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# Proposal for an experiment to study the emission of nuclear fragments from 24 GeV/c proton interaction with Ag, Br by using photographic emulsion with reduced sensitivity.

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## 1. Introduction.

For the past few years the Warsaw group has been investigating the emission of $Li^{8,9}$ and $B^{8}$ fragments from interactions of protons of 9 GeV/c and 24 GeV/c with heavy nuclei of emulsion, Ag,Br./1,2,3,4,5,6/ These fragments can be easily identified in emulsion by the observation of their characteristic decays at the end of their range ("hammer tracks"/7/).

Photographic emulsion technique is well suited for this type of study. It allows to examine the individual disintegrations leading to the ejection of nuclear fragments and to determine with great precision the angles of emission and the energies of charged particles emitted from such interactions. In particular the photographic emulsion makes it possible to observe tracks of charged particles of low energy, for instance those of nuclear recoils.

## 2. Purpose of the experiment.

With the emulsion of normal sensitivity, such as NIKFI-R or Ilford G5 used until now by the Warsaw group, it has been difficult to perform the detailed analysis of the primary disintegrations. This is because in the interactions of energetic protons with heavy nuclei, stars with a large number of prongs are often formed. In such cases the short-ranged recoils cannot be detected against the background of other tracks formed

in such disintegrations. Moreover, in the emulsion of normal sensitivity it is impossible to identify unambiguously the multi-charged, stable*/ fragments of short ranges or even to distinguish them from low energy $\alpha$-particles and protons.

Recently Baker and Katcoff[8] have demonstrated that emulsions with reduced sensitivity are very useful in the study of interactions of protons of energy 1,2 and 3 GeV with heavy nuclei, Ag, Br. They have used Ilford D.I emulsion processed such that it was completely insensitive to singly charged particles thus allowing to examine in detail each disintegration centre. The angular and energy distributions of $\alpha$ particles, light fragments ($2 < z \leq 6$), recoils and fission fragments have been investigated in their work.

A similar approach is suggested in this proposal as an extension of the studies carried out at present by the Warsaw group.

It is proposed to study the emission of $Li^{8,9}$ and $B^{8}$ fragments from interactions of 24 GeV/c protons with heavy nuclei, Ag, Br by using the insensitive emulsion of Ilford K.0 to K.2 series.[9] In these conditions it should be possible to investigate the energy end angular correlations of $Li^{8}$ fragments with other light fragments and recoils and fission fragments ejected from such disintegrations. In this manner additional information should be obtained which may lead to a better understanding of the mechanism of emission of $Li^{8}$ fragments from heavy nuclei at very high excitation energies.

## 3. Proposed experimental conditions.

It is proposed to expose a stack of insensitive emulsions to the proton beam of 24 GeV/c momentum when such a beam is available at CERN.

The stack will be composed of 32 pellicles each of dimensions 2" x 4" x 600$\mu$. These will be 3x10 pellicles of Ilford K.0, K.1 and K.2 emulsion respectively and 2 pellicles of K.5 emulsion, one on each side of the stack.

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* i.e. fragments which do not give rise to "Hammer tracks".

It would be convenient if during the exposure the proton beam entered the stack parallelly to its 2" side to within $1^{o}$. The two pellicles of K.5 emulsion would allow a direct determination of the beam direction in the stack to be made.

The convenient total density of irradiation would be $5 \times 10^{6}$ protons/$cm^{2}$.

The emulsion will be processed at CERN by one of us after some test processing has been made.

4. Microscope work.

Area scanning for stars containing "hammer tracks" will be performed.** It is estimated that at least 1000 such stars will be needed to investigate the $Li^{8}$ correlation with recoil and fission fragments. The high intensity of proton beam should reduce the time needed for scanning, with 2 scanners and 2 physicists it should be possible to complete the whole work in less than a year.

In future, these emulsions will be also used for investigations of the emission of other light fragments.

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** "hammer tracks" can be observed in such insensitive emulsion - see /8/.

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   See this paper for references to other publications on this subject.

9. Ilford Research Laboratory, Photographic emulsions for nuclear research (March 1961).