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Professor P. Panofsky
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Dear Pief:

Enclosed is a proposal we would like to submit for an experiment by our group at SLAC: A Search for 1^+ K^* Mixing Effects by Coherent Production on Deuterium at 12 GeV/c.

If this approach proves successful, we would also be interested in attempting the analogous reactions with incident 12-GeV/c π^+ mesons at a later date. This should yield the corresponding isovectors from the reaction

$$\pi^+ d \to \pi^+ \pi^+ \pi^- d \qquad (1)$$

of the spin-parity series 1^+, 2^-, 3^+ and the isoscalars as well as isovectors from the reactions

$$\pi^+ d \to \pi^+ \pi^- pp \qquad (2)$$

$$\to \pi^0 \pi^+ \pi^- pp \qquad (3)$$

$$\to \pi^+ \pi^+ \pi^- \pi^- pp \quad . \qquad (4)$$

Yours sincerely,

Gerson Goldhaber   George H. Trilling

GG:cf

PROPOSAL FOR AN EXPERIMENT AT SLAC

A Search for 1^+ K^* Mixing Effects by Coherent Production on Deuterium at 12 GeV/c

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Request

We would like to request an experiment with the 82-inch bubble chamber in the Flatte-Murray separated beam at SLAC. The request is for 500,000 pictures of K^+d at about 12 GeV/c.

Background

As more data is accumulated on boson resonances the picture which emerges appears to be compatible with the description of bosons as $q\bar{q}$ structures, á là Gell-Mann and Zweig. In particular, as the A_2 nonet can be identified with the $^3P_2$ $q\bar{q}$ state, one might then expect $^1P_1$, $^3P_1$, and $^3P_0$ states as well. The A_1 and B are reasonable candidates for the isovector components of the $^3P_1$ and $^1P_1$ states respectively according to:

		J^{PC}		
L = 1 $q\bar{q}$ state	$^3P_2$	2^{++}	A_2 (1300)	K^*(1420)
	$^1P_1$	1^{+-}	B (1250)	K^*_B
	$^3P_1$	1^{++}	A_1 (1080)	$K^*_{A_1}$
	$^3P_0$	0^{++}	?	K^*_S

If we now consider the K^*'s which go with these nonets a novel feature can arise. The K^*'s belonging to the A_1 and B nonets, let us call them $K^*_{A_1}$ and K^*_B, both are expected to have $J^P = 1^+$. In fact they differ only by belonging to nonets whose nonstrange neutral members have opposite charge conjugation C. In terms of the quark picture they differ by being $^3P_1$ and $^1P_1$ states respectively. This implies that the particles can mix--as long as there is SU(3) breaking.[1] Thus the observed physical particles in the Q peak--the candidates are K^*'s at 1250 MeV and ~ 1320-1360 MeV could be particle mixtures in a similar sense to the ω and ϕ.

On the basis of presently available data there is evidence for two K^*'s in the Q peak (aside from $K^*(1420)$ which lies above it). Also that there may be interference between them,[1,2] another feature that can occur for two K^*'s with the same spin and parity. There is however no evidence whether or not mixing occurs.

Purpose

We are interested in studying strange boson production from the reaction

$$K^+d \rightarrow K^+\pi^-\pi^+d \quad . \qquad (1)$$

This reaction presumably proceeds via Pomeranchuk exchange and should produce bosons in the Q and L peaks. We feel that this particular reaction may be able to settle the question whether or not K^* mixing occurs. If the two 1^+ K^*'s belonging to the A_1 and B nonets undergo particle mixing and if the Pomeranchuk is a unitary singlet, then they should both be produced in this reaction.[2-7] We would thus expect to observe two distinct peaks at about 1250 and 1360 MeV in the Kππ mass spectrum. If there is no mixing between these two K^*'s, only the K^* belonging to the A_1 nonet, presumably the $K^*(1250)$, should show up. In the experiment of Denegri et al.[8] with K^-d, they have observed the Q and L peaks but have not observed any structure on the Q peak on the basis of 240 events. If we estimate the expected cross section from their results, we should obtain over 1500 events for reaction (1) which should be enough to observe the above mentioned effect.

Here we must stress that it will be important to push the mass resolution as far as possible, and for this reason the $\pm\frac{1}{4}\%$ momentum resolution, which we understand is obtainable in the Flatte-Murray beam, will be extremely important to us.

Search for Higher Mass Strange Bosons

We also intend to study other reactions and in particular we hope to carry on a search for higher mass strange bosons in reactions such as .

$$K^+d \rightarrow K^0\pi^+\pi^-pp \quad , \tag{2}$$

$$K^+d \rightarrow K^+\pi^-pp \quad , \tag{3}$$

for example. Here reaction (1), because of the diffraction dissociation mechanism, emphasizes the spin parity series 1^+, 2^-, 3^+, etc. while reaction (3) can only occur for the spin parity series 0^+, 1^-, 2^+, etc.

Furthermore, we will continue our search for K^* decay into the $\bar{\Lambda}N$ channel[9] through reactions such as

$$K^+d \rightarrow \bar{\Lambda}ppp\pi^- \quad , \tag{4}$$

for example.

Identification of Events

From our experience with the 9-GeV/c K^+ beam at Brookhaven we feel confident that we will be able to measure and identify the above event types. In particular, as we expect to concentrate on the events with one or two slow protons (or deuteron).

References

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