CHOICE OF BEST CONDITIONS TO PRODUCE OMEGA MINUS HYPERONS

D.R.O. Morrison
CERN – Geneva

Problem

The confirmation of the existence and the study of the properties of the omega minus hyperon is important as a test of SU 3 theory. We ask the question "What is the most useful momentum of incident K−, is it 3.5, 5 to 6, or 10 GeV/c?" A "useful" momentum is one for which
1) the cross-section to produce Ω− is the largest possible;
2) the properties of the Ω− can be studied.

Experimental Information

The most widely known data on the production of strange particles are those of Λ and Σ hyperons by pions, and also of Ξ− hyperons by K− mesons. The comparison of these reactions with Ω− production by K− is inadequate and also misleading. The comparison is poor because the above reactions can be expressed as a single meson exchange graph and involve unit change of strangness, whereas Ω− production cannot be expressed by a simple Feynmann graph and it involves a strangeness change of the baryon of two units.

Total Lambda production by pions has a peak of ≈ 1 mb near 1 GeV/c, then falls and then rises steadily, being 1.45 mb at 10 GeV/c. Such an early peak near threshold may also occur for production by K−, but is NOT characteristic of more complicated reactions. From memory and from discussions with members of the European 4 GeV/c π± collaboration, there seems to have been no recorded instance of Ξ− production by pions below 6 GeV/c. With 10 GeV/c π− a cross-section for production of Ξ− of 15.5 ± 4.5 µb (12 events) was found by the CERN group of Bigi et al.1). With 8 GeV/c π+ the CERN Warsaw collaboration have found three events on a comparable number of photographs (80,000) despite the fact that π+ is less efficient than π− to produce negative hyperons.

Results on searches for Ω− hyperons on film at 3.5, 5 and 6 GeV/c indicate also that the cross-section is small (probably < 1 µb) near threshold.
The conclusion is that the total production cross-section of Omegas increases monotonically with incident K-momentum. There are, however, more channels available at higher energies and consequently one should discuss the following points:

(a) Can we analyse the events at 10 GeV/c?
(b) Do the most interesting channels (low multiplicity) decrease in cross-section with increasing energy?

For (b), the effect due to the increase in the number of channels in going from 5 GeV/c to 10 GeV/c may decrease the cross-section by a factor of about two, whereas we may expect (by comparison with the reaction \( \pi^+ p \rightarrow K^- \ldots \)) an increase of a factor of ten in the total production cross-section of Omegas.

For (a), it is found that, with 10 GeV/c \( \pi^- \), the \( \Xi^- \) are produced backwards in the CMS (average \( P_L = -0.68 \) GeV/c). They are hence of low momentum in the laboratory and easy to measure. With 8 GeV/c \( \pi^+ \), it has been found that kinematical fits to strange particle production reactions with no missing neutrals can be made frequently and without serious difficulty. It is reasonable to expect that events with an Omega produced by 10 GeV/c K\(^-\) can also be studied.

References
1) A. Bigi, S. Brandt, W.A. Cooper, Aurelia de Marco, Ch. Peyrou, R. Sosnowski, A. Wroblewski, "On the Associated Production of K-Y Pairs by 10 GeV/c \( \pi^- \) in the Hydrogen Bubble Chamber", (Submitted to Nuovo Cimento).