

New focus for elastic and diffractive scattering

A regular feature of the international physics calendar is the International Conference on Elastic and Diffractive Scattering, known also as the Blois Workshops, after their 1985 birthplace in France.

The content of this year's meeting embraced a broad spectrum of problems ranging from the classical analysis of elastic scattering and total cross-sections to the "hard" or deep inelastic phenomena which test the underlying quark-gluon structure of hadrons.

These meetings have traditionally concentrated on broad questions of elastic and diffractive scattering, however the shift of emphasis in physics is now reflected at Blois by interest in the wide range of "soft" hadronic processes which dominate reaction cross-sections.

On the traditional side, a substantial part of the conference was devoted to analysis of forward scattering parameters like total cross-sections, real parts etc, using dispersion relations and fundamental asymptotic theorems which bound the possible growth of those parameters with energy.

The present experimental situation in this field was summarized by S. Pruss, followed by theoretical presentations by B. Nicolescu, A. Donnachie, T.T. Wu, A. Martin and others. The data for proton-proton and proton-antiproton scattering seem to support dominance of the 'crossing-even' part of the scattering amplitude (which contributes equally to both proton-proton and proton-antiproton scattering), with little



evidence for a substantial 'odderon' term which contributes with opposite sign in the two cases.

The 'pomeron' physics of high energy behaviour was a central feature of the conference. The experimental data seem to suggest that behaviour with increasing energy depends on the magnitude of the scale which characterizes the process - i.e. whether the process is "soft" or "hard".

Hard processes, in general, show a much more rapid increase with increasing energy than the soft ones. In order to distinguish between these two cases, the notions of "soft" and "hard" pomerons are introduced. The phenomenological situation was summarized by A. Donnachie. It is believed that the "hard" pomeron should be described by perturbative quantum chromodynamics (QCD), the fundamental theory of strong interactions between the quarks and gluons.

The approximate theory of the pomeron in perturbative QCD has been developed by Balitskij, Fadin, Kuraev and Lipatov (BFKL). It is now being applied to the phenomenological description of "hard" processes like deep inelastic electron-proton scattering in the

A regular feature of the international physics calendar is the International Conference on Elastic and Diffractive Scattering, known also as the Blois Workshops, after their 1985 birthplace in France, and initiated by Basarab Nicolescu and Jean Tran Thanh Van. In this photo of Blois organizers past and present are (left to right) E. Predazzi, K. Kang, A. White, M. Block, Jean Tran Thanh Van, M. Haguenaer, Basarab Nicolescu, H.M. Fried, K. Goulianos, N.N. Khuri and C.-I. Tan.

kinematical range accessible at the HERA collider.

The theoretical and phenomenological issues of the pomeron in QCD were reviewed by M. Ciafaloni, L. Lipatov and N. Nikolaev, and discussed in many other presentations. The experimental data on violent (deep inelastic) electron-proton scattering were presented in several contributions from both the H1 and ZEUS collaborations at HERA. The highlights are: the rapid increase of the structure functions with decreasing Bjorken parameter x ; and the detailed measurements of the structure final states aimed at pinning down the specific correlation between diffusion in transverse momentum and increase with decreasing parameter x , etc. All those measurements aim at revealing the microscopic dynamical structure of the QCD pomeron.

A valuable insight into the pomeron comes from the study of deep inelastic diffractive processes. The experimental data were reviewed by H. Abramowicz (ZEUS) and J. Dainton (H1), while the theory and phenomenology of diffraction was reviewed by A. Kaidalov. Deep inelastic diffraction reveals the quark-gluon content of the pomeron and one may intro-

duce quark and gluon distributions in a pomeron by analogy with those of ordinary hadrons.

The data prefer a "soft" pomeron in inclusive diffractive production with a "hard" gluon spectrum, but the situation in exclusive production of vector meson states is different. Several contributions discussed the possible role of a "hard" QCD pomeron in deep inelastic diffraction. It should also be emphasised that the very notion of the quark/gluon content of the pomeron as well as the "hard" diffractive processes were introduced for the first time by G. Ingelman and P. Schlein at the first Blois Workshop at 1985.

Another group of problems discussed during the meeting concerned spin physics. The experimental situation was summarized by Alan Krisch while the theory review was given by Stefano Forte. The experimental data on polarized electroproduction from both the SMC collaboration at CERN and SLAC (Stanford) were presented and several theoretical talks discussed various models for polarized quark and gluon densities.

The experimental and theoretical parts of the conference were summarized by W. Bartel and by J. Kwiecinski respectively.

The valuable content of the Blois meetings has recently become very topical following theoretical progress in understanding high energy behaviour in terms of quantum chromodynamics and its implications for both present and future experiments.

J. Kwiecinski

Channeling and related crystal effects

Channeling, the interaction of particles with oriented crystals, has been applied in a wide variety of scientific and technological areas. A workshop at Aarhus, Denmark, this summer highlighted progress and future directions.

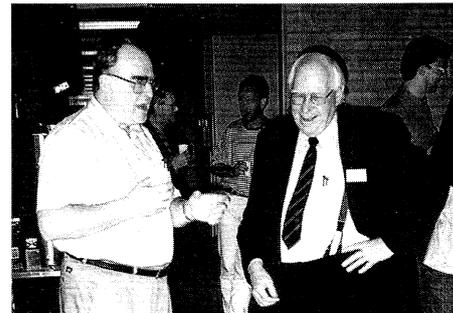
Radiation emission has been explored and linked to coherent bremsstrahlung and other oriented crystal radiations. Dramatic effects have been found for ultra-relativistic electrons with Lorentz factors of 10^{5-6} . Single crystals are unique for investigations of quantum electrodynamics in strong external fields because probabilities for processes in axial/planar fields are determined by the magnitude of these fields in the particle rest frame.

Erik Uggerhøj of Aarhus reported on an extensive series of experiments concerning radiation emission, pair production, and shower formation carried out at CERN by the NA43 collaboration.

As Vladimir Baier of Novosibirsk and Yuri Kononets of Kurchatov noted, theoretical treatment of these interconnected radiation distributions is challenging and much work needs to be done. In general, the agreement with the CERN experiments is good, but many areas like polarization phenomena and particle production need investigation.

Prominent among high energy applications is extraction from accelerators. At the workshop, Alexei Asseev reported on beam extraction using a bent crystal at Serpukhov. Konrad Elsener and Jukka Klem reviewed recent CERN SPS studies driven by the possibility of using crystals for extraction of LHC beams.

David Cline of UCLA (left) and Friedel Sellschop of Johannesburg at the recent International Workshop on Channeling and Other Coherent Effects at relativistic Energies at Aarhus, Denmark.



Thornton Murphy of Fermilab announced a step in that direction, with a demonstration this summer of extraction from the Tevatron at 900 GeV.

Bent crystal channeling is also used for handling extracted high energy beams. Niels Doble presented a beautiful example of a beam for the CERN NA48 CP-violation experiment. Yuri Chesnokov reported that beams had been deflected through angles up to 150 milliradians at Serpukhov.

Vladimir Samsonov and Alexei Khanzadeev of PNPI discussed a demonstration of channeling spin precession at Fermilab where hyperons were precessed in bent crystals. Although challenging, this technique may offer a method for measuring charm baryon magnetic moments.

'Parametric radiation' is the newcomer in the field of oriented crystal radiation. This can be thought of as Bragg reflection of virtual photons from incoming electrons in a crystal. It is monochromatic, intense, and easily tunable. Hideo Nitta of Tokyo Gakugei reported on the status of the theory while Uwe Nething reviewed recent measurements at Darmstadt.

Heavy ion channeling is used mainly to study atomic cross-sections. Jens Ulrik Andersen of Aarhus discussed resonance capture studies