NAL PROPOSAL No. 244

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September 1973

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During the latter part of the year 1972, we exposed a small stack of Ilford G-5 nuclear emulsion to a beam of 200 GEV protons with a flux of $2x10^4$ protons | cm^2 at NAL. By "along-the-track" scanning method, 400.3 meters of proton track were scanned and 1244 interactions were found. Out of this, 227 interactions were classified as white stars which consists of only relativistic particles, except in some cases the recoil target proton appears with non-relativistic velocity. The white stars were used to find the multiplicity and the angular distribution of the secondary particles. The multiplicity distribution parameters i.e. $<n_{ch}>$, D and f were calculated. From the angular distribution of the secondary particles, the Castagnoli's method of determining the primary energy was checked.

Apart from the above analysis, we were interested in the coherent production of multiparticle final states. Recently several theoretical 2-5 papers have considered a special type of inelastic interaction between a high energy particle and a nucleus acting as a whole: a coherent interaction[6] i.e., an interaction where the nucleus remains in its fundamental state. The consequence of this is that no individual nucleon in the nucleus plays a particular role in the interaction and that the total amplitude is given by the sum of the amplitudes for each nucleon. This means that for the nucleus to act coherently in a reaction, one would expect that the recoil momentum (q) should not much exceed the inverse of the nuclear radius R, i.e., $q = R^{-1}$, nor the Fermi momentum which is typically a few times R^{-1} ($h = c = 1$). The coherent reactions should thus appear as much more forward peaked than the reactions on free nucleons and their differentials cross-sections at zero degree should also be larger. The simplest example is elastic scattering on nuclei which has been observed and extensively studied in a very large range of nuclear masses, incident particles, and energies, primarily by spark chamber and counter techniques 6-7. Inelastic coherent reactions, in the sense that the nucleus remains intact but the incident particle does not, have only been observed by nuclear emulsion 8-12 and bubble chamber 13-14 techniques at low energies. The space resolution in nuclear emulsion is very high. It has been found that the cross section for the reaction ($\Pi^- + \text{nucleus} \rightarrow \Pi^+ \Pi^- \Pi^- + \text{nucleus}$) is much smaller[5] at (6 to 8) GeV/c than at 14 and 16 GeV/c. The coherent production at 45 and 60 GeV/c in nuclear emulsion were also studied by Russian groups. The possibility of further increase of the cross-section was suggested by the Polish group [11, 15], who worked with an average energy of negative pion $\simeq$200 GeV. This study at 200 GeV/c is of course not free from a number of serious objections.

In our recent analysis of coherent production of particles by 200 GeV protons was observed in nuclear emulsion from the data obtained in 400 meters of track length found by along-the-track scanning method. The interaction length for trident production via the coherent process for the experiment at 200 GeV turned out to be $\lambda_3 = (19.1 \pm 4.2)$ meters in nuclear emulsion which gives a $6_{3coh} = (11.2 \pm 2.5)$ ml.

Our experimental results indicates that the cross-section for coherent production is increasing with energy up to 200 GeV. What happens at higher energies, we do not know. Our new experiment at 300 and 400 GeV would answer this question. Hence we are very anxious to have an emulsion exposure at 300 and 400 GeV to answer this important question.

Proposed Experiment

It is proposed that a small stack of 24 pellicles of Ilford G-5 nuclear emulsions of dimensions 10 cm x 15 cm x 600 micron thinkness be exposed to 3×10^4 particles | cm^2 with 300 GeV proton beam. Each beam shall enter the stack from 10 cm. width side in such a way that the beam is parallel to the plane of the emulsion (along its 15 cm length).

The development of the stack will be our responsibility.

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