NAL PROPOSAL NO. 228

SCIENTIFIC SPOKESMAN

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Proposal to Extend the Energy Range of a Study of Multiparticle Production in pp Collisions

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Summary:

The Michigan-Rochester Collaboration, in a pair of coupled experiments, has obtained a total of about 31,000 exposures of the bare 30-inch ANL/NAL bubble chamber to 100 GeV/c protons (Proposal 138-I) and 12,000 exposures of this chamber to 400 GeV/c protons (Proposal 138-II). We wish to substitute the remaining pictures at 100 GeV/c for an equivalent exposure at 60 GeV/c. This will provide us with valuable measurements of the total cross section and of multiparticle production processes to compare with Serpukhov and ISR experiments in this same energy range.

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Physics Justification:

The major physics justification for this experiment can be found in the original proposals Nos. 62 and 80, wherein we discussed in some detail the goals of our program for the investigation of high-energy hadronic collisions. Because our motivation throughout has been largely to study the energy dependence of various production processes, we feel that it would be more profitable from the physics viewpoint to substitute for the remaining fraction of our 100 GeV exposure an equivalent amount of data at an incident energy of 60 GeV; this would serve to overlap the data taken previously at Serpukhov[1]. In this manner we could ascertain, using one set of rules and acceptance criteria, the energy dependence of both the total cross section and of the partial cross sections for the larger components contributing to the pp total cross section between 60 and 400 GeV/c, an order of magnitude variation in squared center of mass energy.

Of particular interest in this regard is the measurement of the diffractive part of the inelastic cross section[2], a measurement which may be somewhat more difficult to perform in the large Serpukhov bubble chamber Mirabelle. Also, the techniques we have developed for measuring complex topologies[3] can be exploited, over the entire range of energies from 60 GeV to 400 GeV, to ascertain the detailed form of the approach

to scaling of the single-particle inclusive cross section for π^+ and π^- mesons as well as for K_s^o, Λ^o and π^o mesons.

Technical Details:

With the completion of the NAL hadron-beam tagging system it is now feasible to obtain secondary proton beams to the 30-inch chamber at momentum-values essentially independent of the primary machine energy. At 200 GeV/c primary momentum, for example, the effective p/π^+ ratio for 60 GeV/c secondaries at the bubble chamber is close to unity. Consequently, a 25,000 picture exposure would provide us with a sample of ~5000 pp interactions at 60 GeV/c. This would suffice for a general comparison of the large multiparticle production channels with our data at 100 GeV/c and 400 GeV/c. Alternatively, should it prove feasible to run the primary accelerator beam at 60 GeV/c, this would enable us to acquire this same number of pp interactions using fewer pictures. Since this mode of running would provide us with the simplest data to analyze, it represents our first choice, although in compensation for the added complexity introduced by the tagging system we would, using this mode of operation, also be provided with approximately 3000 tagged π^+p interactions at 60 GeV/c.

References

1. See preprints of the French-Soviet Collaboration for pp data at 50 and 69 GeV/c.
2. C. M. Bromberg et al., Michigan-Rochester preprint (1973).
3. P. Slattery, report presented at the Vanderbilt Conference (1973).