

Collider workshop

The promise of initial results after the start of operations at CERN's SPS proton-antiproton collider and the prospects for high energy hadron collisions at Fermilab (Tevatron) and Brookhaven (ISABELLE) provided a timely impetus for the recent 'Topical Workshop on Forward Collider Physics', held at Madison, Wisconsin, from 10–12 December. It became the second such workshop to be held, the first having been in 1979 at the Collège de France, Paris.

The 100 or so participants had the chance to hear preliminary results from the UA1, UA4 and UA5 experiments at the CERN SPS collider (see January/February issue, page 3), together with other new data, including that from proton-antiproton runs at the CERN Intersecting Storage Rings.

As clear from the title of the Workshop, interest centred on interesting physics from collisions whose products are confined in the 'forward' angular region — within 30° in the centre-of-mass. Nowadays, angle has been replaced by rapidity as a convenient variable, and this region corresponds to ± 5 rapidity units at the SPS and ± 6 at the Tevatron, excluding a small central zone.

If they exist, long range correlations (similar phenomena seen under quite different kinematical conditions) should be observable in this angular range. Other expected processes include production of weak bosons (the W and Z), heavy flavour(s), and maybe Higgs particles. However the copious production of pions under these conditions makes for high backgrounds when trying to pick out electrons and muons, and sophisticated detection techniques are needed.

The UA1 and UA5 results were presented by A. Kernan and R. Meinke respectively. The data as presented show three striking fea-

tures. The distributions of charged particles follow KNO (Koba/Nielsen/Olesen) scaling, even at relatively high multiplicities. In contrast to the ISR data, some evidence for long range correlations is seen. The average transverse momentum per particle increases to 500 MeV.

The UA1 experiment was able to report relatively copious production of events with high transverse energy. Previous experiments, notably the NA5 study at the CERN SPS (see May 1981 issue, page 155), found that such processes are relatively abundant. Klaus Pretzl reviewed the NA5 study with a calorimeter trigger. Events have been seen with transverse energy of up to 18 GeV out of 22 GeV available in the centre-of-mass, over a rapidity range of ± 0.8 . Jet production is certainly not evident.

A related question is the effect of fluctuations in the high multiplicity tail of the particle distributions. This might be the reason why the events with large transverse energy appear to contain many particles with low energy. These fluctuations can produce peculiar neutral to charged pion ratios and angular distributions. This might mean that particle jets are there but are hard to find.

Related theoretical progress was reported by Geoff Fox, who has been busy (with Robert Kelly) calculating QCD effects in hadron-hadron collisions, including gluon 'bremsstrahlung'. He finds that if the products of high transverse momentum collisions are selected using a total transverse energy trigger, rather than having a planar jet structure, they are instead isotropic, with many gluons being radiated. This may be an explanation for the non-appearance of jets under NA5 conditions. It could mean that clean separation of jets from background is difficult. Further data from the proton-antiproton collider

experiments will shed more light on this question.

Cosmic ray experiments have events in and beyond the energy range attainable in the colliders. However this was the first time that laboratory and cosmic ray data could be explicitly compared. Two cosmic ray findings are now confirmed — the rapidity plateau now extends to ± 4 , and average transverse momentum per particle rises to 500 MeV. Peculiar events, such as the much-publicized Centauro, have not yet been seen at collider experiments, but could arise as a result of large high multiplicity fluctuations.

New cosmic ray data from the 'Fly's Eye' detector now operational in Utah were presented by G. Cassiday. This uses an arrangement of mirrors and photomultipliers to observe the radiation produced by extensive air showers. It allows the interaction point in the atmosphere to be located and thus determines the absorption length of the proton-nucleus collision. The aim is to measure total proton-nucleon reaction rates down to millibarn levels at up to 100 TeV in the centre-of-mass. Early results suggest that the total reaction rate is still rising, even at these energies.

Less spectacular but still important are the antiproton results emerging from the CERN ISR. Data were presented by P. Grannis, M. Block and L. Camilleri.

With hadron colliders promising new discoveries, theorists were able to provide substantial input. One field ripe for further study is heavy flavour production. Stan Brodsky presented ideas of intrinsic flavours in the nucleon which result in heavy flavour production at large energy transfers. This could explain the relatively high charm production levels observed at the ISR, but production of heavier flavours (beauty and top)

would provide an exacting test. (These ideas have to be reconciled with recent data from Fermilab and from the European Muon Collaboration's study of charm production by high energy muon beams at the SPS.) While there is some evidence for beauty production at the ISR (presented at the meeting by D. Dibitonto), discovery of top flavour production at the SPS collider would help complete the picture. Also drawing

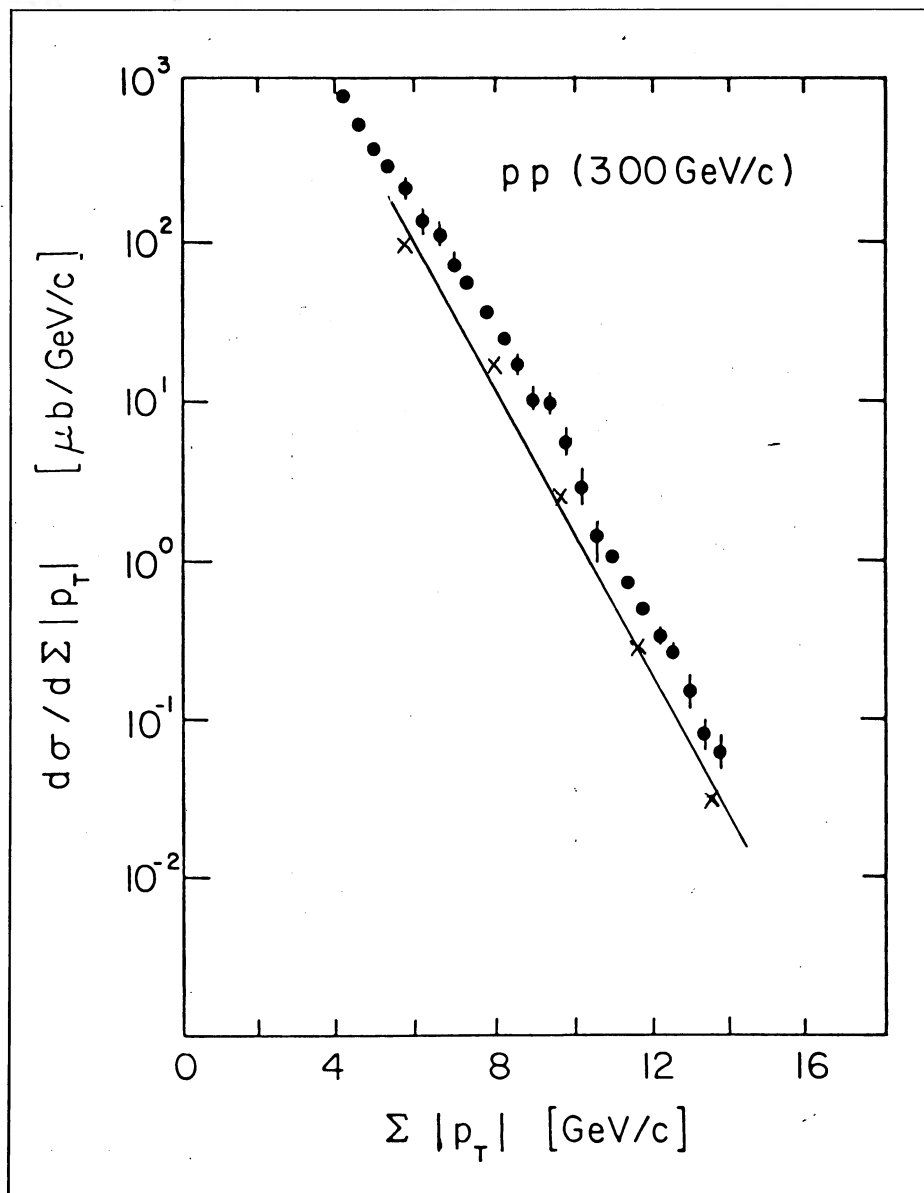
on the high charm production levels seen at the ISR, M. Jacob and R. Horgan have predicted that forward-produced top particles should indeed show up at high energy proton-antiproton colliders. At the Madison meeting, R. Odorico presented other arguments to explain the observed charm production levels. Further studies at colliders will certainly be useful in solving this problem.

At Madison, latest calculations on

the production of weak bosons, Higgs particles, etc., were presented. Hopefully at future such meetings theorists will be able to fit the observed data.

These meetings are now a regular feature of the particle physics scene, the next one being scheduled for 10–12 June in Rome.

(We are grateful to D. Cline for providing us with the material from which this report was compiled.)



Data (upper points) from the full wide-angle calorimeter of the NA5 experiment at CERN using a large transverse energy trigger. The relatively high reaction rates observed are difficult to reconcile with production of well-defined particle jets. Initial new calculations (by Geoffrey Fox and Robert Kelly) including gluon bremsstrahlung appear to provide a promising fit to the data at these transverse energies.