OBSERVATION OF f_1(1285)π and $\eta'(958)\pi$ IN THE REACTION $\pi^- p \to p\eta\pi^+\pi^-\pi^-$ AT 18 GeV/c

E852 COLLABORATION
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Preliminary results are reported on the production of $f_1(1285)\pi$ and $\eta'(958)\pi$ in the reaction $\pi^- p \to p\eta\pi^+\pi^-\pi^-$ at 18 GeV/c. The data were obtained using the Brookhaven MultiParticle Spectrometer. Clean high statistics $f_1(1285)\pi$ and $\eta'(958)\pi$ signals are observed. The $f_1(1285)$ is seen to decay primarily through the $a_0(980)\pi$ channel.

1 Introduction

Indications of substantial contributions from the exotic $J^{PC} = 1^{-+}$ partial wave have been reported in the reactions

$$\pi^- p \to p f_1(1285)\pi^- \tag{1}$$

and

$$\pi^- p \to p\eta'(958)\pi^- \tag{2}$$

by BNL [1] and VES [2] experiments, respectively.

Both of these final states are accessible from $\pi^- p \to p\eta\pi^+\pi^-\pi^-$ since both the $f_1(1285)$ and the $\eta'(958)$ have a significant $\eta\pi^+\pi^-$ decay mode.

This paper reports preliminary results from experiment E852 based on a data sample representing approximately 25% of the expected total. A description of the apparatus is given in these proceedings by N.M. Cason. [3]

In the analysis, the two gamma clusters in the lead glass were kinematically constrained to fit an η hypothesis. [3] Also the azimuthal angle, ϕ, of the recoil track measured in the cylindrical drift chamber surrounding the target was required to be within 20 degrees of the predicted azimuthal angle of the recoil proton, and the missing mass squared was required to be within 1.0 GeV^2/c^4 of the proton mass squared.

The effective mass of the $\eta\pi^+\pi^-$ in the selected events is shown in Fig. 1. Both π^- combinations are used. Clear peaks are seen in the mass regions of the $\eta'(958)$ and the $f_1(1285)$. The peak in the 1285 MeV/c^2 region may be a combination of $f_1(1285)$and $\eta(1295)$ [1] that may be resolved by subsequent partial wave analysis.

Figure 1: M($\eta\pi^+\pi^-$) for events of $\pi^- p \rightarrow p\eta\pi^+\pi^-\pi^-$.

Figure 2: M($\eta\pi^+\pi^-$) with $a_0(980)$ cut.

2 Study of the reaction $\pi^- p \rightarrow p f_1(\mathbf{1285})\pi^-$; $f_1(\mathbf{1285}) \rightarrow \eta\pi^+\pi^-$

The two body effective mass of the $\eta\pi^-$ and $\eta\pi^+$ combinations for the events in Fig. 1 was found to exhibit a prominent peak in the mass region of the $a_0(980)$. A scatter plot (not shown) of $\eta\pi$ effective mass versus $\eta\pi\pi$ effective mass indicates that the $a_0(980)$ is strongly associated with the $f_1(1285)$, implying that the $f_1(1285)$ decays primarily to $a_0(980)\pi$.

The $\eta\pi^+\pi^-$ effective mass for events satisfying an $a_0(980)$ cut ($\eta\pi$ effective mass between 0.91 $GeV/c^2$and 1.05 GeV/c^2) is shown in Fig. 2. The enhancement of the $f_1(1285)/\ \eta(1295)$ is clearly evident.

The four body effective mass of events consistent with $f_1(1285)\pi$ is shown in Fig. 3. These events satisfy the $a_0(980)$ cut, and a $f_1(1285)$ cut (1.22 $GeV/c^2 \leftrightarrow$ 1.34 GeV/c^2). Fig. 3 contains approximately 16,000 $f_1(1285)\pi^-$ candidates for input to partial wave analysis of this channel.

3 Study of the reaction $\pi^- p \rightarrow p\eta'(\mathbf{958})\pi^-$; $\eta'(\mathbf{958}) \rightarrow \eta\pi^+\pi^-$

A cut was applied to the events of Fig. 1 to select $\eta'(958)$ candidates. The effective mass of the $\eta\pi^+\pi^-$was required to be between 0.94 GeV/c^2 and 0.98 GeV/c^2. The $\eta'(958)\pi$ effective mass of events satisfying this cut is shown in Fig. 4. There are no obvious peaks in this spectrum but it is consistent with structure in the region of the $a_2(1320)$. The plot contains approximately 4500 events.

Figure 3: $f_1(1285)\pi^-$ effective mass distribution.

Figure 4: $\eta'(958)\pi^-$ effective mass distribution.

4 Summary

In a sample of the E852 data on the reaction $\pi^- p \rightarrow p\eta\pi^+\pi^-\pi^-$ we obtain approximately 16,000 $f_1(1285)\pi^-$ and 4500 $\eta'(958)\pi^-$ events.

The $f_1(1285)\pi^-$ data is characterized by clean η and $f_1(1285)$ signals. The $f_1(1285)$is observed to decay mainly to $a_0(980)\pi$. The full data set will provide approximately a factor of 80 higher statistics than the sample of experiment E818. [1]

The $\eta'(958)\pi^-$ spectrum observed is similar in shape to that observed by VES [2] and contains approximately the same statistics. The full data set will result in a fourfold improvement in the statistics of this state.

Partial wave analysis of the $f_1(1285)\pi$ and the $\eta'(958)\pi$ states is in progress.

References

1. J.H. Lee et al, *Phys. Lett.* B **323**, 227 (1994).
2. Yu.P. Gouz et al, Proc. XXVI Int. Conf. on High Energy Physics, Aug. 6 - 12, 1992, Dallas, p 572.
3. "Study of the $\eta\pi^-$, $\eta\pi^0$ and $\eta\eta$ systems in $\pi^- p$ interactions at 18 GeV/c", N.M. Cason et al, these proceedings.