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STATUS REPORT ON WA10 AND ADDENDUM TO THE PROPOSAL P 11*

Study of $\bar{p}p$ resonances in the reaction $\pi p \rightarrow p\bar{p}\ \pi p$

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Recently, some narrow resonances have been observed in the $p\bar{p}$ system which may be candidates for the long sought four quarks baryonium states***. The S(1936) meson, which has been seen in total and elastic cross sections, is one such candidate, and others are the 2020 MeV and 2200 MeV seen recently in the reaction $\pi p \rightarrow \pi p\ p\ \bar{p}$. One of the key measurements required for identifying these states with baryonium - the spin - has not yet been made. In order to obtain detailed information on the spin, a sizeable sample, relatively free of backgrounds and biases, needs to be obtained in order that a study of the decay angular distribution can be made.

In experiment WA10, we have analyzed approximately one half of our data on the reaction $\pi^+p \rightarrow \pi^+p\bar{p}p$ taken at 50 GeV/c and we present here evidence that, for certain kinematic regions which correspond to production by meson exchange (small momentum

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* CERN/SPCS/74-31, SPSC/P11, March 7, 1974

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*** for references, see "Experimental Review on the Baryon-Antibaryon interaction, by L. Montanet - CERN/EP/PHYS 77-2 June 17, 1977 transfer between the target proton and (πp_{recoil}) system and low πp_{recoil} mass) there is production of a narrow $p\bar{p}$ resonance in the region of the S(1936). In order to firmly establish the production of $p\bar{p}$ resonances in this reaction and in particular to obtain a sample which is both large enough and sufficiently free of biases and background to permit a determination of the spin, we require additional running time. We propose to modify the apparatus slightly to increase our detection efficiency and to reduce backgrounds and triggering biases.

<u>Evidence for the observation of the S(1936) meson</u>.

The system we use for the WA10 experiment is shown in Fig 1. It consists of

- a beam spectrometer (particle identification, momentum measurement)
- a recoil proton spectrometer (direction and momentum measurement)
- a forward spectrometer (direction measurement and particle identification)

This system has been used to collect high statistics data on the reactions with the topology of $Kp \to K^o \pi p$. At the same time but with a second priority trigger level, the system was used to collect samples of reactions with three forward tracks, eg. $\pi p \to \pi p p\bar{p}$. The same channels with π,K and p incident, producing $\pi^+\pi^-$, K^+K^-, $p\bar{p}$ pairs were collected with the same priority at both polarities at 50 GeV/c incident.

Approximately one half of the data obtained at + 50 GeV/c for the reaction $\pi^+ p \to \pi^+ p p\bar{p}$ are shown in Fig 2. ($\pi p\bar{p}$ effective mass) and Fig 3. ($p\bar{p}$ effective mass). No peaks are seen in the $\pi p\bar{p}$ spectrum, while we see an indication of the S(1936) meson in the $\bar{p}p$ spectrum, with the kinematic cuts mentioned above.

This present sample, whose sensitivity is approximately 15 ev/nb, shows a peak in the S region containing approximately 40 events, indicating a production cross section times branching ratio of 2-3 nb. The sensitivity of the complete data sample already taken is about 30 ev/nb at +50 GeV/c and 60 ev/nb at -50 GeV/c. Unfortunately these will contain both triggering biases and background which will make a spin determination difficult.

Modifications to the apparatus

The present system is not optimized for the collection of data for the reaction $\pi p \rightarrow \pi p \bar{p} p$. There are three minor modifications which can be made to improve our efficiency and to reduce triggering biases and background.

1) We have used a 16-cell Cerenkov counter in WA10 to aid in particle identification. This counter did not play a critical role in the $K^{o}\pi$ channel, but for certain kinematic regions of the $\pi p\bar{p}$ channel it could provide a significant reduction in background. We estimate that by making minor modifications to the counter, we should be able to reduce the background due to $\pi\pi\pi p$ events in our present sample by about one order of magnitude. Our present sample of $\pi p\bar{p}$ events contains little background from other reactions due to our kinematic cuts.; an improvement in the operation of the counter will however allow us to widen these cuts and thus improve our acceptance for the $\pi p\bar{p}$ channel.

2) the trigger counter arrangement will be modified. A scintillator matrix was used for the $K^{o}\pi$ channels, but it is not well suited for the $\pi p\bar{p}$ system with small $p\bar{p}$ mass, as the spacing between these two articles is roughly equal to the size of the counters. A pulse height counter telescope will be used instead

3) the highest priority level will be given to the 3-track trigger, reducing the dead time from about 40% to less than 5%.

Beam request

If we assume that the new data are to be taken at +50 GeV/c (and we would like to defer a firm decision on the beam momentum and polarity until we have analyzed part of our -50 GeV/c data) we estimate that, with the improvements we envision for the apparatus, we will obtain a sample of sensitivity 60 ev/nb for each 20 day running period. Thus a single running period will probably allow a firm establishment of the existence of the S (and any other $p\bar{p}$ resonances produced in this reaction) whereas two running periods should permit us to make a determination of the spin.

The modifications to the apparatus should require few weeks to complete. We therefore request that an early decision be made to permit us to begin our modifications immediately.

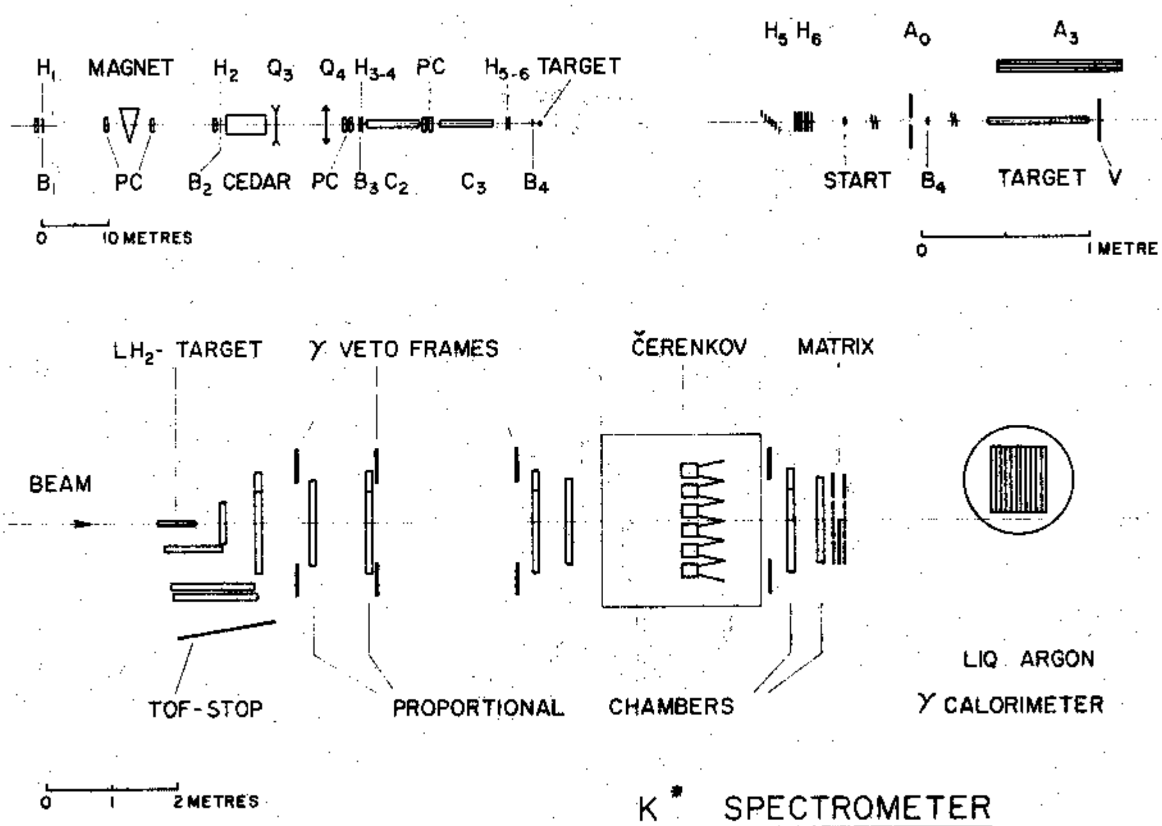

Fig. 1 Experimental layout

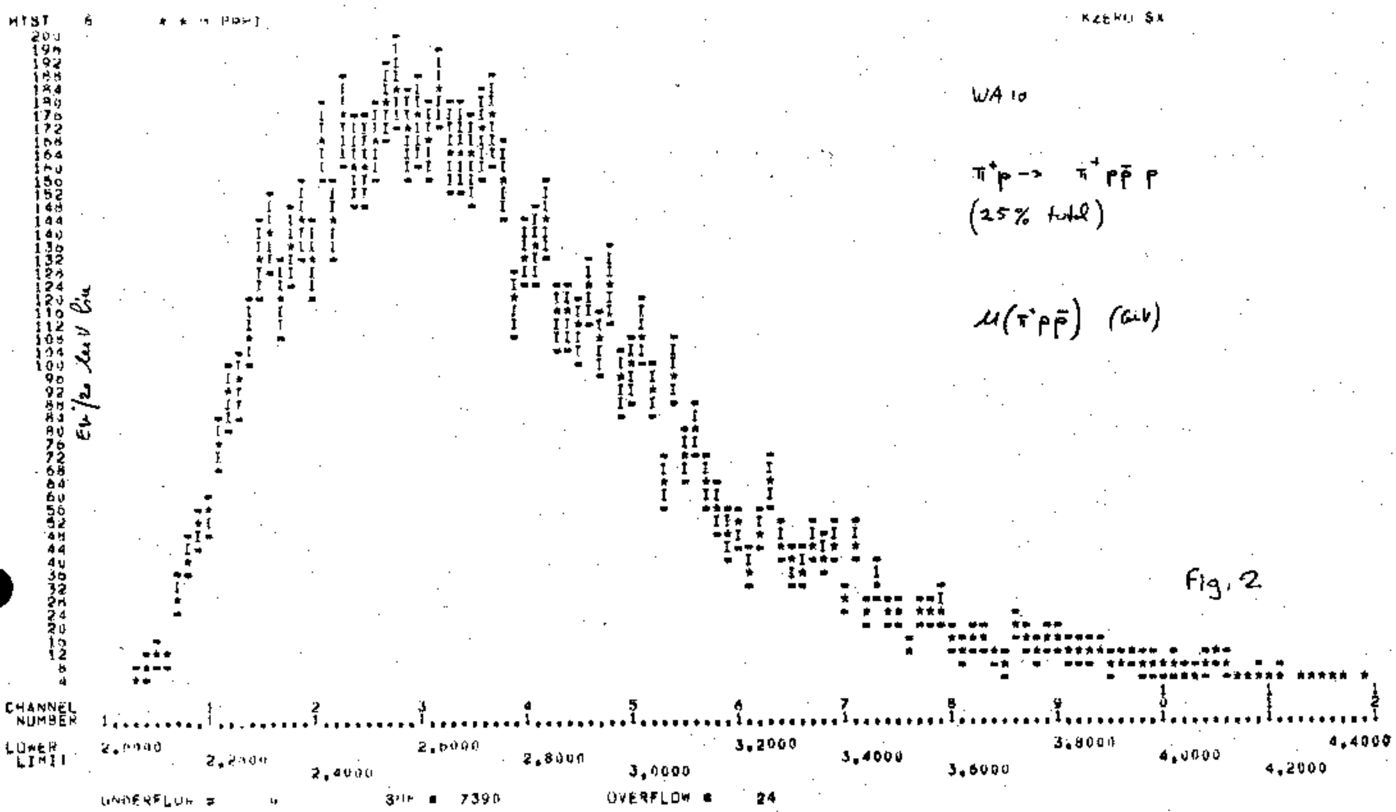
HIST 6
KZERO SX
WA 10
$\pi^+ p \to \pi^+ p \bar{p}\, p$
(25% total)
$M(\pi^+ p \bar{p})$ (GeV)
Ev/20 MeV Bin
CHANNEL NUMBER
LOWER LIMIT
2,0000 2,2000 2,4000 2,6000 2,8000 3,0000 3,2000 3,4000 3,6000 3,8000 4,0000 4,2000 4,4000
UNDERFLOW = 0
SUM = 7390
OVERFLOW = 24

Fig. 2

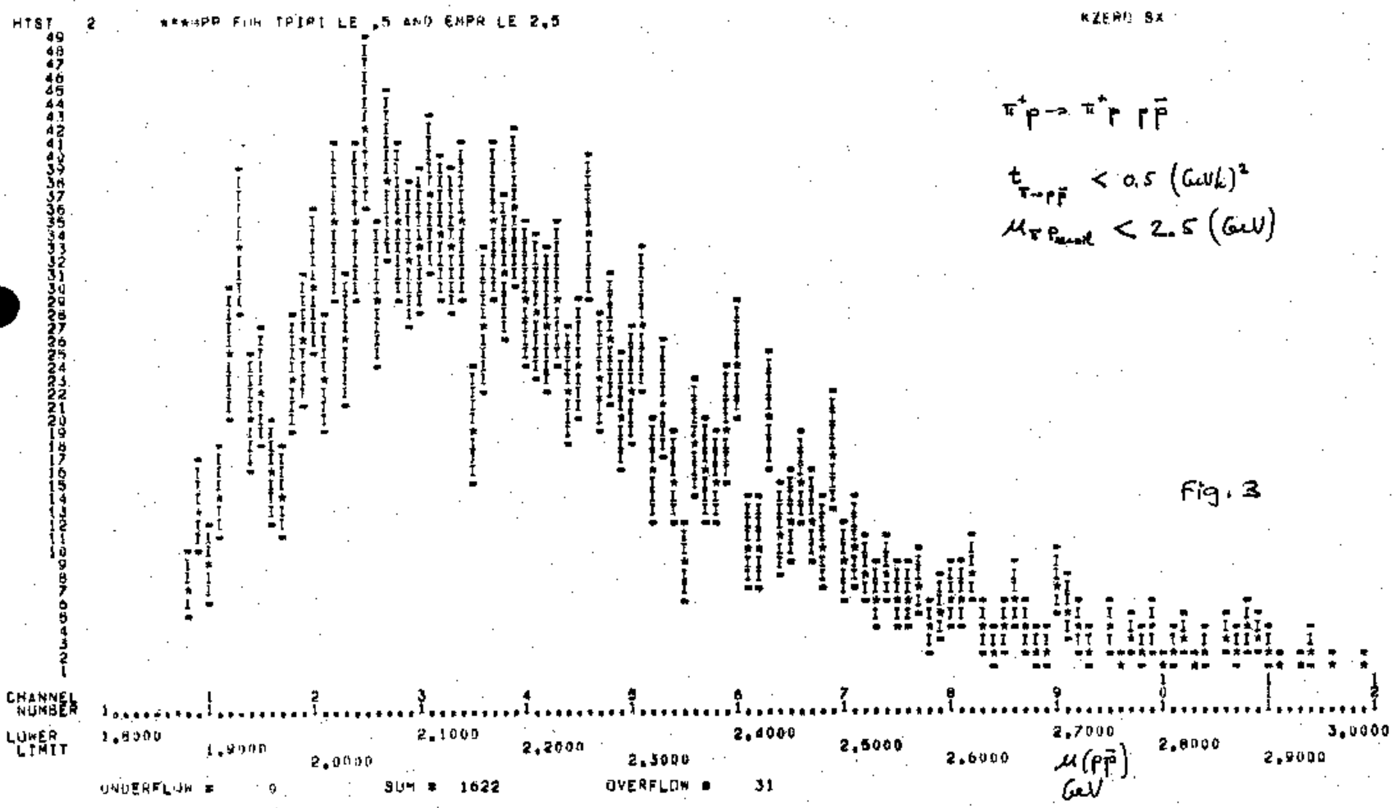
HIST 2
KZERO SX
$\pi^+ p \to \pi^+ p\, p \bar{p}$
$t_{\pi \to p\bar{p}} < 0.5\ (\mathrm{GeV/c})^2$
$M_{\pi p_{\rm recoil}} < 2.5$ (GeV)
CHANNEL NUMBER
LOWER LIMIT
1,8000 1,9000 2,0000 2,1000 2,2000 2,3000 2,4000 2,5000 2,6000 2,7000 2,8000 2,9000 3,0000
$M(p\bar{p})$ GeV
UNDERFLOW = 9
SUM = 1622
OVERFLOW = 31

Fig. 3