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OBSERVATION OF f-f' INTERFERENCE IN
 $\pi^- p \rightarrow K^- K^+ n$ AT 6 GeV/c

By

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ABSTRACT

We present preliminary results from a study of $\pi^-p \rightarrow K^-K^+n$ at 6 GeV/c with the Argonne Effective Mass Spectrometer. The 100,000-event data sample shows a dramatic drop in the Y_4^0 moment of the K^-K^+ decay angular distribution at a K^-K^+ mass of 1500 MeV. This feature is interpreted as a result of f - f' interference, which can also explain the excess of D-wave cross section near 1450 MeV observed previously.

In a previous experiment with the Argonne Effective Mass Spectrometer (EMS), we studied the reaction $\pi^-p \rightarrow K^-K^+n$ at 6 GeV/c with a 16,000-event data sample.¹ The data were analyzed in terms of t-channel moments $\langle Y_4^m \rangle$ of the K^-K^+ decay angular distribution. One of the most interesting aspects of the data is a broad enhancement in $\langle Y_4^0 \rangle$ near 1350 MeV, which we have fitted to interfering f and A_2^0 D-wave Breit-Wigner resonances. Figure 1 shows our data and the results of the fits, along with the contributions from the f , A_2^0 , and interference terms separately.

Also shown in Fig. 1 is the prediction for $\pi^-p \rightarrow \bar{K}^0K^0n$, which differs from our reaction in the sign of the interference between $I=0$ and $I=1$ states decaying into $\bar{K}K$. This prediction disagrees with preliminary data of Beusch et al., who have measured $\pi^-p \rightarrow \bar{K}^0K^0n$ at 9 GeV/c and obtained a $\langle Y_4^0 \rangle$ spectrum which has much the same shape as our data.² The f - A_2^0 interference term is thus constrained to be small, and both experiments are left with a large excess in $\langle Y_4^0 \rangle$ at $\bar{K}K$ masses around 1450 MeV. A structure at this mass has been previously suggested by Beusch et al. on the basis of $K^0\bar{K}^0$ data alone.² Because of limited statistics, the nature of this high mass D-wave enhancement has remained a mystery until now.

In a new EMS experiment on $\pi^-p \rightarrow K^-K^+n$, we have obtained more than six times the statistics of the previous one. Figure 2 shows preliminary data for the cross section and the Y_4^0 moment in the t-channel. Backgrounds from other processes, which rise smoothly with increasing K^-K^+ mass, are substantial (10 to 30% for $\langle Y_4^0 \rangle$ at 1500 MeV) and have not yet been subtracted. We believe

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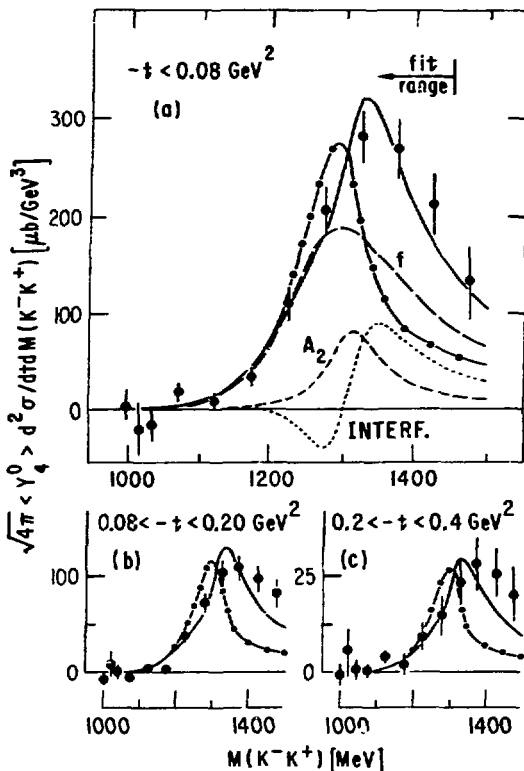


Fig. 1. Fits to the $\langle Y_4^0 \rangle$ mass spectra in the t ranges indicated. The solid line is the fit, the dot-dashed line is the prediction for $\pi^- p \rightarrow \bar{K}^0 K^0 n$.

that both the excess near 1450 MeV and the dramatic drop in $\langle Y_4^0 \rangle$ around 1500 MeV are the result of f - f' interference.³ This would also explain the excess seen in $\pi^- p \rightarrow \bar{K}_s^0 K_s^0 n$ since f - f' interference should be the same for the two reactions.

Qualitatively, our data suggest a 180° phase difference in the amplitudes for production and decay into $\bar{K}K$ of the f and f' . Added to this, the rapidly changing Breit-Wigner phase of the narrow f' then causes the f - f' interference to change from constructive to destructive near 1500 MeV. The magnitude of the effects which we observe in $\langle Y_4^0 \rangle$ are consistent with this picture, and also with the data of Beusch et al.⁴ on $\pi^- p \rightarrow \bar{K}_s^0 K_s^0 n$. Beusch et al. have interpreted their data in terms of an upper limit for the $f' \rightarrow \pi\pi$ decay rate, $\Gamma(f' \rightarrow \pi\pi)/\Gamma(f' \rightarrow \text{all}) < 1\%$.

By isolating the one-pion-exchange part of f' production, we

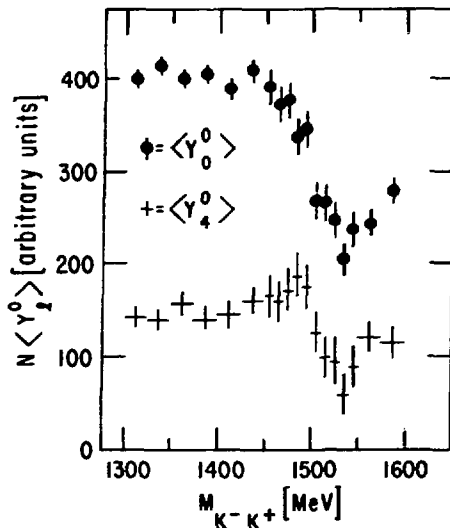


Fig. 2. Preliminary results from the new experiment on $\pi^- p \rightarrow K^- K^+ n$ at 6 GeV/c, $0.08 < t < 0.20$ GeV². The data have not yet been fully corrected for substantial backgrounds.

expect to extract the $f' \rightarrow \pi\pi$ branching ratio. This number, combined with our values for the $f \rightarrow \bar{K}K$ branching ratio and the relative $f-f'$ production phase, will give a precise value for the SU(3) mixing angle of the 2^+ nonet. The sign of the interference is already obvious from our data, and implies that the mixing angle is slightly less than the ideal angle of 35.3° , i. e. that the f' contains more octet than for ideal mixing.

In addition, we expect to perform an amplitude analysis for $\bar{K}K$ masses up to 1800 MeV. Isospin decomposition of the amplitudes should be possible because the same experiment also has 40,000 events of the reaction $\pi^+ n \rightarrow K^- K^+ p$ (equal to $\pi^- p \rightarrow \bar{K}^0 K^0 n$ by isospin invariance). Comparison with our $\pi^- p \rightarrow K^- K^+ n$ data will allow measurement of the interference between $I=0$ and $I=1$ states, which has the opposite sign in the two reactions.

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5. H. Lipkin, private communication and Nucl. Phys. B7, 321 (1968).