Fermilab Proposal No. 317

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PROTON DIFFRACTION DISSOCIATION ON HYDROGEN AND DEUTERIUM

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I. Motivation

We propose to compliment our Experiment No. 186 on coherent proton dissociation off deuterium with similar measurements using hydrogen. The primary purpose of this measurement is to compare the cross section for $pd \to xd$ to that for $pp \to xp$ over the same mass and t range.

At high energies the nuclear process becomes sensitive to the short time behavior of hadronic interactions, and yields information that cannot be inferred directly from the s-matrix elements observed in hydrogen experiments[1]. It means that comparing our hydrogen and deuteron measurements we can study the space-time development of the production process. The only existing data which can be used for this comparison are from Fermilab Experiment 221.[2]

While our preliminary results from deuterium in general agree with these data[3], there appears to be some discrepancies, in particular in the t dependence observed in the region $\mu_x^2 \sim 10$ $(GeV/c^2)^2$. In this region reference 2 reports a turnover in $d\sigma/dt$ for $|t| < .1$ $(GeV/c)^2$ in contradiction to our results on deuterium. This t dependence at small t is important and this discrepancy should be resolved.

In general, it is difficult to make detailed comparisons between the results of different experiments. For these reasons we propose to compare measurements done in the same apparatus under similar conditions.

II. Apparatus

We propose to do these measurements in the same apparatus that we presently use for "Act II" of Experiment No. 186.[4] The only necessary change would be the addition of some 0.5 mm - 5 mm detector stacks to the present systems. This would give us a useable t range of $0.01 < |t| < 0.1$ $(GeV/c)^2$. With the present vacuum chamber we can reach an M_x^2 of 60 $(GeV/c^2)^2$ at 300 GeV, corresponding to an x of 0.9. With the current increased beam intensity, the modification to the jet target system, which is currently underway, to reduce the target density will probably be necessary. Otherwise the mechanical and electronic hardware, as well as the current on-line software is suitable for these measurements. The bulk of the effort will be in analysis, but most of the present off-line programs will be useful.

As for the previous Soviet-American collaborative experiments, the computing facilities of Rockefeller University and of the University of Rochester will be used for data analysis. Approximately 30 hours of Argonne 370/195 time will be needed for translation of the raw data tapes.

III. Running Plans

We envision running in a mode where we switch between hydrogen and deuterium every few hours - getting data from both reactions essentially simultaneously. Thus many system atics will cancel. We will need about two months, running 4 to 6 shifts a week to take data on hydrogen, deuterium, and for background measurements and checks.

The same team assembled for Experiment No. 186, with perhaps a few changes, will participate in this work. These data could be taken this summer after the conclusion of Experiment No. 186 "Act II."

References and Footnotes

1. K. Gottfried, CERN Preprint TH1735 (1973).

2. S. Childress, et al, Phys. Rev. Lett. 32, 389 (1974).

3. See Appendix to this proposal.