

Fermilab Proposal No. 345

Scientific Spokesman:

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Proposal to Study Multiparticle Production in 100 GeV/c
Antiproton-deuterium Interactions with the
NAL 30-inch Bubble Chamber

October 1974

Proposal to study multiparticle production in 100 GeV/c anti-proton-deuterium interactions with the NAL 30-inch bubble chamber.

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ABSTRACT

We propose to study multiparticle production in the interactions of 100 GeV/c antiprotons in the 30-inch deuterium bubble chamber. Our request would be 100000 pictures with a Cerenkov tagged incoming beam. The downstream wide gap spark chamber hybrid system will be used to improve on the measurements of the fast secondaries and to study the forward, neutral particle production.

I INTRODUCTION

Antiproton-proton reactions at 100 GeV/c will be studied in the 30-inch hydrogen bubble chamber of FNAL.⁽¹⁾ Together with experiments at 9, 12, 15, 23 and 32 GeV/c a study of the s-dependence of many features of the $\bar{p}p$ -interaction will be possible. The corresponding antiproton-neutron reactions have been studied at 9 and 15 GeV/c. Therefore an experiment at 100 GeV/c would be a valuable extension in energy.

We propose to take 100000 pictures in the deuterium filled 30-inch bubble chamber and to use the same beam and set up as for the 100 GeV/c antiproton-proton experiment.

The analysis will include the following topics:

- 1) Determination of $\bar{p}n$ cross sections and multiplicities. Comparison of the features of 100 GeV/c pp , $\bar{p}p$ and $\bar{p}n$ reactions.
- 2) An s-dependent analysis of the $\bar{p}n$ reactions making use of the data at lower energies.
- 3) Study of the π^0 production.
- 4) Study of the diffractive system

$$n \rightarrow p\pi^-$$

$$n \rightarrow p\pi^-\pi^+\pi^-$$

which could be obtained in fits to

$$\bar{p}n \rightarrow \bar{p}p\pi^-$$

$$\bar{p}n \rightarrow \bar{p}p\pi^-\pi^+\pi^-$$

- 5) The fragmentation processes

$$n \xrightarrow{\bar{p}} \pi^-$$

$$n \xrightarrow{\bar{p}} \Lambda^0$$

will add to the understanding of the fragmentation of the nucleon. The study of the corresponding fragmentations of the proton

$$p \xrightarrow{\bar{p}} \pi^-$$

has given interesting results⁽²⁾.

- 6) Properties of the multiplicity distributions. There is a marked difference in the s-dependence of for instance the $\langle n \rangle/D$ ratio for pp and $\bar{p}p$ reactions. A study of the s-dependence of the $\langle n \rangle/D$ ratio for $\bar{p}n$ reactions would contribute to the understanding of this feature.
- 7) The possible existence of a Δ - $\bar{\Delta}$ component in the deuteron wave function. It has been suggested that a way to test such a picture is to study inelastic reactions on the deuteron⁽³⁾. It is necessary to have access to the data from the $\bar{p}p \rightarrow \bar{p}p\pi^+\pi^-$ reaction in order to be able to estimate the kinematical background.
- 8) Two particle correlations. The correlation between the average number of π^0 and charged pions is very different for $\bar{p}p$ and pp reactions.
It seems to be a sensitive parameter to test models of multi-particle production. There is also an appreciable s-dependence. The corresponding measurement for $\bar{p}n$ reactions is therefore of interest.
- 9) The strange particle cross section is rising in pp interactions being $\sigma(\Lambda) = 3.2 \pm 0.4$, $\sigma(K^0) = 9.2 \pm 1.0$ and $\sigma(\bar{\Lambda}) = 0.23 \pm 0.10$ at 100 GeV/c. The information on strange particle cross sections is shown in the figure⁽⁵⁾. Similar cross sections in $\bar{p}n$ will make a fairly detailed study of the production of K^0 , Λ^0 and charged hyperons possible.

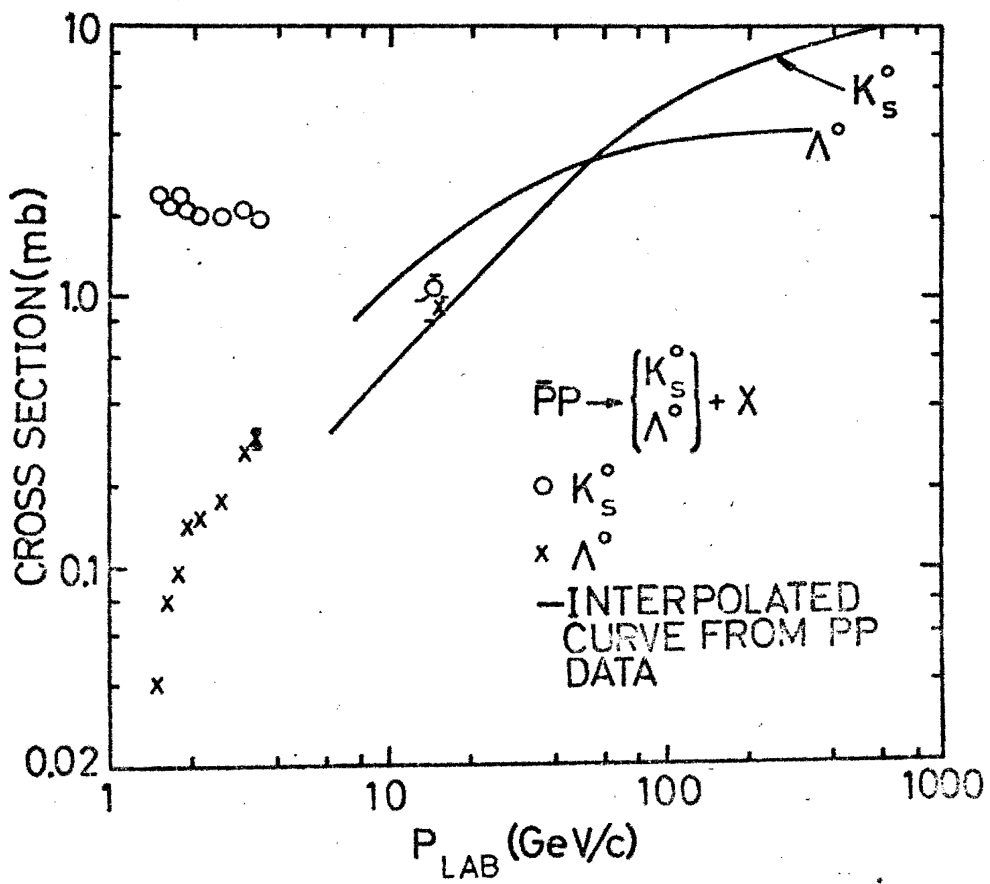
II TECHNICAL DETAILS

We refer to NAL proposal no 311⁽¹⁾ for technical details and propose to use the same beam system and selection criteria.

The measuring equipment consists of a Flying Spot Digitizer (Liverpool) and a Spiral Reader (Stockholm). Both groups have long experience in antiproton-proton as well as proton-deuterium experiments in bubble chambers. Measuring equipment and man power is available, but all financial aspects of the experiment have not yet been solved.

REFERENCES

1. NAL Proposal no 311
2. Liverpool-Stockholm Coll: A test of factorization predictions for the fragmentation processes $p \rightarrow \bar{p} \pi^\pm$ of 9.1 and 4.6 GeV/c.
3. M. Goldhaber: IIème Conférence Internationale sur les Particules Élémentaires, Aix-en-Provence (1973), 209.
4. J.W. Chapman et al.: Production of γ , Λ^0 , K_S^0 and $\bar{\Lambda}^0$ in pp collisions at 102 GeV/c. University of Rochester Report UR 457.
5. F.T. Dao et al.: NAL-Pub-73/81-EXP.



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AB ✓
MP ✓

Stockholm 16.10.1974

Dr. Donald R. Getz
PAC
FNAL
Batavia

RECEIVED
STOCKHOLM OFFICE

OCT 21 1974

Dear Dr. Getz:

Please find enclosed a slightly corrected version of the proposal I sent to the Oct 4th. The name S.O. Holmgren was mis written, other changes are trivial.

Best wishes

Sigvard Nilsson

PROPOSAL #

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✓ MASTER

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