Groups covered such physics topics as jets, structure functions, rare decays, the electroweak sector, new theories, etc. It was clear that there is a wealth of intriguing physics to be studied, but a lot of initial simulation studies are required to achieve optimum use of the new facility. The simulation packages now on the market give some very different answers, and some initial tidying up is needed.

Groups looked at components for vertex detection, lepton identification, calorimetry, electronics, and computing, while others looked at detector design. To keep in touch with reality, a rough cost estimate was requested for each detector. One important conclusion was that detectors could be built and operated for the Supercollider with luminosities up in the $10^{33}$ range, with the exception of vertex detectors, where new technology is called for to avoid radiation damage problems. Calorimetry should not be affected by the high luminosity and these will probably be the most important parts of the SSC detectors.

Specialized detector ideas were developed for specific topics, while wide solid angle detectors were envisaged as general-purpose devices with the emphasis on new physics. Of the three which were eventually proposed and costed, one was non-magnetic, one was a conventional magnetic design and the third was magnetic with scintillating fibres.

Timescale from first serious discussion to final installation is estimated at about eight years, and each detector could involve some 500 physicists. It looks as if about 600 million dollars will be required overall for detector development and construction, and the necessary computer power will also be large.

The accelerator specialists looked at interaction region layout and design, electron, fixed target and antiproton options, dynamic aperture and tracking, magnetic field quality and the injector. Here again the conclusion was that a lot of computer simulation work, with Tevatron measurements as benchmarks, must be carried out before the final design is selected. Beam extraction options studied included stochastic type extraction as well as more esoteric ideas such as the use of bent crystals to filter out primary protons or other secondary beams from the proton-proton collisions in the experimental areas.

The hope is to have the conceptual design of the Superconducting Supercollider in place for April 1986. The problem of site selection is the subject of a document to be submitted to the US Department of Energy in April. Actual construction would then start in October 1987 with first beams scheduled for 1993. It is a project of great vision being attacked with courage and enthusiasm. It would open a new region of physics where the theoreticians promise much.

*(We thank Jorge Morfin for information on the Snowmass meeting.)*

# Physics in a spin

*Organizing committee chairman Jaques Soffer (right) talks with André Martin of CERN during the recent Spin Physics Symposium at Marseille.*

*(Photo H. Ely-Aix)*

Observers at major particle physics meetings these days could easily come away with the impression that our understanding of Nature is in good shape. With the electroweak theory now established and with the picture of quark fields (quantum chromodynamics) well advanced, it seems sometimes that all that remains to be done is to explain the origin of the Universe.

This is surely an oversimplifica-

*Other applications of spin at Marseille: below, 1957 Nobel prizewinner Owen Chamberlain and, opposite, Jon Rosner of Chicago try their hand at 'petanque'.*

*(Photos: Mairie de Cassis)*

tion. There are many questions in conventional physics still to be solved, and until these are, our understanding must be regarded as suspect. Many of these outstanding questions are in the area of spin physics.

About two hundred physicists travelled to Marseille in September to attend the 6th International Symposium on High Energy Spin Physics; this series began at Argonne in 1974, and the previous symposium was held at Brookhaven in 1982. Under the chairmanship of J. Soffer (Marseille) and a distinguished International Advisory Committee, the Symposium gathered specialists in polarization physics from all over the world. The meeting reflected optimism about the future of spin physics, an optimism clearly driven by the successful start-up of many new polarized beam projects and by the discovery of several new spin effects.

The topics covered included spin effects at large transverse momentum, hyperon polarization, analysing power in elastic processes, and experiments at intermediate energies including dibaryon resonances. There were reports on new polarized beam developments at many Laboratories and on perspectives, plans, and theoretical predictions for the spin physics in future machines.

One highlight was the report of successful acceleration of polarized protons to 17 GeV at the Brookhaven AGS. Both this project and the discovery of a large and totally unexpected one-spin effect in high transverse momentum proton-proton elastic scattering at the AGS were covered by Alan Krisch (Michigan) — see October 1984 issue, page 328. J. L. Laclare (Saclay) presented a short movie on spin motion at Saturne in his review talk on the polarized proton capabilities and experimental programme at Saturne II. New results and future projects with polarized beams and targets at KEK (Japan) were discussed by A. Masaike, and L. Van Rossum (Saclay) presented the Fermilab project.

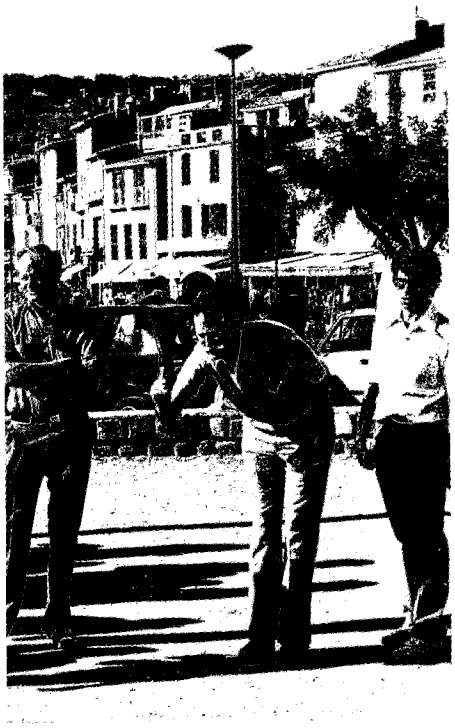
One major highlight was the sharp increase in the electron community's interest in spin. This is especially evident at DESY which was well represented at the Symposium. V. Soergel and K. Steffan presented detailed plans for polarizing the electrons at the HERA electron-proton collider, now under construction. P. Schmuser and D. Barber discussed the many exciting and important experiments that will be done with these polarized electrons. Many participants, led by E. Courant (Brookhaven) and O. Chamberlain (Berkeley) also stressed the need for proton polarization at HERA.

Significant progress on obtaining polarized gas jets was reported by D. Kleppner (MIT). He discussed the CERN projects and the Michigan/MIT/Brookhaven project. Hopefully there will soon be 'junk-free' pure polarized proton gas jets to allow inclusive spin studies.

G. M. Bunce (Brookhaven) reported on a new AGS experiment which aims to study several two-body processes at high energy and large angles. He presented the striking spin alignment properties of the rho meson produced in pion-proton scattering; these results are difficult to interpret theoretically and might be a serious signal of non-perturbative phenomena as suggested by G. Nardulli (Bari) and in the talk by G. Preparata (Bari) who presented an alternative approach based on the Massive Quark Model.

K. Heller (Minnesota) gave an extensive review of lambda and hyperon polarization in hadron-hadron inclusive reactions at high energy; a number of known results have consolidated such as the strong polarization of all the hyperons except the antilambda. Other new results were discussed such as the measurement of a large fraction of lambdas produced in the sigma radiative decay at Brookhaven or the dilution of the lambda polarization by nuclear targets. The large lambda polarization, first observed in 1976 at Fermilab, still lacks a convincing theoretical interpretation.

E. Gabathuler (Liverpool) discussed the new experiment of the European Muon Collaboration at CERN with a polarized muon beam and a polarized proton target. The aim of the EMC experiment is to investigate spin-dependent effects



in deep inelastic scattering to test theoretical predictions, to understand the spin structure of the proton, and look for a possible polarization of the 'sea' of additional gluons and quark-antiquark pairs inside the nucleons.

Spin effects, especially at short distances, provide demanding tests for quantum chromodynamics. In particular, the 'perturbative' approach (taking into account only the lowest terms in a series expansion) seems insufficient. Theoretical approaches have been suggested to get over this hurdle, and in addition other mechanisms have been put forward. These ideas were the subject of many presentations at Marseille.

Heavy quark spectroscopy was considered from a theoretical perspective by J. Rosner (Chicago) who also gave an extensive review of the present status of magnetic moments and the spin-dependent potentials among quarks.

A theoretical summary was given by E. Leader (Birkbeck College, London) who discussed the importance of measuring spin-dependent nucleon structure, relevant both for present machines and for future ones, such as HERA, which will probe very deep inside the proton. Leader also stressed the apparent incompatibility of perturbative QCD with the newly discovered spin-dependence in proton-proton elastic scattering. There was extensive heated theoretical discussion on this subject with most experimentalists keeping their heads well down.

One important part of the programme was devoted to spin phenomena at intermediate energies. Contributions from Laboratories all over the world were presented in a workshop jointly organized by C. Lechanoine-Leluc (Geneva) and R. Silbar (Los Alamos). A detailed study of proton-antiproton scattering is made at the LEAR ring at CERN and at KEK in Japan, where a narrow resonance was observed in the charged kaon mode. Experiments at intermediate energies are now using excellent polarized proton beams and there are polarized neutron beams at Saturne produced from deuteron beams. The activity in proton-deuteron scattering with polarized particles was discussed by A. Boudard (Saturne). The nucleon-nucleon system is investigated in great detail and the precise measurements of various spin correlation parameters in proton-proton scattering can be compared to theoretical models. A new effort is being made both at SIN in Switzerland and at Saturne in neutron-proton scattering which is crucial to complete the picture. Measurements using a polarized deuterium target are now planned at SIN and TRIUMF in Canada with the hope of solving the present disagreements in pion-deuteron elastic scattering.

The future of spin physics was discussed in a round-table meeting that examined the possibilities offered by the CERN Collider and future machines. The participants —'Moderator' R. Cool (Rockefeller) with D. Cline (Wisconsin), E. Courant (Brookhaven), L. Evans (CERN), A. Martin (CERN), G. Sauvage (Orsay) and T. L. Trueman (Brookhaven) discussed the new windows that could be opened by having polarized beams in accelerators, existing, under construction or proposed. The physics with polarized beams and/or targets at these energies would allow deeper insights into the inner structure of the nucleons and the very clear signals of the underlying theory often achieved by polarization measurements could test new theories.

The Symposium closed with a talk by O. Chamberlain (Berkeley), who spoke about the early spin experiments in the fifties. These pioneering experiments, where Chamberlain played a prominent role, were the roots of the spin physics community. During the last thirty years this community has worked to successfully convince both itself and the physics community at large that spin is not a 'useless complication' and that many important aspects of particle physics can be best clarified by polarization experiments. Hopefully the next Symposium, to be held at Serpukhov in autumn 1986, will again give new exciting and unexpected spin physics results.

*(Information from C. Lechanoine-Leluc, A. Krisch, G. Nardulli and J. Soffer.)*