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M E M O R A N D U M

To/A : EEC

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Subject/: Objet Request for additional beam time for S133

The 6.5 days production run of Experiment S133 ($\pi\pi$ scattering lengths in Omega) took place in April 1974. 1/3 of the data were analysed and the results presented at the London Conference[1]. These were essentially:

from $\pi^-\pi^+n$: $\left|a_o + \frac{a_2}{2}\right| = (.26 \pm .05)\mu^{-1}$

from $\pi^+\pi^+n$: no result on $|a_2|$ because of an unfavourable signal/background ratio;

to compare with the Weinberg prediction: $a_o + \frac{a_2}{2} = .14$, $a_2 = -.045$;

and with other experimental results for a_o showing higher values of .4 - .6.

The full analysis of the experiment which was performed at 3.2 GeV/c and with a field of 7.2 kgs, is expected to yield an improved result for $\left|a_o + \frac{a_2}{2}\right|$, an upper limit for $|a_2|$, and a value for a_1^1, based on statistics of > 1000 events/μb for each of the two reactions, for $M_{\pi\pi} < 400$ MeV.

The background, which is the main limitation to the quality of these results, is due essentially to the reactions $\pi^\pm p \to \pi^\pm p\pi^o\pi^o$, $\pi^\pm p \to \pi^\pm p\omega^o$ and to a lesser extent $\pi^\pm p \to K^\pm pK^o$. We intend to suppress almost completely this background by

a) inserting 5 mm Pb in all veto counters, and

b) running at a higher magnetic field ($\sim$ 12 instead of 7.2 kgs)

thereby improving also the kinematical resolution.

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1) Y. Lemoigne et al.: The reactions $\pi^\pm p \to \pi^\pm\pi^+n$ and the $\pi\pi$ scattering lengths. Geneva, June 1974.

We ask therefore for an additional 5 - 6 days of beam time to repeat the experiment, with strongly reduced background, and at a higher energy of about 3.8 GeV/c, with the following aims:

- from $\pi^- p \to \pi^- \pi^+ n$, to derive a second result on $|a_o + \frac{a_2}{2}|$, at a different energy, so as to gain confidence that it does not depend on Dalitz plot reflections from N^* production (which would influence differently the Chew-Low extrapolation at different energies)

- from $\pi^+ p \to \pi^+ \pi^+ n$, to get a reliable result on $|a_2|$.

By-products such as a_1^1 and $\pi^- p \to K^- K^+ n$ should also benefit from the reduced background.

We recall the main virtues of this experiment, which are:

- high statistics
- same layout for $\pi^+\pi^+$ and $\pi^-\pi^+$, allowing a direct comparison of scattering lengths once the background problem is solved
- little t-dependence of the efficiency (at small t), allowing a clean Chew-Low extrapolation
- left-right symmetric layout, giving a clean identification of s-p interference (determination of δ_1^1).

The run can take place during parasitic time (GGM run) but should then be longer to make up for the shorter spill time. The Cerenkov filling should be such as to give a pion threshold of 3.3 ± .2 GeV/c.