COMMENTS ON HYBRID VISUAL-MAGNETIC SPECTROMETERS

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Fields et al., (NAL Summer Study Report A. 3-68-12) have suggested a combination visual-magnetic spectrometer which is alleged to provide for the study of general hadron collisions up to ~ 100 BeV/c. Since this device is likely to be quite expensive, it is of some importance to attempt an evaluation of the physics capability of this device compared to other detection systems. Our comments on this subject are best expressed by a series of statements.

1. The large bubble chamber (25-ft and/or 12-ft) will probably be adequate for a general survey of topological cross sections as well as allowing for the detailed study of a small number of final states that fall into the 4c or 1c class. It should be emphasized that there is a great deal of information available from final states that are under-constrained (more than one missing π^o). For example, the basic features of a multiperipheral model of high-energy collisions can probably be tested without full knowledge of the final states.

2. The large chamber has one additional advantage over the small spectrometer, namely, the secondary interactions of particles in H_2 can frequently be useful in identifying the particle coming from the first vertex. For example, a K^- will frequently make a slow Λ but a π^- will very seldom produce such a Λ.

3. However, in my opinion, a small hybrid system can be of great advantage provided the possibility exists for selecting interesting final states. This is in part due to the small cross section for any given final state at high energies and the need for high statistics for correlation studies. There are two broad classes of final states to be considered, namely, final states which are studied for the purpose of meson and baryon spectroscopy and final states which give insight into production mechanisms. Clearly there is no hard distinction between the classes. Examples of the former would be the reactions

$$K^- + p \rightarrow K^+ + [S = -2 \text{ states}],$$

$$\pi^- + p \rightarrow p + [\text{high-mass bosons}],$$

whereas examples of the latter might be the study of $\pi^- + p \rightarrow 3\pi + p$ to study diffraction dissociation process ($\pi \rightarrow 3\pi$). At present, only very crude triggering schemes have been used for the first class of events and the study of the second class of processes has been restricted to simple two-body final states using spark chamber and counter techniques. Clearly, before any hybrid system can be designed a great deal of thought must go into the triggering schemes and requirements. (For example, wire chambers in a large magnetic field adjacent to the visual device seem essential to many triggers). In my opinion, without broad trigger capabilities, these hybrid systems will be of little use. It seems likely also that if these devices are to be used at high energies

(~50 BeV/c), knowledge from survey experiments (say in a large bubble chamber) would be instrumental in the design of the trigger.

4. Instead of relying on very high precision momentum measurements in such spectrometers to sort out events with 1 or no missing π^o's, it is probably more reasonable to surround the device with heavy spark chambers in order to "see" all missing neutrals with high efficiency. Even if the γ-ray energy is not well measured, the knowledge concerning the existence and number of π^o's as well as the γ-ray angles will be invaluable in selecting and purifying final states. The time resolution of the spark chamber should reduce the γ-ray pointing confusion. With such additional information the requirements for the high precision magnetic spectrometer would probably be much less severe than that discussed by Fields et al.

5. It seems very likely that a properly designed rapid-cycle 1-m bubble chamber at NAL would be in constant demand. One can anticipate that the first experiments at NAL with such a device would be with relatively low-energy beams. Later this device might be useful in a high-energy hyperon beam or as part of a triggered hybrid spectrometer. Since similar devices already are in use or are being considered at other laboratories, I suggest that the decision concerning such a device be delayed for a year or so. Similar remarks hold for the streamer chamber. It would be worthwhile to reopen this question in the 1969 Summer Study.