PARTICLE PRODUCTION AT 45° AND 60° IN THE CERN PS

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G E N E V E

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* * *

Particle production at 45° and 60° from the internal target of the CERN PS was studied. The experimental setup is shown in Fig. 1. The machine was operated at 19.2 GeV/c on a two-second cycle with 100 macc long bursts, the intensity being about $2 \times 10^{11}$ protons per burst. The target was beryllium poudre tamis 200, supplied by Pechiney, and contained about 1% oxygen and 1/4% other metals. A CERN 2-metre bending magnet, located 646 cm from the target, deflected the particles by an angle of 27.7°. The last counter was located 1238 cm beyond the magnet. The solid angle subtended by the counters was about $0.27 \times 10^{-4}$ steradian, and the momentum bite was about 1.6%. The vertical focusing of the bending magnet increased the intensity of particles at the counters by a factor of two. The data given below have been corrected for this effect.

Three types of counters were used:

1) scintillation counters, which counted all particles having a momentum such that they were bent into the channel by the magnet.

2) threshold Čerenkov counters, $\beta > 0.8$, which counted pions (and muons and electrons) but not protons at the momenta of interest. Subtraction of (2) from (1) yields the number of protons, assuming that the number of kaons is negligible by comparison.

3) DISC counters covering the range $0.86 < \beta < 0.89$ and $0.90 < \beta < 0.95$. Such counters have a rejection in excess of $10^4$ and thus are ideally suited for detection of the small kaon component remaining in the beam 19 metres from the target.

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The results, corrected for decay, are presented in Figs. 2 and 3. These data are not corrected for:

i) scattering in the air and in the counters; about 20% of the particles are lost;

ii) target efficiency.

None of these corrections changes the relative number of particles appreciably. The results for pion and proton production are qualitatively consistent with measurements by Fitch et al.\textsuperscript{1)}, though the absolute values seem somewhat higher than theirs (by a factor of about 2). As the target used was not in the fringing field of the CERN FS, the comparison of intensities of positive and negative particles in this measurement should be particularly reliable. Also, the data at 45° and at 60° were taken with exactly the same bending angle and distances, the whole beam setup simply being rotated 15° about the target, so that the relative intensities at the two angles should be quite accurate.

It should be noted that the pions have not been separated from muons and electrons.

The ratio $K^+/K^-$ intensities between 0.8 - 1.8 GeV/c stays approximately constant at a value of 6 ± 1 at both production angles.

One of the principal motives for undertaking this measurement was to investigate the possibility that a high intensity $K^0_s$ beam might be constructed using a swept neutral beam coming straight from the target. Figure 2 indicates that the number of $K^0_s$ mesons in such a beam would be more than adequate for almost any conceivable experiment, but that the neutron contamination would be about 25 times the original $K^0$ flux. As most strange-particle experiments can be done using charged $K$ beams of high purity and well-defined momentum, such an impure $K^0_s$ beam would be useful only under special circumstances.

One family of experiments for which it might be applicable is that involving regeneration of $K^0_s$ mesons. The first such experiment was performed recently at Berkeley by Piccioni et al.\textsuperscript{2}). For
a source of $K^0_2$'s he used the $\pi^-$-proton associated production reaction. In this reaction the cross-section for $K^0$ production is about 1 mb, while that for neutron production is about 25 mb; thus the neutron contamination might be expected to be about the same as that in a $K^0_2$ beam straight from the target. The $\pi^-$-proton reaction has the advantage of somewhat better momentum definition, but the disadvantages of limited available flux and relatively complex beam transport.

There are at present no other $K^0_2$ sources capable of giving the $K^0_2$ intensity required for such experiments (one to ten $K^0_2$ per pulse). In particular, schemes involving charge exchange of charged $K$ beams are not intense enough by several orders of magnitude.

It appears probable that at least one more regeneration experiment will be undertaken within the next few years, in order to determine the sign of the $K^0_1-K^0_2$ mass difference. The experiment appears feasible with either $K^0_2$ source but will take several hundred thousand pulses. On the basis of present information, it is difficult to say which source of $K^0_2$'s is to be preferred.

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REFERENCES


FIGURE CAPTIONS

Fig. 1 : Experimental arrangement.

Fig. 2 : Fluxes of $\pi$, $K$ and protons at 45° and the ratios of $p$ to $\pi^{-}$ intensity.

Fig. 3 : Fluxes of particles at 60°.
Fig. 2.
Fig. 3.

\[ \frac{d^2 N}{d\Omega dp} \]

Be Target
60°

\( P \)

\( \pi^- \)

\( K^+ \)