The implications for particle physics of the 1987 supernova explosion were discussed by A. de Rujula and also by M. Roos, J. Ellis and B. Degrange.

Within the specific field of particle physics, the present year was mainly one of consolidation while waiting for the results of the new experiments which are in a more or less advanced state of preparation. The parameters of the main high energy machines are listed in Table 1. In particular at Uppsala the first physics results from two new accelerators were presented. From Tristan, the $e^+e^-$ Japanese collider with centre mass energy $\sqrt{s} = 50$ GeV, we heard from A. Bodek and T. Kondo that the hadronic events collected by the Tristan detectors Venus, Topaz and Army are consistent with five flavours of quarks, so that the limit on the top quark mass can now, or will soon be displaced from $23$ GeV (Petra) to $25$ GeV. From Fermilab, L. Holloway presented the evidence for the first American-born intermediate vector bosons W and Z, produced by the Tevatron working at $\sqrt{s} = 1.6$ TeV.

The future development of particle physics depends very much on the progress of accelerators and detectors. Two plenary sessions were devoted to new ideas on particle acceleration (T. Weisberg) and to developments in detector technology (T. Ypsilantis).

At the Conference, the standard model of strong and electroweak interactions was further consolidated, as discussed by others among them by P. Darrilat, K.

### Table — STATUS OF ACCELERATOR PROJECTS

<table>
<thead>
<tr>
<th>Location</th>
<th>Name</th>
<th>Length (km)</th>
<th>Particle</th>
<th>Beam Energy (GeV)</th>
<th>Luminosity (cm$^{-2}$s$^{-1}$)</th>
<th>Running</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beijing, China</td>
<td>BEPC</td>
<td>0.24</td>
<td>$e^+e^-$</td>
<td>2.8</td>
<td>$(3-17) \times 10^{30}$</td>
<td>1989-92</td>
</tr>
<tr>
<td>CERN, Europe</td>
<td>LEP 1</td>
<td>27</td>
<td>$e^+e^-$</td>
<td>55</td>
<td>$1.6 \times 10^{31}$</td>
<td>1989</td>
</tr>
<tr>
<td></td>
<td>LEP 2</td>
<td>27</td>
<td>$e^+e^-$</td>
<td>95</td>
<td>$2.8 \times 10^{31}$</td>
<td>1993</td>
</tr>
<tr>
<td></td>
<td>SPS/PACOL</td>
<td>7</td>
<td>$\pi^+\pi^-$</td>
<td>315</td>
<td>$4 \times 10^{30}$</td>
<td>1987</td>
</tr>
<tr>
<td>Hamburg, FRG</td>
<td>HERA</td>
<td>6.3</td>
<td>$e^+e^-$</td>
<td>30 + 820</td>
<td>$2 \times 10^{31}$</td>
<td>1990</td>
</tr>
<tr>
<td>Serpukhov, USSR</td>
<td>UNK 1</td>
<td>20</td>
<td>$p$</td>
<td>3000</td>
<td></td>
<td>1990</td>
</tr>
<tr>
<td></td>
<td>UNK 2</td>
<td>20</td>
<td>$p$</td>
<td>3000</td>
<td></td>
<td>1993</td>
</tr>
<tr>
<td>Tsukuba, Japan</td>
<td>TRISTAN</td>
<td>3.2</td>
<td>$e^+e^-$</td>
<td>25</td>
<td>$6 \times 10^{30}$</td>
<td>1987</td>
</tr>
<tr>
<td>Fermilab, USA</td>
<td>TEVATRON</td>
<td>7</td>
<td>$\pi^+\pi^-$</td>
<td>900</td>
<td>$1.2 \times 10^{30}$</td>
<td>1987</td>
</tr>
<tr>
<td>Stanford, USA</td>
<td>SLC</td>
<td>83</td>
<td>$e^+e^-$</td>
<td>51</td>
<td>$6 \times 10^{30} - 6 \times 10^{32}$</td>
<td>1987-90</td>
</tr>
<tr>
<td>USA</td>
<td>SSC</td>
<td>83</td>
<td>$\pi^+\pi^-$</td>
<td>20000</td>
<td>$10^{25}$</td>
<td>1995-96</td>
</tr>
</tbody>
</table>

The SSC is so far approved by the U.S. President. In addition to these projects, a large hadron collider (LHC) to be placed in the LEP tunnel has been proposed by CERN. It would by the mid 90s generate collisions between protons of 8 TeV and between 50 GeV electrons and 8 TeV protons.
tical papers not far from that originated the top quark mass would be in the conclusion is that within the standard day”. It has prompted a flurry of theore­awarded the title of “experiment of the year”. This was obtained from the study of charged lepton signals (electrons and muons) in proton-anti-proton collisions at √s = 0.63 TeV at the SppS collider at CERN. The most trustworthy lower bounds on mt are from the e^+e^- experiments of Petra and Tristan (mt > 25 GeV) the UA1 collaboration at CERN presented a new limit mt > 44 GeV (95% c.l.). This was obtained from the general, e^+e^- colliders are the most ef­ficient quark discoverers, if their energy is enough for production. If indeed 2m^t > M^Z, then the chances of SLC and LEPI are small (although LEPI is in a bet­ter position because it can reach a beam energy of 55 GeV). At LEPI the top quark can only be observed if mt < 100 GeV (and only many years from now). It follows that the hadron colliders have the best chances in the near term. At the SppS collider of CERN, the increased luminosity obtained with ACOL will allow the range mt < 100 GeV to be ex­plored. Above this range there is only the Fermilab Tevatron with its larger centre of mass energy: √s = 1.6 + 2 TeV in comparison with the SppS collider (√s = 0.63 TeV).

Thus it now appears quite likely that the top quark is too heavy to be present (because of phase space) in Z-decay products. If so, which experiment will be able to discover it in the near future? In general, e^+e^- colliders are the most ef­ficient way to discover the quark, if their energy is enough for production. If indeed 2m^t > M^Z, then the chances of SLC and LEPI are small (although LEPI is in a bet­ter position because it can reach a beam energy of 55 GeV). At LEPI the top quark can only be observed if mt < 100 GeV (and only many years from now). It follows that the hadron colliders have the best chances in the near term. At the SppS collider of CERN, the increased luminosity obtained with ACOL will allow the range mt < 100 GeV to be ex­plored. Above this range there is only the Fermilab Tevatron with its larger centre of mass energy: √s = 1.6 + 2 TeV in comparison with the SppS collider (√s = 0.63 TeV).

Another subject that received much attention at the Conference was the pres­ent limits on the number of quark and lepton families. These limits are derived by counting the number of existing neu­trino species using different methods. From the observed abundances of light elements in the Universe (especially helium) one derives that at most two new species of light neutrinos, in addi­tion to the known, are allow ed. But new families are only possible if the top quark is relatively light. In conclusion, the family repetition which is so peculiar and mysterious is not to continue for ever.

In the field of strong interactions interesting new results were also presented at the Uppsala conference. I found especially important the set of new results on the nucleon structure functions by the BCDMS collaboration at CERN. The impact of these new results on our know­ledge of the parton densities in the nu­cleon, especially in connection with the d/u ratio, was much discussed. Also in­teresting are the results by the EM group at CERN on the structure functions of polarized protons.

The continuous improvement in the description of the process of hadroniza­tion, i.e. the transformation of quarks and gluons into jets of hadrons, was well reviewed by G. Gustafson from the Lund School (that has contributed so much to this subject).

Current progress in heavy ion physics was summarized by W. Willis who, in his balanced report, correctly stressed the importance of formulating and perform­ing quantitative tests of thermalization in the collision products and of the pre­sence of a mixed phase (the ordinary nu­clear matter mixed with quark-gluon plasma). Experiments now in progress should probably produce decisive results by the next EPS conference (in Madrid 1989).

J. Prentice defined the past year as a “vintage year” for hadron spectroscopy and reviewed the most recent additions to the long list of existing mesons and baryons. These days, newcomers must be somewhat exceptional to be noticed: for example a baryon carrying three
units of strangeness $\Omega^*$ (2253), like the famous $\Omega$ (1642) that in the sixties established the SU(3)-symmetry among the u, d and s light quarks, or a baryon carrying both charm and strangeness.

From time to time it is good to interrupt a long series of experimental results by listening to a pure theoretical talk. The eminent Russian field theorist L.D. Faddeev offered a very clear and solid seminar on a possible strategy toward giving sense to theories with anomalies.

The fascinating interplay between particle physics and cosmology was described by J. Ellis. He stressed with special emphasis the importance of obtaining an experimental solution to the problem of dark matter in the Universe (see page 138). An exciting possibility discussed by Ellis is that the mysterious all pervading substance could be made of photinos, the supersymmetric partners of the ordinary photons. Supersymmetry at relatively low energy was also discussed by G. Kane in his report on the possible avenues beyond the standard model. While the relevance of supersymmetry for physics at energies accessible now or in the predictable future in our laboratories is at the centre of the debate, many theorists think that supersymmetry can be considered as established at the Planck mass. This belief arises from the, at present, most promising framework for a theory of quantum gravity, namely the theory of superstrings, reviewed by M.B. Green. As perhaps one could have anticipated, there is now less optimism about any short-range practical feedbacks into particle physics of this really gigantic conceptual enterprise.

I think that a very lively and healthy picture of particle physics has emerged once more at the Uppsala conference. In this respect the formula with both parallel and plenary sessions has confirmed its virtues. Although perhaps more demanding for the audience it has the merit of offering a larger number of facets of the field. The community of particle physics is at present working very hard to explore better the foundations of the standard model hoping to find a clue toward a new layer of physics. In this respect, as I tried to make clear in my summary talk, the most important goal of particle physics in the next decade is to clarify experimentally the origin of the Fermi scale of mass, of order $G^* = 300$ GeV which fixes the W and Z masses. In other words, one has to validate the Higgs sector of the electroweak theory, which is responsible for the spontaneous breaking of the gauge symmetry. There are, in fact, convincing theoretical arguments indicating that some form of new physics must be hidden near the Fermi scale. In particular, a fundamental Higgs appears to require supersymmetry signals just above the Fermi scale. Alternatively, some form of compositeness should become manifest, or possibly even supersymmetry and compositeness. Whatever the final outcome, it seems unavoidable that experimental studies in the TeV energy domain will lead to new fundamental discoveries. The large effort which is being made precisely aims at crossing this new frontier of particle physics.

There is a vacancy for an experimental physicist to join the Nuclear Structure Facility (NSF). The experimental group is involved in carrying out and supporting a broadly based research programme using a 20MV tandem.

The successful applicant will liaise with university research teams, collaborate in nuclear research programmes and play an active role in initiating and developing new programmes. Other duties will involve work on the design and development of major equipment through to commissioning, operation and maintenance. As a member of the in-house team of scientists he/she will be expected to provide expertise in the methods of experimental nuclear physics and to aid and direct the technical and scientific support staff in operating the NSF and for diagnosing problems as they arise.

Applicants should have a good honours degree in an appropriate discipline or equivalent with a period of postgraduate experience. A Ph.D degree in nuclear physics and a period of post doctoral experience in experimental nuclear physics would be an advantage. The appointment will be in the grade of Higher Scientific Officer with a salary range of £2030 to £2508, starting salary depending on qualifications and experience. The superannuation scheme is non-contributory.


**1987 Nobel Prize for Physics**

Following closely on the award of the 1988 EPS Hewlett-Packard Europhysics Prize, the 1987 Nobel Prize for Physics has been awarded to J.G. Bednorz and K.A. Müller of the Zürich Laboratory of IBM for their discovery of high temperature superconductivity in a layered oxide of copper, barium and lanthanum.

An appreciation of their work will be given in the next issue of *Europhysics News*.

**University of Namur**

**Postdoctoral Positions**

The Institute for Studies in Interface Sciences (ISIS) of the University of Namur has several research positions at the postdoc level for physicists or chemists to work in the following areas:

1. STM microscopy and spectroscopy;
2. Thin film synthesis and interface characterisations;
3. Theoretical research in physico-chemical properties of interfacial systems. The one-year positions are renewable and available immediately.

Applications should reach Prof. A. Lucas, ISIS-FUNDUP, 61, rue de Bruxelles, B - 5000 Namur, Belgium. Tel. (32) (81) 22 90 61.