

40th Session of CERN Council

The Council met on 18-19 December under the chairmanship of Dr. G. W. Funke.

Progress Report

The Director General, Professor B.P. Gregory, introduced the Progress Reports of the Departments and singled out for special mention seven developments in the field of 'instrumentation'. He emphasized that some of examples illustrate that, despite the fact that CERN is a large and highly organized Laboratory, it is still possible for the work of individuals, pursuing individual ideas, to flourish.

1. Streamer chamber

One of the latest products of the evolution of the spark chamber as a particle detector is the 'streamer chamber'. It came initially from the work of the late G.E. Chikovani in the USSR and has been taken up at several Laboratories (for example, Stanford, DESY and Daresbury). The principle of operation was described in CERN COURIER vol. 7, page 219.

The first CERN streamer chamber came into use recently in a search for quarks at the 28 GeV proton synchrotron. Taking advantage of the fact that the tracks, or streamers, which are produced depend upon the ionization caused by the charged particles it was a sensitive device to look for particles carrying a fraction of the electron charge. Quarks are postulated to have charge $1/3 e$ or $2/3 e$ and, for example, a $1/3 e$ particle would produce $1/9$ of the ionization of a conventional particle and thus be clearly distinguishable in the streamer chamber photographs. The CERN experiment using the streamer chamber indicates that if quarks exist their production cross-section at available energies is very low.

2. Proportional chamber

Another spark chamber off-spring is the multiwire proportional chamber (reported in CERN COURIER vol. 8, page 220). In this type of chamber, each wire acts as an independent proportional counter giving out a pulse proportional to the energy lost in the sensitive volume surrounding it. The chamber acts as a virtually continuously sensitive detector which does not need to be triggered and can perform the same duties as a counter hodoscope with the advantage that it is a hundred times cheaper.

A prototype chamber has already performed very well in a secondary particle beam where it gave very clean and instantaneous information on the beam profile. Other properties of this type of chamber are still being perfected but several experiments will probably already use such a chamber in the coming year.

3. DISC counter

The Differential Isochronous Self Collimating counter is a special type of Cherenkov counter developed at CERN several years ago. Its important property is that it can distinguish between particles which have velocities very close to one another.

Such a counter was used early in 1968 in a CERN experiment on high energy particle production by 19 GeV/c protons. It was then transported to the Serpukhov Laboratory in the Soviet Union to be used in a similar experiment at the higher energies available from the Soviet machine — the production of particles by 70 GeV/c protons. The counter proved very efficient at higher energy and distinguished very clearly between negative pions, negative kaons and anti-protons. The results of this first CERN/Serpukhov experiment are to be published shortly.

4. Polarized targets

Promising results from a new type of polarized target (using the dynamic orientation of nuclear spins by cooling of the interaction between electron spins) have been achieved by a CERN group. In polarized targets, the spins of protons are lined up in a particular direction, thus simplifying the interpretation of some particle collisions.

Using organic compounds such as butyl alcohol, which contains five times the number of hydrogen atoms (and hence five times the number of protons available to be polarized) compared with the 'conventional' LMN targets (see CERN COURIER vol. 7, page 28), polarizations of the order of 40% have been achieved. This is low compared with the LMN figure of 70% but still means that the density of polarized protons in the new type is twice as high. One side effect of this work is that use of polarized targets at electron machines is becoming feasible.

5. Bubble chamber studies

To finalize many aspects of the large European hydrogen bubble chamber project, a 1 m model has been built (see CERN COURIER vol. 7, page 143, vol. 8, page 129). Incorporating many of the new features of the large project — such as the expansion system operating from below — it is designed to test thermodynamic and optical properties.

The preliminary work has shown that the expansion system operates as expected and that the turbulence in the hydrogen is low.

6. Ultrasonic bubble chamber

(This very recent achievement is reported fully on page 316).

7. Computer system

Two projects involving the use of a CDC 3100 computer have been implemented during 1968. The first is known as FOCUS and its main purpose is the management of data-links to the central computers (see CERN COURIER vol. 7, page 250). It is being used for 'remote access' to computing. This means that some users can have computing on tap in their offices, where a typewriter console enables them to call for computing, feed in new instructions or receive results.

The second project involves the use of a display console at the computer (see CERN COURIER vol. 8, page 101). It can be used to 'rescue' events recorded on track chamber photographs which the normal computer program has rejected. It can also be used to produce an immediate visual display of mathematical functions fed to it from an adjoining keyboard and to watch the variation of these functions as the parameters are changed.

Professor L. Van Hove presented a brief review of some of the major advances in particle physics which have usually been the product of several years of experimental work and theoretical interpretation.

Electromagnetic interaction

A major contribution from CERN to the understanding of the electromagnetic interaction has been the very precise measurement of the magnetic moment of the muon in the g-2 experiment (see CERN COURIER

vol. 6, page 152, vol. 8, page 244). The result reported at the Vienna Conference in September was more than a factor of ten more precise than the previous measurement (1962) and it shows that quantum electrodynamics — the theory of the electromagnetic interaction — continues to hold good down to distances of $1/25$ the size of the proton.

The importance of accurate measurements in this field is that the theory is highly developed and yields a very precise figure for direct confrontation with experiment. So far the experimental results have not been in conflict with the theory.

A new experiment to push the accuracy of the measurement of the magnetic moment of the muon a factor of ten further still is now under study at CERN. This should reach the borderline where the existence of strongly interacting particles in Nature begins to interfere indirectly with electromagnetism, so that it is no longer possible to consider a purely electromagnetic interaction even for a particle like the muon which is not directly subject to strong interactions.

Strong interaction

The way in which the strongly interacting particles, the hadrons, couple with photons has been greatly clarified in the past year. The most fundamental form of the coupling is via the vector mesons, such as the rho, omega and phi mesons. Experiments at Orsay, DESY and CERN have yielded results which all lie very nicely in the region predicted by various theoretical methods.

The beautiful symmetry properties of the hadrons, which have been known for several years, and which led to the quark model hypothesis, have been investigated further bringing in additional properties concerning mass and spin. At the Vienna Conference, B. French from CERN presented in his report the updated version of graphs relating the square of the mass to the spin of particles, in which known particles fall remarkably cleanly on straight lines. (In connection with this topic, many of the nucleon resonances used in drawing up such graphs were identified in the theoretical work of the phase shift analysis group at CERN, while several mesons were experimentally found by the missing

mass technique to which CERN contributed a great deal.) From this representation it seems that the list of particles can extend to surprisingly high mass and spin. In the field of mesons, one can learn a lot from other experimental results. A striking one is the split of the A_2 meson discovered at CERN by the missing mass technique, and another is the impressive decay chain of heavier into lighter mesons discovered in the 81 cm bubble chamber at CERN.

All this in turn has had important and highly fruitful implications in recent progress towards a theory of strong interactions.

It has become clearer how the strong interaction differs in mechanism from the electromagnetic interaction, where the force between two electrically charged particles is conveyed by the exchange of a photon, itself uncharged. The hadrons also interact by means of an exchange mechanism but here the hadrons themselves are exchanged and all take part on essentially equal footing in the exchange mechanism. Furthermore, the fact that hadrons occur with many different spin values plays an essential part in the mathematical formulation (Regge theory).

One happy revelation is that many aspects of particle interactions become simpler at higher energies. It is now possible to use information obtained at high energy to gain insight into lower energy phenomena, which are often more involved. Also more theoretical information can now be extracted from high energy collisions producing many particles, so that a much larger fraction of the recorded collisions can be put to good use. By 'mapping' the hadrons according to spin and square of mass, theorists have entered into a new, very active phase of progress in understanding strong interactions, and quite a few of these exciting developments took place in the CERN Theory Division.

Weak interaction

The observation of the breakdown of parity symmetry in the 1950s opened the door to a great deal of new knowledge on all forms of weak interaction. In 1964, the observation of the breakdown of charge parity symmetry was expected to be similarly fruitful, but up to now it has been more a source of frustration.

There is still only one particle, the long-lived neutral kaon, observed to exhibit this breakdown. A considerable part of the CERN experimental programme has been given to its investigation (including the first observation of its decay into two neutral pions) but, overall, the problem remains very hard. Experimental numbers often disagree with each other, and theoretical ideas, although numerous, have not helped to advance the field.

On the other hand, another CERN contribution to weak interaction theory has recently proved remarkably accurate in a wide variety of experimental tests. It concerns those decays of the strange particles which produce leptons (muons, electrons, neutrinos). A single parameter introduced more than thirty years ago by E. Fermi, has been adequate to describe the decays of the non-strange particles. In 1963, N. Cabibbo, then a fellow at CERN, made use of a single further parameter, now known as the Cabibbo angle, in an attempt to describe strange particle decays. It now appears that this works beautifully.

300 GeV

With the receipt of the letter of intent from Switzerland (see page 320), six countries — Austria, Belgium, Federal Republic of Germany, France, Italy and Switzerland — have now agreed to participate in the 300 GeV accelerator project.

The Council, following a unanimous recommendation from the Scientific Policy Committee, agreed that Dr. J.B. Adams be offered the position of Project Director. J. B. Adams led the team that built the CERN 28 GeV proton synchrotron and was, for a short time Director General of the Meyrin Laboratory. (A full biography appears on page 310.)

The appointment is initially for one year with the title 'Project Director', but it is the intention that he be nominated Director General of the new Laboratory when this comes formally into being. In the meantime, he will be on the CERN Meyrin staff as a senior scientist.

With this very important step behind them, the Council decided that the remaining decisions on the project should be taken as fast as possible. One of the main

decisions is the selection of the site for the Laboratory. Among other things, knowledge of where the accelerator is to be sited is an important aspect of its final design.

Further information on the proposed sites was presented to the Council by the consultant geologist Dr. L. Bjerrum. It has emerged quite recently that some further geotechnical studies are needed on a few sites. In addition, information on the conditions under which the Laboratory would be accepted into a country have not been received from all Member States proposing a site. Though it could prove difficult to push the geotechnical work to a conclusion quickly, the Council decided that all necessary site information should be presented in time for a final decision on the site to be taken at the June Council Meeting.

Among the six countries who have so far declared their intention to participate in the project, there are five sites offered:

Doberdo	Italy
Drensteinfurt	Federal Republic of Germany
Focant	Belgium
Gopfritz	Austria
Le Luc	France

Another important step which must precede the coming into being of the 300 GeV Laboratory is the ratification of the amendments to the CERN Convention. These amendments make it possible to set up a new Laboratory within the existing CERN Organization and were agreed by the Council a year ago. They are now with European governments for approval and several delegations were able to indicate that their countries will give approval before the June meeting.

During 1969, the budget to continue work on the 300 GeV is divided into two parts — 3.9 million Swiss francs to conclude the present preparatory work (site investigations, etc...) and a provisional indication of 4.3 million to enable the final design of the machine to start. The latter sum will be voted later in the year and may be influenced by the major decisions which are to be taken on the project. Ten Member States agreed to support the 300 GeV studies in 1969 — Austria, Belgium,

Denmark, Federal Republic of Germany, France, Italy, Netherlands, Norway, Sweden and Switzerland.

Budgets

The budget for the basic programme of CERN in 1969 was agreed as 224.6 million Swiss francs. A firm estimate for 1970, 235.9 MSF, and a provisional determination for 1971, 247.3 MSF, were also agreed (all figures at 1969 prices). A provisional determination for 1972, which would normally be made at this time, has not been voted because a major review of the future programme at CERN Meyrin, in the light of the imminent start of the 300 GeV project, is under way. This review will affect the 1972 figure which is the beginning of the period following completion of the proton synchrotron improvement programme and of the intersecting storage rings.

The budgets for the ISR construction over the next three years were agreed as follows — 1969: 88.5 MSF, 1970: 79.4 MSF (firm estimate), 1971: 30.4 MSF (provisional determination).

All these budgets were agreed with a reservation on the personnel figures which were used in drawing them up. The personnel figures are to be discussed at a special meeting early in 1969 and the Director General assured Council that, in the interim, nothing would be done in terms of recruitment of staff, which would prejudice the outcome of the discussion.

The percentage contributions of the Member States to the CERN budgets for the next three years have been revised, in accordance with the Convention. The new figures are based on United Nations statistics of average net national income over the years 1965, 6, 7.

In addition to this revision, no contribution has been entered for Spain. As reported on page 320, a letter announcing the intended withdrawal of Spain from the Organization as from the end of 1968, had been received. The Council was very pleased to learn from the Spanish delegation that this decision is being reconsidered. The Spanish government has already declared that it will continue to support the national high-energy physics

groups, which have developed so well at several Spanish Universities and research centres. The matter will be taken up again at the March Council session.

The percentage contributions are therefore (with the corresponding figures for 1966, 7, 8 in brackets):

Austria	1.96	(1.90)
Belgium	3.77	(3.56)
Denmark	2.26	(2.05)
Federal Republic of Germany	23.27	(23.30)
France	19.90	(19.34)
Greece	0.60	(0.60)
Italy	12.89	(11.24)
Netherlands	4.43	(3.88)
Norway	1.52	(1.41)
Spain	—	(3.43)
Sweden	4.59	(4.02)
Switzerland	3.20	(3.11)
United Kingdom	21.61	(22.16)

Appointments

The Council made several appointments for the coming year. Dr. G.W. Funke was re-elected President of the Council and Mr. J. Martin and Mr. A. Chavanne were elected Vice-Presidents. Dr. W. Kummer was re-elected Chairman of the Finance Committee. Dr. E. G. Michaelis was appointed Leader of the Synchro-cyclotron Division for a further two years.

At the end of the session, the Director General expressed his satisfaction and gratitude to Council for the progress which had been made during the year both on the future 300 GeV project and on CERN Meyrin.