EIGHTY-SECOND SESSION OF THE COUNCIL

Geneva - 17 and 18 December 1986

DRAFT MINUTES*

* These Draft Minutes are circulated without having been seen by the President of the Council, but with his consent.
DRAFT MINUTES

The Council was composed as follows:

**President:** Prof. W. Kummer

**Members:**
- H.E. Mr G. Reisch
- Prof. W. Majerotto
- Mr G. Birbaum **
- Mr P. Levaux
- Prof. J. Lemonne
- Mrs M.J. Simoen **
- Prof. P. Olesen
- Mrs B. Sode-Mogensen
- Dr O.B. Nielsen **
- Prof. H.H. Andersen **
- Prof. P. Lehmann
- Mr C. Prettre
- Prof. P. Petiau **
- Mr H.H. Lejeune **
- Mr R. Leclerc **
- Mr F. Gudin **
- Dr J. Rembser
- Prof. K. Tittel
- Dr E. Weber **
- Prof. N. Antoniou
- Mr N. Couniniotis *
- H.E. Mr R. Franceschi
- Prof. N. Cabibbo
- Mr G. Castellaneta **
- Dr M. Gigliarelli Fiumi **
- Prof. M. Dardo **
- Prof. J.C. Kluiver
- Dr P. van't Klooster
- Prof. A. Graue
- Dr L. Westgaard *
- H.E. Mr A. Costa Lobo
- Mr E. Aquilès de Oliveira *

* Alternate.
** Adviser.
H.E. Mr E. Artacho
Prof. C. Lopez
Mr M. Perez del Arco **

Dr I. Vallin
Prof. P. Carlson
Dr B. Brandt **
Mr J. Gustavsson **

Mr J. Vernet
Prof. B. Hahn
H.E. Mr E. Andres **
Mr B. Ecoeffey **
Mr W. Frei **
Dr P.E. Zinsli **
Mr R. Hofmann **

Prof. E.W.J. Mitchell
Prof. E. Gabathuler
Dr D.V. Thomas **
H.E. Mr J.A. Sankey **
Mr M. Bowthorpe **

Observers:

Prof. A.Y. Ozemre
Mr A. Algan

Prof. R. Sosnowski

Representatives of Turkey

Representative of Poland

Also present:

Mr J. Bezemeer
Prof. J. Sacton

Chairman of the Finance Committee
Chairman of ECFA

* Alternate.
** Adviser.
CERN Officials:

Prof. H. Schopper
Director-General

Dr G. Brianti
Technical Director

Dr R.F. Heyn
Director of Administration

Prof. R. Klapisch
Director of Research

Mr J.A. Martinez
Director of Human Resources

Prof. E. Picasso
Director and LEP Project Leader

Dr J.J. Thresher
Director of Research

The Division Leaders and staff concerned.

* * *
The PRESIDENT declared the Eighty-second Session of the Council open.

1. **REPORT OF THE CREDENTIALS COMMITTEE**  
   (Item 1 of the Agenda)

   Dr HEYN reported that the Committee, consisting of the President of the Council and one of the Vice-presidents, Professor Kluyver, had found that the delegates' credentials were in order.

   The report of the Credentials Committee was approved.

2. **APPROVAL OF THE DRAFT MINUTES OF THE EIGHTY-FIRST SESSION**  
   (Item 2 of the Agenda) (CERN/1628/Draft and CERN/1628/Draft/Corr.)

   Mr BEZEMER proposed that the following sentence be added at the end of the fifth paragraph on page 36 of the Draft Minutes: "There had been a consensus in favour of such a procedure in the Finance Committee."

   It was so agreed.

   On the proposal of Mr BEZEMER, it was also agreed to amend the second paragraph on page 40 of the Draft Minutes to read: "Mr BEZEMER reported that, in view of the Organization's tight budgetary situation, the Finance Committee had concluded that it would be difficult...etc."

   The Minutes of the Eighty-first Session (CERN/1628 and CERN/1628/Corr.), as amended, were approved.

3. **ADOPTION OF THE AGENDA**  
   (Item 3 of the Agenda) (CERN/1629/Rev.2)

   On the PRESIDENT's proposal, it was agreed to include short reports on the status of the TRISTAN facility (Japan) under Item 4, on appointments to the Pensions Board under Item 11, and on the External Auditors under Item 14.

   The Agenda (CERN/1629/Rev.2), as amended, was adopted.
4. **PROGRESS REPORTS**  
(Item 4 of the Agenda)

- **Progress report - Director-General**

The DIRECTOR-GENERAL presented a general report on some of the Organization's scientific activities, an edited version of which is given in Annex I.

Replying to Professor LOPEZ, the DIRECTOR-GENERAL said that a preliminary interpretation of the UA1 events as showing evidence for the top quark had not entirely been discounted and the events still awaited complete explanation. However, now that statistics had been improved, the peaking was not so pronounced and it was therefore not clear whether they were to be identified as top quark events or explained as QCD events.

Professor HAHN observed that there was still a substantial community in Europe which preferred to work on small-scale experiments. In that regard, he wished to know whether there was any discussion at CERN on the proposal to build a European Hadron Facility (EHF), in particular in connection with the possibility of installing it in the ISR tunnel.

The DIRECTOR-GENERAL pointed out that the idea of the EHF had developed in the medium-energy physics community and not at CERN. The community had drafted a proposal to build a facility and had proposed a number of possible sites, including Switzerland, Trieste and CERN. So far, CERN had not picked up the proposal and was not intending to take any initiative in that direction. Although CERN would give serious consideration to any proposal to use the ISR tunnel for that purpose, its decision would substantially depend on the conclusions of the CERN Review Committee and the associated Council decisions in 1987.

The PRESIDENT said that it was regrettable that, whereas the medium-energy physics community really required an improved PS for its research, financial limitations obliged CERN to grant the high-energy physics programme the highest priority in the use of existing facilities, thereby forcing the community to seek other alternatives.

The DIRECTOR-GENERAL stated that CERN had agreed to act as host to a number of members of the medium-energy community so that they could consult CERN's accelerator experts in preparation for the drafting of their final proposal. That was the full extent of CERN's involvement.

Professor SACTON remarked that ECFA had set up a panel to assess the physics case for the EHF and the practical feasibility of constructing somewhere in the world what was, in technical terms, a standard facility.
Repling to Professor MAJEROTTO, who asked whether the ion programme would, if successful from the physics standpoint, be taken further or whether because of financial restrictions it would be left to the United States, the DIRECTOR-GENERAL stated that the future of the ion programme at CERN would depend on the outcome of the preliminary round of pilot experiments during the 34 days of running time in 1986 and 1987. Since it would be a considerable time before a dedicated facility was available for research with relativistic ions somewhere else, and since the future of the proposed RICH project in the USA was uncertain, he was convinced that if the $^{16}$O pilot runs proved successful, the community would press to continue their research at CERN. If there were no plans for a dedicated facility elsewhere, CERN should then seriously consider including a heavy-ion programme in the Organization's long-term programme of activities.

Repling to a question from the PRESIDENT, he said that so far CERN had insisted that the ion programme be largely financed by the outside participating institutes. However, it remained to be seen whether resources of the order of 100 million Swiss francs would be available in the outside institutes for the ambitious long-term aim of using lead ions. It was too early to discuss whether such a project should be treated and financed as a special CERN programme.

Professor KLUYVER stated that while he would not question the need to make LEP and the high-energy programme main priorities, it was important that CERN encourage more modest programmes such as the ion programme, which was making a considerable contribution to the life of the Laboratory by providing interesting physics on a short time-scale at relatively low cost. He hoped that CERN would continue to enjoy sufficient financial resources to maintain such activities.

Professor GABATHULER said that he wished to congratulate CERN on the preliminary results from the heavy-ion programme, which had been introduced on schedule. In view of the fact that in future years there would be increased competition between the heavy-ion programme, the pp programme and LEP for use of the PS and SPS, he wondered whether there would be much room left for the non-heavy-ion fixed-target programme.

The DIRECTOR-GENERAL said he wished to remind delegates that the LEP injection system was designed in such a way as to make SPS fixed-target activities compatible with LEP operation. As the filling time for LEP was half an hour and the SPS was free for several hours thereafter, it should be possible to inject heavy ions into the SPS between LEP injection operations.

Dr BRIANTI stated that since the PS and SPS had already been operated on a pulse-to-pulse basis, when LEP came on stream it would be possible to send a succession of pulses of different particles through the accelerator complex with a two-second time slot for the LEP and fixed-target programmes.
The PRESIDENT said that nowhere else in the world had any remotely similar operation been attempted. It was a remarkable achievement and CERN could be proud of the ingenuity of its accelerator staff.

Mr VERNET said that although 1986 had been a relatively difficult year for the Organization, the quality of the work done at CERN had remained as high as ever and the Director-General and his staff were to be congratulated on their achievements. He hoped that Council would take the opportunity of expressing its appreciation, in particular when the CERN Salary Index for 1987 (Item 8 (iii) of the Agenda) came to be discussed.

- Report on the TRISTAN Facility - President of Council

The PRESIDENT said that he wished to inform Council that the TRISTAN Colliding Beam Accelerator in Japan had achieved its first electron-positron collisions at a centre-of-mass energy of 50 GeV during the night of 14 November 1986, almost five years after the ground-breaking ceremony in November 1981. The collisions had also been confirmed by the observation of a hadronic-like event and large-angle bypass scattering during the following nights. The maximum luminosity achieved had been about $2.6 \times 10^{29} \text{ cm}^{-2} \text{s}^{-1}$.

It was an important development since it was the first time that the Fourth Region in high-energy physics had commissioned a powerful accelerator. He proposed to convey the congratulations of Council to the KEK Laboratory immediately and, when he attended TRISTAN's formal inauguration ceremony in the spring of 1987, to express the best wishes of Council for its future work in the elementary particle physics field.

The Council took note of the Director-General's report and of the President of Council's report on the TRISTAN facility.

The meeting was adjourned in open session at 4.15 p.m. and resumed in closed session at 4.45 p.m.

The meeting was adjourned in closed session at 5.00 p.m. and resumed in open session the following day at 10.05 a.m.

5. SENIOR STAFF APPOINTMENTS  
(Closed Session)  
(Item 5 of the Agenda) (CERN/1638) (Confidential)

The PRESIDENT reported that, in closed session, Council had decided to appoint:

- Dr P. Darriulat as a Director of Research for a period of three years from 1 July 1987.
6. **ELECTIONS**  
(Closed Session)  
(Item 6 of the Agenda) (CERN/1639) (Confidential)

The PRESIDENT reported that, in closed session, Council **had decided** to re-elect:

- Professor W. Kummer as President of Council for a period of one year from 1 January 1987;

- Professor J.C. Kluyver as a Vice-president of Council for a period of one year from 1 January 1987;

The Council **had also decided** to elect:

- Professor P. Lehmann as a Vice-president of Council for a period of one year from 1 January 1987.

On the recommendation of the Finance Committee, Council **had also decided** to re-elect:

- Mr J. Bezem er as Chairman of the Finance Committee for a period of one year from 1 January 1987.

On the recommendation of the Consultative Committee on Employment Conditions (CCEC), Council **had decided** to re-elect Dr M. Gigliarelli Fiumi as Chairman of CCEC for a period of one year from 1 January 1987.

On the recommendation of the Scientific Policy Committee, Council **had decided** to elect:

- Professor I. Mannelli as Chairman of the Scientific Policy Committee for a period of one year from 1 January 1987;

- Professor M. Davier as a member of the Scientific Policy Committee for a period of three years from 1 January 1987;

- Professor A.N. Skrinsky as a member of the Scientific Policy Committee for a period of three years from 1 January 1987;

- Professor B.H. Wiik as a member of the Scientific Policy Committee for a period of three years from 1 January 1987.

On the recommendation of the Scientific Policy Committee, Council **had also decided** to re-elect:

- Professor A.N. Diddens as a member of the Scientific Policy Committee for a period of three years from 1 January 1987.
7. **PROGRAMME AND BUDGETS**  
(Item 8 of the Agenda)

i) **Draft Budget of the Organization for the Thirty-third Financial Period 1987** (CERN/FC/2597/Draft 2 and CERN/FC/2997/Draft 2/Add.)

Dr HEYN, introducing document CERN/FC/2997/Draft 2, said that the personnel budget, in line with the long-term staff plan submitted to Council in June 1985, totalled 369 million Swiss francs at 1986 prices.

The materials budget of 386 million Swiss francs was in line with the long-term estimates approved in June 1986. About 50% of the materials budget would be earmarked for the LEP project, which was the Organization's first priority, including both machine and experiments.

Other non-recurrent investments would amount to about 8% of the materials budget whereas about 42% would be spent on recurrent operating costs. Such costs included the operation of existing accelerators and related experimental areas, totalling 43 million Swiss francs. The operation of experiments, experimental facilities and the Computer Centre would total 37 million Swiss francs, technical support would amount to 24 million, administrative support would total 19 million, and energy and water would cost 42 million Swiss francs.

The 1987 budgetary allocations were not sufficient to cover the currently estimated payments due in 1987 for LEP construction.

As explained in the document on the financial position of the LEP project (CERN/FC/2991), the additional payments might total 187 million Swiss francs. For 1987 Switzerland had pledged 30 million Swiss francs in advance contributions, to be set against its contributions in 1990 and 1991. In 1987 the Organization might therefore need to take out short-term loans up to a maximum of 157 million Swiss francs. The matter had been extensively discussed by the Finance Committee and its conclusion had been set out in a recommendation to Council (see CERN/FC/2997/Draft 2/Add.).

The amount should be regarded as a ceiling which would either not be reached or would be reached for only a short time (cf. Section VI on page vi, and page 25 of the document). Page 50 showed the annual LEP spending profile, with estimated payments broken down by category.

A special effort was being made to promote research and development at CERN, for which purpose 5 million Swiss francs had been allocated (page v, Section IV, 4.2).

Finally, with reference to page 53 of the document, Additional Resources, an extra 1 million Swiss francs had been earmarked to cover the cost of the CERN Review Committee, and following discussions in the Committee of Council, the amount could now officially be added to the 1987 Budget.
The final version of the Budget, in 1987 prices, would as usual be submitted to the Finance Committee in February 1987. The version would include information requested by the Finance Committee at its December 1986 meeting.

Mr BEZEMER reported that the Finance Committee had unanimously decided to recommend Council to adopt the Budget as proposed by the Management.

Several delegates had mentioned the staff situation, and concern had been expressed that numbers in lower grades were declining while higher grades, 8 and 11 in particular, were still growing, with a consequent impact on the personnel budget.

It was clear that extensive liquidity problems would be experienced in the next few years and measures would have to be taken to solve them. In that context, several Member States were advancing appreciable amounts against their 1987 contributions or those for later years. The possibility of short-term bank loans had also been discussed. The recommendation set out in document CERN/FC/2997/Draft 2/Add. had been formulated by the Committee in order to clarify the situation.

Professor SACTON said that the European Committee on Future Accelerators (ECFA) had expressed its deep concern about the continuous erosion of budgetary expenditure on non-recurrent items. In 1986, 33 million Swiss francs had been spent under the heading, whereas in 1987 only 26 million had been set aside, excluding the pp improvement programme.

The DIRECTOR-GENERAL said that it had always been clear that it would be very difficult to carry out the LEP project within a constant budget and that special technical and financial measures would be required. He very much appreciated the assistance given by the Finance Committee and Council and he wished to thank those Member States that had helped the Organization in its efforts to solve the cash-flow problem, which had arisen for the first time in 1986 and would persist for the next two to three years. Particular thanks were due to Switzerland which had helped with a longer-term advance.

While such financing procedures might be unconventional, they would enable the LEP project to be carried out as quickly as technically possible, to the benefit of the CERN users who were eager to start experiments on the LEP accelerator.


Council authorized the Finance Committee to approve the final budget at 1987 prices at its next meeting in February 1987.
On the recommendation of the Finance Committee, set out in
document CERN/FC/2997/Draft 2/Add., Council authorized the CERN
Management to resort, for LEP expenditures in budget year 1987, to
either advance contributions and/or short-term bank loans up to
167 million Swiss francs.

ii) Calculated Cost Variation Index and Estimate of True Income
for 1987 (CERN/FC/2968/Rev.2 and CERN/FC/2968/Rev.2/Corr.*

CERN Salary Index for 1987 - Report by the Consultative
Committee on Employment Conditions (CERN/1637-CERN/FC/3006)

Dr HEYN introduced documents CERN/FC/2968/Rev.2 and

Mr BEZEMER reported that the discussions in the Finance
Committee had been easier than in recent years, partly because
inflation had declined and the amounts involved were therefore
appreciably lower. The Committee had decided to recommend Council to
approve the Management's proposal relating to both the materials and
personnel budgets.

Dr GIGLIARELLI FIUMI, introducing document CERN/1637-
CERN/FC/3006, said that the Consultative Committee on Employment
Conditions (CCEC) had examined the calculated salary index at its
September 1986 meeting and, having accepted first the validity of the
calculation on which it was based and second that from the technical
viewpoint the calculation had been properly made, had unanimously
recommended that the Finance Committee and Council approve the index.

Council took note of documents CERN/FC/2968/Rev.2,
CERN/FC/2968/Rev.2/Corr.* and CERN/1637-CERN/FC/3006 and, on the
recommendation of the Finance Committee, unanimously approved an
overall index of 2.27%, composed of a salary index of 2.35%, giving an
average index for personnel expenditure of 2.28%, and a materials
index of 2.25%.

The DIRECTOR-GENERAL stated that he had asked the Finance
Committee whether it would consider recommending a higher than cal-
culated overall index so that the materials budget could be increased
to offset the shortfall arising from the fact that the full materials
index had not been granted in 1982 and 1983. In that context, the
Scientific Policy Committee, ECFA and the CERN Long-Range Planning
Committee had strongly recommended that resources be earmarked for
long-term research and development. It was regrettable therefore
that the index could not be increased. He was, however, grateful that,
despite some difficulties, the full calculated salary index had been
approved. He was sure that the staff would interpret the award as
recognition of their excellent work over the past year.

* English version only.
   (Item 9 of the Agenda) (CERN/1640-CERN/FC/2954)

Dr HEYN introduced document CERN/1640-CERN/FC/2954.

The DIRECTOR-GENERAL noted that during the period 1987-1989
Spain and Portugal would still be making contributions under the
transitional arrangements agreed for them. Greece's contribution had
been held constant at 0.4% of contributions for several years and it
was proposed to continue with the arrangement over the next three
years.

In November 1986, Mrs Papandreou, as the Greek minister
responsible, had visited CERN to discuss relations between Greece and
CERN. The discussions had covered not only Greece's contributions but
also measures to co-ordinate and strengthen participation by Greek
scientists in the CERN programme. CERN's relations with Greek industry
had also been examined, with the aim of enabling Greek firms to
profit to a greater extent from CERN technological know-how and to
tender more easily for CERN contracts.

With regard to the Greek contributions, the Minister had
announced that, of the approximately four million Swiss francs
outstanding on its contributions, Greece would remit half by the end
of 1986 and the remainder over the coming two years. She had also
indicated that the Greek authorities were prepared to discuss the
possibility of increasing the Greek contribution from 1990 to its
normal level. Greece was thus making a big effort to improve the
situation and he therefore urged Council to accept the proposal in
document CERN/1640 that the Greek contribution be kept at a
constant 0.4% of total contributions for the next three years.

Mr. COUNINIOITIS made the following statement:

"We share the Director-General's views about my Minister's visit.
Indeed, we believe that the visit of the Alternate Minister for
Industry, Energy and Technology, Mrs Papandreou, to CERN on
21 November 1986, was very successful.

It allowed both sides to clarify points of common interest and to
lay the basis of fruitful collaboration between my country and the
Organization.

As far as the financial relations between Greece and CERN are
concerned, I would like to repeat what the Alternate Minister
announced to the Management:

1. Half of Greece's outstanding contributions will be paid by the
   end of 1986. The transfer procedure has started and the money
can be expected to reach the Organization by the end of the year.

2. The balance of the outstanding contributions will be paid within
   the next two years.
3. The 1987 contribution will be paid during 1987.

4. Greece is prepared to make every effort to negotiate an increase in its percentage contribution to the CERN budget with effect from 1990.

I would like to take this opportunity to clarify two points which may have given rise to some confusion.

First, at the Finance Committee, a proposal was made that the Committee should recommend Council to fix the Greek contribution at 0.4% for 1987 only and to increase it for each of the remaining two years to 1989. This proposal was not made by the Netherlands or any other delegation, but by the Chairman of the Finance Committee.

To tell the truth, I understand the Netherlands Delegation's confusion, since at that time I also thought that Mr Bezemer, when making his proposal, was speaking on behalf of his country.

As you all know, all delegations supported the Management's proposal that the Greek contribution should be fixed at 0.4% for 1987, 1988 and 1989.

Secondly, it appears that the Netherlands Delegation believes that Greece is paying "something around one-third of the level it should be".

This belief is no doubt attributable to their endeavour to solve the Organization's difficult financial situation by every possible means. I expect that the Management can make available all information on the appropriate levels of Greece's contributions.

In conclusion, for allowing my country to pay the outstanding contributions as well as the contributions for the three years to come, may I ask for support of the Management's proposals, contained in the document we now discuss?"

Mr BEZEMER noted that, as Chairman of the Finance Committee, on no occasion had he spoken on behalf of the Netherlands Delegation, and his remarks should not be so construed.

Council unanimously decided that the scale of contributions for 1987, 1988 and 1989 set out in document CERN/1640-CERN/FC/2954 should be applied.

9. THE LAA PROGRAMME OF ACTIVITIES
(Item 10 of the Agenda) (CERN/1641 and CERN/1642, as circulated)

The DIRECTOR-GENERAL said the Italian authorities wanted to introduce an "other programme" under the terms of the CERN Convention*, which was a programme financed by one or more of the

* Article II.4 of the CERN basic Convention, dated 1 July 1953, as amended 17 January 1971.
Member States outside the normal budget. In the past few months, the content of the programme had undergone a number of important changes and developments and in its final form would, in essence, be a development programme on detectors for use in large hadron colliders, which were likely to be the next generation of large accelerators in various regions of the world.

The LAA programme would be financed for five years by Italy at a cost of 30 billion lire (roughly 37 200 000 Swiss francs at current rates of exchange), and would be open to scientists from all Member States, and even to physicists from non-Member States. Professor Zichichi would be the project leader, but it would be carried out under the authority of the Director-General. Management and accounting of the funds, equipment and supplies would be governed by CERN Financial Rules and Regulations, and staff would be appointed in conformity with the Organization's Staff Rules and Regulations.

The fact that the project was being financed single-handed by Italy would, of course, be taken into consideration, as had been the case with similar programmes in the past. Details of the execution of the programme would be laid down in a memorandum of understanding, based on the principles and guidelines laid down in document CERN/1642, to be drawn up between the Italian Delegate to Council and the Director-General.

He wished to apologize that delegates had not received document CERN/1642 earlier, but certain formal matters had required clarification with the Italian authorities and the resolution had therefore only recently been finalized.

Professor MITCHELL said that it was a pity that the paper had been distributed at such a late stage but that nevertheless the United Kingdom Delegation felt that the proposal for the programme in its present form was a most sensible and constructive one, especially in view of the need for long-term research and development work on detectors and accelerators at CERN. His Delegation was very satisfied with the outcome of the discussions between CERN and the Italian authorities and could approve the project.

In answer to a question from Professor MITCHELL, the DIRECTOR-GENERAL confirmed that the overheads were indeed covered in the costing, which also included funds for building office and laboratory premises. The contracts given to new staff working on the project would be for a maximum of five years, i.e. the duration of the funding period.

Dr REZEMBER said that he wished to thank the Italian authorities for the contribution to research and development work at CERN that the programme would now provide. At a forthcoming meeting, he hoped to have the opinion of the Scientific Policy Committee on the proposal in its new form, as its Chairman had been unable to attend the present Council session.

The PRESIDENT pointed out that the Scientific Policy Committee had not yet had time to discuss the latest form of the
proposal. However, when previous versions of the project had been discussed there had been many suggestions from members of the Committee that the funding from Italy would be best spent on a research and development programme. He therefore felt sure that the Scientific Policy Committee would be very pleased at the outcome, but he would ask its new Chairman to comment on the programme at a forthcoming meeting.

The DIRECTOR-GENERAL added that at the last meeting of the Scientific Policy Committee in November the need for additional funds for technological development work on detectors and accelerators had been stressed. Members of the Committee had urged him to convince Council to make available additional funds for such work and he had mentioned their request when the cost variation index had been discussed earlier in the meeting. The LAA project in its current form seemed to be an answer to their plea that alternative sources of funding for development programmes should be found.

Mr BEZEMER said that it had not been possible to discuss the new form of the project in the Finance Committee, but speaking personally he hoped that the procedure followed in the case of the LAA project would not be seen as a precedent, since such special programmes did have an impact on the overall CERN programme. He also hoped that, in future, similar proposals would be discussed in detail in the Finance Committee.

The DIRECTOR-GENERAL said that the Finance Committee had discussed the financial aspects of LAA in June 1986 and had formally approved it as an "other programme". The changes to the technical content of the programme did not have any bearing on financial approval for it.

Professor LEHMANN said that while he agreed that it was unfortunate that there had not been more time to discuss the latest proposal, he wished to thank the Italian authorities for their generous gesture, which gave CERN additional resources for development. He was quite convinced that the project would be carried out in the spirit of open international collaboration that was characteristic of the Organization.

Professor SACTON said that the background to the LAA project was rather complicated. So long as it had been considered as a possible addition to an approved experiment at CERN, he had refrained from comment, since it was not ECFA's task to discuss individual experiments. However, it had subsequently developed into a full programme for research and development work on detectors for future accelerators. As he had repeatedly stressed the importance of such work for the long-term future of CERN and high-energy physics in general, he wished to express his strong support for the LAA programme. New experimental tools to cope with the higher data flows expected from new machines were vital. He was also glad to hear that the programme would be open to physicists from all countries and that its results would be available to the whole high-energy physics community.
However, at the June 1986 session of Council, Professor Rubbia had presented an interim report of the Long-Range Planning Committee (LRPC) which had unanimously recommended that from 1987 onwards a certain percentage of the CERN materials budget should be devoted to research and development work on new accelerator technologies. ECFA was concerned that no action had been taken on the recommendation by Council and he hoped that the Italian initiative, if approved, could extend to accelerator development.

Mr VERNET said that the Swiss Delegation recognized the merits of the Italian proposal. The Swiss scientific community was fully aware of the importance of such development programmes if the future quality of work at CERN was to be ensured. However, given the complexity of the programme, his Delegation did not feel ready to judge, especially as it had not heard the opinion of the Scientific Policy Committee, and it would therefore abstain in the vote.

Professor MAJEROTTO said that he wished to know how CERN intended to go about supervising the project and hoped that responsibility for it would be given to an existing scientific body at CERN or to a special committee set up for the purpose.

In reply, the DIRECTOR-GENERAL pointed out that, if it was accepted, LAA would be managed in the same way as other existing development programmes at CERN. Generally speaking, the procedure was that the project leader put forward proposals to the CERN Management for their approval. Such programmes were usually presented as part of the long-term development programme discussed by the Scientific Policy Committee. Since the LAA project was rather unusual, he intended to report on any definite proposals to the Scientific Policy Committee.

He wished to support the remarks of the ECFA Chairman on the importance of long-term accelerator development, in which CERN was taking certain steps and for which ECFA had organized a number of workshops to encourage research.

Professor KLUYVER said that the Netherlands Delegation was also grateful for the generosity of the Italian authorities in helping provide money for much-needed research. He was glad that it would be a CERN programme, carried out in the spirit of CERN.

Council decided, by 13 votes in favour and one abstention (Switzerland), to approve the LAA programme of activities as an "other CERN programme of activities", following the conditions laid down in document CERN/1642.

Mr FRANCESCOI said that the Italian Delegation wished to express its satisfaction at the approval of the resolution. The decision was in line with Italy's keen interest in the work of CERN and the programme would enhance the image of the Organization.

The meeting was adjourned at 11.10 a.m. and resumed at 11.35 a.m.
10. **CERN PENSION FUND**

(Item 11 of the Agenda)

- **Revision of the Rules of the Pension Fund** (CERN/FC/3018)

Dr GIGLIARELLI FIUMI, introducing the document, stressed the importance of two matters: firstly, the transformation of the widow's pension into a pension for a surviving spouse, the additional cost of which could be covered by an increase in contributions from 21.74% to 22% of reference salary; and secondly, the proposal contained in the cover note (paragraph 5, p.2) for a study on the possibility of placing the Pension Fund more directly under Council control.

The revision of the Rules marked the end of the work of the tripartite Working Group on Pensions. He wished to thank all its members, and in particular Messrs. Frochaux, Leclerc and Dörr for their important contribution to the work of revision.

Mr BEZEMER said that the revised Rules had been discussed at the Finance Committee meeting held on the previous day and that the Committee had recommended them for approval.

Dr van't KLOOSTER pointed out, with regard to Article III 1.02 and 1.04 (pp. 74 and 75 of the document), that acquired rights which implied long-term commitments could not always be recognized in law, as the Netherlands Delegation had frequently stated. Exceptional situations could arise when a country was no longer able to respect such commitments. In the Netherlands, for instance, a law could be passed whereby the pensions of civil servants were reduced.

On the recommendation of the Finance Committee, Council **unanimously approved** the revised Rules of the Pension Fund and the related proposals (CERN/FC/3018).

- **Staff Insurance Scheme - Adjustment of Pensions** (CERN/FC/3021)

Presenting the document, Mr ULLMANN said that the Finance Committee had recommended the proposal set out in the document, i.e. that pensions in payment should be adjusted by 2.35%, the same rate as salaries.

Mr BEZEMER said that at the Finance Committee the French Delegation had pointed out that it was anomalous that the tax factor was used in the calculation of the pensions index, since pensioners paid tax.

On the recommendation of the Finance Committee, Council **took note** of document CERN/FC/3021 and **unanimously decided** that pensions in payment be adjusted by 2.35%.
- The Technical Deficit of the CERN Pension Fund (CERN/FC/3024)

Mr ULLMANN, introducing the document, said he wished to repeat the warning of the actuary regarding the technical deficit, which was a constant drain on the Fund, although it was not recognized as a debt.

Some years previously a group of independent actuaries had warned that the technical deficit was self-generating and that unless action was taken it would continue to grow. It had now reached more than 200 million Swiss francs, a large sum on which no income was earned. So that the Fund could reach its target of a net yield of 3.5% per annum, the Administration of the Fund would be grateful if Council would do what it had set out to do in 1985, namely to stabilize the technical deficit by increasing the Organization's contribution to the Pension Fund by steps of 0.5% of pensionable salary from 1986 onwards.

The proposal in the document was that CERN's contribution towards stabilizing the technical deficit in 1987 should be increased from 0.5% to 1%, (at an estimated cost of 1.6 million Swiss francs). However, in view of the cash problems facing the Organization, the Administration of the Fund was ready to look into the possibility of having that amount added to the Organization's acknowledged debt to the Fund which would be settled sometime in the future.

Mr BEZEMER said that the Finance Committee had been divided in their view of the proposal contained in the document and had voted that a decision be delayed.

On the recommendation of the Finance Committee, Council decided to delay the decision on the proposal contained in document CERN/FC/3024 until the second half of 1987, without ruling out retroactive implementation.

- Appointments to the Pensions Board

Council unanimously decided to re-appoint Dr C.J. Zilversehoon as Chairman of the Pensions Board for one year from 1 January 1987 and also to renew the mandates of Mr M. Lemne and Dr M. Gigliarelli Fiumi as Council observers on the Pensions Board for three years from 1 January 1987.

Dr ZILVERSCOOON, speaking on behalf of the members and beneficiaries of the Pension Fund, said that Council's unanimous approval for the new version of the Fund's Rules represented a happy outcome of six years' study by the tripartite Working Group on Pensions. He wished to express his deep satisfaction at the spirit in which the members of the Group had carried out their tasks, despite the serious nature of the social issues at stake, which had financial implications both for the staff and for the Member States of the Organization. Particular thanks were due to the Group's Chairman, and to Mssrs. Frochaux and Leclerc for their efforts on pensions.
guarantees in the event of dissolution of the Organization. He wished to thank Council for what had been achieved in bringing CERN pensions up to a reasonable level in the past few years, in particular for helping to narrow the gap in pensions between CERN and the reference organizations from 40% six years previously to only 5% at present; for recognizing the importance of pension guarantees in the event of dissolution of the Organization, or of a single Member State withdrawing from CERN; and for the measures taken so far to deal with the technical deficit. He recognized that the delegates did not always have an easy task in influencing their national authorities. Finally, he hoped that the remaining gap of 5% between pensions in the reference organizations and those at CERN could soon be bridged.

11. CERN STAFF RULES AND REGULATIONS - NINTH EDITION (Item 12 of the Agenda) (CERN/1636-CERN/FC/3003)

Dr GIGLIARELLI FIUMI said that CCEC had approved the text of the revised Staff Rules and Regulations at its September 1986 meeting. There were no fundamental changes in policy and practice in the new Rules and the financial consequences would be negligible.


12. DRAFT TIME-TABLE OF COUNCIL SESSIONS AND COMMITTEE MEETINGS 1987 (Item 13 of the Agenda) (CERN/1632/Draft 2)

The PRESIDENT said that for the purposes of streamlining, the meetings traditionally held in September and November would be replaced by a single meeting to be held in mid-October.


13. OTHER BUSINESS (Item 14 of the Agenda)

- External auditors

The PRESIDENT reported that he had been informed by the President of the Netherlands Algemene Rekenkamer that one of the two external auditors, Mr M.J. Winters, would no longer be working for CERN and would be replaced by Mr H.S. Beuker. On behalf of Council he wished to thank Mr Winters for his work for the Organization.

Council took note that Mr M.J. Winters, one of the two External Auditors from the Netherlands Algemene Rekenkamer, was being replaced by Mr H.S. Beuker.
The PRESIDENT said that it was the last meeting for three members of Council. First, it was with great regret that the Organization bade farewell to Dr Vallin, the Swedish Delegate, who was leaving to take up an important post as Administrative Director of the Swedish Medical Research Council. It was particularly sad to see him leaving at a time when construction of LEP was nearing completion, as he had taken an active part in assuring Swedish support for the project. On behalf of all the delegates to Council and the other CERN committees and working groups, and of the Administration of the Organization, he wished him every success in his new post and hoped that he would maintain an interest in developments at CERN.

Dr VALLIN said that he wished to thank all those who had made his time at CERN easier by their help and friendliness. CERN represented the best of international co-operation, not only due to its scientific excellence but also because of the high standard of the Organization overall. It seemed important to him that, at a time when everyone was preoccupied with practical, short-term problems, the inherent strength of the Organization should not be forgotten. All the delegates had a duty to bring it to the notice of those political circles in their home countries which would make the decisions on which CERN's long-term future would depend. He wished the delegates and the staff of the Organization all the best for the future.

The PRESIDENT said that Professor Perkins, who had been unable to attend the meeting for personal reasons, was leaving the Scientific Policy Committee both as a member and as its Chairman. The Organization had often benefited from his advice and he proposed to send him a letter of thanks.

Ambassador Paolini of the Italian Delegation had left Geneva, and he also wished to send him a letter of thanks for all his efforts on behalf of the Organization.

The DIRECTOR-GENERAL said that he wished to join in all that had been said regarding the three departing members of Council and to thank them for their help to the Organization in the past few years. On behalf of all the staff of the Laboratory, he wished them well for the future.

The session rose at 12.15 p.m.

* * *

87/14/5/e
PROGRESS REPORT

BY

THE DIRECTOR-GENERAL
The DIRECTOR-GENERAL presented to the Council at its Eighty-second Session, under Item 4 of the Agenda, a general report on some of the Organization's scientific activities, an edited version of which is given below:

"In view of the wide range of activities at CERN during the past year, I shall have to be selective. Full details of all current CERN activities will be published in the 1986 Annual Report. In my presentation today, I shall report on accelerator performance, the first experiments with relativistic $^{16}$O ions, the UA1 and UA2 results, LEP and LEP experiments and certain management topics.

**Accelerator performance**

As in previous years, the SPS was operated for fixed-target activities during one period of the year instead of two, to reduce the loss of running time caused by the change-over from collider to fixed-target operation. After initial start-up difficulties, the best performance to date was achieved: $3.4 \times 10^{13}$ protons per pulse accelerated to 450 GeV, and over $10^{17}$ protons delivered to the experiments per day, which meant an average efficiency rate of 80%. Here, efficiency is defined as the time available for physics compared to scheduled hours and in period 4 it was as high as 86%. Despite the decision taken some time ago not to carry out much machine-development work for the fixed-target and collider programmes a number of improvements have been introduced, including double extraction for neutrinos, giving 23% more intensity; a very small beam spot (16 $\mu$m x 10 $\mu$m) for NA 34; and a new test beam, X 1, for UA1. An increasing proportion of fixed-target runs is now devoted to test beams for the UA, LEP and HERA and some other (e.g. space research) experiments, owing to the fact that CERN is the only European laboratory which can provide high-energy hadron beams.

There was no collider operation during the second half of the year since in August the Antiproton Accumulator (AA) was shut down so that construction of the Antiproton Collector (ACOL) for the $p\bar{p}$ improvement programme could begin. During the collider run in the first half of the year, UA1 tested a new microvertex device for the detection of short-lived particles, designed to be installed close to
the point where the proton and antiproton collisions occur. However, owing to difficulties which necessitated changes to the design of the new device, UA1 had to be taken out of the beam and some 620 hours of running time were therefore devoted to the Gas Jet Target, UA6. UA2 did not operate in 1986 because the collaboration is concentrating its efforts on the upgrade in order to be ready for the higher intensities to be provided by ACOL from autumn 1987.

Extensive accelerator studies were carried out during the year in preparation for the collider upgrade including operation with 6 bunches of protons against 6 bunches of antiprotons, beam separation and lifetime and background for strong/strong beams.

The AA, which will continue to play an essential role in the pp collider complex when ACOL comes on stream, has been further improved and a new record has been achieved of $5.2 \times 10^{11}$ antiprotons in one stack stored for some 1150 hours without loss. Installation of ACOL around the AA is proceeding according to schedule, and we hope the machine will come into operation next summer.

LEAR

Following the introduction of an improved mode of operation in 1985, LEAR can now run concurrently with the SPS pp collider using some 10% of the antiprotons. This has resulted in a considerable increase in running time for LEAR.

There is increasing interest in the study of antiprotons at low energies and even if possible at rest. During the year, antiprotons extracted at 200 MeV/c were slowed down to 21 MeV and subsequently to 3 KeV via a beryllium foil and then held for some 100 seconds in a Penning trap (see Fig.1) not many centimetres in length. In order to carry out various measurements, it is hoped to increase the storage time by about a factor of 100 and also the number of antiprotons stored. For example, two experiments are intending to measure the inertial and gravitational masses of the antiproton to discover whether gravitation is different for matter and antimatter. There is also a project to produce real antimatter by combining an antiproton with a positron to create an antihydrogen atom. This has never yet been achieved.
The relativistic ion programme

In recent years, considerable interest has developed in the study of nuclear matter at very high energy densities; CERN is the only laboratory in the world where the completely new domain of nuclear-elementary particle physics can be explored at relatively low cost. This is being done by accelerating $^{16}\text{O}$ in the accelerator complex.

The kinds of particle which can be accelerated in an accelerator are determined by the ratio of their electric charge to their mass. Although all CERN accelerators are designed to accelerate protons, deuterons and alpha particles, with an electric charge-to-mass ratio smaller by a factor of two, were successfully accelerated at CERN a few years ago. It was therefore assumed that oxygen atoms could be accelerated once the oxygen had been stripped of its eight electrons, since its charge-to-mass ratio would then be almost the same as that of deuterons and alpha particles. In principle, therefore, all that is required is a source giving fully stripped oxygen ions. However, as the energy-mass ratio is not quite the same, further accelerator development has been necessary and in addition a number of problems associated with beam diagnostics and the transition energy had to be overcome.

Since CERN was unable to provide adequate new resources, GSI at Darmstadt and the Lawrence Berkeley Laboratory (LBL) in the United States submitted a joint proposal to build a $^{16}\text{O}$ ion source in co-operation with Grenoble University and to carry out experiments. CERN agreed to grant 17 days running time in 1986 and 17 days in 1987 for pilot experiments using the Linac 1, Booster, PS and SPS complex. The community, which comprises some 300 physicists from all over the world, has provided all the equipment for the source complex, with GSI providing the beam transport system and LBL the pre-accelerator, and has financed its installation. Four batches of $5 \times 10^8$ ions were sent to the SPS in September 1986. After the necessary tuning had been carried out and experience of handling the ions had been obtained, very clean oxygen beams (98-99%) were achieved at the full SPS energy of 400 GeV with the same spill quality as for protons despite the much lower intensity. Seven experiments took data in four beams for 17 days, during which time the efficiency of the accelerator chain was greater than 90%. This is a remarkable achievement on which the CERN accelerator staff are to be congratulated.

Since the ions have a charge of 8, an oxygen nucleus receives a total energy of $8 \times 400 \text{ GeV} = 3200 \text{ GeV}$. This is the highest energy ever achieved for an artificially accelerated object in an accel-
erator. Expressed in other terms, since the oxygen nucleus has 16 protons and neutrons, the energy achieved is 200 GeV per nucleon, the first time that nuclei have been accelerated to relativistic energies.

One source of concern was whether the experiments would be able to handle the ions, since if two complicated nuclei are collided they break up into many particles and additional ones are produced. During a test run in September, the first pictures were taken by a streamer chamber. Although easily identifiable, there are up to 300 or 400 tracks in some of the events.

High-energy elementary particle physics is mainly concerned with quark-quark/antiquark and electron-electron/positron collisions, i.e. the interactions between the fundamental building blocks of matter. In the case of $^{16}$O ions, however, the aim is to investigate nuclear matter in bulk. Nuclear matter is found on earth in large nuclei such as $^{238}$U, which has 238 protons and neutrons, or in outer space in neutron stars. At normal temperatures, the behaviour of nuclear matter is the province of low-energy nuclear physics. The new approach is to "heat up" the nuclear matter and there are definite theoretical predictions about its behaviour under these conditions. We know that there are three quarks inside a proton or a neutron, held together by many gluons in 'bags'. In a normal uranium nucleus, the protons and neutrons retain their individual quark 'bags' (see Fig.2). Some theorists predict that the quark bags will melt when heated up and disappear at the phase transition, allowing the quarks and gluons to move around freely in a nuclear volume which is referred to, by analogy with the ionization of a hydrogen atom, as quark-gluon plasma. The main purpose of the present experiments is to determine whether this phase transition actually exists in nature.

The theory describing the strong interaction, called the theory of quantum chromodynamics (QCD), predicts that the phase transition will occur at energy densities of ~ 3 GeV/fm$^3$. One of the main problems is to identify the various signatures of this phase transition, which may include the emission of strange particles such as $K$ mesons, muon pairs and photons, etc. Several experiments are therefore required to search for different types of signature.

The most effective way of heating up nuclear matter is to collide two heavy nuclei such as uranium. The possibility of building a special storage ring for the purpose is currently under discussion in the United States but the final decision will undoubtedly depend on the outcome of the pilot experiments at CERN where, in a more modest programme, $^{16}$O ions are accelerated on to a uranium, lead or gold
target. The main fear was that when the oxygen was fired on to an uranium target, for example, the fragile uranium nucleus might merely break up without any heating up process occurring. This indeed always happens. The aim of the experiments is to ascertain whether at least a part of the uranium nucleus remains and has been heated up. The projectile and target fragments tend to be emitted in the very forward direction, whereas if heating up of the nucleus occurs, the parts of the nucleus which evaporate with the high temperature are emitted in every direction. The first task of all the experiments was therefore to observe the transverse energy and thereby to measure the temperature of the nucleus since this would give an indication of whether or not heating up had occurred within the nucleus.

CERN approved a number of experiments for the $^{16}$O programme: WA 80 (LBL, GSI, Lund, Münster, Warsaw, Oak Ridge NL) using the Plastic Ball provided by LBL to detect single photons, NA 35 (14 European laboratories and LBL) using a streamer chamber to detect strange particles, NA 36 (Europe, India and USA) using the old EHS superconducting magnet to look for strange particles and antiparticles, NA 34/2, HELIOS, (16 institutes in 9 countries, Europe, Israel, US, USSR), using a magnet to detect dimuons and NA 38 (10 European laboratories) to investigate the dimuon spectrum. CERN insisted that wherever possible existing equipment should be used.

In addition, there has been a renewal of interest in emulsion experiments and four have been approved, involving some 150 physicists from 40 laboratories in China, Canada, Egypt, Europe, India, the USA and the USSR (see Fig.3). In addition, there is a plastic-lead stack experiment to investigate free quarks conducted by a team of two(!) and three other small experiments using a beam dump, a silicon detector and foils respectively. Most of the experiments are located in the North Area, while one, WA 80's Plastic Ball experiment, is in the West Area.

The first run was completed only a few days ago but some preliminary results are already available. WA 80 has obtained encouraging results demonstrating that the multiplicity and the transverse energy increase with heavier target nuclei, the transverse energy reaching some 120 GeV in the case of gold, thereby giving evidence for high temperatures inside the nucleus. The HELIOS collaboration has obtained a preliminary transverse energy distribution for oxygen on lead showing transverse energies of up to approximately 200 GeV. NA 35 has also produced a transverse energy density spectrum showing hot collisions (Fig.4) which are candidates in the quark-gluon plasma search.
To summarize what has been achieved to date, the experiments have shown that they can cope well with a very high number of particle tracks (up to 400, see Fig.5); that events with high transverse energy occur relatively frequently ($E_T > 250$ GeV) with a cross-section of about 100 $\mu$b (Fig.4); that nuclear matter has a high stopping power for oxygen ions even at 200 GeV per nucleon, much higher than expected, implying that nuclear matter is black and not transparent as some theorists had predicted; and that the results are encouraging with respect to reaching the necessary energy densities of about 3 GeV/fm$^3$. These conclusions suggest that the conditions are favourable for the investigation of quark-gluon plasma. GSI and LBL are now proposing to improve on the oxygen source using $^{32}$S or even $^{40}$Ca so that higher energy densities can be achieved. Analysis of the results over the coming months will show whether further experimentation in this field is justified.

**$p\bar{p}$ physics programme**

The main question of interest in high-energy physics is how far all the forces known in nature, gravity, the electromagnetic and the weak and strong forces, can be unified. The discovery of the $W^\pm$ and $Z^0$ particles at CERN was a big step forward in the unification of the electromagnetic and the weak forces. However, this unification is not complete. As a next step, there are hopes that the electroweak force could be unified with the strong force (QCD). There are a number of theories relating to this unification. The Grand Unified Theories (GUTs), suggesting that there are no new phenomena between the $W^\pm$ and $Z^0$ mass energy of approximately 100 GeV and energies of $10^{15}$ GeV, have now largely been ruled out by a number of recent experiments. In contrast, the Supersymmetry Theory (SUSY) predicts the existence of new particles between these energy scales. While the unification of the electromagnetic and weak forces is not yet complete, preparations are already being made for the next step, namely the unification of the electroweak and strong forces. Ultimately, the aim is to unify these forces with gravitation in a single Theory of Everything. In this connection, one concept under consideration is that of Superstrings, but at the present state of knowledge it is difficult to define experimental tests. For the time being, therefore, the main interest lies in experiments to investigate the still open portions of the Standard Model (e.g. Higgs sector) and to test other theories which go beyond the Standard Model (e.g. SUSY).
The Salam-Weinberg-Glashow Standard Model achieves partial unification and explains a large amount of experimental data, such as the $W^\pm$ and $Z^0$, but fails to determine the ratio of the two elementary charges, the electrical charge $e$ and the weak charge $g$, known as the free parameter $\sin^2 \theta_W$. Many experiments are trying to measure this quantity since it is a fundamental constant of nature. It can be determined both from the mass measurements of the $W^\pm$ and $Z^0$ and from neutrino-lepton scattering experiments. The best value for $\sin^2 \theta_W$, reported in summer 1986, is $0.229 \pm 0.003$ stat. $\pm 0.006$ syst., giving $e/g = 0.478 \pm 0.014$. This value must now be understood.

Another major area of interest relates to the nature and number of the elementary building blocks of matter. The existence of the top quark, predicted by theory, is still an open question. Some years ago there were indications from the UA1 experiment that the top quark had been detected. With better statistics this result can now be interpreted in terms of conventional physics and it is possible that only LEP will provide an answer to the top question. Another major area of interest is to ascertain whether there are more than three families of quarks and leptons.

Neither UA1 nor UA2 have taken data during 1986: UA1 organized a test run for the microvertex detector and UA2 was occupied with work for the UA upgrade. However, both collaborations have continued to analyse 1985 data.

UA1 had a number of interesting events with a jet of particles emerging in one direction and missing energy on the other side. One early interpretation of these 56 monojet events was that the missing energy might correspond to the decay of a supersymmetric particle. Recent analysis has shown this not to be the case and that these events are to be interpreted as the decay of a $W$ into a tau lepton and a neutrino, where the tau decays into a hadron jet. This provides an excellent opportunity to study this decay and compare it to theory (Fig.6).

Another interesting question related to the existence of three kinds of lepton families is the concept of universality. It predicts that each of the three families should have the same behaviour with respect to the various forces. In particular, the strength of the weak force should be the same for all three families. The UA1 results have provided a good test of this universality (including the $\tau$) by confirming that the weak force is indeed within the experimental errors the same for all three kinds of leptons.
The small unexplained background in the monojet events (Fig. 6) may indicate the decay of $W^\pm$ particles into an even heavier lepton belonging to a fourth family. Whatever the background turns out to be, these events have provided a lower limit of 41 GeV on the mass of the fourth lepton, if it exists.

Since the concept of universality should equally apply to quarks, the $W^\pm$ and $Z^*$ should also decay into quark pairs. However, such events are hard to detect experimentally since the strong force produces an enormous background of jet pairs by quark and antiquark scattering, whereas the weak interaction produces only a few decays of the $W^\pm$ into quark pairs. Nevertheless, UA2 has now obtained evidence for the decay of the $W^\pm$ and $Z^*$ into quark-antiquark pairs (Fig. 7).

Details of other CERN experiments will be given in the 1986 Annual Report.

**LEP construction**

In view of the comprehensive reports given on previous occasions by Professor Picasso, I shall restrict myself to an account of recent developments.

With some modifications to the PS and SPS, the existing accelerator complex will serve substantially as the injection system for LEP. To complete the injection scheme, a linear accelerator pre-injector, LIL, to accelerate electrons and positrons to 600 MeV, and a small storage ring, EPA, with a somewhat unusual geometry to save space, have been built (Fig. 8). From LIL and EPA the electrons and positrons will be accelerated to 3.5 GeV at the PS and then to 20 GeV at the SPS before being transferred to the LEP ring.

The pre-injector system, which has been built in collaboration with the Laboratoire de l'Accélérateur Linéaire (LAL) at Orsay, consists of two linacs. In the first of these, electrons are accelerated to 200 MeV and impinge on a target to produce positrons. These positrons, and electrons from a separate source, are then alternately accelerated to 600 MeV in the second linac. During the last few months, the 600 MeV linac system and the EPA storage ring have come into operation and electrons have been successfully transferred to the PS and accelerated to 3.5 GeV. All the design values for the equipment so far tested have been either reached or exceeded. As an example, $5 \times 10^{10}$ electrons per bunch, compared to the
design goal of $2.5 \times 10^{10}$ electrons per bunch, have been accelerated to 3.5 GeV in the PS. All the equipment for the production of positrons has been installed and tests on the first linac will begin in early 1987. The transfer of electrons and positrons to the SPS will begin in 1987.

Substantial amounts of components for LEP are arriving on schedule at CERN and the associated problems of large-scale testing of equipment have necessitated the development of new testing methods.

Some 2500 out of the 3300 special steel and concrete dipole magnets required to keep the electrons on track have already been delivered and tested at CERN. Of these only eight have been found to be at the limit of the tolerances and are now used in the two test half-cells. Other equipment currently arriving at CERN in large quantities includes such items as quadrupole magnets, large sections of the vacuum chamber and the cabins for the LEP monorail system.

Turning to the civil-engineering work, the last section of the tunnel in the plain, from Point 2 to Point 3, is scheduled to be completed in January 1987. Difficulties have arisen with the excavation of a 380-metre section of tunnel close to Point 4 owing to the discovery of water at a geological fault in the region where the limestone of the Jura meets the molasse of the plain. The flow of water into the tunnel has now been stopped and injections of concrete are continuing to eliminate any further seepage. During the next few weeks, several horizontal borings will be carried out over the remaining 380-metre section to assess the quality of the rock structure so that a decision can be taken on how to excavate the remaining section with explosives or whether to introduce a small tunnelling machine. The problem is very localized and it is hoped that any outstanding difficulties will have been eliminated by the spring of 1987. Elsewhere in the underground structures, concreting is well under way and installation of tunnel infrastructure equipment such as cables, ventilation and lighting has already begun.

**LEP experiments**

Meetings of the LEP Experiments Committee, which investigates the technical aspects of the four LEP experiments, and the Finance Review Committees, which assess the financial situation of the collaborations, were held in the autumn. Apart from minor problems, no major
areas of difficulty were identified. Good progress is being made in detector construction and components are arriving at CERN for all the experiments.

It is now possible to give the collaborations precise dates on which installation of the experiments in the experimental areas can begin. Since LEP is due to start up in early 1989, the experiment installation schedules are very tight and all four collaborations have requested more time to install their detectors. The whole experiment installation situation is therefore currently under review.

Experiment L3 will be the first to be installed at Point 2 since, unlike the other three experiments, it cannot be rolled in and out of the beam owing to its size and there was some concern that any delay in its installation would have implications for the machine start-up schedule. Fortunately, the experiment is on schedule and installation will begin in mid-1987.

L3 is an excellent example of how effective international co-operation in high-energy physics can be. For instance, in the case of the bismuth germanium oxide (BGO) required for photon and gamma detection, germanium oxide is being supplied by the Soviet Union and mixed with bismuth in the United Kingdom before being shipped to Shanghai where a special factory of some 200 people has been set up for the production, cutting and polishing of single crystals. The crystals are then transported to CERN for testing. As of December 1986, some 2200 of the 8000 crystals required have already been delivered, and of these more than 2000 have already been accepted by the collaboration.

Similarly, the more conventional lead glass used by the OPAL experiment to detect gamma rays is provided, for the barrel, by the Japanese group from Tokyo University, and for the end-caps by the British part of the collaboration; the lead glass itself is purchased in both cases from European firms. Thousands of lead-glass components are now arriving and being stored in the old BEBC hall along with a special rotating device, also developed by the Japanese, to test and calibrate the lead glass in a test beam.

The ALEPH magnet yoke, which has been built in Italy, has been delivered to CERN and installed in the BEBC hall.

All the equipment for the four experiments will be tested at the surface before being installed in the experimental areas.
LEP 200 Workshop

ECFA organized a LEP 200 Workshop at Aachen between 29 September and 1 October 1986, at which the considerable physics interest of LEP 2 was confirmed. The Chairman of the Scientific Policy Committee, Professor D. Perkins, summarized the physics interest under three basic headings: "bread and butter" - precision measurements on $W^\pm$ pair production (above 83 GeV) and investigation of three boson coupling; "probable jam" - top quark, Higgs particle and mechanism; and "possible cake" - new exotica and SUSY particles.

The planned upgrade in stages through energies below the $W$ pair production energy was discussed and considered a reasonable approach from the physics point of view.

Another important conclusion of the Workshop was that the experiments as currently conceived and built would be equipped to handle higher energies with only minor modifications and that, barring unforeseen developments on the technical front, new experiments would not be required.

Professor E. Picasso, the LEP Project Leader, presented various scenarios for the energy upgrade using superconducting cavities, a procedure which now seems technically feasible. He estimated that the final energies of approximately 100 GeV per beam could be obtained some five or six years after the decision to go ahead with the upgrade and more or less within a constant budget. The first stage will be to install superconducting cavities in two or possibly three of LEP's empty half-cells (Fig.9). The decision on how to continue with the LEP upgrade - whether, for instance, to replace all the copper cavities with superconducting cavities, or to open up two rf stations at Points 4 and 8 - will be determined by the performance of these SC cavities in the free regions of the LEP straight sections.

Administrative matters

In addition to finding solutions to the short-term problems of providing adequate resources for the LEP and other programmes, the Management has been introducing measures to restructure CERN services with a view to achieving increased efficiency, so as to save both money and personnel. In January 1986, the general technical services were regrouped into a new Technical Services (ST) Division. The expectations from this measure have been largely fulfilled and most of the aims attained.
During the year it was decided to set up Technical Boards with a view to regrouping accelerator services to improve interdivisional cooperation and efficiency and to prepare for the necessary restructuring of services once LEP construction is complete and LEP operation, which will be closely linked to that of the other accelerators, begins. Boards have been set up for:

- Electrical engineering (Electrical distribution systems, power converters)
- Mechanical engineering (Design, workshops, special techniques, vacuum, cooling and ventilation)
- Electronics for research
- Communications (computer networks, telephones)
- Beam instrumentation
  for accelerators and beam lines
- Process controls and electronics for accelerators.

Finally, owing to the rapid development in the electronics field, there is a lack of standardization in office automation equipment at CERN and the time seems right to improve this situation. It has therefore been decided to set up a Management Information Service in 1987 to define a common office automation policy for administration and personnel matters, for text processing purposes and for electronic mail, etc.

**Personnel**

To reinforce personnel management and planning, Council approved the proposal to appoint a Director of Human Resources. Mr J. Martinez took up his appointment in May 1986 and considerable progress has been made since that time. However, not all problems can be resolved in six months and various measures are being introduced in stages.

In 1985, Council approved the Management's long-term personnel plan until the year 2000 under which the Organization undertook to reduce staff numbers in the coming years. Since the retirement rate over this period remains relatively low, it was
decided to limit recruitment and to fill a maximum of one in two vacancies. During 1986, some 100 people have left CERN and only 47 have been recruited. Since the natural retirement rate will not increase substantially for another five or six years, the Management intends in spring 1987 to submit a proposal to implement an early departure scheme, which will have an important role to play in the efforts to reduce staff numbers.

The introduction of a performance appraisal scheme is also under active investigation. As a first step towards that end, a system of periodic interviews has been introduced, under which supervisors meet their staff individually once a year to assess tasks and to discuss ways in which objectives can be achieved. It is hoped to submit proposals to introduce further steps during 1987.

The Consultative Committee on Employment Conditions (CCEC) has completed its review of CERN salaries and conditions and has submitted its final report to the Finance Committee, which took note of the report but decided to take no action for the time being. However, it is hoped that Council will take some decisions in that regard once it has received the final report of the CERN Review Committee.

Many other topics relating to the personnel have been discussed during the year but the foregoing covers the main issues and developments.

* * *
FIGURE 1
Protons and Neutrons contain each 3 quarks many gluons

Normal nucleus
Protons and Neutrons keep their individuality
"quark bags"

Heating – up the nucleus
Melting of quark bags
(Phase transition)

"free" quarks
"free" gluons
inside nucleus
Quark-Gluon Plasma

FIGURE 2
Transverse Energy Density

$^{16}\text{O} + \text{Pb} 200 \text{ GeV/nucleon}$

![Graph showing the distribution of transverse energy density with $d\sigma/dE_T$ (barn GeV$^{-1}$) against $E_T$ (GeV).]

- **DATA**
- 16-fold convolution $p+\text{Au}$
- Hijing

$E_T$ (GeV)

Central collisions

"Hot" collisions

Energy density in fireball: Bjorken estimate $E = \frac{dE_T}{dy} (\pi R_{proj}^2)$

$\approx 3 \text{ GeV/fm}^3$

Hot collisions = Quark Matter search candidate

**FIGURE 4**
Jet pairs

\[ \text{WZ} \]
\[ W \rightarrow q + \bar{q} \]

\begin{align*}
\text{(a)} & \\
\text{(b)} & \\
\text{UA2} & \\
\text{QCD} & \\
\end{align*}

\[ \frac{(m/100)^5 \, dN}{dm} \text{ (GeV}^4) \]

Mass of jet-pair

![Graph showing distribution of jet pairs with WZ decay and QCD comparison.](image)
Fig 1: LAYOUT OF UL/EPA Showing Beam Measurement Regions

Injection and Measurement Lines (See fig 4)

Accelerating Sections (See fig 3)

UL-V

LIL-W

UL-V Region (See fig 2)

\[ e^{-}\text{target} \]

\[ 200 \text{ MeV} \leq \%

\[ 600 \text{ MeV} \geq \%

FIGURE 8
Half of straight section

Beam separators

Interaction point

RF lattice layout

half-cell

Dispersion suppressor
EIGHTY-SECOND SESSION OF THE COUNCIL

Geneva - 17 December 1986 - 2.30 p.m.
18 December 1986 - 10.00 a.m.

Council Chamber

DRAFT AGENDA

17 December 1986

1. Report of the Credentials Committee

2. Approval of the Draft Minutes of the Eighty-first Session
   CERN/1628/Draft
   CERN/1628/Draft/Corr.*

3. Adoption of the Agenda
   CERN/1629/Rev.2

4. Progress Report:
   - General Report   - Director-General

CLOSED SESSION

5. Senior Staff Appointments
   CERN/1638
   (Confidential)

6. Elections
   CERN/1639
   (Confidential)

* English version only.
18 December 1986

7. Report on the Closed Session

8. Programme and Budgets:
   CERN/FC/2997/Draft 2
   ii) Calculated Cost Variation Index and Estimate of True Income for 1987
       CERN/FC/2968/Rev.2
       CERN/FC/2968/Rev.2/Corr.*
       CERN Salary Index for 1987
       Report by the Consultative Committee on Employment Conditions
       CERN/1637
       (CERN/FC/3006)

   CERN/1640
   (CERN/FC/2954)

10. The LAA Programme of Activities
    CERN/1641

11. CERN Pension Fund
    - Revision of the Rules of the Pension Fund
      CERN/FC/3018
    - Staff Insurance Scheme Adjustment of Pensions
      CERN/FC/3021
    - The Technical Deficit of the CERN Pension Fund
      CERN/FC/3024

12. CERN Staff Rules and Regulations Ninth Edition
    CERN/1636
    (CERN/FC/3003)**

13. Draft Time-Table of Council Sessions and Committee Meetings 1987
    CERN/1632/Draft 2

14. Other Business.
    * * *

* English version only.
** Document already distributed.