CERN LIBRARIES, GENEVA

66-35

CM-P00053642 EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH

LETTER OF INTENTION

10 August, 1966

To : Members of the Electronic Experiments Committee

From : J.V. Allaby, G. Bellettini, G. Cocconi, A.N. Diddens, G. Matthiae, E.J. Sacharidis and A.M. Wetherell

Re : Experimental programme for e_3 beam in 1967

This letter outlines a proposal to construct a 20 GeV/c spectrometer for use in proton scattering experiments in the e_3 beam. Two experiments using this spectrometer are discussed: (1) The measurement of particle production spectra in 20 GeV proton-proton collisions - An experiment which was started in the e_2 beam, but was curtailed by the PS breakdown in February, 1966, and discontinued because of subsequent decisions on the layout of bubble chamber beams in the East Hall; (2) A search for polarisation phenomena in p-nucleus collisions by means of a double-scattering experiment of protons on lead.

The spectrometer we propose would be an improved version of the one constructed and used in the e_2 beam[1]. It would utilise standard beam transport elements (4× 2 m bending magnets, 2 split-pole quadrupoles, and 4× 2 m standard quadrupoles) with in addition a septum magnet and a C-bending magnet. The latter two elements would enable us to vary the accepted scattering angle over the range 10- 60 mrad, which is the first improvement over our original fixed angle spectrometer. The second improvement is the incorporation of an intermediate focus to enable unwanted particles to be physically removed from the beam by means of a slit collimator. This should greatly reduce background produced by the high flux of protons accepted by the spectrometer when set to detect positive particles. With this feature, however, the spectrometer becomes long - about 90 m in total - so one proposes to locate the target inside the PS ring, thus saving valuable space in the East Hall. An attractive feature of this is that the hydrogen target does not need special radiation shielding, since it is inside the PS ring walls.

In order to minimize the hazards of hydrogen near the P.S.,

L. Mazzone propcses to construct for us a liquid hydrogen target using liquid helium as refrigerant, so that a minimal quantity of hydrogen will be needed.

The first experiment one proposes to carry out using this spectrometer would be a precise measurement of the spectra of particles produced in high energy proton - proton collisions, with particular attention being paid to the shapes of these spectra near the kinematic limits, which yield information of the production mechanisms. Such an experiment was started in the e_2 beam in collaboration with Meunier, Spighel, Stroot and co-workers, who provided the DISC counter. The combination of the high-momentum resolution spectrometer and the high velocity resolution DISC was found to be extremely powerful for the identification of the secondaries produced. Although the experiment in the e_2 beam never had data taking runs, the equipment was completely tested and the data taken during these tests were presented in Ref.1. We would like to continue this fruitful collaboration and complete the measurements started in e_2 .

A second experiment at present under serious consideration would be a search for polarization phenomena in p - nucleus scattering. A previous experiment by this group gave the differential cross section for high-energy p - nucleus scattering from several nuclei [2]. The characteristic diffraction scattering was clearly seen, but the diffraction minima were filled up with respect to the calculated Bessel-function distribution in a manner which could not be explained by the finite angular resolution of the experiment. In analogy with the situation in low-energy nuclear physics, one is led to speculate on the possibility of non-negligible polarization of the protons scattered in the region of the diffraction minima. If appreciable polarization were produced, one would be able to prepare beams of polarized protons which would be a powerful tool for further investigation of the strong interactions at high energies. We feel this possibility merits an experimental search for such phenomena.

In order to detect polarization effects, one would carry out the classic double scattering experiment. A thin lead foil in the e_3 beam, placed slightly upstream of the hydrogen target, would be the first target.

The first half of the proposed double-focusing spectrometer would then momentum analyse the small-angle elastically scattered protons and direct them onto a second lead target, in the region of the intermediate focus. The second half of the spectrometer would then momentum analyse the doubly scattered protons. Detection could be by means of the sonic spark chambers already developed by this group[3]. The spark chambers after the second scattering would detect a selected range in polar scattering angle and be sensitive over the whole azimuth, so that polarisation would be apparent in a left-right asymmetry of the distribution of second scatterings.

It is estimated that one would need ~ 4 weeks of extracted beam around April 1967 for the small-angle production experiment, and ~ 4 weeks around September 1967 for the p - nucleus polarization experiment. Both experiments would run in parallel with the externally produced secondary beams from e_3. Each data taking period should be preceded by a setting-up period in which, for example, 1 : 10 ejection would be an acceptable operation.

After discussions involving Petrucci and potential other users of the e_3 beam, one has arrived at a possible location for the spectrometer we propose. It is indicated on the attached drawing. The septum magnet we require is still being designed, but all other elements are standard and, we believe, available.

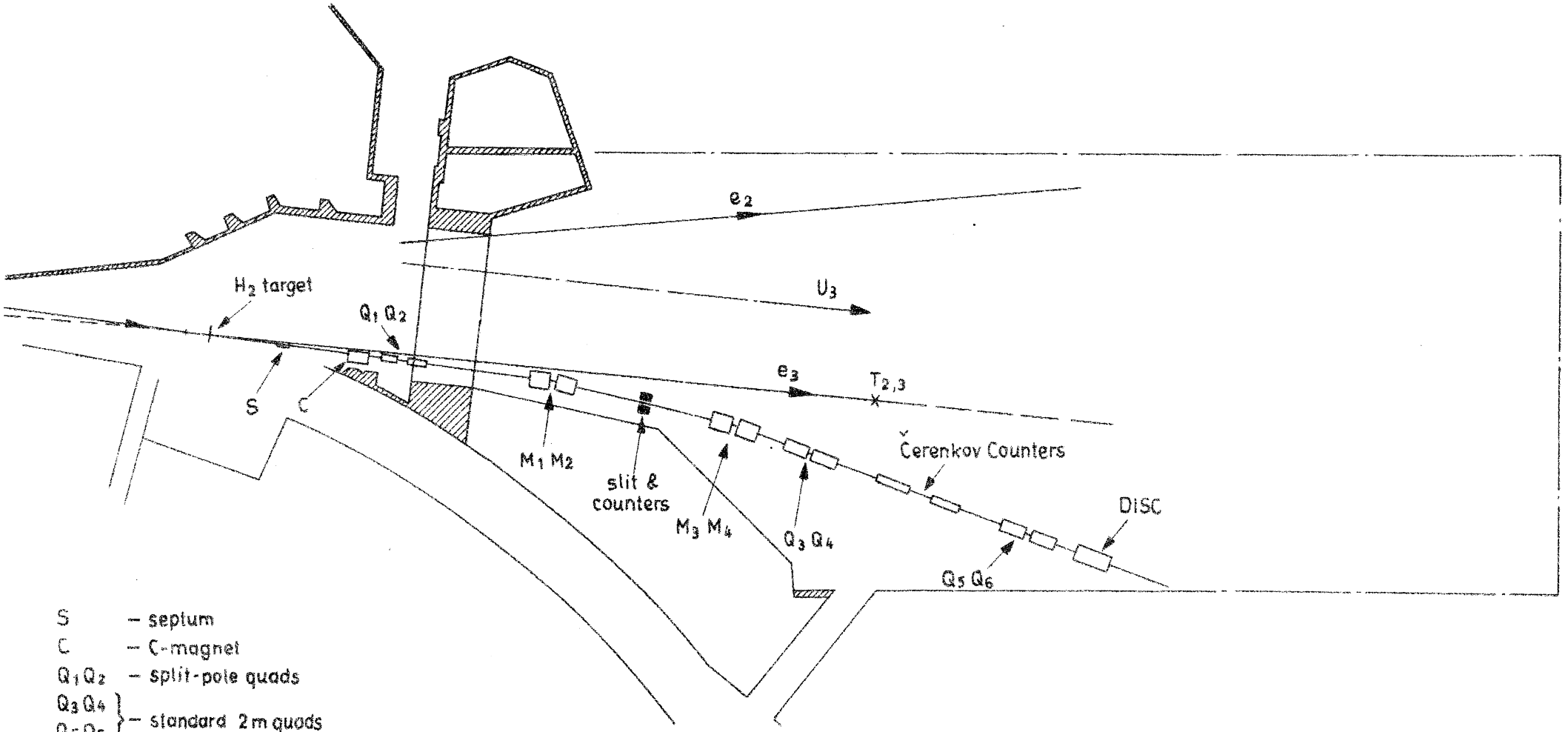
In conclusion, our first experiments in the e_3 beam require a high momentum resolution spectrometer to detect only one particle in the final state. For these experiments, a target located inside the PS ring seems desirable. For the future, however, one anticipates the construction of more complicated experiments involving detection of more than one final state particle. For this reason we wish to stress the desirability of retaining sufficient space in the e_3 beam for eventual location of a hydrogen target in the East area, as a more general facility for proton - proton experiments.

---

1. J.V. Alaby, G. Bellettini, G. Cocconi, A.N. Diddens, S. Gjesdal, G. Matthiae, E.J. Sacharidis, A. Silverman, A.M. Wetherell and J.P. Garron, L. Hugon, R. Meunier, M. Spighel, J.-P. Stroot and P. Duteil, NP/Int. 66-2 (22.6.1966)

2. G. Bellettini, G. Cocconi, A.N. Diddens, E. Lillethun, G. Matthiae, J.P. Scanlon and A.M. Wetherell, Nucl.Physics 79, 609 (1966).

3. G. Bellettini et al., CERN 65-33 (NP Div.), 25 Oct. 1965.



S – septum
C – C-magnet
$Q_1 Q_2$ – split-pole quads
$Q_3 Q_4$, $Q_5 Q_6$ } – standard 2 m quads
$M_1 M_2$, $M_3 M_4$ } – 2 m bend magnets

Small-angle Spectrometer

e_3 beam