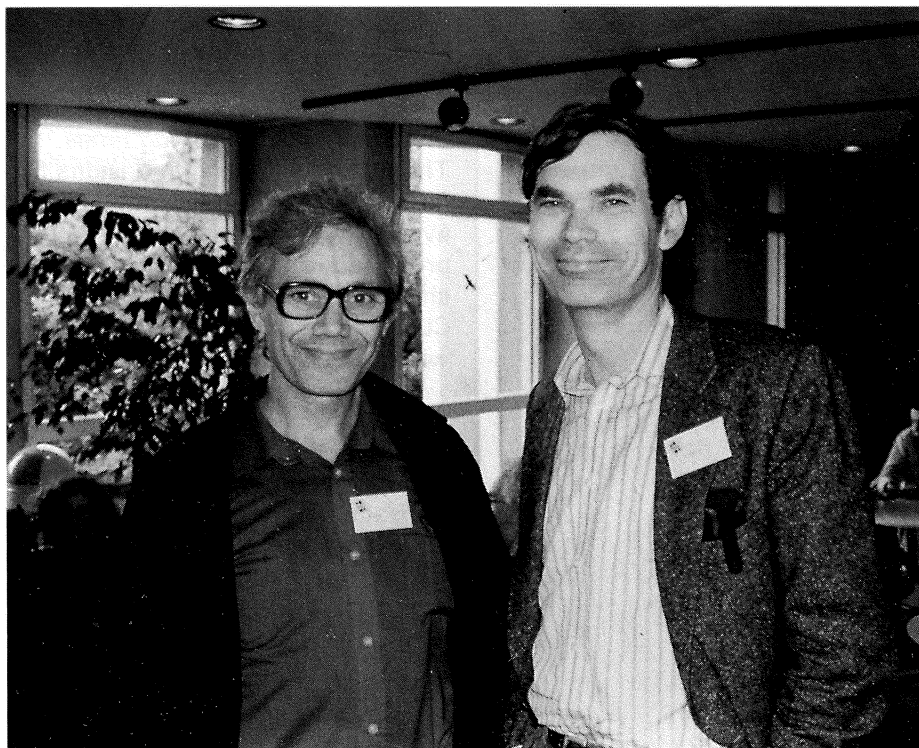


Al Mueller (right, Columbia) and E. Levin (Leningrad) – new trends in quark-gluon field theory.

(Photo P. Waloschek)



evolution of structure functions was reviewed by J. Stirling, Wu-Ki Tung, M. Glueck, D. McKay, M. Krawczyk and D. Strozik-Kotlorz. Particular emphasis was given to the dependence upon input distributions and to the predictions for the low- x region, using data culled from current experiments. An improved theoretical treatment of gluon radiation at small x which allows simulations of deep inelastic processes was the subject of talks by G. Marchesini and B. Webber.

The property of QCD factorization, separating structure functions and the contributing hard scattering probabilities, was discussed by J. Collins. D. Treleani emphasized the importance of multiple quark/gluon collisions inside two colliding hadrons, especially at high energies such as those envisaged for the next generation of proton colliders.

P. Landshoff and S. Brodsky emphasized how non-perturbative as-

pects of strong interactions have to be carefully estimated before any quantitative analysis based on a perturbative approach.

L. Lipatov summarized the status of the Pomeron (responsible for elastic scattering) in (perturbative) QCD, making clear that the small- x region is a transition between the moderate- x perturbative QCD regime and the nonperturbative limit of the time-honoured Regge approach. A complete understanding of this transition will naturally take care of the small- x region.

One of the most interesting new ideas and which may very well become one of the central issues at HERA is the concept of saturation of quark and gluon densities at very small x . Stated simply, QCD predicts a rapid rise in the number of constituents as x becomes very small. At sufficiently large quark/gluon densities, one can no longer ignore their mutual interac-

tions, including intra-nucleon scatterings and annihilations. Under these conditions a nucleon struck by a penetrating electron would resemble a dense gas of quarks and gluons, very different from anything studied so far. Its main feature would be saturation of quark and gluon densities. E. Levin, M. Ryskin and A. Mueller outlined the theoretical ideas, and J. Kwiecinski and G. Schuler speculated on the kinematical regions where such effects could show up, with Al Mueller suggesting that already at HERA energies first hints might be seen of such proton 'hot spots'.

Summarizer Stan Brodsky emphasized the unique nature of experiments at HERA in providing a trustworthy description of the nucleon, exceedingly important for accurate estimations of the potential of proposed proton-proton colliders (the SSC in the US and LHC at CERN), as well as revealing new facets of the nucleon structure.

From A. Ali and J. Bartels

Phi factories

Plans for 'phi factories' gathered momentum with a recent workshop at UCLA. These machines, high luminosity electron-positron colliders working near the phi resonance at 1020 MeV, have been proposed at Laboratories in Europe, the US, Japan and the USSR (July/August 1989, page 26).

Physics interest centres around symmetry breaking effects, particularly CP violation, the delicate particle/antiparticle left/right asymmetry seen in the decays of neutral kaons.

One of the major decay modes of the phi is a pair of neutral kaons, one of the long-lived type, the oth-

Muons in action – the muon spin rotation station at the Swiss Paul Scherrer Institute.

er short-lived. This is potentially a valuable source of neutral kaons.

Current designs for phi factories fall into two classes – compact machines with superconducting elements (e.g. Novosibirsk and UCLA) and larger conventional rings (Frascati, KEK, Mainz). Synchrotron damping time is shorter in the former at the expense of more complicated filling procedures. Room-size compact machines could also be considered as candidates for compact synchrotron light sources or for other types of particle factory. However the detectors for use at these compact rings would not be correspondingly scaled down.

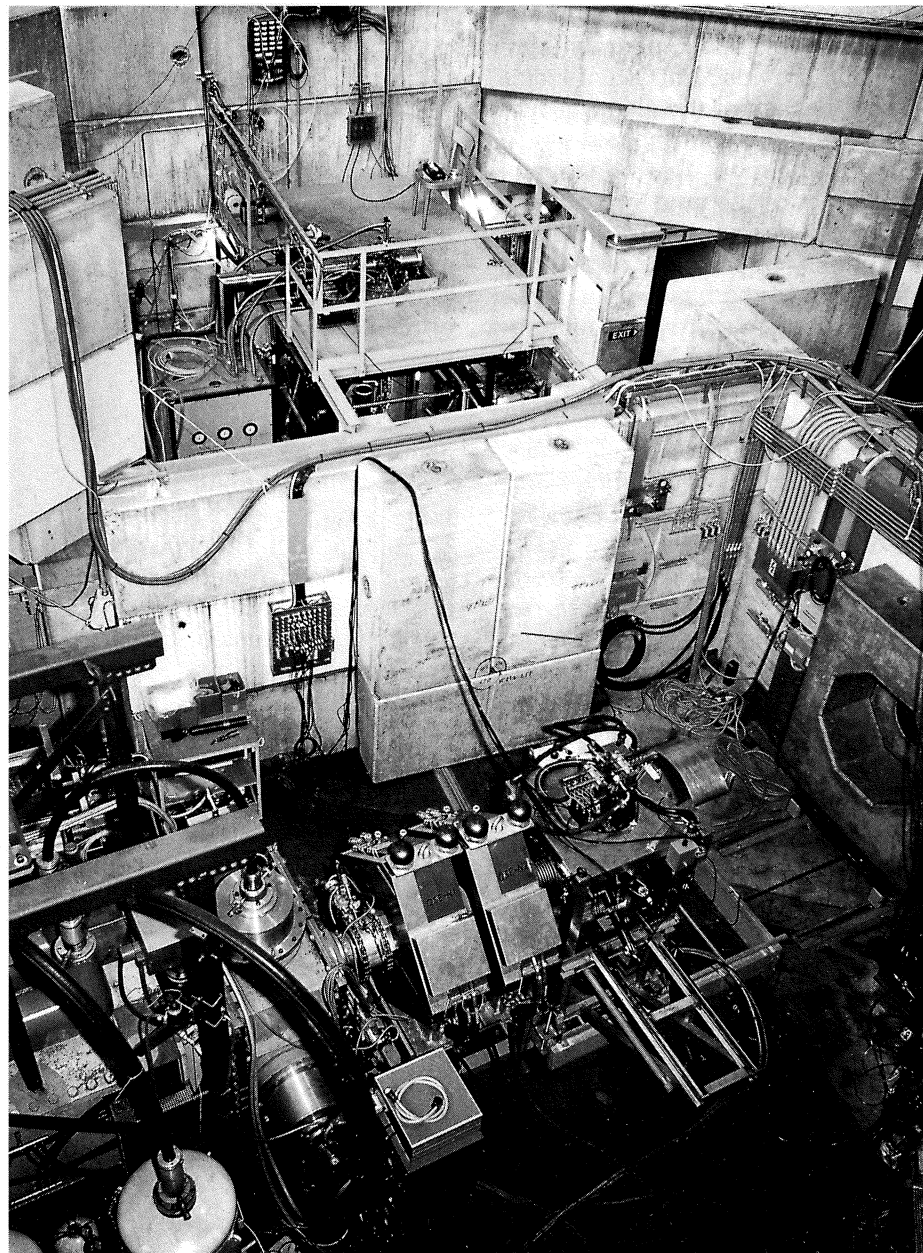
Luminosity should reach 10^{33} per sq cm per s, providing some 10^{10} phis per year decaying into neutral kaons and opening up a useful range of physics. At the UCLA meeting, detector and machine specialists felt that the special requirements of a phi factory were within reach.

Musing over muons

The Standard Model of modern physics looks simple – six types of quark grouped pairwise into three families, each associated with a different type of weakly interacting particle, or lepton – the electron, the muon and the tau.

Despite its many successes, this picture cannot be the end of the road. Why is the muon about two hundred times heavier than the electron? The answer is hidden by the Standard Model's price tag.

The physicists attending a workshop on Low Energy Muon Science in the 1990s, held at the Swiss Paul Scherrer Institute (PSI) in April, were looking for ways to learn



more about the muon and uncover what lies behind the Standard Model.

Experiments searching for new muon decay modes probe down to one decay per hundred million and in some cases even much less, but even this close no cracks show up in the Standard Model facade. Convinced there has to be a deeper

message, the physicists prepare for new rounds of experiments to subject the model to even closer scrutiny.

A related issue is the masses of the three neutrinos which accompany the trio of leptons. Again there are as yet no theoretical guidelines, but neutrino masses play an important role in basic pro-