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PROPOSAL FOR AN EMULSION EXPERIMENT IN
THE FAST EJECTED PROTON BEAM OF THE PS

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The aim of the experiment is to study the production and the interactions of negatively charged hyperons by separating them from the background by means of a pulsed high magnetic field. In the fast ejected proton beam this experiment can be done with one pulse per emulsion stack.

The experimental arrangement is as follows (the attached figure 2 shows the geometry): secondary particles coming from a thin foil target placed in the 25 GeV proton beam enter an emulsion stack at a distance of about 3cm from the target. A magnetic field of 200 KGauss selects these particles according to their momenta; the incident angle of a particle determines its momentum (see figure 1a!).

The negative baryons can then be separated by measurement of the incident angle and grain density in the first 500 μ of emulsion. In the angular interval corresponding to negative particles of 450 - 1000 MeV/c (see figure 1b!) baryons produce grey tracks whereas pions and kaons produce minimum tracks and can be excluded visually without grain counting; the majority of antiprotons can be excluded by measuring the incident plane angle and grain counting over several fields of view in the microscope.

The fast ejected proton beam of the PS provides optimum conditions for the experiment:

- 1) the intensity is about $5 \cdot 10^{11}$ protons per pulse; hence one pulse yields sufficient particles in one stack even with a very thin target.
- 2) the beam is focused to about 1-2mm in diameter.
- 3) with the effective target size of about $0.02\text{mm} \times 3\text{mm}^2$ a momentum resolution of ± 25 MeV/c can be achieved.

4) the particle burst is extremely short (2.1 μ sec) compared to the pulse of the magnetic field (\sim 5000 μ sec); the maximum variation of the field over the duration of the particle burst will be less than 0.1 KGauss at a field strength of 200 KGauss.

Background. All charged nonrelativistic particles not originating in the target can simulate hyperons. Such particles may come from interactions of the beam fringe in any parts of the coil, or from secondary interactions on the inside walls of the coil. The experiment is feasible only if this kind of background ("coil-background") is very low.

Test. In order to obtain exact numbers concerning the "coil-background" a test without magnetic field will be made. (This can be done in February when measurements of the beam fringe and the beam stability will be carried out). Two pulses will be made, one without the target, the other with the target. The pulse without the target will show the "coil-background" apart from that fraction which comes from interactions of secondary particles. The pulse with the target will give both the intensity of all target particles and the full intensity of "coil-background" (in the test emulsions these correspond respectively to tracks pointing in the direction of the target and tracks pointing in other directions).

Technical details of the experiment. The magnet coil will be placed at the beginning of the 25m-channel of the neutrino beam. The beam will enter and leave the coil through a hole of 11mm diameter. The beam will be enclosed in the vacuum tube which extends up to the coil. Thus spurious material in the beam path is reduced to a minimum. The position of the target and the emulsions in the coil are shown in figure 2.

A copper foil of 20 μ thickness will be used as target. The effective target size will be the spot where the beam hits the foil.

An X-ray film at the end of the beam hole will check the beam position for each pulse.

About 5 stacks of G5 emulsions (12 pellicles of 1200 μ) will be exposed. The full intensity of the beam (about $5 \cdot 10^{11}$ 25GeV protons per pulse) will not be used. It will be decreased to about 5% by taking only one bunch out of 20. The number of interactions will be $4 \cdot 10^6$. They will produce about $4 \cdot 10^2$ tracks/mm² in the most populated parts of the emulsion. Independently of the calculations the test plates used for the background test will give a rough estimation of the number of tracks.

State of preparations. Two coils have been built in Munich; they have been tested and are ready for the experiment. Only one of these will be needed. These coils are of the type which has been constructed in the CERN emulsion group where they have been used for several exposures; they can stand about 3000 pulses at 200 KGauss. As only a total of about 5 pulses are wanted one may reasonably take the full power of the condensor bank for two pulses in order to reach 230 KGauss. The state of preparations allows the experiment to be done immediately. At the PS it could be done at the end of the shut-down before the start of the neutrino run.

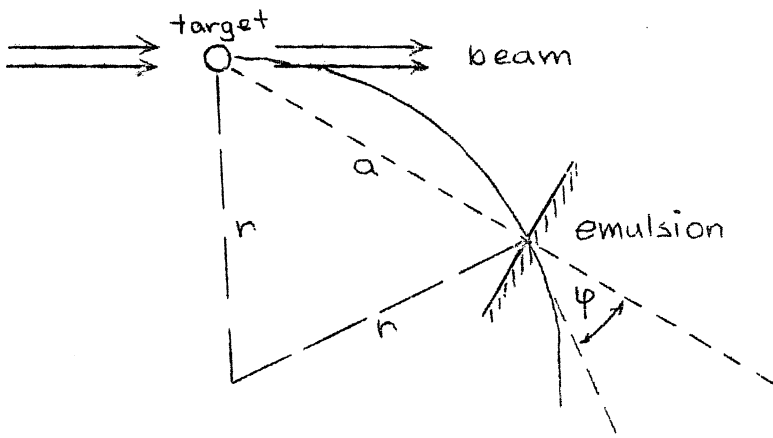
Scanning. In the interval of incident angles corresponding to particles of a momentum between 450 and 1000 MeV/c only baryons produce grey tracks. These grey tracks will be picked up and the plane angle will be measured to give the momentum of the particle. Over 500 μ of track length grains will be counted. The result of both measurements will determine a point in the momentum-grain density plane. If this point lies very near or below the antiproton curve the track will not be followed any further. In this way about 60 or 70% of the antiprotons will be discarded. Our effective target size allows momenta to be determined to ± 25 MeV/c, hence only a small percentage of hyperons ($< 5\%$) will be missed by this procedure.

The time for separating 100 hyperons from the background is estimated at 30 scanner days.

Machine time. The experiment could be done together with the proposed CERN-Warsaw experiment in the same set-up. One shift is required for both experiments together.

Suitability of the method. The proposed method for separating hyperons is practicable in the momentum range up to 1000 MeV/c. Above this value the grain densities of the baryons become too low for visual distinction from pions. The method may be especially useful in studying the interactions of negative hyperons. Even decaying negative hyperons should be found at a better rate than in bubble chamber pictures.

Fig. 1a



$$\sin \phi = \frac{a}{2n}$$

$$B_{\text{gauss}} \cdot r_{\text{cm}} = \frac{10^4}{3} \cdot \rho_{\text{MeV/d}}$$

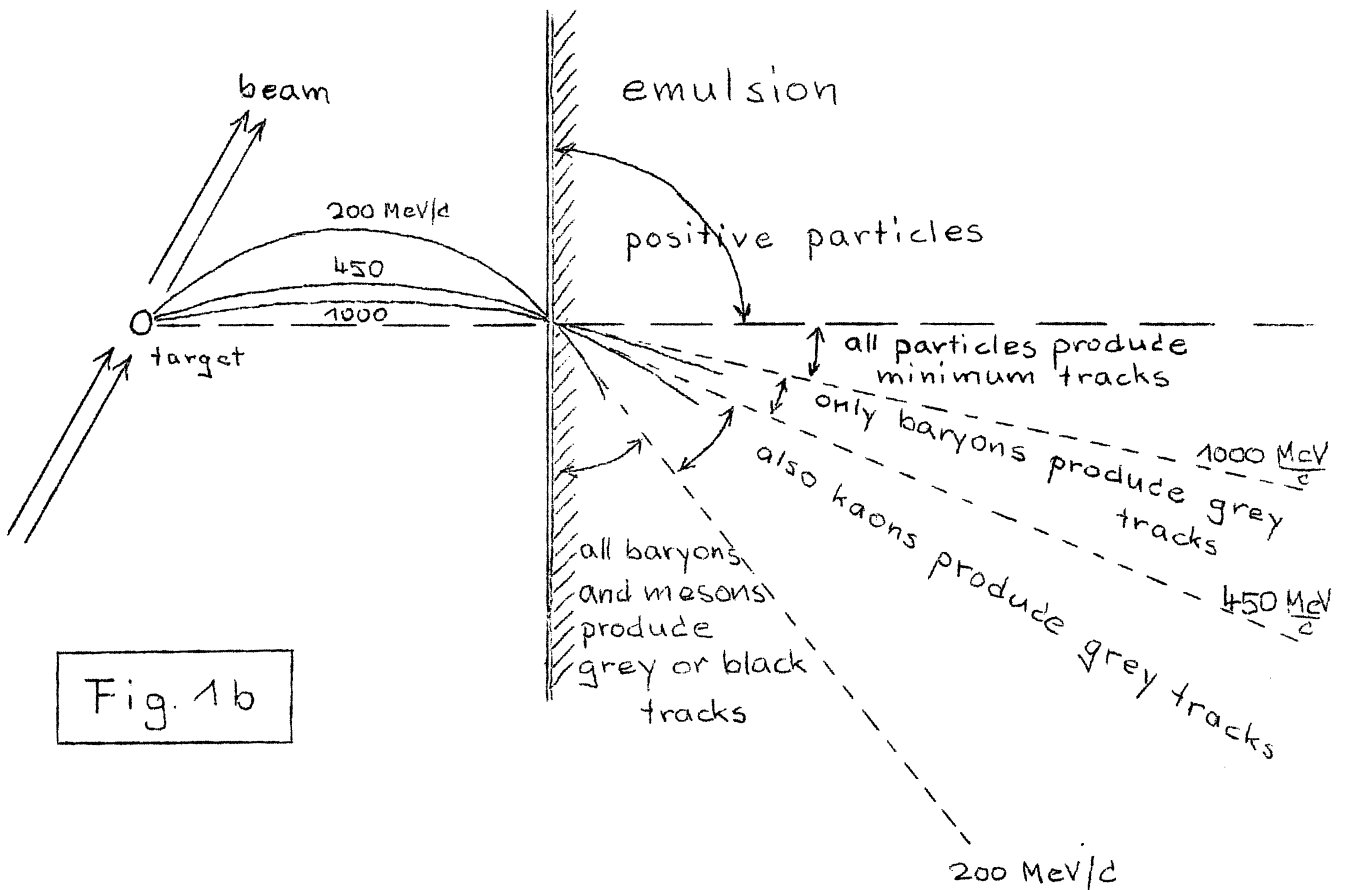


Fig. 1b

