# EXPERIMENT TO MEASURE PROPERTIES OF Y*'S PRODUCED AT HIGH ENERGIES

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## ABSTRACT

A simple experiment is proposed in which $Y^*$ production is examined in a rapid-cycling chamber whose lights are triggered by a spark-chamber spectrometer. It is shown that it is possible to consider experiments in which the detection level is on the order of 2000 events/μb.

## I. INTRODUCTION

The reactions to be studied are $K^- p \to Y^{*\mp}\pi^{\pm}$ where the $\pi^{\pm}$ takes a large (~90%) amount of the lab momentum and where

$$
\begin{aligned}
Y^{*\pm} \to\ & \Lambda(\Sigma^0)\pi^{\pm} \\
& \Lambda(\Sigma^0)\pi^{\pm}\pi^{\mp}\pi^{\pm} \\
& \Lambda(\Sigma^0)\pi^{\pm}\pi^{0} \\
& \Sigma^{\pm}\pi^{\pm}\pi^{\mp}(\pi^0) .
\end{aligned}
$$

The proposal is to use a 300 cycle per second or a 300 expansion per pulse hydrogen bubble chamber of 1 meter diameter and 1/2 meter depth operating in a 40-70 kG magnetic field. Such a chamber has not been built but is a possible extrapolation from a 10-cm diameter 90 exp/sec chamber already operating at SLAC.

The direction of the incoming beam particle will be measured by a spark chamber in front of the chamber and the momentum, mass, and angle of the outgoing pion will be measured by a standard single particle spectrometer placed downstream of the chamber. This downstream spectrometer will provide a signal to trigger the lights of the chamber.

The identification and the measurement of the $Y^*$ will be done in the bubble chamber.

Assuming the trigger will be such as to leave less than 4 GeV/c of momentum inside the chamber, the size and magnetic field of this chamber are well matched to this experiment.

## II. CROSS SECTIONS AND RATES

For one interaction per pulse, one can stand 25 tracks/picture. Since we assume the beam direction is determined by a spark chamber, then we will have 60 cm of hydrogen/track leading to a total track length of 4500 meters per machine pulse. We therefore obtain 1 event/μb/70 pulses.

D. Morrison [Phys. Letters 22, 528 (1966)] gives the cross section for

$$K^- p \rightarrow \Lambda \pi^- ,$$

as 10 μb at 10 GeV, and from data at lower energies shows this cross section varies probably as $p_{lab}^{-2}$.

Therefore one would predict a cross section of 0.4 μb for 50 GeV/c $K^-$. In order to do something like a $d\sigma/dt$ distribution for a given channel, one would like in the neighborhood of 1000 events. From the rate discussion above this would mean $(70/0.4) \times 1000 = 1.75 \times 10^5$ pulses or about 200 hours of scheduled machine time. Assuming there are no more than 20 times more events in all the other channels, the number of pictures taken will be on the order of 50,000.

## III. PRACTICAL EXPERIMENT

The above discussion represents an idealized experiment. What could one do with say a scheduled 600 hour experiment--with an additional 100 hours of parasitic time (on the assumption that the chamber operation is proven before any time is used)?

Assume an efficiency of beam, chamber, and accelerator of 1/3, and assume a 50% trigger efficiency for all channels. Then from the previous numbers, we get

$$\frac{600}{200}\,\frac{1}{3} \times 1000 = 1000 \text{ events per channel with a } 0.4\ \mu\text{b cross section.}$$

The total number of pictures taken would be

$$1000 \times 20 \times 2 = 40{,}000,$$

a small enough number so that the experimental results could be available within six months after the run. The small number of events combined with the crowded and complex nature of each picture would make practical the use of quite conventional measuring apparatus.

A cross section to 10% accuracy for each channel as a function of energy for 3 additional energies from 20-70 GeV in an additional 200 hours of running time is also quite possible.

## IV. ELIMINATION OF $\pi^-p$ ELASTIC SCATTER BACKGROUND

It is possible that a small contamination of $\pi^-$ in the incoming beam may make a serious background of $\pi^-p$ elastic scatter in the trigger [since $\sigma(\pi^-p)$ is expected to be several mb as opposed to several $\mu$b for the $K^-p$ interactions]. If it is necessary to reduce these, one can put a Cerenkov counter in the beam and anti the trigger whenever there is a coincidence between an incoming and outgoing pion.

## V. SUMMARY

It appears that such an experimental setup (as sketched in Fig. 1) could be useful in a peripheral $Y^*$ program at NAL. If it were to be proven a successful technique, it could be extended to other similar experiments involving $N^*$'s of high mass. Furthermore, since the wire-chamber spectrometers needed for this experiment will probably already exist at NAL before any 300 cycle bubble chamber could be developed, it would not involve much in the way of equipment costs.

Operating the bubble chamber would require more technical help than normally used in a counter experiment.

If the Cerenkov counter behind the bubble chamber is set for $K^+$, one could also study $K^-p \to \Xi^{*-}K^+$ and where

$$\begin{aligned} \Xi^* \to\ & \Xi^-\pi^+\pi^-(\pi^o) \\ & \Xi^o\pi^-(\pi^o) \\ & \Xi^o\pi^-\pi^+\pi^- . \end{aligned}$$

But this experiment should be done at lower energies (20-30 GeV) because the cross sections are small.

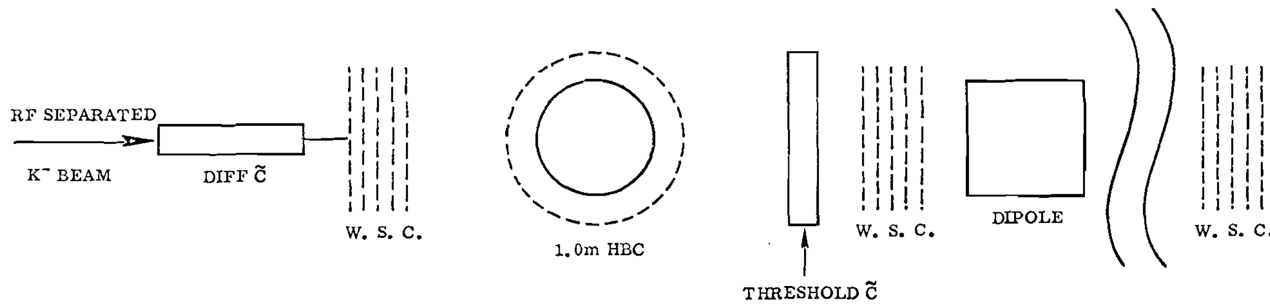


Fig. 1. Experimental arrangement for study of $Y^*$ production.