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EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH

PHYSICS III COMMITTEE

REQUEST FOR SHIFTS FOR THE PERIOD BEFORE THE SC SHUTDOWN

(Experiment S.C. 19 b)

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Lately, the interest in the reaction $\pi^- + p \rightarrow \gamma + n$ in flight has considerably increased. Sanda and Shaw and Donnachie and Shaw[2] have shown that the photoproduction in the region of the Δ (1234 MeV) resonance data, taken at their face value, require an isotensor electromagnetic current. If, in addition, one believes the results of the UCLA group[3] on the radiative capture in flight, the electromagnetic current should have a C - even (i.e. time-reversal violating) component, most probably identical with the isotensor component. Such a current would not only consistently describe all photoproduction and radiative capture data (including our previous results[4]) but would also explain a completely different, possible (2 ½ standard deviation) indication of time reversal violation in electromagnetic interactions : the left-right assymmetry in the excitation of the Δ (1234 MeV) by inelastic scattering of electrons on polarized protons[5] . Further more, it would not be in conflict with any other known experimental fact. Obviously, the existence of an exotic C-even isotensor electromagnetic current would have far-reaching consequences in many branches of particles physics. It seems imperative to either confirm or definitely disprove the model of Sanda, Shaw and Donnachie. According to their analysis better photoproduction and radiative capture, experiments have the greatest chance of achieving this goal.

Our method[4] of measuring the radiative capture is considerably different from the method of the UCLA group and we believe that it is superior. We are in an excellent position to carry out a definite test on the existence of the exotic electromagnetic current. In our last proposal (P H III 71/3), we asked for a minimum number of shifts to check some of the experimental points measured by the UCLA group. At that time, the model of Sanda, Shaw and Donnachie did not exist and the UCLA data seemed rather unbelievable. Given a definite and plausible theoretical model, a much more serious effort is needed to check the UCLA data and the model.

We propose to measure the reaction $\pi^- p \rightarrow \gamma n$ at the CM angles of

60^{o} , 90^{o} , and 120^{o} for nine values of incident momentums between 220 and 380 MeV/c. Extended Monte-Carlo calculations have shown that using our method, one should be able to achieve the required accuracy. In order to convincingly test the existence of exotic currents irrespective of the outcome of the experiment, we need 250 shifts.

However, according to the degree of agreement between our future results and the existing data as well as different theoretical models, one could decide to terminate the experiment before all data points have been taken. To make the decision possible at the moment when the completion of the full experiment is still feasible before the SC shut-down 100 shifts should be allocated in 1971.

The previously proposed measurement of the cross section for the reaction $\pi^{-} p \rightarrow \pi^{o} n$ in the forward direction will be carried out in parallel, as proposed, under the condition that it does not disturb the main experiment. The tests of the large Na I crystal in the proton beam have demonstrated its homogeneous response to localized particles, so that we see no reason why the expected (shower-escape limited) resolution of ca 10 % for 200-400 MeV γ rays could not be achieved.

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2) A. Donnachie and G. Shaw, Daresbury Nuclear Physics Laboratory Preprint DNLP/P 79.

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4) J. Fevier, J.C.Alder, C. Joseph, B. Vaucher, D. Schinzel,
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