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PROGRESS REPORTS PRESENTED TO COUNCIL

RAPPORTS D'ACTIVITÉS PRÉSENTÉS AU CONSEIL

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THEORETICAL PHYSICS DIVISION (TH)

As usual, the Theory Division has continued a broad research programme during this period, with the most active area being phenomenology. As has been the case for several years, LEP has provided much of the focus for phenomenological studies. Work has been done on fitting the Z peak and on calculating higher-order effects in QCD and QED, as well as the forward-backward asymmetry for b quarks. Radiative corrections have been calculated for $e^+e^- \rightarrow W^+W^-$ and ZH, and single photon production has been discussed. The mean multiplicity has been estimated, a new jet algorithm described, and work has continued on Monte Carlo programmes for hadrons in final states. The possibility of extracting the strong coupling from τ decays has been pursued, and different measures of it reviewed.

With the advent of HERA, there has been a resurgence of interest in lepton-proton collisions. The photoproduction cross-section has been studied, as has the production of W bosons. Low momentum-transfer and high transverse-momentum physics have been explored, as have elastic and diffractive J/ψ production, QED radiative corrections, and general properties of hadronic final states.

As for hadron-hadron collisions, heavy flavour production has been reconsidered, and the associated neutrino flux estimated. The possibility of measuring the handedness of jets has been discussed, and the spin of the proton continues to be a hot topic. Soft hadron-hadron physics and the Pomeron have not been forgotten. With an eye to future higher-energy colliders, possible non-perturbative electroweak effects have continued to be studied, and new methods for calculating multidimensional phase space have been developed. Several members of the Division participated in the Evian meeting on the LHC, and one CERN theorist gave an invited talk there.

The strangeness-changing non-leptonic Hamiltonian has been studied anew, as has CP violation, B meson decays, and baryon masses. The role of monopoles in confinement has been studied, and the pion-nucleon coupling and nuclear physics have been reviewed.

The available electroweak data have been reanalyzed to extract more precisely the expected values of the top quark and Higgs boson masses, and to constrain extensions of the Standard Model that include Technicolour or supersymmetry. It has been confirmed that the present data already provide good evidence for the gauge nature of the electroweak bosons' selfinteractions. Studies have been made of Grand Unified Theories, and of electroweak symmetry breaking in supersymmetric theories, and refined estimates have been made of radiative corrections to the masses of supersymmetric Higgs bosons. A string-theoretic constraint on the electroweak mixing angle has been derived, and a new theoretical argument given for fixing the top quark and Higgs boson masses.

There is an active group of theorists working on statistical QCD, using lattice theory techniques as well as studying heavy-ion collisions. Theoretically, progress has been made with accelerated computational algorithms in various models, work done on Gribov copies, susceptibilities and correlation lengths. Hybrid Monte Carlo methods have been discussed, as well as intermittency in statistical systems related to QCD, Kosterlitz-Thouless-like phase transitions, the quark propagator and covariant gauges at finite temperature. Interaction rates in a heat bath, the bubble free energy, and magnetic mass have been discussed. The effects of nuclear shadowing on J/ψ and Υ production have been reconsidered, and the scaling properties of heavy-light meson systems investigated.

Work continues on the interfaces between particle physics, astrophysics and cosmology. The behaviour of solar neutrinos in vacuum and in magnetic fields has been considered. New estimates have been given for the scattering of dark matter off germanium nuclei, and ways of using LEP and RF cavities to look for axions have been proposed. The stability of cosmological potentials and the electroweak phase transition have been reconsidered, and new cosmological string backgrounds have been proposed. Baryon number violation at finite temperature continues to be an active subject.

String theory continues to inspire much of the more abstract work in the Division. Particular attention has been paid to compactification schemes, especially to mirror symmetry, effective actions, orbifolds, special geometry and Landau-Ginzburg potentials. String theory has been shown to favour $g = 2$ for magnetic moments of particles of arbitrary spin. New discussions have been

given of scattering at Planckian energies, and of the W quantum numbers carried by black holes in string theory. Other aspects of W algebras have been investigated, as have strings with central charge 24, and in more than one dimension. Loop space and the ground ring have been studied, as have fusion rules and their relation to the operator product expansion. Two-dimensional gravity and supergravity have been actively investigated. Various aspects of quantum groups have also been pursued.

An area which is attracting increased interest is the interface between particle physics and condensed matter physics. This has been reflected in studies of 3-dimensional field theories, and anyons in particular. The simplicity of macroscopic quantum systems has been stressed and the quantum Hall effect has been discussed. Several members of the Division have participated in a workshop on the links between these two subjects, and with theories of quantum gravity.

PARTICLE PHYSICS EXPERIMENTS DIVISION (PPE)

LEP EXPERIMENTS

The second half of 1991 and the first half of 1992 have been extremely productive for the four LEP experiments as can be judged from the number of published physics papers, which number more than ten for each of the experiments. In order to be so productive, the very sophisticated LEP detectors must operate efficiently which requires careful and regular maintenance. The shut-down period from November 1991 to March 1992 was used to carry out such maintenance and a few major repairs on the detectors. During 1991, leaks had developed in the carbon fibre vacuum pipes in two experiments. After careful investigation of all the carbon-fibre sections in the ring and on all spare sections, it was decided to exchange all the carbon-fibre pipes of ALEPH, DELPHI and L3 for aluminium pipes, the additional radiation thickness being considered acceptable for the present layouts. Only the beam pipe of OPAL was left untouched because a change would have left insufficient time to recommission the vertex detector. All four experiments managed to finish their modifications on time.

ALEPH

Besides the exchange of the beam pipe and as a consequence, the dismantling and remounting of the vertex detector, the main effort concentrated on the study and repair of a HV short in the outer field cage of the TPC. For the repair of one muon chamber, one end-cap had to be moved into the garage position. During the short shut-down in May, the first of the two new luminosity monitors was installed.

DELPHI

The central electro-magnetic calorimeter (HPC) had developed strong aging effects during the run periods. Intensive R&D investigations on test modules showed as a cause the combination of the natural radioactivity of the lead and some materials used in the construction and cleaning of the modules. It was found that the aging rate could be reduced very substantially by the use of carbon grids and cathodes in the wire chambers. It was, therefore, decided to modify 10 of the 144 modules during this shut-down as a test for the modification of the complete HPC. On the Barrel Ring Imaging Counter (B-RICH), 2 of the 24 drift tubes had to be repaired after having developed gas leaks in the quartz vessels. One quarter of the Forward RICH, a staged component of DELPHI, was completed by equipping it with the missing read-out chambers and electronics.

L3

The major activity besides the exchange and re-alignment of the beam pipe concentrated on the modifications of the end-caps in view of the addition of a

forward muon chamber system. This staged item requires major modifications to the huge end-doors, separating them by 10 cm from the Barrel and including magnetization by toroidal coils. On the BGO system, modifications were carried out in the read-out to reduce the noise. In the Barrel muon chambers, a few broken wires were removed.

OPAL

Major repairs and modifications were carried out on the Vertex Detector. On the other detector components, only normal maintenance was required. In parallel, construction of a new silicon strip detector with double sided read-out is continued. A new luminosity monitor has also been designed and approved by the Research Board.

FIXED TARGET EXPERIMENTS

CP Violation

The data analysis of the experiment NA31 to measure the CP violation parameter ε'/ε is being finalized. The combined value from all data is $\varepsilon'/\varepsilon = (2.3 \pm 0.7) \cdot 10^{-3}$. The experiment has also obtained improved values for the branching ratios of the rare decays $K_L \rightarrow e^+e^-e^+e^-$: $(4 \pm 3) \cdot 10^{-8}$ and $K_L \rightarrow \pi^0\gamma\gamma$: $(1.8 \pm 0.4) \cdot 10^{-6}$. A new proposal for an improved measurement of ε'/ε was approved by the Research Board (NA48), after a successful test of a liquid krypton calorimeter module.

Neutrino and Muon Experiments

The CHARM-II Collaboration has finished data taking in 1991 on the scattering of neutrinos and antineutrinos on electrons(WA79). From the 1987–1990 data, the electroweak mixing angle was obtained as $\sin^2\theta_W = 0.237 \pm 0.007$ (stat.) $\pm$ 0.007 (syst.)

Two new neutrino experiments have been approved to search for oscillations of ν_μ into ν_τ.

The Chorus Experiment (WA95) will look for τ decays from $\nu_\tau N \rightarrow \tau^- X$ in an emulsion target of 800 kg. Extensive R&D was carried out in 1991 on detector components.

The NOMAD Experiment (WA96) will use a high resolution magnetic detector with the UA1 magnet and detect the ν_τ by means of kinematical cuts.

The Spin Muon Collaboration (SMC, NA47) measures the asymmetries in deep inelastic scattering of longitudinally polarized muons on polarized protons and deuterons. In 1991, considerable data on deuterons were obtained for the first time. In parallel to the preparation of new runs with protons and deuterons, an improved target is under construction.

Spectroscopy and Heavy Flavour Production

The NA12/2 experiment has continued data taking on central meson production by pions and protons. The analysis of $\eta\eta$ systems, supposedly rich in gluonium states, has been emphasised. In 1991 a liquid hydrogen target surrounded by time of flight counters and a set of novel microstrip gas counters have been implemented which resulted in a cleaner set of fully constrained events.

The hyperon experiment WA89 continues to study the production of charmed-strange baryons using the Σ^- beam and the Omega spectrometer. A lead glass calorimeter and transition counters have been added.

Experiment WA91 will search for non-$q\bar{q}$ mesons produced in the central region of $p\bar{p}$ interactions. A test run in 1991 with the Omega spectrometer confirmed the anticipated performance of the parallel triggers and the momentum resolution.

The production of beauty particles will be studied in the WA92 experiment using the Omega spectrometer, a high precision silicon micro-strip 'decay detector' and a fast secondary vertex trigger. A technical run was successfully completed in 1991.

Heavy Ion Experiments

The various experiments of the intense heavy-ion programme have continued to analyse their data from the Sulphur ion runs in 1990 and 1991. Most of the Collaborations have submitted plans for the use of Lead ion beams as of 1994. The Research Board has approved three new set-ups.

ISOLDE

The past 6 months have seen the delivery and installation of the components for the first stage of the new ISOLDE facility at the PS Booster. The system is presently being commissioned. The General Purpose Separator will initially feed 3 beamlines. A large set of experiments has been approved for the first round at the new facility.

LEAR EXPERIMENTS

Fundamental Symmetries

The CP-LEAR (PS195) experiment is studying CP violating phenomena in the neutral kaon system by measuring interference effects and asymmetries between K^0 and $\bar{K}^0$ of the three main decay modes. The new data of decays into $\pi^+\pi^-$ at large eigenvalues determine for the first time the CP violating parameters from the asymmetry between particle and antiparticle decays. The group also studies three-pion and semi-leptonic final states, where CP-and T violating effects are predicted which have not yet been observed.

Meson Spectroscopy

The Crystal Barrel (PS197) experiment accumulated 25 million $p\bar{p}$ annihilations at rest in 1991. Most events were taken with triggers requiring only neutral particles in the final state, providing access to $\pi^0\pi^0$, $\eta\pi^0$, $\eta\eta$ and $\eta\eta'$ resonances not observed before in $p\bar{p}$ annihilations.A detailed study was published on the f_2 (1515),observed in the $3\pi^0$ final state. For the decay into $\eta\eta$, a scalar meson was observed at 1560 Mev, which might be identified with the f_0 (1590), being a strong candidate for glueballs. The f_0 and the a_0 are also observed in the $\pi^0\pi^0$ and $\pi^0\eta$ final states.

The Obelix experiment (PS201) studies $\bar{p}$ and $\bar{n}$ annihilations. In 1991 the electromagnetic calorimeter was completed. Final results were published on $p\bar{p}$ annihilations at very low momentum. Several other charged final states were investigated. Some candidates were found for the exotic C(1480) meson.

The Jetset experiment (PS202) focuses on the reactions $p\bar{p} \rightarrow \phi\phi \rightarrow K^+K^-$ K^+K^- and $p\bar{p} \rightarrow K_s^0 K_s^0 \rightarrow \pi^+\pi^-\pi^+\pi^-$ using a hydrogen gas jet target. The cross-section for $\phi\phi$ production was observed well above background. This reaction is of particular interest as it is the only one at LEAR with a purely gluonic intermediate state. A new RICH counter has been added recently.

Inertial antiproton mass

The PS 196 experiment captures antiprotons in a Penning trap using 5.9 MeV antiprotons which are degraded in a thin foil. The cooled antiprotons were stored for up to 3.4 months. The inertial proton and antiproton masses were found to be equal to 4 parts in 10^8 by comparing their respective cyclotron frequencies. The measurement resolution has recently been improved to 2 parts in 10^9 so that a significantly lower limit on the mass difference might soon be obtained.

The PS 189 experiment has chosen an RF mass spectrometer (RFMS) to measure the same quantity. A RF-Quadrupole (RFQ) is required to decelerate the antiprotons from the lowest LEAR momentum of 60 MeV/c to the 20 MeV/c accepted by the spectrometer. The resolving power of the RFMS has been improved to $m/\Delta m = 4 \cdot 10^5$. In November, the deceleration of protons was demonstrated.

R&D ACTIVITIES

The challenging experimental environment of high-energy hadron colliders such as LHC has triggered a variety of new development activities, bringing the total number of R&D projects approved by the Research Board to 26. The progress of the projects started earlier has been very impressive as could be judged at the recent presentations of Expressions of Interest for LHC experiments at Evian. Some ten of the projects have been approved for continuation into a

second year. PPE Division is participating in many of them with some 40 of its staff, including a significant number of our research physicists.

The activities supported under the LAA project continue as an important part of the R&D program, with sixteen staff supported by LAA working in the division. Much of this work is aimed at applications in LHC detectors.

SUPPORT AND ADMINISTRATION

The support in mechanical areas of detector development and construction for the approved experimental programme, including R&D projects, as well as mechanical support for the operation of the current large detectors, has been provided by the Detector Unit of the Division. Despite some recruitment, the staffing level has seen a net reduction of about ten percent over the past two years (due to retirement and early departures). This obviously has very serious consequences on the support which can be provided. More recruitment is urgently needed.

The Division continues to support an ever growing visitor programme both through the Users' Office and through the Administration and Secretariats group. This is also an area which suffers heavy staff depletion due to early retirement and where more recruitment will be necessary in the near future.

ELECTRONICS AND COMPUTING FOR PHYSICS DIVISION (ECP)

ECP consists of a team of 120 computer scientists, technicians and support staff, working on computing related to experiments from on line data collection to analysis of physics results, and of a team of 150 designers and support staff, working on all the aspects of electronics for experiments. In addition, a small team is taking care of the infrastructure of the LEP experiments area.

COMPUTING

In the RA (Readout Architecture) group the status reports of the RD-11, RD-12 and RD-13 projects, presented to the DRDC session of April, have been accepted and the work is continuing. RD-11 has produced new algorithm benchmarks for calorimetry and tracking on MacVideo, DataWave, MasPar, Blitzen and ASP. RD-12 is completing the design of a general purpose timing and control system and it has initiated a collaboration with the CNET of Grenoble for the study of a digital filter. RD-13 has measured the speed performance of a real time UNIX based data acquisition system and a full system for a beam test data acquisition is in preparation.
In the GPMIMD Esprit project CERN is evaluating the T9000 transputer-based parallel MIMD computer by mounting an on-line application in collaboration with NIKHEF and an off-line application in collaboration with the ALEPH experimental group. Participation in this work has begun using the present generation of Transputers since the introduction of the T9000 and C104 chips has been delayed.

The DS (Data Acquisition Systems) group's main activity has been the development of a data-acquisition system based on the VMEbus and UNIX workstations, in collaboration with the experiments CHORUS, NA48 and NOMAD. Since this is a 2-year programme, the specification phase has just started; areas where the design can start have been identified, such as the run control, the data formats, the hierarchical architecture and the event building. A study on the required communication infrastructure has been carried on, preparing the ground for a decision to be taken soon. A first release of the remote histogramming facility (based on PAW) has been issued, and the specification of the next phase has been defined.

Tests and assessments have been performed on the area of the real-time embedded systems, both on the hardware side - VIC bus, RAID - and on the software side - LynxOS, new versions of OS9, VIC libraries.
Support has been provided as usual to experiments and test beams, with particular attention to the setting up phase after the annual shut down.
The detached personnel have continued their fruitful involvement within experiments and projects.

The main highlights of the SA (Simulation, Reconstruction and Analysis) group's work for the first 4 months of the year are: For the 3 supported LEP experiments (Aleph,Delphi and Opal) preparation work for the LEP startup has been the main concern, preparing software to analyse data from new hardware and upgrading offline computer farms in readiness for the expected increase in data.
Work has started on the NA48 offline software chain. Software engineering methods are being studied for the design of the system.
Pattern recognition, trigger and background studies have been done for the LHC meeting in Evian, and work continues on the various DRDC experiments, simulating the behaviour of the detectors and preparing for test beam running later in the year.

Within the PT (Programming Techniques) group a collaboration with Apple Computer has been set up to provide manpower, equipment and software tools for the L3 slow control system, ARGUS. In addition, a new project called CORTEX has been approved to study the construction of a generic set of tools for future Slow Control and safety systems, with possible extensions for Run Control. In Aleph, the last three months have been occupied commissioning the DAQ for the 1992 running period and the data taking efficiency so far has been consistently above 95%.
The WorldWideWeb information system has been installed and is under test in the Aleph experiment and the WWW Macintosh and X-Window browsers are being debugged (the latter was produced outside CERN). Additional servers are being provided, such as the SLAC SPIRES preprint data base, the NIKHEF telephone book and the Software Technology Interest Group (STING) glossary.
In order to make GISMO phase II more portable the NeXT graphics code has been re-written in C++ and is being tested with an interface to X-Window/Motif. The

conversion of DALI (ALEPH event viewing) to X-Window is continuing and new features have been provided. Principles and methods of DALI were presented in two academic training lectures.
A new version of the GSS system and of the graphics was installed for the 4 LEP experiments to improve operator - system interaction. Communication with the LEP Central Alarm Server has been tested and is working.

The PI (Production support and Infrastructure) group has updated its loan pool of minicomputers by the addition of VMEbus-based systems. Complementary efforts are underway to train the personnel to be able to provide first-line support for VMEbus-based real-time software such as the OS-9 real-time kernel and the SPIDER data acquisition system. The development of a VMEbus to G-64 adapter has been undertaken on behalf of the Aleph experiment. The On-Line Computing Services Liaison Meeting, which began in February, has discussed a number of support-related topics which have prompted further actions. The "Online" newsletter has been launched to inform about services and developments in on-line computing and electronics at CERN.
The Industrial Support contract for production and cluster operators and for cluster supervisors has been agreed upon by the Finance Committee and the selected firm (DCS) will provide manpower for the experiments by July 1992. Contacts have been taken with several experiments to make sure that the personnel proposed by DCS will be operational right from the beginning.

ELECTRONICS

The EDA (Electronics Design "A") group is participating in the design of electronics for the DELPHI and NA48 experiments. New trigger control modules for DELPHI are being specified and prototypes of the NA48 liquid Krypton calorimeter electronics have been successfully tested. Several one-off designs have been made for other CERN experiments (e.g. CHORUS) and for the FASTBUS infrastructure.

The EDE (Electronics Design "E") group has a major involvement in the operation of the PS195 experiment now taking data at LEAR. Electronics in VME is being designed for the measurement of polarisation of the SMC (NA47) polarized target. FASTBUS readout modules (SIROCCOs) for Silicon Strip Detectors are being

delivered to ALEPH, DELPHI and OPAL. The group is contributing to several other projects : RD3, RD20 and WA93 for which a low power phototube base was recently tested.

In the EDI (Electronics Design "I") group the DRDC proposal P31 has been approved into project RD23; work is progressing. For the ALEPH SiCal the front-end electronics has been produced, tested and installed on the detector. The trigger mixer boards are operational. For CHORUS data have been taken with the CCD camera prototype and the data processing unit, and are now being analyzed.

The EDN (Electronics Design "N") group has been created in February 1992 aiming at the provision of the necessary support for the reconstruction of the neutrino beam for CHORUS and NOMAD. The corresponding activities started with the dismantling of the radioactive elements of the neutrino cave, ordering of the pulse transformers for horn and reflector, renewal of the capacitor banks and discharge circuits in BA7, mechanical studies, writing of the specifications for the new beam control system with the help of a specifications study group.
The activities related to ALEPH are: operation of the superconducting magnet and related controls; installation and testing of a bubble counter system for gas leak detection; installation of a commercial monitoring system (SA) for the superconducting magnet.

Omega experiments run well with a few planes of silicon microstrip detectors developed by the EDU (Electronics Design "U") group. The prototype of a 15000 channel silicon micropixel detector is being tested. The preparation of WA92 goes well and the integration of the contiguity trigger processors is on its way.
The OPAL pretrigger central logic is installed and runs in the pit. The upgrade of the electromagnetic trigger has been done and is working in the pit. A first version of front end electronics for the new Silicon tungstene calorimeter is available.
The fast RICH electronics has been delivered and 12000 channels are being assembled.
The work around the fast digital link goes well. The VME/HIPPI source board is tested. The work on HIPPI/TurboChannel interface is going in time. The prototype of the NOMAD ADC is expected at middle of May.

The MIC (Microelectronics research and development) group is steadily progressing on all fronts. The Analog section has produced and tested a number of full custom designs for RD2, RD9 and RD19. Pixel devices were delivered to WA94 (Omega) and tests could take place with the readout system. The digital section is working on micropipeline architectures, a time to digital converter IC for NA48 while preparing R&D activities in the field of packet switching networks for event building in future HEP experiments.

The layout section of the PES (Production Engineering and Support) group was recently merged with a similar outfit of the accelerator sector. CERN advanced PCB layout activities are now centralized in the group thus leading to rationalization of the activity. The group is providing electronics engineering support and hence contributes to most projects in the research sector.

During the first six months of 1992 the ECP Electronics Pool has started the application of the rental scheme to the totality of the Pool instruments. This should allow the Pool to become self-financed for the expenses covering the purchase of new instruments and the maintenance. The quality test activity, run to qualify new instruments for Pool standardization, was concerned with High Voltage supplies and multihit TDC's.

LEP Experimental Areas Infrastructure

The first term of the year has been devoted to finishing the work of the LEP winter shut down. In particular, the gas distribution networks for the OPAL and DELPHI detectors were considerably modified due to the LEP 200 extension project. These networks had to be fully tested and certified. Important cabling work for ALEPH end DELPHI was also completed. Supplementary supports were constructed for accommodating various extra equipment. The background shielding inside the tunnel at points 4 and 8 has been motorised, and can now be controlled remotely. Before LEP start up we carried out all tests concerning the various safety systems and the transmission of their alarms.
Beside the LEP programme, the group has also been involved in the cabling of the CHORUS, NA 35 and NA 48 experiments, as well as in the dismantling of the Neutrino control room.

COMPUTING AND NETWORKS DIVISION (CN)

Central and Distributed Computing.

Several important changes took place before the LEP restart to allow optimal computing facilities to be made available for the LEP groups. Additional facilities for LHC, mainly the large Central Simulation Facility, came into widespread use.

The IBM section had a busy time with 4 consecutive upgrades to complete: the hardware upgrade of the IBM 3090-600 to an ESA 9000/720 at Christmas, a major software upgrade to VM-ESA 1.1 shortly afterwards and a final hardware upgrade to a model 900 at the end of February. Moreover, the old Siemens 7890 machine, running Physics and ADP services simultaneously, has been replaced by a small but modern Comparex 8/850 to run ADP services until such time as the AS-MI group has moved all administration applications over to their new UNIX platform. All these upgrades went very smoothly.

Site planning activities started early in the year in view of the arrival of the new 3480 IBM robots, which will bring the overall capacity of the systems to 38000 cartridges by the end of 1992. Moreover, evaluation of two Exabyte robots has been completed successfully. These will be used on the main VXCERN cluster and in the CORE (Centrally Operated RISC Environment) applications later in the year.

Negotiations with Merlin-Gerin for the acquisition of the replacement Uninterruptable Power Supply in the computer centre were completed in February. Factory tests and on-site tests were run successfully and the final commissioning of the system is scheduled for the week-end of May 16th and 17th.

A serious study was made to understand the plans and the software issues around IBM's roll-out of their mainframe UNIX operating system, AIX/ESA.

It was decided to keep the existing CRAY X/MP until about the end of 1993 and the service, used by several large groups at CERN, was consolidated: the swap space has been reconfigured and data migration was successfully implemented. In addition, an initial evaluation of Massively Parallel Computer Systems was started, and a couple of them were benchmarked. The division also participated in discussions with the European GP-MIMD2 consortium to understand the potential for a collaboration.

A DECsystem/5900 was introduced to replace the overloaded CERNVAX system. This system is the basis of a joint Ultrix data centre project between CERN

and DEC. The central VAX clusters for physics and for engineering applications continued to be used heavily. More disks have been added to the VAX engineering cluster and back-up on these machines has been moved from expensive TA90 units to cheap Exabyte drives and stackers. An initial investigation of DEC's new Alpha architecture was started to understand the implications for our services.

At Christmas last year, the Silicon Graphics servers used in the SHIFT project were augmented from two systems to four, and a large amount of additional disk space was introduced. There was intense activity in the CORE area with, primarily, the commissioning of the Central Simulation Facility (CSF) consisting of 16 HP720 workstations in parallel during the first quarter. This Central Simulation Facility now provides around 50% of the total compute cycles delivered by the Computer Centre for use by the LEP and LHC experiments. CSF has superseded the HOPE service, which was terminated before Easter. Enhancements were implemented for collecting systems statistics and automatic reporting of problems for SHIFT and CORE.

The Unix workstation support team continued its support of Hewlett/Packard, HP/Apollo, SUN and DEC workstations, and additionally announced the availability of IBM workstation support. A large amount of work went into server functionality, user documentation, system distribution services and other structural offerings.

Oracle database usage continued to expand as reflected by the introduction of the AIS system and other Oracle servers at CERN. CN accepted the request from the SL division to operate a central server for LEP logging that should be operational by the summer. The conversion from Oracle version 5 to 6 was successfully completed, and new efforts will now be put on the installation of new products as well as the ongoing broad-ranging support activities.

Networking

A consolidation programme for the internal computer networks was started, in view of the increasing dependence of the whole Laboratory on networking. Working methods were revised, a campaign was undertaken to correct deficiencies in the cabling infrastructure, and money was earmarked for supplementary equipment. Fibre-optic networks were installed for three of the LEP experiments. The workload to keep the networks running smoothly remained very high.

External networking continued to grow, with 250 gigabytes transferred in the month of March, a new record. The transatlantic line from MIT was upgraded to 512 kilobits per second, giving a total transatlantic capacity of 2 megabits per second. With an upgrade of the line from Amsterdam to 512 kilobits per second also on order, and tests underway with the European Space Agency OLYMPUS satellite, CERN remains the busiest centre in Europe for academic computer networking.

Several hundred users are now registered for the call-back modem system for working from home.

Applications Software

The main activity of the Simulation Section has been the development, testing and installation of Version 3.15 of the GEANT simulation program, containing new developments in the areas of electromagnetic and hadronic processes, relevant for the design of the LHC detectors. Important developments have taken place in the graphics and interactive packages, allowing the representation of the experimental setup with hidden line removal and surface shading. In parallel with this work, the development of the next major release of the program has progressed and the new geometrical modeller is now in advanced prototyping phase. An interface between GEANT and the SET Neutral File Format was developed and will be released soon. The work on the definition of a generalised parametrization scheme is in progress in close collaboration with experimental groups.

For the CERN Program library, the main progress has been in the area of distribution and access to the Library. We are using extensively the facilities provided by the ASIS (Applications Software Installation Server) project in order to host the sources, libraries and executables needed by the user community. We are organizing a user consultancy service local to the CERN Program Library Office, which will handle requests concerning the installation, maintenance and distribution of the software. We expect this to be fully in operation by summer.

The revised edition of the CERNlib manual is expected to be ready for a draft edition by the end of June, which will allow us to collect feedback to be reflected into the final edition scheduled for autumn.

The FATMEN package was extended to provide new functionality, particularly in the area of VAX support. Numerous new features have been added,

strengthening the support for the distributed computing environment. CSPACK has reached a good level of stability. It is widely used at CERN and outside.

Discussions on the HEP Data Base package started during the summer of 1991. The first version of this HEPDB package will be released with the next program library in June 1992. It is likely that at least 6 experiments will be using the package by the end of the year. The collaborative effort between CN and the experiments, particularly L3 and OPAL, has proved extremely fruitful.

New drivers for one of our standard graphics packages (GKS) have been acquired and distributed to users. A portable version of the PHIGS standard graphics package, to be made available to the whole HEP community, has been acquired and installed on several platforms. Some 10 collaborating Institutes have already obtained the package under the license agreement. New versions of the PAW package have been released, introducing a number of new features, in particular a first implementation of a KUIP interface with MOTIF. A number of new features have been introduced in HIGZ, including 3D routines, used also by PAW for plotting of 3D Ntuples. The KUIP users manual has been extensively revised and the HIGZ and HPLOT manuals are being rewritten. Members of the section are daily involved in consultancy activity in the area of graphics, standards, PAW, HIGZ, etc.

The documentation of most AS Group packages has been converted to LaTeX and styles have been developed to obtain a coherent, functional and pleasing presentation in book form as well as online on the computer. Special attention has been paid to provide easy keyword access and to allow hypertext searches on the information database. All documentation has been made available in PostScript form on the ASIS server and in text form via the XFIND and WWW (World-Wide Web) systems. A uniform LaTeX environment has been installed on all centrally supported systems and a document "TeX at CERN" describing the CERN TeX environment and its extensions has been made available.

Computing for Engineering.

In digital electronics, support was given for RACAL REDAC, DAZIX and P-CAD CAE/CAD and for design with Programmable Logic (PLD's). A faster DAZIX version was installed along with the Logic Automation component library, and the electrical rules checking package was evaluated. The transfer of data to RACAL REDAC for PCB layout was streamlined. File backup for the CAE SUN cluster is now done via the computer centre IBM ES9000. P-CAD was updated to

v5. For RACAL REDAC, an HP4000 server replaced the Apollo 570. Guidelines for the development of PLD's in the CERN environment were published. The use of Framemaker for documentation writing was generalised. Terms were negotiated for CAPS, a CD-ROM based component datasheet library. On the analog side, support for the I-SPICE, SABER and PSpice simulators continued. Multi-user network licensing of SABER was generalised and a schematic capture frontend was introduced. PSpice licence conditions were re-negotiated and PSpice was evaluated on SUN. An Analog Open Day was organised along with the Analog CAE User Group.

In the mechanical field, support was continued for EUCLID-IS and for the Pro/Engineer evaluation. The older workstations are steadily being replaced by DEC VS4000s. Preparations, including update of CERN-written application code, were made for a move to version IS220 or IS230. A comparative analysis of EUCLID-IS and Pro/Engineer was commissioned. AutoCAD was upgraded to v11. MAFIA 3.1 for RF cavity design was installed and plans were made for the use of a workstation cluster as batch server for compute-intensive engineering software. Within the Computer Aided Detector Design (CADD) initiative there were further practical data transfer successes and evaluation was started of the BMW NFAS software as an aid to data conversion.

In microprocessor support, the VICbus (VME Inter-Crate bus) was finalised for publication as a draft ISO standard. Participation in the IEEE P1003.4 (real-time extensions to POSIX) Working Group continued. A SUN-based software repository, initially for OS/9 related code, was set up. A flexible general contract was established with the OS/9 supplier, Microware. Experience with the LynxOS real time Unix system grew in support of the accelerator controls project and new experiments also began to show interest in this system. A new round of VMEbus blanket purchase tendering was completed. There was an encouraging evaluation of the Nuthena Foresight system-level simulation package.

A new activity was the assumption of a coordinating role for PC services based on Novell Netware, the aim being better integration among Novell servers and with the rest of CERN's computing infrastructure. General agreements were made to enhance the availability of mathematics packages such as MathCAD, Mathematica and TK Solver. The X server-client model was investigated for use with engineering software. Help was given to the technical training service to set up their PC equipped workroom and, with them, a number of training courses were organised.

II. TECHNICAL DIVISIONS

- Accelerator Technologies Division (AT)
- Mechanical Technologies Division (MT)
- Proton Synchrotron Division (PS)
- SPS and LEP Division (SL)
- Technical Support Division (ST)
- Technical Inspection and Safety Commission (TIS)

ACCELERATOR TECHNOLOGIES DIVISION (AT)

The groups have devoted a considerable effort in the shutdown work, while continuing to progress on the LEP 200 and LHC projects.

1. CRYOGENICS

• *Operation of existing cryoplants and cryogenic facilities*

Operation of the existing cryoplants for LEP and SPS experiments and for accelerator components (s.c. cavities and quadrupole magnets) restarted after the shutdown. Three cryoplants are in permanent service for LEP200 and LHC tests. Nevertheless, large quantities of liquid helium had to be purchased to fulfil the very high demands of the cavity test program, and during the accelerator shutdown, the ex-RCBC cryoplant now feeding NA44 was used as a complementary liquefier. Cryogenic support was given to experiments NA35, NA38, NA44, NA45, NA47, NA48, NA49, RD5 and to the OMEGA spectrometer. Intensive R&D work continued for LEP200 and LHC in the central cryogenic laboratory. Training courses for technicians were organized with precious help from retired staff and from outside institutions.

• *Cryogenics for LEP200*

The two 6 kW/4.5K cryoplants delivered in 1991 have been successfully operated and will undergo reception tests with the final control programs which must be supplied by the contractor in May. The plant at Point 2 is planned to take up normal operation after the May shutdown. The plant in hall SM18 will feed LEP200/LHC test facilities. The 400 W/4.5 K cryoplant delivered in December 1991 to cool the SPS s.c. cavities, was installed and commissioned. Work is progressing for installation starting in summer of the 12 (18) kW/4.5 K cryoplants at Points 6 and 8.

• *Cryogenics for LHC*

Experiments concerning flow and heat transfer to boiling or pressurized superfluid helium continued at CERN and at CEA Grenoble. A new cryohydraulic test facility simulating operating conditions of LHC magnets

became operational in May and gave very encouraging initial results. Studies and tests of critical cryomaterials have been pursued as well as the implementation of the cryogenic infrastructure for single magnet and LHC string tests in hall SM18.

2. MAGNETS

- *Existing accelerators*

At PS, the coil supports of LIL + EPA dipole and quadrupole magnets have been modified, the ISOLDE magnets installed and a detailed field map of a PS magnet created for introduction into operational procedures. At SPS, the repair of beam line and machine magnets damaged by radiation was continued and the tendering documents for replacement of coils and other components have been prepared.

During the LEP shutdown, the demagnetization of the vacuum chambers has been completed successfully. To allow operation at 90° phase advance, the sextupole magnets had to be connected into different families and a number of correcting dipoles have been displaced and modified. Eight former ISR octupoles and four spare sextupoles have been added into the ring; an equipment has been installed to monitor the tunnel air and dipole magnet temperature and improve the accuracy of beam momentum; one quadrupole was modified for purposes of beam monitoring. The 16 (+ 1 spare) sextupoles needed for the Pretzel scheme have been ordered .

The work on LEP 200 magnets is progressing satisfactorily; all MBI full steel dipole cores have been measured and prototype coils for the new s.c. insertion quadrupoles have been made. The rearrangement of the insertion quadrupoles has been studied and two of them have already been displaced to make room for s.c. cavities.

- *LHC models and prototypes*

The last of the four dipole models of 1 m length built by industry has been tested, reaching the short sample limit of 7.9 T at 4.2 K after only two quenches and 9.8 T (close to the record of 10 T obtained in October 1991) at 2 K after some training. Studies are progressing to eliminate training while some of these first models are being modified in industry. New magnet models have been designed and the tooling for their assembly at CERN is being procured.

The tests of the first 10 m long prototype magnet (TAP) made with HERA type coils were successfully completed at CEA, Saclay, France. At 4.5 K, the first quench occurred at 5.8 T, practically the short sample limit, thus confirming the soundness of the twin-aperture configuration; at 1.8 K, the magnet attained 8.3 T without problems. The manufacture by industry of the 10 m long LHC prototype dipoles is proceeding with some slight delay with respect to schedule; two of them have been modified to incorporate separate coil/collar systems.

The construction of the first main quadrupole prototype has advanced well at CEA, Saclay, with the completion of the coils; the prototype of dipole-sextupole correctors has been successfully tested at CERN at 1.8 K.

The capacity of the test station for short magnets has been doubled and the manufacturing of the main components for the long magnet test station is progressing in industry. A test station for short sample measurements of superconducting wires at temperatures ranging from 1.6 K to 4.5 K and at fields up to 11 T has been ordered.

3. VACUUM

The shutdown work of all accelerators involved maintenance, modifications and upgrading of the vacuum systems, some examples of which are given here:

- for LEP, new thin vacuum chambers (ALEPH, DELPHI, L3), modifications of the sector around point 2 in view of future installation of s.c. cavities, installation of new equipment (Pretzel separators, polarization wigglers and collimators, cavities and kickers for longitudinal and transverse feedback, etc.), checks during demagnetization.
- for SPS, exchange of one third of the sector valves, revision of all pump groups, installation of new equipment (s.c. cavity bimodule, LHC experiment on beam deflection by crystals), modification of the controls of the second sextant
- for the PS complex, new slow ejection and upgrade of the controls of one third of the ring, new beam windows and repair of magnets on EPA, additional UPS (uninterruptable power supplies).

The ISOLDE beam line and the vacuum system of the General Purpose Separator has been assembled and commissioned including the controls.

Machines running under ultra-high vacuum, in particular LEAR and LEP, required a substantial work load for bakeout during the final weeks of the shutdowns.

Development activities have been actively pursued for various projects:

- for LEP 200, the manufacture at CERN and in industry of new vacuum chambers to be installed in the next 1992/1993 shutdown continued and the database for vacuum components is being prepared
- the definition of the LHC vacuum system has progressed and the design of components has been started.

4. SUPERCONDUCTING RADIOFREQUENCY CAVITIES

The last two bulk Nb cavities are under acceptance test. Technology transfer for the s.c. sputter coated cavities was pursued such that one manufacturer has delivered the first cavity fulfilling specification ($Q = 4\ 10^9$ at 6 MV/m) and the other two are also close to this target. The installation of the new cavity testing area in hall SM18 continued: the clean room, the demineralized water and high purity water systems and the RF equipment are ready; one of the three installed cryostats has been filled with liquid He at the beginning of May.

In parallel further tests for HOM couplers, cryogenics layout and improved sputter layers are continued. A thorough study of the assembly procedure of the s.c. cavity modules has also been conducted in order to improve their performance and obtain reproducible performance.

5. OTHER ACTIVITIES

During the shutdown, an extensive survey and realignment programme has been completed at the SPS (full radial realignment), at LEP (vertical survey along 10 km with 30 quadrupoles corrected, survey of experiments and new components) and at the PS complex (LIL, EPA, ISOLDE beam line). The survey and control of the LEP 200 civil engineering work continued.

In parallel with the overhaul and maintenance work, the upgrading and extensions of LEP cooling and ventilation systems have been pursued (back-up

chilled water pumps for the experiments, noise dampers on the air extractors, new cooling facilities for the LEP 200 cryogenics plants, improvement of the communication system between LEP points, etc.)

Among the other activities, that concerning industrial controls was mainly directed towards the implementation of the controls of the new cryoplants.

MECHANICAL TECHNOLOGIES DIVISION (MT)

1. MECHANICAL ENGINEERING STUDIES

The three groups for the mechanical engineering support for the Accelerator Sector have supplied to their clients about 50'000 hours in the first half of 1992, for making design studies and manufacturing plans. This total includes the industrial support which represents the equivalent of 22 man-years.

1.1 MACHINES CONSOLIDATION GROUP (ESM)

Maintenance and consolidation of all the CERN accelerators still implies a lot of studies, requiring a large part of the resources of the group. New studies were started in 1992 :

- the proton line for LEAR

- the installation of ISOLDE in an experimental Hall,

- the studies for the LINAC - Pb,

Some studies related to LHC are also performed, such as the LHC beam dumping system and the magnet measuring benches, to be installed in the SM18 building. In the same way, some studies related to the CLIC Test Facility are performed in the group.

1.2 LEP200 AND INFRASTRUCTURE GROUP (ESI)

The drawings for the definition of the LEP200 machine are finished as well as those defining the vacuum system for the different stages of LEP200 project. Collimators production in industry and in the CERN workshops has started under the supervision of the group. Design has also continued for the modification of all underground structures for new cryogenic components.

Infrastructure studies have been made for the LHC test cell and the magnet measuring benches to be installed in building SM18, and for the LHC experimental area caverns with associated service and lifting facilities.

Other activities imply improvement studies of robotics facilities and support to the power converter group. Design of furnaces, of a scanning device for RF super conducting cavities for the Surfaces and Materials group have also been made and production started for some components.

1.3 LHC MAGNET DESIGN SUPPORT GROUP (ESH)

Mechanical studies and design of LHC components have progressed satisfactorily since the beginning of 1992, with enhanced emphasis on the design and procurement of a new LHC 1m model dipole to be assembled at CERN and its associated tooling. In support to the AT-MA group, the essential parts have been ordered in industry and should be delivered before June 1992. The skinning press and collaring tooling are nearing completion. Mechanical transducers aimed at instrumenting the models have been developed and will be calibrated in a new traction machine operating at 1.8 K.

Other studies such as short section cryostat and cold mass, dipole measuring stands with their cryogenic boxes, vacuum and electrical junctions, beam screens, etc. are progressing. Prototype components such as magnet end parts, cold magnet discharge valve, support posts, junction bellows, for the LHC test half-cell have already been provided. Prototype vacuum vessels built in Poland and Russia are nearing completion.

2. MANUFACTURING FACILITIES GROUP (MF)

The mainstream of the activity is essentially constituted by small to medium sized jobs (40 to 200 hours) involving several technologies and very short delays. A few, more consistent jobs have been recently completed (LIPS RF cavities, LEP collimators). The construction of the improved version of the RFQ for the Linac pre-injector is well advanced and shall be terminated by mid-July. The work for the research sector is rather limited and essentially concentrated in the CNC metrology section, while the work related to LHC studies is steadily increasing, covering a wide range of items such as magnet cryostats, several models of laminations produced by electro-erosion, heat exchangers, etc.

The jobs related to LEP200 are the largest fraction, with the notable example of the construction programme of some 87 Aluminium vacuum chambers of the dipole type, which has started in March 1992 and shall be completed for the 92-93 LEP shut-down. For this purpose some special machines and tooling are being recuperated from the firms who originally produced the LEP vacuum chambers and will be installed in a yard being set up for the execution of the programme.

In the meantime the second phase of the MINOS project is being implemented and completion is foreseen for the end of 1992. At that time all MT mechanical activities of the Prevessin site shall be concentrated in building 904, with the new Industrial Support mechanics and sheet-metal workshop, a well equipped free workshop, the ironmongery and light structures workshop and the lab areas dedicated to SL technical support, SPS septa coils construction and the machine-tools maintenance section.

3. SURFACES AND MATERIALS GROUP (SM)

Following the reinstallation of the metallurgy and materials analysis activity an X-ray diffractometer with thin film, texture and residual stress attachments and a high performance scanning electron microscope with an energy dispersive X-ray analyser have been commissioned and are now producing first results.

Development work on superconducting cavities continues to make good progress. The design study of the system to inspect the internal surfaces of cavities has been completed and certain components ordered. The technique of infrared spectroscopy to analyse organic contaminants on metallic surfaces has been used recently by the MT-SM group to identify impurities at the ppm level in doped liquid argon for calorimeters.

A large improvement in the resolution of photomechanically produced components such as high defintion fanouts and hybrid circuits on ceramics will soon be possible following the installation of a laser photoplotter capable of producing master documents with 5 micron features. This still requires however the improvement of premises to be compatible with dustfree working conditions.

The MT-SM group has continued to provide a large volume of work to the CERN community on a daily basis in the fields of metallurgy, surface treatments, heat treatments and brazing, thin films, photomechanical technologies, surface analysis, chemistry, polymer resins and special gases and fluids.

4. OTHER ACTIVITIES

4.1 INFORMATIC SUPPORT SECTION (DI-SI)

On top of the normal activities of the informatic section which cover the maintenance and user support of the local computer network, common to the AT and MT Divisions, the support for CAD packages, applications have been developed to allow for the exchange of data and drawings between the different CAD packages, and for the general management of all the drawings produced in the division including their electronic approval, and viewing on a PC screen. In the database field, CASE techniques are being used to analyse and design a tool to communicate with the Finance Division database, allowing for a faster, and more uniform approach to cross-charging within CERN for the workshop, design or installation activities of the division.

4.2 INSTALLATION GROUP (IN)

The group has been heavily involved in the normal winter shut down of the machines, mainly for the underground galleries installations, in view of LEP200 and for the new installation of the ISOLDE separator. Now MT-IN prepares the dismantling of the SC complex.

In parallel the group is in charge of the renovation of the workshops and laboratories of the division. This concerns the mechanical workshop on the Prevessin site, the chemical and metallurgical laboratories for the SM group and a new workshop for the LHC model construction and testing.

PROTON SYNCHROTRON DIVISION (PS)

The customary annual shutdown at the beginning of 1992 has been the occasion for various renovation, maintenance and installation activities in the PS Complex, with all the nine accelerators of the Complex commencing operation in early or mid-March. The following summarizes the activities related to these accelerators to date as well as the work related to the planned future activities.

WORK IN WINTER SHUTDOWN 1991/92

Some of the different tasks carried out during the winter shutdown in the PS Complex included the complete cleaning and improvements on the ion source, the final installation of the new PS slow extraction scheme, and the renovation of the second part of the PS water cooling circuits with the help of the ST division. Maintenance work in the PS East Hall was concerned with controls, beam detectors and magnets.

At the 800 MeV PS Booster Synchrotron (PSB), celebrating its 20th anniversary of first acceleration of protons to 800 MeV on May 26, work has concentrated on the preparation of the PSB for lead ion acceleration namely, power supplies for the injection line, kicker magnets upgrading, beam diagnostics, RF beam control system and vacuum upgrade.

For the new ISOLDE experimental area, the first four months saw some major installation activities including the General Purpose Separator, the target zone and the PC-based control system. Other ancillary activities related to this new facility have been completed namely, the radiation shielding, access control, etc. The 60 kV pulser needed for the ISOLDE target (running with the PSB beam) has been assembled and tested and its performance goal satisfied, i.e. 60 kV$\pm$2V in 10 ms after the passage of the beam pulse.

A new power stripline to supply the antiproton-collecting magnetic horns (14 kV, 400 kA) has been fabricated and tests to find more reliable horn designs have continued. The low-energy antiproton storage ring, LEAR, was equipped with an improved transverse damper to stabilize the high-density, low-energy antiproton beams, now cooled routinely by means of electron cooling. In the LEAR experimental area, preparations have been made for the display of antiproton beam profiles from position sensitive photomultipliers.

The hidden defects in the wedging of all bending magnets and in some of the quadrupoles of the LEP pre-injector (LPI) were repaired in collaboration with the AT division. In the Electron-Positron Accumulator (EPA) being part of LPI,

all leaking vacuum feedthroughs of the ion-clearing electrodes were replaced and the closed orbit observation pick-ups equipped with new electronics for a wider range of intensity, with simplified maintenance.

This time was also used to do the complete switch over of the LPI controls from the Norsk Data system to the new UNIX-based CERN-standard computer controls. All the modifications planned after the November 1991 tests were accomplished. The use of two old ND-120 computers was discontinued and the computers disconnected as foreseen in the PS/SL Control Consolidation Project.

Preliminary tests performed last year for the LHC detector R&D on radiation damage to fibres by γ-rays produced by 500 MeV electrons from EPA have provided significant results; at the request of LAA, these will be pursued in a new dedicated test area built at the end of the LPI electron linac; this area will be commissioned after the May shutdown.

ACCELERATOR OPERATION

The PS Complex started as scheduled on 9 March for the first operation period of 1992, mainly foreseen for LEP, LEAR and SPS working with sulphur ions for fixed target physics; this schedule was adhered to even though some delays had occurred during the installation and tests of vacuum systems due to temporary labour teams not being sufficiently experienced in this domain; it was necessary to postpone some of the equipment tests planned for the last week of the shutdown. For the same reason, several errors were discovered on different systems after the start up of the accelerators. After the start-up with a low intensity beam of 1.3×10^{12} protons per pulse, numerous problems were encountered which seriously perturbed the setting-up of the accelerators. The most important were the existence of an obstacle in the vacuum chamber of PS straight section 58, a fire in a quadrupole magnet in the TT2 ejection line towards the SPS and an incorrect positioning of two PSB vertical recombination septum magnets, causing a limitation of the proton intensity.

Once these problems were overcome, the PS provided per supercycle four batches of sulphur beam which was increased in intensity by a factor of about 4 this year (in comparison with the previous run of October 1991) after careful adjustments of the ion source of Linac1. The ion intensity reached values between 3 and 4×10^{10} charges per supercycle with a recorded maximum of 4.65×10^{10}. The ions period ended in May with the supply of high intensity oxygen. After a final three week period in the proton mode for LEAR, Linac1 will be decommissioned and dismantled after 33 years of service. Linac2 has continued to be the mainstay of all protons at CERN and has also provided deuterons during the ion physics period in May.

The Antiproton Accumulator/Collector rings (AAC) commenced operation with a 20 mm Li lens as the collecting device in March. The performance of the Antiproton Accumulator (AA) has been marred by problems in the vertical core cooling system as well as some other problems in the rf h=1 system. However, ample production has been attained to keep the LEAR clients satisfied. LEAR worked with antiprotons for several experiments in the South Hall, namely, PS201 (Obelix) at 308.6 MeV/c, Jetset at 609 MeV/c, PS195 (CP violation) and PS197 (Crystal-Barrel) at 200 MeV/c and PS196 (antiproton trap) at 105 MeV/c.

The East Hall test experiments started after Easter with beams of 2.5. 10^{11} protons per pulse successfully delivered by the new PS extraction system. At the end of April, beam from the PSB to the ISOLDE target has been adjusted and commissioning of the new beam line finalized.

For the EPA ring, the March start-up saw the measurement of normal closed orbits, confirming the successful accomplishment of the major magnet repair activities since November 1991. Positrons were delivered to the SPS for acceleration to LEP energy on March 23 as scheduled. Soon after positrons and electrons were delivered as usual in four batches of about 10^{11} particles ($2e^+$ and $2e^-$) per batch.

OTHER ACTIVITIES

After the shut-down, control activities have been mainly focussed on the preparation of the second slice of UNIX-based Controls Consolidation project, i.e. the Linac2 conversion and Lead Linac controls. The specifications for the required application software have been formulated. The hardware layout and transformation plan has been worked out with the various service groups concerned. A project to provide access to the control system from the PC network has been defined. It will permit some accelerator development work, data analyses and prototyping of new ideas on controls from the office network.

As a first step towards injection into the LHC, the installation of an RFQ as a pre-injector for Linac2 has been organized for the shutdown 1992/93. Studies of the injector (PS Complex) parameters for the LHC have continued, particularly for the repercussions and compatibility of LHC type beams with other beams required from the PS Complex. The infrastructure to be provided by CERN and the equipment to be supplied by the partners of Heavy Ion Project Collaboration (CERN, GANIL, GSI, INFN Legnaro, INFN Torino, India) has been defined so that orders to industry can be placed. Work on a detailed design report has commenced. Work on the laser-ion source, instrumental for high ion luminosity in LHC, has continued. Measurements have been carried out using superimposed laser pulses with different wavelengths.

Electron cooling of oxygen ions was studied in LEAR in May with the aim to get a better basis for a performance estimate for a LEAR-type ion-cooling ring for LHC. Feasibility studies for SuperLEAR have advanced together with the definition of physics beam requirements for presentation at the meeting of the SPS and LEAR Experiments Committee in September.

Installation and acceptance tests of a new synchronized laser provided short pulses (5 to 50 psec) in the CERN Linear Collider (CLIC) Test Facility are being carried out. This new equipment will be used in June to illuminate a CsI photocathode in an improved RF electron gun to produce a dense electron bunch and study the production of RF at 30 GHz. A study of the CLIC drive beam generation by 30 GHz FEL action has been initiated and the stability of the lattice of the CLIC damping rings is being studied.

SPS AND LEP DIVISION (SL)

The year started with the customary winter shutdown and hectic activity on both machines. On the SPS, the main effort was centred around ECX4, the pit that formerly housed the UA2 experiment. A new floor was installed at the tunnel level in order to reconvert ECX4 into a normal SPS straight section. A bimodule 352 MHz superconducting cavity for lepton acceleration was installed on the new structure. The associated cryogenic equipment consisting mainly of a 400 Watt refrigerator and cold box was installed in the garage area (ECA4) formerly used to assemble the UA2 detector. The increased circumferential voltage provided by the superconducting radiofrequency system will allow the removal of some of the less efficient copper cavities.

Another area of intense activity was LSS6 where more than 100 km of radiation damaged cable was replaced. This is now becoming a regular feature of the SPS shutdown, costing of the order of 1 MCHF per year as cables are successively replaced in the most radioactive areas. Work also started on cleaning out the neutrino cave in preparation for the installation of a new primary and secondary beamline for the next programme of neutrino physics due to start in 1994. In order for the physics programme to start up on time, the primary proton beam and production target must already be installed next year.

The SPS started up quite smoothly on 16 March as foreseen and has been running reliably ever since, providing ions for the fixed-target experiments as well as electrons and positrons for LEP. Considerable work has gone into improving the bunch intensity on the lepton cycles, mainly limited by the transverse and longitudinal mode coupling instabilities driven by the high peak current. The intensity per bunch was improved by almost a factor of 2 compared with last year by lengthening the bunches using subharmonic cavities and bunch shaking. Acceleration of electrons and positrons now involves three separate radiofrequency systems running at 100, 200 and 352 MHz.

The first operational period of the year ended on 11 May after a five-week run with sulphur ions at 200 GeV per nucleon and one week with deuterons. As a result of the excellent operation of the source and improvements to the SPS beam observation and radiofrequency systems the accelerated intensity of sulphur ions was on average a factor of five greater than last year. Advantage was taken of the availability of heavy ions during a machine studies period of 18 hours to make a precision calibration of the SPS energy for the UA4 collaboration which had finished data taking in the proton antiproton collider run at the end of last year. This made use of oxygen ions , always available together with the sulphur, to measure the difference in their revolution frequency compared with protons on the 270 GeV flat top used for UA4 data taking. This technique, derived from that originally used for energy calibration

in LEP, has improved the precision of the calibration of the SPS energy by an order of magnitude.

LEP was shut down on November 11 for maintenance and for the next step in the LEP200 upgrade programme. At point 8 the civil engineering of the new klystron galleries housing the radiofrequency equipment for LEP200 was finished and work commenced on the excavation of the klystron galleries in point 4.

The installation of the additional hardware needed in order to increase the number of bunches per beam from 4 to 8, the so-called "pretzel" scheme was concluded. This consists mainly of another 5 electrostatic separators recuperated from the SPS to complement the four horizontal separators already installed last year. In order to make room for these, 8 copper cavities had to be removed. In addition, six sextupoles were installed in order to allow some degree of separate control of the tunes of the two beams.

Operation of LEP above the W-pair threshold requires a change in the machine optics. In particular, high luminosity can only be achieved by increasing the phase advance per cell from 60 to 90 degrees in order to compensate for the fact that the beam size increases with energy. Pretzel operation is also simplified by the 90 degrees phase advance per cell so it was decided to move to the new 90 degree optics right from the startup. This in turn required that the chromaticity correction sextupoles be powered in four families instead of the six families needed on the 60 degree optics and entailed a considerable amount of recabling work.

The 1 GHz cavities for the new longitudinal feedback system were installed. However, commissioning of this system will be somewhat delayed due to an accident at the factory during fabrication of the 1 GHz klystron. An old klystron loaned by DESY has been installed in order to allow equipment commissioning to begin.

A very large effort was made by the magnet group of AT division to demagnetize the LEP vacuum chamber around the whole of the ring. In addition, after the problem with the DELPHI vacuum chamber encountered last year, all experimental chambers were inspected for signs of bubbling of the inner metallic liners. As a result, it was found necessary to exchange the carbon fibre chambers of both L3 and ALEPH for thin walled aluminium chambers. In view of this unforeseen additional work as well as the interference with the installation of the electrical sub-stations for LEP200 , the shutdown planning was extremely tight.

The LEP ring could be closed for equipment tests on 19 March. The experiments were ready for closure by 23 March and first beam could be injected into LEP on 1 April. The configuration chosen for the new 90 degree lattice was

governed by the simultaneous constraints of good beam-beam performance, pretzel operation and the ability to polarize the beams at energies within the Z0 lineshape. The new working point with integral tunes Qx=94, Qy=100 gave a satisfactory performance in the early stages of commissioning. However, severe problems were encountered when the beams were squeezed to their final optical configuration at 46 GeV. These problems were associated mainly with difficulties in controlling the vertical closed orbit and dispersion with adequate precision. It was therefore decided to revert to another 90 degree optics with integer tunes Qx=91, Qy=97 which had been successfully used in machine studies last year and for which reference settings existed. This optics is known to be inferior from the point of view of the beam-beam interaction and this was indeed confirmed experimentally. It was nevertheless used to get the physics programme started whilst the results obtained with the preferred optics were analyzed.

During the machine studies period scheduled from 6 May, the 94/100 optics was successfully commissioned and will be used once more for the second period of LEP operation. The quality of the optics under strong beam-beam conditions has yet to be evaluated.

Several SL groups were involved in the R&D effort on the LHC. In the Accelerator Physics group an extensive campaign of computer tracking has been carried out to define the machine aperture and to establish the necessary corrector scheme. In addition, the problem of the coupling impedance resulting from the many small holes needed to cryopump the beam enclosure through the synchrotron radiation shield has been tackled.

The Beam Transfer group has been involved in prototype work for the LHC abort kickers as well as the detailed optical layout of the transfer lines between the SPS and the LHC. The possibility of providing a neutrino beam for the ICARUS experimental the Gran Sasso using one of the LHC extraction channels has also been studied.

The SPS Radiofrequency group has been involved in extensive studies of the requirements of the LHC superconducting radiofrequency system, including cavity and power amplifier design and the definition of the transverse feedback system in collaboration with JINR Dubna. Finally, the Power Converters group has taken responsibility for support of the power converters for the LHC test stand and for the procurement of new power converters for the LHC prototype magnets.

The CERN study of a 2 TeV Linear Collider (CLIC) is interdivisional. The LEP Radiofrequency group provides the overall project coordination as well as playing a leading rôle in the solution of many of the difficult problems encountered during the study.

TECHNICAL SUPPORT DIVISION (ST)

In 1991, the Civil Engineering work once again had a heavy impact on the workload of the Division. The LEP200 Project requires a series of 25 new buildings which range from relatively straight forward experimental type halls to thickly sound-proofed halls housing the helium compressors for the cryogenic installations of the new superconducting radio-frequency systems. In this same context, extraneous tunnels parallel to the main ring have to be built around points 4 and 8. This construction represents a particular challenge to the firms in so far as big excavation works take place in closest vicinity to the delicate LEP machine components and no perturbation should be made to the existing tunnel.

1. GROUPE MANUTENTION LOURDE, TRANSPORT ET MAINTENANCE D'EQUIPEMENTS DE LEVAGE

Section Manutention Lourde - Transport

Véhicules CERN

Le parc de véhicules CERN comprend 627 voitures particulières, patrimoine de l'Organisation, et 129 voitures en "leasing", ce qui permet de faire face d'une manière flexible aux besoins fluctuants des visiteurs et des programmes CERN. Dans le nouveau système de gestion, les frais sont supportés directement par les locataires après rétrocession du budget central.

Transport

L'activité Transport du personnel et du matériel sur le site ou en longues distances s'est poursuivie. En outre, il a fallu assurer le transport du matériel de l'exposition CERN à Séville *(Expo '92)* avec les véhicules CERN et ceux d'une firme extérieure.

Manutention

Les activités de la Section Manutention ont principalement porté sur :

- la participation lors de l'arrêt des machines PS, SPS et LEP
- la fin de l'installation d'ISOLDE
- le démontage des expériences UA1 et UA2
- les nouveaux faisceaux, ainsi qu'une activité soutenue sur différents points du domaine pour les besoins de l'installation du LEP 200
- différentes activités liées au projet LHC.

Activités de maintenance "Equipements de Levage et Autres"

- Contrat principal (METAREG/E-042)
  Travaux de maintenance programmés : 18 000 heures
- Contrat maintenance des ascenseurs (6 contrats)
- Travaux supplémentaires
  4300 heures dans le cadre du contrat E-042 pour, notamment:
  - Monorail LEP (dépose et repose aux points 8 et 4)
  - Bouchons blindés / tunnel LEP
  - Modifications / adaptations de ponts roulants.

2. GROUPE INSTALLATIONS ELECTRIQUES

Le début du 1er semestre 92 a été consacré aux travaux du shut-down des accélérateurs, le shut-down du LEP ayant commencé deux mois plus tôt en 1991.

Ce shut-down a été utilisé pour les opérations classiques de maintenance du réseau, impossibles durant la marche des machines. Les travaux dans le PS ont été orientés vers la mise en service d'ISOLDE et la préparation du nouveau LINAC à ions plomb. Les travaux les plus importants du projet LEP200 ont porté sur l'installation de cellules 3,3 kV pour les compresseurs pour la cryogénie aux points 2, 4, 6, 8, le doublement de la capacité de compensation de puissance réactive au point 2, l'installation de deux nouveaux compensateurs et filtres d'harmoniques aux points 4 et 8, ainsi que de deux postes d'arrivée 66kV/18kV dans ces points. Il faut mentionner que les transformateurs équipant ces nouvelles installations ont été fabriqués en Ukraine dans le cadre de la collaboration entre le CERN et le Laboratoire de Serpukov. Le câblage des alimentations pour la RF supraconductrice a été aussi une importante activité. Le poste 66 kV de Prévessin a été porté à deux jeux de barres, et le nombre de départs a été doublé pour permettre l'alimentation des points 4 et 8 du LEP. Il a été mis en service en mai 1992. Le groupe a contribué pour la partie distribution électrique au vaste programme de rénovation de bâtiments du laboratoire. Les premières études pour le LHC ont été lancées.

3. GROUPE CONTROLES ET COMMUNICATIONS

Dès le début de l'année, l'activité du Groupe a été très intense et les divers départs de personnel ont engendré des difficultés qui n'ont pu être aplanies malgré un recours accru au support industriel.

Salle de Contrôle - TCR

L'ancien système de supervision intégré dans les diverses "work-stations" commence à porter ses fruits et permet de gérer de façon optimale les divers équipements techniques répartis sur les Sites.

Le système de contrôle BBC, de supervision de l'infrastructure technique, a été remplacé par un nouveau système basé sur les principes du système de contrôle LEP.

Contrôle des Accès

Le group a fourni plusieurs nouvelles installations de contrôle d'accès, par exemple, les zones RF cryogéniques du LEP, Zone Nord SPS, Accès Site de Meyrin.

Systèmes de Communication (téléphone, Liaisons Radio, Vidéo, etc..)

- Remplacement de l'ancien parc de téléphones en location PTT.
- Réalisation d'un système de *"call accounting"* en vue de la mise en service d'une automatisation du trafic téléphonique sortant.
- Remplacement de l'ancien système général d'interphonie par un système moderne, intégré dans les voies de communication principales (TDM, réseau téléphonique).
- Etude pour le remplacement de plusieurs caméras d'observation de faisceau au PS, par des caméras de technologie différente.
- Réalisation d'une liaison vidéo par fibre optique entre les Sites de Meyrin et de Prévessin.
- Remplacement de l'ancien central *"téléphones rouges"* par un central digital, intégré au système général des téléphones.

Systèmes de Sécurité

Une refonte de l'ensemble du réseau d'alarmes de niveau 3 (sécurité des personnes) a été entreprise, dans un but d'unification des systèmes.

4. COOLING, VENTILATION AND AIR-CONDITIONING GROUP

The Cooling, Ventilation and Air-Conditioning Group has the task to operate all of the large cooling and ventilation equipment at CERN, with the exception of the LEP machine, and to design and build new installations.

The equipment of the new surface buildings for LEP200 are to be achieved following the foreseen schedule and, in addition, the cooling system for ISOLDE has been successfully commissioned and is now in operation. Special attention and help are also given to the LEP experiments. The installations for the Neutrino cave have been designed and the consequent calls for tenders are in preparation.

The overhaul programme and the modernization of the PS main ring cooling system and experimental area are completed.

5. GROUPE GENIE CIVIL

La construction de l'important complexe ISOLDE (mouvement de terre : 25 000 m^3, béton coulé : 1 500 m^3) s'est achevée en décembre 1991. Ceci a permis au séparateur d'isotopes de reprendre ses activités en mars 1992.

L'augmentation de puissance du LEP à 200 GeV concerne le génie civil dans les réalisations suivantes :

L'exécution des galeries souterraines pour les klystrons aux Points 4 et 8

Les travaux au Point 8 ont connu des retards mais le doublement des moyens, en machines et en personnel, a néanmoins permis la réalisation de la jonction avec le tunnel existant le 8 mars 1992, avant la mise en route du LEP. Au Point 4, l'installation de chantier, très conséquente du fait de la cohabitation avec les équipements existants, est opérationnelle. Les excavations commencées le 8 avril dernier devraient avoir parcouru 210 m à fin juin.

Les bâtiments de surface, au nombre de 19, aux Points 2, 4, 6, 8 et 18

L'extension des tours de refroidissement aux Points 2, 4, 6 et 8

dont la réalisation se poursuit dans le respect des délais et des budgets.

Des explorations, avec un Bureau d'Ingénieurs extérieur et l'Université d'Edimbourg, sont en cours actuellement pour étudier les infiltrations d'eau et de sable dans le tunnel LEP en piémont du Jura.

Les travaux de réhabilitation des zones et le programme de consolidation sont poursuivis activement dans le cadre des budgets à disposition. Un effort particulier est consenti au niveau des réceptions de toitures, façades, revêtements intérieurs et voiries. Parmi les plus gros travaux dans cette catégorie, citons le bâtiment 104, globalement rénové à 40 % et la zone SC encore en étude.

En parallèle, à la demande d'autres divisions du CERN, le groupe a procédé à la construction ou à la modification d'un certain nombre de bâtiments, dont les plus importants sont les 165, 236, 927 et 176, tous terminés à fin juin.

6. GROUPE GESTION ET ORGANISATION

Organisation - Gestion

Personnel

Une attention particulière est apportée aux conséquences du nouveau système MOAS, à la préparation de l'avancement, au programme de formation, compte tenu notamment des départs non compensés qui entraînent un redéploiement des tâches.

Budget et Contrats

Intégration du nouveau système comptable entraînant des changements pour la gestion des travaux. Préparation de projets de consolidation, révision du programme et des contrats de support industriel.

Maintenance du Site

Poursuite des études pour l'amélioration des contrats de nettoyage et de jardinage vers des principes de qualité adaptée et des obligations de résultats.

TECHNICAL INSPECTION AND SAFETY COMMISSION (TIS)

1 Radiation Protection Group

As usual, the RP Group concentrated its activity at the beginning of the year on the annual shutdown of the CERN accelerators. With the regular replacement of radiation damaged equipment like cables in existing installations, the problem of radioactive waste continues to grow with time. The dismantling of the installations of the Charm neutrino experiment required a careful planning to minimize the personnel dose for both the dismantling and the storage phases of this operation. The work was performed under close supervision of RP by an outside firm specialized in radioactive work. The voluminous radioactive waste was conditioned into standard containers for intermediate storage on the CERN site. Meanwhile the planning for the installation of a new neutrino experiment in the existing neutrino tunnel has started, with the active collaboration of RP to ensure that the ALARA principle is followed.

The new data base for individual monitoring is now fully operational and the dose information for all persons under individual dosimetric control has been completed. It is accessible both on and off line, and the updated information is sent regularly to the authorities in the Host States. The film dosimeter system has shown excellent results in an international intercomparison organized by the IAEA in Vienna.

The planning for the LHC continued, with the RP Group mainly working on questions related to the radiological impact on the environment of this machine. Other subjects for which the Group's expertise was requested were the Lead Linac and Super Lear.

2 General Safety Group

The safety inspections concentrated on areas which are only accessible during the annual shutdown. The alarm systems and safety installations of the four LEP experiments have been thoroughly tested. A formal procedure for the temporary inhibition of level 3 alarms for technical reasons has been defined. Special attention was given to the commissioning of the ISOLDE

project, the cryogenic installations for LEP 200 and new experiments. The dismantling of obsolete installations and the transformations of existing buildings were followed closely.

The Special Health and Safety Committee (CSHS) met twice during this period. The work sites of outside contractors, especially civil engineering for LEP 200, were visited regularly together with the Host-State inspectors.

The Technical Support Section completed the replacement of obsolete radiation monitoring systems in the SPS and PS installations with equipment identical to that developed and used for LEP. New monitoring systems for ISOLDE and LEP 200 (in building SM 18) have been commissioned successfully.

3 Service Médical

Au cours du premier semestre de l'année 1992, le Service Médical a poursuivi la surveillance médicale du personnel selon deux axes:

- un axe préventif, tant par les examens médicaux et de laboratoire que par le suivi du personnel à son poste de travail, et l'analyse des incidents ou accidents en participant aux enquêtes techniques avec le service de sécurité;

- un axe curatif, en assurant les premiers soins.

En outre, une attention particulière a été portée au personnel qui a reçu durant les 20 dernières années des doses de rayonnements ionisants intégrées supérieures à 100 mSv, ainsi qu'au personnel qui travaille en horaires irréguliers dans les salles de contrôle MCR, PCR et TCR, et dont plusieurs ont maintenant une carrière de plus de 20 ans de travail avec ce type d'horaires.

4 Groupe Secours et Feu

Le premier semestre a été une période calme pour les activités d'intervention. Les travaux de génie civil ont été à l'origine de quelques interventions plus spécifiques de ce type de chantier. Les chantiers de démantèlement de certaines installations ont nécessité une attention particulière sur le plan de l'organisation des secours.

Le projet de modernisation du central d'alarme a été poursuivi en priorité. Le transfert de l'ancien central vers le nouveau local est prévue pour juin 1992. Les procédures de coordination pour les appels aux services de secours des pays-hôtes, principalement dans le Département de l'Ain (numéros 18, 144) ont bénéficié de progrès manifestes.

5 Chemistry, Fire and Materials Group

In the Gas and Chemistry Section, the collection, conditioning and dispatch of hazardous waste from the CERN sites continued to be one of the major tasks. The dispatch of electrical equipment containing PCB (PolyChlorinated Biphenils) to an approved French treatment plant started again. The present procedures for chemical waste collection, storage and disposal have been reviewed to ensure compatibility with new legislations. A campaign for the recuperation of used electric batteries has started.

The Fire Prevention Section carried out a study on fire prevention at CERN and proposals for improvements were made. Based on a series of tests and the experience gained in previous years about the production of high-expansion foam with air polluted by smoke, a detailed technical study was performed for the installation of foam generators in the LEP underground experimental halls.

An analysis of the data accumulated over the past decade enabled the Materials and High-dose Dosimetry Section to reduce the number of routine dosimeters installed in the CERN accelerators to about one third of the previous number, without losing essential information on the radiation ageing. Material irradiations were concentrated on tests at cryogenic temperatures of LHC machine components. Studies started on the safety aspects, such as the fire resistance and the reduction of toxic and corrosive gases in the case of fire, for the LHC detectors.

III. ADMINISTRATION

- Director-General Unit (DG)
- General Administration Division (AG)
- CERN Pension Fund
- Administrative Support Division (AS)
- Finance Division (FI)
- Personnel Division (PE)

DIRECTOR-GENERAL UNIT (DG)

EXTERNAL RELATIONS OF THE DIRECTOR-GENERAL

The present heading regroups various activities conducted under the direct authority of the Director-General in the field of the external relations of the Organization, - especially diplomacy with Non-Member States, public image and relations with industry.

1. Relations with Non-Member States

1.1 Organization of LHC workshops in Non-Member States

CERN Council, in its "Resolution on LHC" of 20 December 1991, asked the Director-General to provide, before the end of 1993, detailed information (among other things) on the possible involvement of Non-Member States in the future LHC project.

As a part of a general strategy aiming at promoting participation in the LHC programme, workshops are being organized in various key Non-Member States, in order to present to their local HEP communities (on the model of what was done for the European research community at the Evian Conference in March 1992) the LHC scientific programme and the various Expressions of Interest presented for future experiments on the LHC machine. The Director-General participates personally in these meetings, and contacts are also taken with the governments on these occasions.

The first of these meetings recently took place in Protvino, Russia, May 27–29, to be followed by meetings in China, Japan, Canada and later on, possibly in a modified version, in India, USA and South America.

1.2 Other developments

The first half of the year has seen a consolidation of the activities related to the contacts of CERN with Non-Member States. Of major importance have been the changes in the ex-Soviet Union and the confirmation by the Government of the Russian Federation that it is the successor of the former USSR with respect to all existing Agreements with CERN and the associated Protocols. In practice this

has meant that the existing collaboration has continued without any major change and that the deliveries of equipment for LEP 200 have proceeded according to schedule. Discussions on the possible Russian contribution to the construction of the LHC are in progress. Several Republics of the newly created Commonwealth of Independent States have also expressed interest in closer association with CERN.

In the area of Central and Eastern Europe the Hungarian Government formally applied for membership of CERN at the end of January and the official negotiations took place at CERN on 29 April. At its June Session Council is expected to take a positive decision on the accession of Hungary with effect as from 1 July 1992.

As a result of the approval already given by Finance Committee last year, several tons of surplus equipment were transported to Bucharest by Romanian trucks in mid-May. Also in May a senior engineer and a technician from Albania spent some weeks at CERN testing and repairing the equipment to be shipped to Tirana.

Following the signing of the Protocol to the Cooperation Agreement last year, the annual Israeli contribution to the CERN Associates budget (150 KSF) has been received and the special budget established in Israel (850 KSF) has been used.

Further to the signature, last summer, of a Cooperation Agreement with the Chinese Academy of Sciences, the Chinese Government has also expressed its desire to sign an Agreement through the State Science & Technology Commission. The Director-General and the President of Council have been invited to visit China to establish such an Agreement. During the early part of this year, a number of senior representatives from both China and Japan have been received at CERN.

Collaboration with Brazil and Chile is being developed and a cooperation agreement with Argentina has been signed. Contacts have also been established with the Peruvian and Mexican communities and detailed discussions are going on, in particular with Mexico.

Contacts with Canada and the United States have been actively pursued. However, the discussions under way in Canada on the proposed KAON factory, and in the United States on the future of the HEP programmes, did not allow much progress to be made in developing a framework for future collaboration with CERN.

2. The public Image of CERN

The reorganization of CERN's Public Relations Services was completed in spring 1992. The new unit - the Communication and Public Education Group (COPE) - is now fully operative, with a staff of 36 people and an exploitation budget of 1,2 MCHF.

2.1 Communication

A major task, in the first half of the year, has been to identify all publications of the Organization in order to allow centralised budgeting for the production and future updating of these documents. A project has been undertaken and completed for setting up mechanisms enabling the production of the Weekly Bulletin on PostScript printers rather than the Off-Set machines, which are either being phased out.

2.2 Media

The media have been particularly interested in CERN's contribution to "EXPO'92" in Seville. 150 journalists visited the "Pavilion of the Universe" where CERN's exhibition is located, in a special press preview prior the opening of the exhibition. An important article by the Director-General was included in a colour magazine published jointly by "La Repubblica", "Le Monde", "El Pais" and "The Independent". 7 million copies of this supplement which was launched to coincide with the opening of Expo 92 were published in four languages.

The merging of the Photographic and Audio-visual units with the Media Section in January 1992 has much improved the co-ordination between these services. The Audio-visual unit produced a 3 minute video clip which explains dramatically what a particle accelerator is and which are the aims of CERN's research. This film will be seen by the millions of people who will pass through the LEP accelerator exhibit at Seville. The Photographic service has prepared plans for their imminent move to new premises and have started a programme to archive CERN's early photos.

2.3 Public Visits

At CERN, a sustained effort is being made to give the general public an opportunity to visit the laboratory. In spring 1992 the interest in the public visits continued to be high, with between two and three thousand people visiting CERN every month. A thorough review of the logistics of the public visits was begun in autumn 1991 and is still underway. Temporary improvements have been introduced, but more permanent adjustments will have to wait until the fall of 1992.

2.4 MICROCOSM

The MICROCOSM Project, approved by the Council of CERN in December 1988, now operates as a freely accessible exhibition and constitutes a welcome addition to CERN's visit system. Thanks to the generous contributions from external donors (both public and private), the Project will be completed according to schedule, before the end of 1992. A formal inauguration of MICROCOSM is foreseen before the end of this year.

Some of MICROCOSM's space is reserved for temporary exhibitions: an exhibition of ESA, the European Space Agency (opened in July 1991) presents ESA's scientific space research programme under the title "From Giotto to Ulysses". Later on, MICROCOSM will host exhibits of non-accelerator research in particle physics from underground installations such as Gran Sasso, followed by an exhibition on fusion research in Europe.

2.5 Exhibitions and other PR activities

The main priority of the Exhibition team has been the installation of the CERN exhibits in the Pavilion of the Future at EXPO'92 in Seville. A bank of spark chambers to show cosmic rays, a radiation detector, an aerial view of the CERN site with animated LEP beams, a model of the L-3 detector, a full-size illuminated photograph of the ALEPH detector with laser beams simulating particles, and projections of collision events are on display.

EXPO'92 has also organized a permanent stand for CERN in the 'Ambiente' Pavilion, where the more technological aspects of CERN's work will be displayed along with exhibits of many of those major industrial suppliers contributing to

CERN instrumentation. The organizers of EXPO'92 have given CERN an official Day, 30th September. CERN intends to fully exploit this privilege which has been granted only to Sovereign States and to a few major multi-national companies.

Preparations continue in collaboration with other European science laboratories for a European Science Exhibition, which will tour the Member States under the name Cosmorama. A CERN exhibition is being prepared to go to Warsaw in August, as Poland has become a new Member State.

3. Relations with Industry

The increasing importance of this aspect of CERN's activities has been recognized by the decision of the Director-General that the Head of the Liaison Office for industry and technology should report directly to him.

The Liaison Officer, in addition to his traditional task of maintaining contacts with firms and trade organizations in CERN Member States, initiating and following-up joint technical collaborations and organizing technology transfers, has multiplied exploratory contacts with the industrial sectors of the new Eastern European Member States.

The relations with the Commission of the European Communities are being pursued and it is hoped that CERN may directly benefit from the coming Human Capital and Mobility Programme. An even more important aspect of these contacts is that they might enable CERN to act as a catalyzer, so that its industrial partners or associated research institutes may benefit from EC programmes.

It has been decided to reinforce this activity within CERN by calling upon the experienced assistance, on a part-time basis, of senior people familiar with the various relevant sectors of the Organization.

GENERAL ADMINISTRATION DIVISION (AG)

BUREAU DU CHEF DE L'ADMINISTRATION

Le bureau, chargé de missions factuelles pour le Chef de l'Administration, a également pris une part active aux travaux de divers comités tout en poursuivant ses activités de coordination et de gestion (personnel et matériel) des différentes unités composant l'Administration centrale du Laboratoire.

SERVICE D'AUDIT INTERNE

Comme chaque année le Service d'Audit Interne a orienté une partie substantielle de ses activités vers la révision des Comptes 1991 de l'Organisation et de la Caisse des Pensions. Des vérifications ont été préparées compte tenu du programme de révision des Commissaires aux Comptes eux-mêmes et effectuées au mieux des possibilités des effectifs restants.

D'autre part, un certain nombre d'autres investigations ou études ont été menées selon un programme initialement établi ou à la demande du Chef de l'Administration ou d'autres responsables. L'Audit Interne s'est aussi attaché à suivre les problèmes posés par la mise en route du nouveau système comptable et financier.

SECRETARIAT DU CONSEIL

Le Secrétariat du Conseil a continué d'assurer ses tâches habituelles: préparation des réunions et des documents du Conseil, de ses Comités et de ses groupes de travail, en particulier le groupe de travail concernant le calcul de l'indice de variation des coûts, ainsi que de l'ECFA et de ces groupes de travail. Il a également assuré la liaison avec les Présidents des différents Comités.

Le Secrétariat a organisé la session spéciale du Conseil sur le LHC, le 19 décembre 1991 et a participé à la préparation de la réunion générale sur le LHC "Towards the LHC Experimental Programme", tenue à Evian-les-Bains, France, du 5 au 8 mars 1992.

Le Secrétariat continue à assurer le secrétariat du MICROCOSM.

SERVICE JURIDIQUE

Le Service juridique a assuré sa fonction de conseil de l'Organisation. Il a pris part aux travaux concernant la prise de brevets et contribué à l'élaboration d'accords de coopération avec d'autres laboratoires.

Il a participé aux travaux de la Caisse de Pensions de l'Organisation, notamment en ce qui concerne la garantie des pensions en cas de dissolution, la révision de son statut, les questions juridiques liées à la gestion de ses biens.

Il a participé aux discussions relatives aux contributions de certains Etats Membres, à divers Comités (notamment le Comité pour la Politique de Sécurité, le Groupe des Pensions) et groupes de travail.

Sur le plan du contentieux, il a défendu les intérêts de l'Organisation, notamment en matière de recours de membres du personnel devant le Tribunal administratif de l'OIT, et a poursuivi sa tâche dans le domaine des assurances. Il a suivi le règlement final de l'arbitrage EUROLEP/CERN et défendu les intérêts de l'Organisation dans l'arbitrage SGIS/CERN.

RELATIONS AVEC LES ETATS-HOTES

Au titre des relations avec les Etats-hôtes, l'Administration a poursuivi sa mission de représentation de l'Organisation auprès des autorités administratives françaises et suisses à tous les niveaux. Elle s'est occupée plus particulièrement des questions suivantes: séjour et emploi des conjoints et enfants des membres du personnel, passage par le tunnel intersites et par la frontière, arrangements avec les douanes et les polices, plaintes lors de vols, transport et circulation, statut des entreprises contractantes et de leur personnel ainsi que de procédures administratives diverses.

CERN PENSION FUND

The Annual Report of the CERN Pension Fund (CERN/1929-CERN/FC/3529) is submitted to Council separately.

ADMINISTRATIVE SUPPORT DIVISION (AS)

Management Information Services (AS-MI)

Administrative Applications

The first months of 1992 were mainly devoted to AIS project activities with the transition from the old systems to the newly introduced purchasing and accounting applications and subsequent consolidation activities.

In January the annual bookclosing was performed with the old system. In parallel, purchasing and reception were 'migrated' from COPICS to SIRIAC. Foundation was loaded with information from various sources (GIP, COPICS, FDB, etc.). After the bookclosing, accounting and invoices were moved from FDB/COPICS to ORIAC/SIRIAC. A large number of special programmes were written to move data from the old systems to the new systems. Due to the chosen strategy (sudden death), this was a very busy and stressful period.

User support (handholding) was a major activity during the last months.

During the entire period, a number of bugs and problems were identified which were solved with the help of INFERENCE. Lists and screens continued to be developed by CERN and put into production (e.g. accounting lists, foundation screens, quarterly report, etc.).

The first real bookclosing with ORIAC took place on 31st March 1992.

A number of enhancements and new modules were implemented related to SIRIAC and ORIAC (e.g. handling of 'provisions', enhancement of functionality for the invoice office, implementation of team invoicing).

New developments started during the first quarter were:

- call accounting; the specification and implementation of an interface between the STK exchange and the accounting application.
- DTA salaire; the payment of salaries and claims through ORIAC.

Text Processing

A second Kodak 1392 (high speed PostScript laser printer) has been installed for testing in the printshop.

A prototype preprint server has been set up as an archive for PostScript files that were printed on the Kodak 1392's. Links are provided for the Library so that these files do not have to be scanned.

The automatic loading of preprints into the Library's database is now being tested.

Personal Computer Support

In this period the emphasis was on continued general computer support to the increasing user community (delivery, installation, software/hardware set-up, diagnostics, repairs, maintenance, etc.).

The section is a heavy user of EDH to process orders and has started using BHT for controlling the extensive section financial accounts.

A maintenance contract has been placed with a commercial maintenance supplier to provide general IBM PC compatible computer support.

User Support

The principal activities have been the introduction into operation of the Budget Holders Toolkit and the Electronic Document Handling systems in the context of the AIS project. In addition, in the interest of economy, the remaining old applications have been migrated from the Siemens mainframe to a new smaller Hitachi mainframe in the computer centre.

Scientific Information Services (AS-SI)

In cooperation with the AS-MI Group, the technical part of the master plan for the modernization of Scientific Information Services, requested and endorsed by the Director-General in 1989, has been completed ahead of schedule. This includes an optical disk storage system for preprints, and several new functions in ALICE, including SDI-service, acquisitions and periodicals control.

Among special actions can be mentioned:

- Transfer of a major part of the card catalogue for older books to the ALICE database.
- Current updating of the Directory of High Energy Institutes file on ALICE, also available in a MAC/FileMaker Pro data base.
- Modernization of central reading room with new furniture and re-used filing cabinets.
- Arrangements for placement of X-windows work stations and CD-ROM stations in the Central Library.
- The removal of the CERN Historical Archive to more appropriate premises has been terminated, and input of backlog to the ALICE Archive file is proceeding.
- All papers from ISOLDE are being entered into the ALICE preprints file from within the project, as an example of decentralized input necessary in future.

Logistics Group (AS-LO)

The first Logistics applications in the AIS Project, Goods Receiving and the Stores Replenishment Order Processing, were implemented, as planned, in January 1992.

Tests have commenced in the EDI Just-in-Time distribution project with one of the Stores important suppliers.

General Services Group (AS-GS)

Housing Section

Restructuration is now complete, thus achieving the aim of leaving pure administrative tasks in the hands of CERN staff while relying on industrial support for everyday operation, the most obvious example being in the Hostel Reception. Users have been almost unanimous in expressing their satisfaction at the improved service. Modern methods of payment are being introduced, and projects are in preparation for increasing capacity and for replacing the ageing barracks.

A project has been developed and submitted for approval foreseeing the grouping together of all members of the Service; a central location has been chosen in order to improve efficiency, polyvalence and, most important, user convenience. A central reservation point dealing with all housing possibilities in France, Switzerland and on the CERN site (dormitories, hostels, flats and hotel rooms) is being established; a wish which has been expressed by users.

Attempts to standardize procedures for renting CERN apartments in Switzerland and in France are being made, as far as legal aspects will allow.

Mail Section

Modernization of the Mail Service is nearly completed. All activities will soon be regrouped and housed in more functional premises where better working conditions can be assured.

Large amounts of data previously processed by several computer programs have now been transferred to a single data base on ORACLE. An automatic data cleaning system will be tested during 1992.

A new contract has been adjudicated for an external firm to take over the addressing unit, in addition to the present distribution activities.

Welcome Section

Following the introduction of multilingual trainee hostesses, CERN is in a better position to receive the wide variety of people visiting the Organization.

In connection with thefts and site security, a professional investigator has been detached from a host state police force. His intervention has already enabled CERN to recover a certain amount of stolen equipment.

Security at CERN gates continues to be entrusted to a service contract firm. Modern access-control equipment is now being installed at the first of several gates. A central control point will handle alarms and the creation of a flying squad is envisaged for rapid and random intervention.

Space Management Section

All Divisions are now using a centralized data base to manage the habitable space they occupy. This facility is proving useful in seeking solutions for the continually increasing demands for space, which is mainly due to the growing numbers of scientific associates.

An inventory of locks (some 12'000 doors equipped and 70'000 keys distributed over 30 years) is nearing completion.

Office of the Division Leader (AS-DI)

Organization and Methods

The Organization and Methods Section examined the procedures employed by the Welcome Service for the registration of industrial support personnel. The present procedures have been charted and recommendations for improved efficiency have been made.

A general study of administrative procedures in the personnel area has started. This was requested by the Administrative Liaison Committee (CLA), and in relation to the AIS project, to which the O&M Section Leader continues to be detached for 50% of his working time. The Organization and Methods Section continues to provide the secretariat for the CLA.

Translation and Minutes

During the period under review the Translation and Minutes Service had to cope with a heavy load of translation work, minute writing and linguistic revision, including in particular the translation into English of the bulky final ruling of the EuroLep Arbitration Tribunal and minute-taking for special committee meetings relating thereto. Efforts are currently being made to build up a data base containing a glossary of terms.

Secretariat

The use of the central conference rooms continues to increase with the growing number of committees, experiments and visits, and also because of modifications and maintenance work being carried out in turn in certain of the rooms. Consequently, the effort involved in the organization and co-ordination of reservations and keeping records of these up-to-date now requires the booking service to be virtually constantly manned, in spite of the existence of a database, publicly available on CERNVM, showing the reservation situation. These difficulties have been minimized due to the collaboration of secretariats throughout CERN and help from the Conference Room/Auditorium operators.

FINANCE DIVISION (FI)

1.— INTRODUCTION

During the early months of 1992, the Finance Division had to deal with a number of problems associated with the introduction of the new accounting system and the new purchasing system which integrate all the data relating to each operation from its inception to final settlement and take account of the latest developments in the accounting field, in particular the 4th Directive of the European Community.

The various problems of adjustment inherent in any new system were overcome as a result of the in-depth work that had gone into designing the system and the efforts made to familiarise users with its data. The Organization now possesses a modern budget and accounting system.

The quiet period for supplies which followed LEP inauguration is definitely over now that new projects are in preparation and the design studies associated with future developments are under way. This will be an increasing trend in the coming months and we are bound to point out that its consequences underline yet again the Division's shortage of human resources.

2.— FINANCIAL AND ACCOUNTING SERVICES

2.1 The activities of the Financial and Accounting Services were marked by two important activities during the first four months of the year:

- the drawing up of the Organization's annual accounts for 1991;
- the introduction of the new accounting system as scheduled.

In view of the time needed to close the 1991 accounts, the new system actually got under way on 20 January 1992. Its introduction formed part of the wider AIS project which imposed substantial constraints such as the introduction of a new administrative data-processing system that would be

integrated on a relational database (ORACLE) with UNIX as the operating system environment. The implementation of this project marks an important change to CERN's budget and accounting procedures.

2.2 In compliance with the specification, the new accounting system is based on the most important international standards and in particular on the rules in force in Europe such as those specified by the 4th Directive of the European Community, except, in the latter case, where in the initial phase at least they do not match CERN's specific requirements.

2.3 All the Financial and Accounting Services were involved in commissioning the new system since CERN now has a completely integrated financial system covering all operations from the placing of orders to the settlement of invoices. To optimize integration of the main financial systems and to centralize all the financial information required for drawing up the Organization's accounts, it was decided to introduce a new system for purchasing and a new accounting system concurrently. The transition from the old to the new system was automated wherever possible. However, in view of the scale of the reform, many operations had to be performed manually. In parallel, the Financial and Accounting Services had to deal with the inevitable problems associated with running in a new management tool and with the major changes thereby entailed.

2.4 CERN now has a modern system which allows the Management to have an immediate idea of the Organization's debtor and creditor position at any time.

3.— PROCUREMENT SERVICE

The period under review showed a slight decrease in activity. Procurement for the LEP 200 Project has, for the most part of the equipment, been executed. During the first four months of the year, 17 contracts were placed, 24 calls for tenders sent out and a total of about 10000 orders established. Finland held a national exhibition in March/April with 13 firms and institutes participating and Germany in May with 22 firms participating. Furthermore, there were 23 one-day technical exhibitions.

The new Purchasing System SIRIAC was put into operation at the beginning of the year. The objectives set have been largely achieved. However, much work has still to be invested in order to ensure a satisfactory support for the user needs in their daily life.

Considerable attention was paid to the upgrading of the database for potential suppliers. This work, involving cooperation with authorities in several Member States will, of course, gradually be expanded to embrace all the Member States.

4.— PLANNING AND BUDGET SERVICE

This Service mainly prepares the Organization's Budget documents as well as the official documents on the contributions of the Member States and on the cost-variation index for Personnel and Materials. The Service also provides the financial part of the Organization's planning documents. It is particularly involved in the financial part of manpower planning and project authorization. It regularly prepares various financial planning and reporting documents.

During the reporting period, the simulation model for the Personnel Budget has been adapted to the introduction of career paths.

PERSONNEL DIVISION (PE)

Merit-Oriented Advancement Scheme (MOAS)

Work continued on the introduction and implementation of this new advancement scheme. In collaboration with the Divisions, recommendations were made for the designation of career paths to present staff, which became effective on 1 March 1992. Specific arrangements were made for handling the cases of appeal resulting from the career path designations. A number of particular situations were examined, within the Career Path Advisory Commission, and reports were made on them. With the MOAS Working Group, procedures were prepared for this first advancement exercise under the new scheme.

Training

The development of the various CERN staff training programmes continued. In Technical Training, new seminars were added in informatics and in other fields. Following the Merit Oriented Advancement System supervisor training seminars, further seminars for the development of supervisors were introduced in Management Training. New seminars addressing specific learning objectives were added to the Language Training programme. The number and quality of applicants for technical and secretarial apprenticeships was high.

Insurance for Unpaid Associates

Unpaid Associates were informed and/or reminded that CERN does not provide free social insurance for them (i.e. for medical expenses, death and disability.) It is assumed that they are insured by their employer's scheme and/or their national social security arrangements, which should cover the consequences of

occupational accidents and illnesses. CERN's responsibility is limited to that which applies under the common law of civil liability. Associates who are not insured elsewhere can already join CERN's health insurance scheme, if they pay the necessary premiums, and the possibility is being examined of offering them similar arrangements for protection against death and disability, at no cost to CERN.

Advanced Information System

Within the envelope of the Advanced Information System project, work started on the investigation, acquisition and implementation of a modern Human Resources Management system. In preparation for this new system, the procedures presently used for Personnel Administration are being scrutinised to improve their clarity and efficiency.

The project to equip Personnel Division with up-to-date informatics hardware is continuing on schedule.