Dalitz plot for $K^{\mp}\pi^{\pm}\pi^{\pm}$ decay and the assumption that the charged and neutral states are an I-spin multiplet. If parity is conserved in the $K^{\mp}\pi^{\pm}$ decay we must have the natural spin parity series $J^P = 0^+, 1^-, 2^+$, etc. For the $K^{\mp}\pi^{\pm}\pi^{\pm}$ decay mode: $J^P = 0^+$ is ruled out for three pseudoscalars in the final state by angular momentum and parity consideration.

$J^P = 1^-, 2^+$, give Dalitz plot distributions which vanish on the boundary. Our data rule this out clearly.[21] Thus we have strong evidence for parity nonconservation and hence a weak decay, consistent with the charm theory predictions.

(vi) Higher mass states. For a K*(1865) there is no specific prediction for a next higher mass state. Experimentally we find from the recoil mass spectrum (see Figure 10) a next higher mass state at 2,006 GeV/c^2. From charm theory a state D* is predicted with mass $M_{D^*} \sim 2$ GeV/c^2. If, without prejudicing the case, we use the nomenclature of charm theory, the observed three peaks in the recoil spectrum can be interpreted as:

$$e^+e^- \rightarrow D^0\overline{D}^0 \tag{1}$$

$$\rightarrow D\overline{D}^* \text{ and } \overline{D}D^* \tag{2}$$

$$\rightarrow D^*\overline{D}^* \tag{3}$$

although the detailed structure is complicated[24], the identity of the possible fourth peak in the recoil mass spectrum near 2.43 GeV/c^2 is not established as yet.

Furthermore, the decay modes

$$D^{*0} \rightarrow D^0\pi^0 \tag{4}$$

$$\rightarrow D^0\gamma \tag{5}$$

have been identified and proceed with comparable rates. These two are the only important D^{*0} decay modes. The fact that D^{*0} has a large radiative decay indicates that it must be narrow and chooses to decay into a D^0 rather than directly into a $K^-\pi^+$ as might be expected for K*(2006). We must conclude that a special quantum number (presumably charm) is conserved in D^{*0} decay to the D^0.

Similar arguments can also be given for the decays[25]

$$D^{*+} \rightarrow D^0\pi^+ \tag{6}$$

$$\rightarrow D^+\pi^0 \tag{7}$$

$$\rightarrow D^+\gamma \tag{8}$$

(vii) Spin. For a K*(1865) one might expect spin values of $J = 3 - 4$, although again for an exotic K* all bets are off. An analysis of the events represented by reaction (2) given above can rule out simultaneous spin assignments for the states at 1865 and 2006, respectively, of 0 and 0 as well as 1 and 0, while the assignments 0 and 1 are consistent with the data.[22] Charm theory predicts $J^P = 0^-$ and 1^- for the D and D*, respectively. These values had been confirmed in more recent measurements.[23]

(viii) Lifetime. For a K* the lifetime is that typical of strong interaction viz. $10^{-23}-10^{-24}$sec. Charm theory predicts weak decay lifetimes in the 10^{-13} sec. region.

Emulsion measurements in cosmic rays[18] and in neutrino beams had observed neutral and charged decays occurring $\sim$10-200 μ from the parent interaction. Recently the lifetimes of the D^0 as well as the D^+ have been directly measured for identified decays in emulsions, high resolution Bubble Chambers, and electronic detectors with Vertex chambers-such as the SLAC-LBL MARK II detector. The present best average values are[26]