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III-6-24. ICEF Project*

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Discussion

Peters, B.: The singly charged fragments from the break-up of heavy nuclei contain a considerable fraction of deuterons and tritons as indicated by the fact that the interaction m.f.p. of these fragments is much shorter than m.f.p. for protons. The amount of energy given to π^0 mesons in a collision of singly charged fragmentation products of heavy nuclei of known energy per nucleon is therefore higher than the energy to π^0 mesons in collision of protons of comparable energy. Results apply to collisions in emulsions. When applied to the atmosphere one may expect a further reduction in the energy going to π^0 mesons due to the smaller atomic weight of the air nuclei.

Koshiba, M.: There are also other evidences on air shower experiments which support rather constant fraction of primary energy of the order of, say, 50% going into π^0 and $\pi^{\pm}$, which is almost constant with the primary energy.

Peters: I am talking about your measurement which indicate, it seems to me, rather lower value than 16% for protons colliding at these energies.

Koshiba: Those points (Fig. 6, III-6-8) have not been obtained from secondary interactions. They are all from primary interaction and also the correction due to the secondary unclear interaction has been in first order made.

Peters: Break-up products of heavy nuclei contain many more deuterons and tritons than the primary cosmic ray. I don't know how many contained in the primary, but in any way, they will give us spuriously high value of energy going into π^0 mesons.

Koshiba: Yes, but I don't see what the relation is between your comment and the results I have shown in the π^0 energy variation with primary energy estimate.

McCusker, C. B. A.: Regarding a question by Dr. Peters, the $\langle n_s \rangle$ in ICEF stack for primary jets is the same as for the Chicago 22 liter stack which was flown at the great height and where the deuteron contamination due to break-up in the atmosphere was small.

Zatsepin, G.T.: Have you any data about the inelasticity for the collision of a proton with a nucleus?

Koshiba: I can not give you the answer at the moment.

Powell, C. F.: I think the point of discussion is centering around the question. The point in issue is whether the results on the inelasticity going into π^0 mesons refer to mesurements based upon secondary particles from fragmentation, where you know energy per nucleon with the highest precision, or they refer to isolated particles coming in. Dr. Peters' point is that if your measurement refer to fragmentation of heavy nuclei, you ought to take into account of increased fraction of deuterons among the secondary products which are singly charged.

Pinkau, K.: Mean free path of the singly charged fragments from heavy nuclei at an energy of 25 Gev is about half of that of protons at CERN machine. The number of deuterons and tritons among those particles must be therfore high and if treated these as protons then they supposedly give us high value for the amount of energy given to π^0 component.

Yamaguchi, Y.: I would like to know if you have found any indications on the differences between primary and secondary interactions (or N-N and π-N collisions).

* The contents of this article are similar with III-6-8 and the separate manuscript was not provided.

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Koshiba: My feeling is that we did not see any difference within the exprimental data we have.

Powell: May I ask a question in relation to Prof. Miesowicz's talk? Can you give us any idea of the kind of statistical weight available in ICEF stack for testing the kind of conclusion that Prof. Miesowicz has drawn? I think it will be very easy to apply these very clear and definite procedures to the analysis coming out of this big stack.

Koshiba: I think if you will include the present ICEF stack and the possible next successful stack exposure, we can easily improve statistics by a factor of ten.

Powell: Increased by a factor of ten. This will be presumably very great value for the critical examination of conclusion. I also like to ask another point related to the analysis of the stack. It will give us the possibility of examining not only the characteristics of primary protons but also the characteristics of secondary interactions due to fast π mesons. And I understood from discussion in some of earlier sessions that, for example, Prof. McCusker's procedures for the estimation of the primary energy would in his opinion, I believe, give a better value for the primary energy taking into account of secondary interactions of nucleons. Will it be easy, I would like to ask to Prof. McCusker, for these procedures to be applied to? As standard procedures irrespective of any question of interpretation.

McCusker: I think in the case of primary interaction it is quite easy to correct or to make first approximation to correcting for the cascading in target nucleus. This is the thing one can do in a very short time.

Matsumoto, S.: You said that P_t distribution of π mesons and other particles are nearly equal. However, I think there is no *a priori* reason that the Castagnoli method can be applied to pion-nucleon and hyperon-nucleon collisions and so on. How do you think about it?

Koshiba: Even in the case of π meson, we don't have this evidence, foreward-backward symmetry in the c.m.s.. What we can say is this. Data from CERN machine indicate that P_t distribution or rather average P_t value is the same within the experimental error for π meson nucleon and hyperon, except possibly a little bit higher value for Σ^+. The same conclnsion has been obtained by Prof. Fretter in magnetic cloud chamber at higher energies that P_t distribution is the same for X-particle and π particle. From our results on ICEF, well naturally you can imagine there are some change, but within the experimental accuracy the result is consistent with the same P_t value for non π particle and π particle.