

Abstract

The angular distributions of the charmonium resonances J/ψ (3097) and $\psi(3686)$ in their exclusive decay to an electron-positron pair are studied.

Experiment 835 at the Fermi National Accelerator Laboratory produced charmonium resonances by annihilating protons with antiprotons in the Fixed Target Mode of the Antiproton Accumulator: A stochastically cooled antiproton beam collides with a hydrogen gas jet, which forms clusters under the right pressure and low temperature. The charmonium decay products are detected out of a large hadronic background with the help of a segmented lead glass sampling calorimeter, which is sensitive to the high mass electron-positron charmonium decay, and a set of Cerenkov threshold detectors that provide good electron/pion separation. Several factors influence the angular distribution parameter α taken from the angular distribution, including the energy scale of the resonance, the coupling strength of the charmonium atom, and how quarks and gluons interact in the dissolution of the proton and antiproton. The angular distribution parameter is determined to be 0.63 ± 0.18 (statistical) ± 0.05 (systematic) at the J/ψ (3097), and 0.66 ± 0.27 (statistical) ± 0.03 (systematic) at the $\psi(3686)$.