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Proposal for a test at the P.S.; submitted to the EEC :

STUDY OF $\pi^- p \rightarrow \pi^0 n$ CHARGE EXCHANGE POLARIZATION WITH A BUTANOL POLARIZED TARGET

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INTRODUCTION

The use of a Butanol polarized target offers the possibility of measuring the polarization in charge exchange reactions without using neutron detectors. Thus much higher statistics can be achieved, resulting in improved accuracy. The method is discussed in some detail in the Letter of Intention of the CERN - ETH - I.C.LONDON - SACLAY Collaboration of June 1969.

We intend to test this technique by measuring the relative background coming from the bound protons of the target in the reaction $\pi^- p \rightarrow \pi^0 n$ with a simple setup , and by measuring the polarization parameter in this reaction at 6 GeV/c and at large t .

The possibility has appeared to locate the rather compact setup close to the PISA - KARLSRUHE experiment S84 and to operate it during the testing period of S84 , right after the 1969 shutdown.

EXPERIMENTAL SETUP

The setup, shown in Fig. 1, is essentially the same as the one used at the P.S. in 1964 for $\pi^- p \to \pi^0 n$ differential cross section measurements. A π^- beam is electronically defined by counters and hits a Butanol polarized target, which is surrounded by Pb-scintillator sandwich counters as thick as allowed by the geometry of the target. An optical spark chamber consisting of Pb plates with holes along the beam axis, detects the showers of the decay photons of forward emitted π^0's. This chamber is preceded by a large anticoincidence counter covered by a frame of lead which defines the forward solid angle allowed for the two γ's; an additional lead disk on the beam axis allows us to exclude events with very small momentum transfer.

The trigger is then given by a beam counter coincidence, and an anticoincidence of all other counters, which prevent the chamber from firing when charged particles or γ's are emitted outside the forward solid angle and the selected t-range. The resolution will be roughly $\Delta|t| = 0.1\sqrt{|t|}$ for a beam momentum of 6 GeV/c.

The sources of background are :

- the background coming from the bound protons of the polarized target has the same magnitude as the signal produced on the polarized protons. Separate measurements of this background will be achieved with a "dry" target (essentially carbon)
- the background due to the target walls amounts to 25% of the signal. By adapting mylar windows to the target, it can be reduced to less than 5%.
- the background coming from inelastic reactions (like $\pi^- p \to \pi^0\pi^0 n$, where a π^0 escapes the detection) is known, from previous experiments, to be small.

Assuming a 5 cm Butonal target, a 300 msec flat top with a P.S. cycle time of 3 secondes, and a security factor of 2, the following Table gives typical event rates expected with the described method.

Machine time	Beam Momentum	Beam intensity π^-	t-range $(GeV/c)^2$	Number of t-intervals	Corresponding error of $P_o(t)$ per interval	Number of good events	Number of background events	Number of pictures
1 week	6 GeV/c	200 000	0.3-0.45*	1	13 %	45 000	45 000	180 000
			0.45-0.60	1	13 %			
			0.60-1.5	5	9 %			
1 week	16-18 GeV/c	100 000	0-0.3	4	8 %	45 000	45 000	180 000
			0.3-0.5	1	25 %			

* 0-0.3 excluded by Pb-mask.

T A B L E

REQUEST OF BEAM AND MACHINE TIME

We are discussing with the PISA-KARLSRUHE Group the possibility of performing our test in the d beam in the South Hall right in front or behind their equipment, and during the setting-up and timing period of their experiment. If no technical incompatibility appears, we ask :

- to set up our equipment during the October 1969 shut-down
- to use the d beam focused on the Butanol target right after the shut down, during 4 weeks,
- for most of the time the beam momentum should be 6 GeV/c, and its intensity 200 000 π^-/ burst.

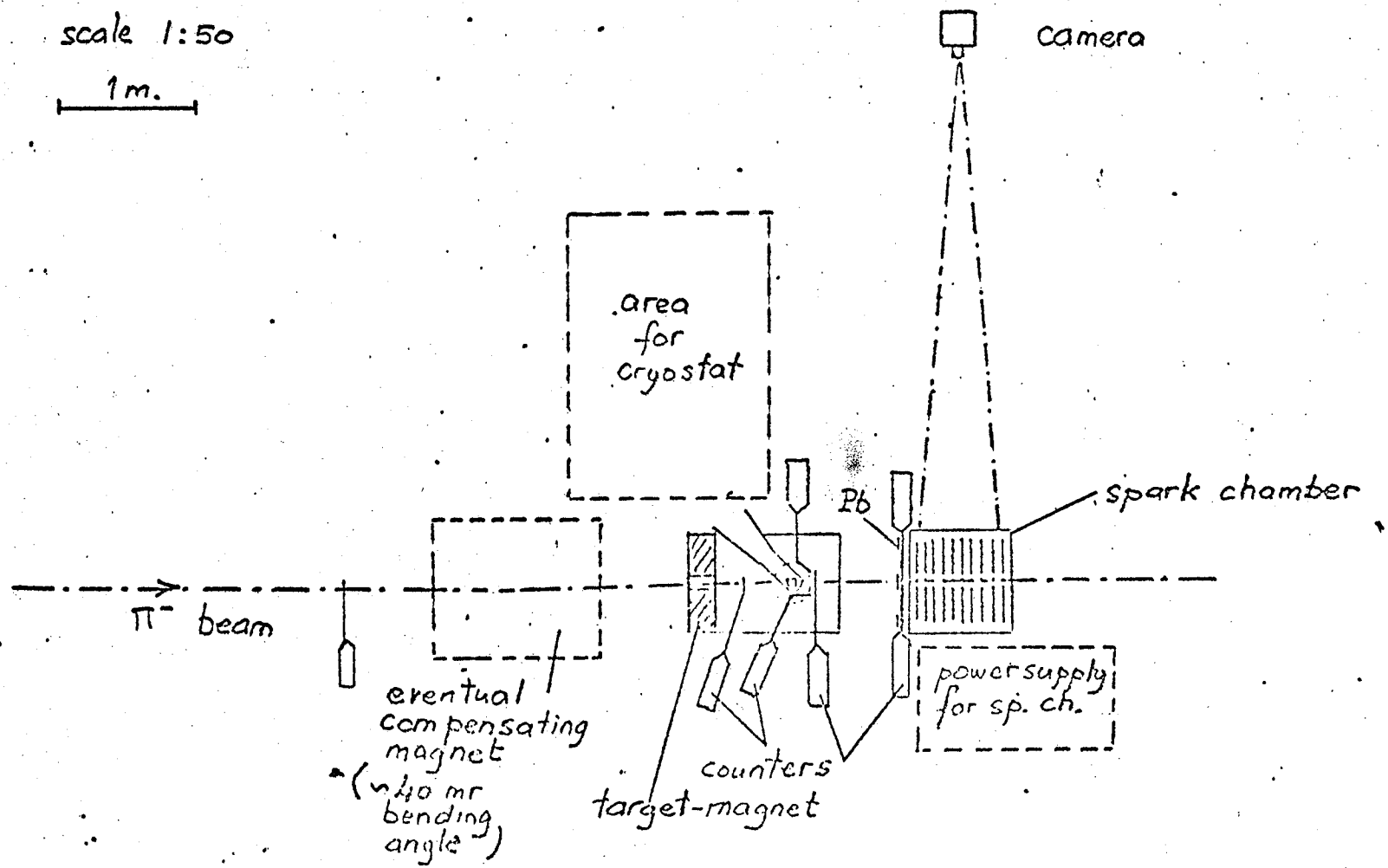
In this 4 weeks, we intend to tune beam and equipment, to measure the ratio signal/background for various lead thicknesses in the anticoincidence counters, and to check the feasibility of proposed method by measuring the $\pi^- p \rightarrow \pi^0 n$ polarization parameter at large momentum transfer $\left(0.3 < |t| < 1.5 \ (\text{GeV}/c)^2\right)$ at 6 GeV/c.

We are studying the possibility of adding a small magnet to compensate the bending angle of the beam in the target magnet. The sp. ch. is ready with its optics. The sandwich counters have to be built.

SUPPORT FROM CERN

We would like to use a CERN Butanol polarized target, with cryostat and magnet. All analysis will be done at Saclay, therefore we do not need any computer time at CERN.

Figure Caption : Experimental layout.



Experimental set-up for a test on $\pi^- p \rightarrow \pi^0 n$ polarization.