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PROPOSAL FOR STUDY OF  $\bar{p}n$  INTERACTIONS AT 12 GeV/c  
IN THE CERN 2m DBC

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ABSTRACT

We propose to study  $\bar{p}n$  interactions at 12 GeV/c in the CERN 2m DBC. In order to make detailed studies of these processes we request 300 000 pictures. This experiment will complement our program of making detailed studies of  $\bar{p}p$  and  $\bar{p}n$  interactions at intermediate and high energies.

## INTRODUCTION

Several studies of  $\bar{p}p$  interactions at intermediate energies ( $\approx 10$  GeV/c) have shown that besides annihilation there are many important differences between  $\bar{p}p$  and  $pp$  interactions. Detailed studies of these inelastic reactions have been helpful in understanding processes like beam and target fragmentation and diffraction dissociation. In contrast to this the study of  $\bar{p}n$  interactions has been very limited. There have been two experiments done at 9 and 15 GeV/c, but due to technical limitations these studies have been restricted to small samples. Thus there exists a clear need for detailed study of  $\bar{p}n$  interactions in this energy region.

In recent years we have been actively involved in the study of  $\bar{p}p$  interactions at 9 GeV/c and are at present working on similar studies at 12 GeV/c. Besides these experiments we have an approved experiment to study  $\bar{p}n$  interactions at 100 GeV/c using the 30" hybrid system at Fermi Lab. The exposure for this experiment is likely to take place in Spring '76. These experiments are a part of our program to make detailed study of  $\bar{p}p$  and  $\bar{p}n$  interactions at intermediate and high energies.

To complement these experiments we propose to take 300 000 pictures with 12 GeV/c  $\bar{p}$  beam in the CERN 2m bubble chamber filled with deuterium. Another motivation for proposing this experiment and the choice of this momentum is the fact that there exist  $pp$ ,  $pn$  and  $\bar{p}p$  experiments at 12 GeV/c and the proposed experiment will provide the missing combination of beam and target particles at this energy. In future these four experiments could act as a reference group at intermediate energy to make  $s$ -dependent studies at high energies.

## OUTLINE OF THE PROCESSES PROPOSED TO BE STUDIED

We propose to study the following processes:

1. Multiplicity distribution and its higher moments and their comparison with data in  $pp$ ,  $pn$  and  $\bar{p}p$  reactions at 12 GeV/c.

2. Study of  $\pi^0$  production and their correlation with number of charged particles.
3. Production of  $K_S^0$  and  $\Lambda$  and their correlations with number of charged particles.
4. Study of fragmentation processes like  $n \xrightarrow{\bar{p}} \pi^-$  and  $n \xrightarrow{\bar{p}} \Lambda$  will be made and compared with our similar analysis in  $\bar{p}p$  experiments.
5. Study of the diffractive systems  $n \rightarrow p\pi^-$  and  $n \rightarrow p\pi^+\pi^-\pi^+$  at this energy will be compared with similar systems at 100 GeV/c.
6. We will study the possible existence of a  $\Delta$ - $\Delta$  component in the deuteron wave function by comparing well defined inelastic channels like  $\bar{p}d \rightarrow \bar{p}pp\pi^+\pi^-$  and  $\bar{p}p \rightarrow \bar{p}p\pi^+\pi^-$ .
7. By excluding events with clear protons, antiprotons,  $\Lambda$  or other similar selection procedure we will enrich the sample with annihilation events and extract information related to them.
8. Annihilation events provide the deepest probe into the structure of nucleon and possibly the best source for new particles. Search for new particles and unexpected effects will be looked for in higher multiplicities.

#### TECHNICAL DETAILS

Experimental and technical details have been discussed at length in proposals by us <sup>(1)</sup> as well as by H. Braun et al <sup>(2)</sup> for  $\bar{p}d$  interactions at 12 GeV/c. We refer to these proposals for details.

We request 300 000 pictures with 10 tracks per picture. This would yield about 100 000  $\bar{p}n$  events with visible spectator proton stopping in the chamber. About 50 000  $\bar{p}n$  annihilation events will be produced.

The events will be measured on the Spiral Reader in Stockholm and the Sweepnik in Helsinki. The groups have expert knowledge of working with deuterium in the 2m chamber from the 19 GeV/c proton-deuterium experiment.

We want to strongly emphasize that this experiment should be included in the 2m bubble chamber program, since it is an obvious complement to existing experiments.

#### REFERENCES

1. Proposal to study multiparticle production in 100 GeV/c antiproton-deuterium interactions with the Fermilab 30-inch bubble chamber. Fermilab Experimental Proposal no 345.

Hybrid Bubble Chamber Study of  $\bar{p}p$  Interactions of 75 GeV/c.  
Fermilab Experimental Proposal no 408.

Proposal for study of antiproton-proton interactions at 75 GeV/c in BEBC. CERN/SPS/75-49/P47.

2. H. Braun et al. Proposal to study  $\bar{p}d$  interactions at 12 GeV/c.