Abstract of the Dissertation

The Charmonium $^1\mathrm{P}_1$ State (h_c)
Produced in Antiproton-Proton Annihilations

by

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A search for the charmonium $^1\mathrm{P}_1$ state (h_c) has been performed in $\bar{p}p$ annihilations close to the spin weighted center of gravity of the triplet P states. A statistically significant enhancement in the $\bar{p}p \to J/\psi\pi^o$ cross section has been observed with characteristics consistent with the expected mass, total width, and production cross section of the singlet P wave state. The resonance is centered at $\sqrt{s} \simeq 3526.15 \pm 0.15 \pm 0.19$ MeV, greater than the center of gravity of the triplet P states by 0.88 ± 0.47 MeV. The upper limit (90% CL) for the total width is ≤ 1.1 MeV. No candidates for the reactions $\bar{p}p \to J/\psi\pi^o\pi^o$ and $\bar{p}p \to J/\psi\pi^+\pi^-$ have been observed; the upper limit (90% CL) $B(^1\mathrm{P}_1 \to \bar{p}p) \times B(^1\mathrm{P}_1 \to J/\psi\pi\pi) \leq 3.2 \times 10^{-8}$ is set. Searches to observe the expected dominant decay mode $^1\mathrm{P}_1 \to \eta_c\gamma$ ($\eta_c \to \gamma\gamma$ or $\eta_c \to \pi\pi\eta, \pi\pi\eta' \to 6\gamma$) show no evidence of a resonance; the upper limit (90% CL) $B(^1\mathrm{P}_1 \to \bar{p}p) \times B(^1\mathrm{P}_1 \to \eta_c\gamma) \leq 2.6 \times 10^{-5}$ is set.