

ABSTRACT

Search for the $Z^-(4430)$ Structure in the $B^0 \rightarrow \psi' \pi^- K^+$ Channel at CDF
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The Belle Collaboration reported in 2008 the observation of a resonance-like structure in the $\psi' \pi^-$ invariant mass distribution in $B^0 \rightarrow \psi' \pi^- K^+$ decays, around 4.43 GeV. This state was named $Z^-(4430)$, a non-zero charge charmonium-like meson state. The $Z^-(4430)$ state is among a group of exotic states that has been discovered in the past five to six years and named X, Y or Z. The real nature of these states is still unknown. Some hypotheses for these states are: multiquark states (either two-meson “molecule” or diquark-antidiquark), hybrid $c\bar{c}$ -gluon mesons, or charmonium for the neutral states. The fact that the $Z^-(4430)$ state has non-zero charge precludes it from being charmonium. The observation of the $Z^-(4430)$ state has not yet been confirmed by any other experiment. CDF detector data is used in the search for this structure. This analysis is based on a data sample of 5.3 fb^{-1} of integrated luminosity, produced in $p\bar{p}$ collisions at the Fermilab Tevatron. The similar decay $B^0 \rightarrow J/\psi \bar{K}^{*0}$ is analyzed as a control sample, for selection optimization. Different selection requirements were tested on quantities such as: the transverse momentum of the K, π mesons and the muons; the impact parameter of the K, π , and K^* mesons with respect to the J/ψ decay vertex; the impact parameter of the B^0 with respect to the beam; the decay time of the B^0 meson; the number of hits in the silicon detector for the muon tracks; the quality of the four track vertex fit. Both B^0 and \bar{B}^0 decays were included in the analysis. A set of requirements that optimizes the signal to background in the B^0 mass distribution for the $B^0 \rightarrow J/\psi \bar{K}^{*0}$ channel was chosen, and then applied to the $B^0 \rightarrow \psi' \pi^- K^+$ decay channel. We compared the B^0 yields in the two decay channels mentioned above and studied the $\psi' \pi^-$ and $\pi^- K^+$ mass distributions in the $B^0 \rightarrow \psi' \pi^- K^+$ decay channel.