluation, also the TEX mathematical system on a PC.

The system of charging Divisions when they exceed their quotas has been in operation since the beginning of the year. This is based upon a computerised database of all work printed. Demand this year is appreciably down from 1987, due to the combination of the decision to print the stores catalogues every two years, less yellow reports and no publicity colour brochures.

DIVISION DES FINANCES**SERVICES FINANCIER ET COMPTABLES (FI-F)**

- 1 Durant cette période, une bonne partie de l'activité a été consacrée aux opérations de clôture et à la préparation des comptes annuels de 1987, qui ont été présentés d'une façon différente pour tenir compte des demandes de certaines délégations du Comité des Finances et du rapport final du Comité d'évaluation du CERN.
- 2 Si on compare les dépenses au 30 avril de cette année avec les dépenses au 30 avril 1987, on constate une augmentation de quelque 114 millions de francs suisses.
- 3 Les provisions pour engagements non échus encore ouvertes à fin avril ne sont plus que de 6,5 millions de francs suisses.
- 4 Le prêt de 50 millions de francs suisses au consortium EUROLEP, qui est financé par une banque, a été reconduit jusqu'à la fin de 1988.
- 5 En ce qui concerne les équipes de visiteurs, le nombre de comptes atteint actuellement 550.
- 6 Des dépenses importantes ont été engagées dans les premiers mois de l'année pour le LAA (Analyseur d'asymétrie leptonique).
- 7 La tendance à la baisse des taux d'intérêt sur le franc suisse qui a été constatée à fin 1987 s'est maintenue et aucun signe sur le marché monétaire ne prévoit actuellement une augmentation des taux.

BUREAU PLANIFICATION ET BUDGETS (FI-PB)

- 8 Les activités du Bureau sont essentiellement centrées sur la préparation et l'édition des documents budgétaires de l'Organisation: budgets annuels et à long terme, variation des coûts et barème des contributions des Etats membres.
- 9 Le Bureau continue à apporter son soutien logistique au Groupe de Planification du Budget (BPG) chargé, entre autre, d'étudier et de préparer des hypothèses de planification en vue des décisions du Directoire et du Comité de Management. Il est en outre chargé, comme par le passé, du suivi au niveau central des allocations budgétaires et de la publication du tableau de bord.
- 10 Le Bureau est également, depuis 1987, largement impliqué dans la préparation d'analyses et d'études faisant suite aux recommandations et suggestions du Comité d'évaluation (tableau de trésorerie, contributions, etc.).

SERVICE DES ACHATS (FI-A)**Section des Contrats (FI-A-CO)**

- 11 Depuis le début de l'année 1988, 662 extensions et 184 avenants à des contrats existants ainsi que 56 nouveaux contrats ont été établis; 23 appels d'offres ont été lancés.
- 12 Comme signe précurseur de l'achèvement du projet LEP, le nombre des appels d'offres et des contrats destinés à couvrir les marchés les plus élaborés et financièrement plus lourds est en déclin. En conséquence, la Section des Contrats a également pris en charge, de manière croissante, des commandes de matériel dont le caractère technique favorise une centralisation directe; 336 commandes ont ainsi été passées.

Section des Commandes (FI-A-CD)

- 13 The first five months of 1988 witnessed no appreciable change in the number of orders placed compared with the same period of 1987. Nevertheless, the continued high level of activity in the LEP and experimental Divisions, counterbalanced by a fall in the purchasing work handled for the PS Division, required a reallocation of human resources amongst three Divisional Purchasing Offices without modifying the overall number of staff employed in the Purchasing Section.
- 14 The year commenced with a short training programme in COPICS for all buying staff and this will be followed by further sessions during the year.

Expositions

- 15 Les expositions de la Norvège au CERN, du 22 au 25 mars 1988 et de l'Italie au CERN, du 31 mai au 3 juin 1988, ont vu respectivement la participation de 10 et 43 firmes. En outre, 21 présentations techniques, limitées à un jour, dont deux groupées de neuf et treize firmes, ont eu lieu depuis le début de l'année.

SERVICE ASSISTANCE ADMINISTRATIVE ET TECHNIQUE (FI-T)

- 16 Durant les cinq premiers mois de l'année 1988, la Section des Factures a traité 30 000 documents, chiffre comparable à celui de l'année précédente.
- 17 Le Bureau de Travail temporaire a encore été très fortement sollicité en ce début d'année: en effet, de nombreuses dérogations à la règle des six mois ont été accordées spécialement pour le projet LEP.
- 18 D'autre part, une nouvelle application a été développée dans ORACLE sous VMIDD. Ce système peut gérer non seulement les contrats de prestations de services et d'entretien (y compris forfaitaires), mais aussi les contrats de travail temporaire.

PERSONNEL DIVISION

Implementation of recommendations of the CERN Review Committee

Several members of the Division participated in studies and preparations for the implementation of suggestions in the Final Report of the CERN Review Committee concerning personnel policy, in collaboration with Staff Association representatives.

Early Departures Scheme

Finance Committee set up a Working Group to study how the recommendation to reduce the staff complement could be put into effect without imposing an additional burden on the budget of the Organization. The Working Group, in which nine Member States were represented, held five meetings in close succession and finally reached agreement on a scheme that is similar to the one that applied from 1980 to 1983. It is hoped that Finance Committee and Council will approve it in June 1988 so that it can be introduced in the later half of the year, and detailed plans and procedures were made on this assumption.

New tools have been developed by the Division to provide more accurate estimates of the effects of various personnel policy assumptions on financial and other aspects of future plans, and they were used to estimate the consequences of the early departures.

Contract policy

Studies continued with a view to defining a new appointment policy. They reached the stage of draft texts that were discussed at various levels of the internal management structure. It is intended to report to the Finance Committee and Council in October 1988.

Performance-linked remuneration system

Following the introduction two years ago of periodic review discussions between supervisors and subordinates, studies are being made with a view to converting this system into a performance appraisal scheme and to seek ways of linking remuneration to performance. Directors, Division Leaders and the Staff Association have been consulted about how the system could operate in their areas of responsibility, and progress will be reported to Finance Committee and Council in October.

Manpower planning

Work continues towards the systematic recording of the distribution of CERN staff by activities, so that a more accurate picture of the present use of staff can be obtained. The establishment of a manpower planning system is under active preparation, aimed at matching staff numbers and qualifications with programme requirements within the budgetary envelopes.

Consultative Committee on Employment Conditions (CCEC)

Following the recommendation of the CERN Review Committee that this tripartite body be dissolved, the Committee of Council felt that a Working Group should be created to examine how it could be replaced. PE Division is participating in this study, with representatives of the Member States, the Management and the Staff Association.

Relations with users

Members of the PE Division have been helping to restructure the Advisory Committee of CERN Users to give it a more important rôle and they have been participating in setting up a Users' Office to improve the services provided to the users' community, as suggested by the CERN Review Committee.

Other activities

The creation of divisional training delegates, in accordance with a recommendation of the Joint Training Board, has strengthened the links between the Training and Education Services and the client divisions.

The Fellows and Associates Service has been involved in widening its programmes in the areas of advanced technology, applied science and computing. Possibilities have been created for doctoral students to do their thesis work in the laboratory, and a European Community Fellowship scheme is being introduced at CERN, under which a number of Fellows would come to CERN each year with financial support from the European Communities within its community incentive action programme.

IV DIRECTOR-GENERAL

- **Services of the Director General**
- **CERN Pension Fund**

SERVICES DU DIRECTEUR GENERAL

Les activités du Service d'Audit interne ont été orientées principalement sur la vérification des comptes 1987 de l'Organisation et de la Caisse de Pensions. Dans le cadre de cette vérification, quelques problèmes particuliers ont été examinés plus en détail à la demande des Commissaires aux Comptes. D'autre part des contrôles habituels ou non ont été effectués ainsi que des travaux liés au programme annuel du Service.

Certains de ces travaux ont été accomplis avec la participation d'un nouveau membre de l'équipe dont l'effectif avait été diminué par un départ.

Le Secrétariat du Conseil a continué d'assurer ses tâches habituelles (préparation des réunions et des documents du Conseil et de ses comités, ainsi que de l'ECFA).

Les tâches du Service des Relations publiques sont largement conditionnées par le vif intérêt que suscitent les activités du CERN et la réalisation du projet LEP: affluence réjouissante des visiteurs en semaine et le samedi.

De leur côté, les médias se sont intéressés eux aussi à la réalisation du Projet LEP (génie civil et installation technique de la machine); aux résultats scientifiques récents (ions lourds, anti-protons, etc.); et à l'avenir à long-terme du CERN et de ses programmes.

Le Service juridique a assuré sa fonction de conseil de l'Organisation; il a pris part à l'étude des problèmes de transferts de technologies dans le cadre des relations de l'Organisation avec les industries, aux travaux concernant la prise de brevets.

Il a contribué à l'élaboration d'accords de coopération avec d'autres laboratoires, participé aux travaux des groupes internes créés à la suite du Rapport Abragam, continué le suivi du dossier d'arbitrage opposant EUROLEP au CERN.

Il a participé à divers Comités (notamment le Comité pour la Politique de Sécurité, le Groupe des Pensions) et groupes de travail.

Il a activement pris part aux travaux concernant la Caisse de Pensions de l'Organisation, notamment en ce qui concerne la garantie des pensions en cas de dissolution.

Au plan du contentieux, il a défendu les intérêts de l'Organisation et a poursuivi sa tâche dans le domaine des assurances.

The Publications and Exhibitions Group produced the three volumes of the CERN Annual Report, introducing chapters specifically devoted to the technologies involved in CERN's work for the first time. The CERN Courier was presented in a poster session at a meeting of the European Association of Science Editors in Basle. A very successful exhibition was prepared in Bologna in collaboration with the University, INFN and ESO. It was held in parallel with the Third ESO-CERN Symposium on "Astronomy, Cosmology, and Fundamental Physics".

The Translation and Minutes Service continued carrying out its usual tasks including preparation of minutes for the SPC, CC, FC, CCEC, SCC, etc., and the translation of texts for the Courier, the Bulletin and the Annual Report. Some members of the Service also acted as interpreters at various meetings; and two underwent further training in this connection. All members of the Service are now equipped with terminals. During May 1988 there was a demonstration of a computerized terminology data bank and a computerized translation system.

CERN PENSION FUND

The Annual Report of the CERN Pension Fund is submitted separately to the Council (CERN/1693 - CERN/FC/3151, CERN/1693/Corr. - CERN/FC/3151/Corr.).

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