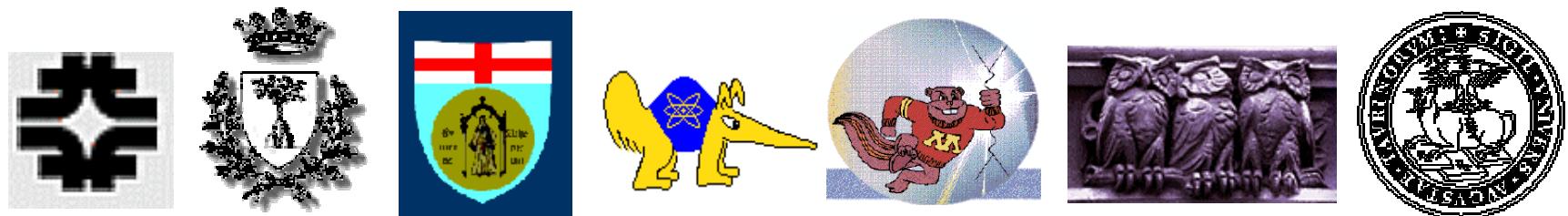
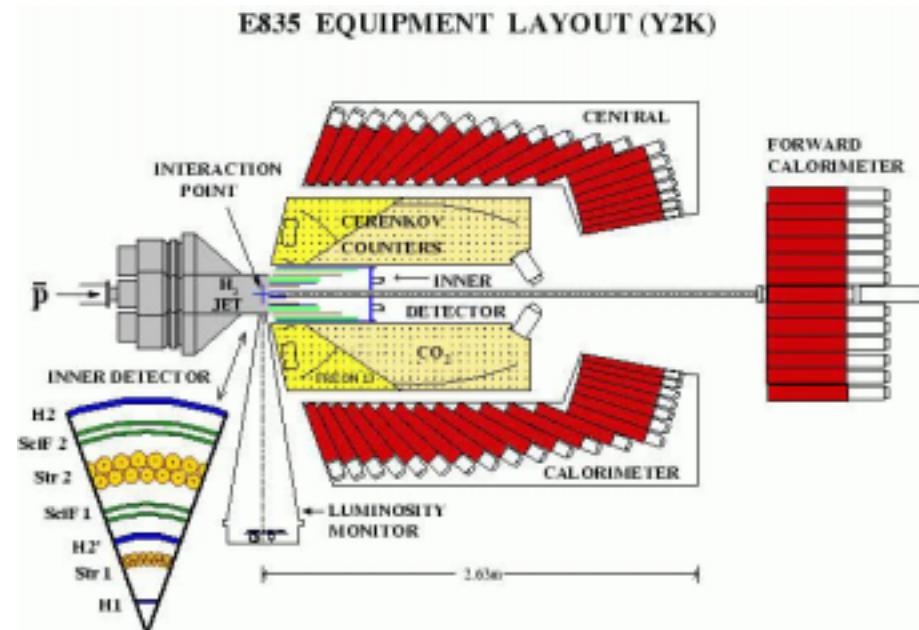
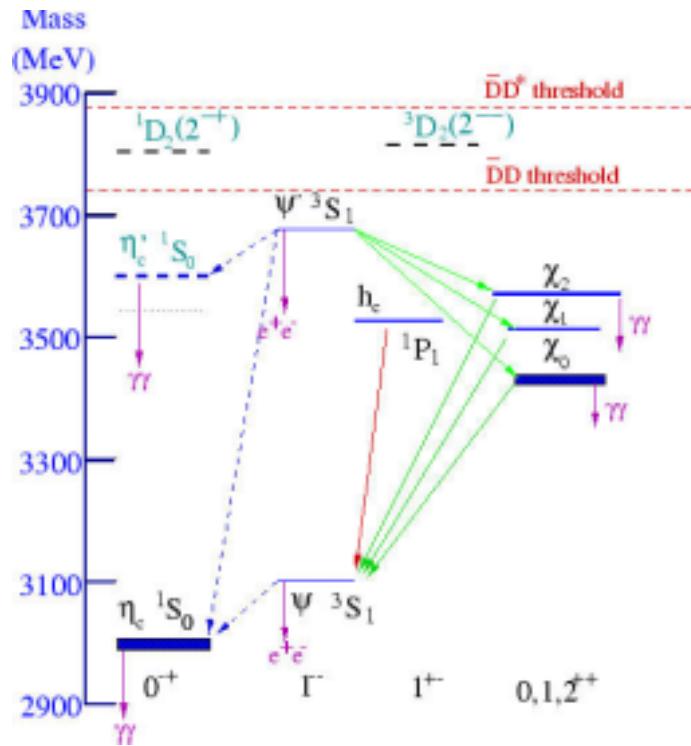


E835 Collaboration - Charmonium



Fermilab, Ferrara, Genoa, Irvine, Minnesota, Northwestern, Torino



$\bar{p}p \rightarrow \bar{c}c \rightarrow$ final state (electromagnetic)

E_cm from measuring momentum of \bar{p} beam

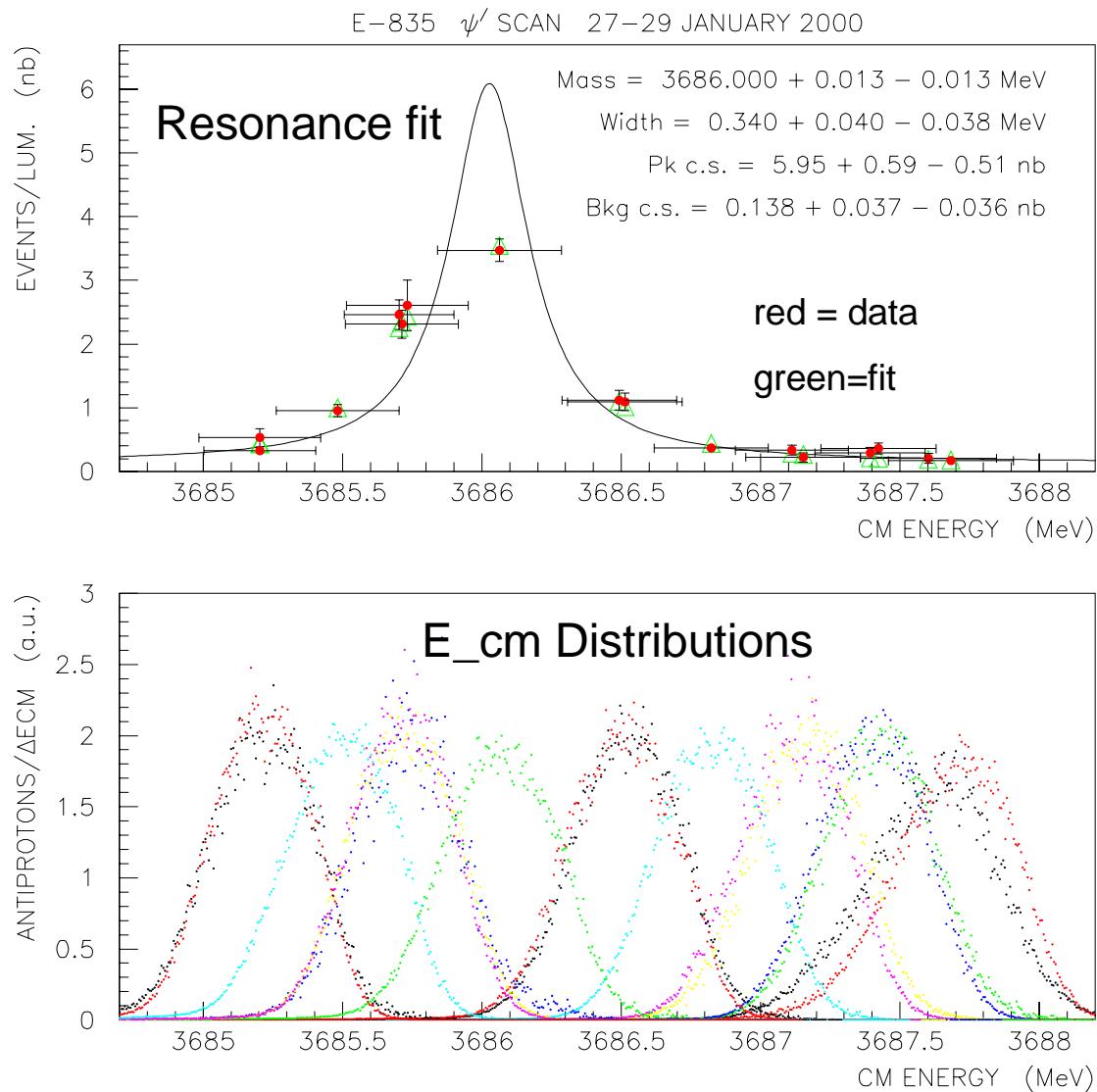
electromagnetic final states (nb to pb) cf mb for $\bar{p}p$ inelastic

E835 ~150 pb⁻¹ in 1996-1997 and ~100 pb⁻¹ in 2000

(E760 took 32 pb⁻¹ in 1991-1992)

Precision measurements of masses and total widths of Charmonium states
Measurements of $\gamma\gamma$ and other branching ratios
Input to and tests of QCD of heavy quarkonium states

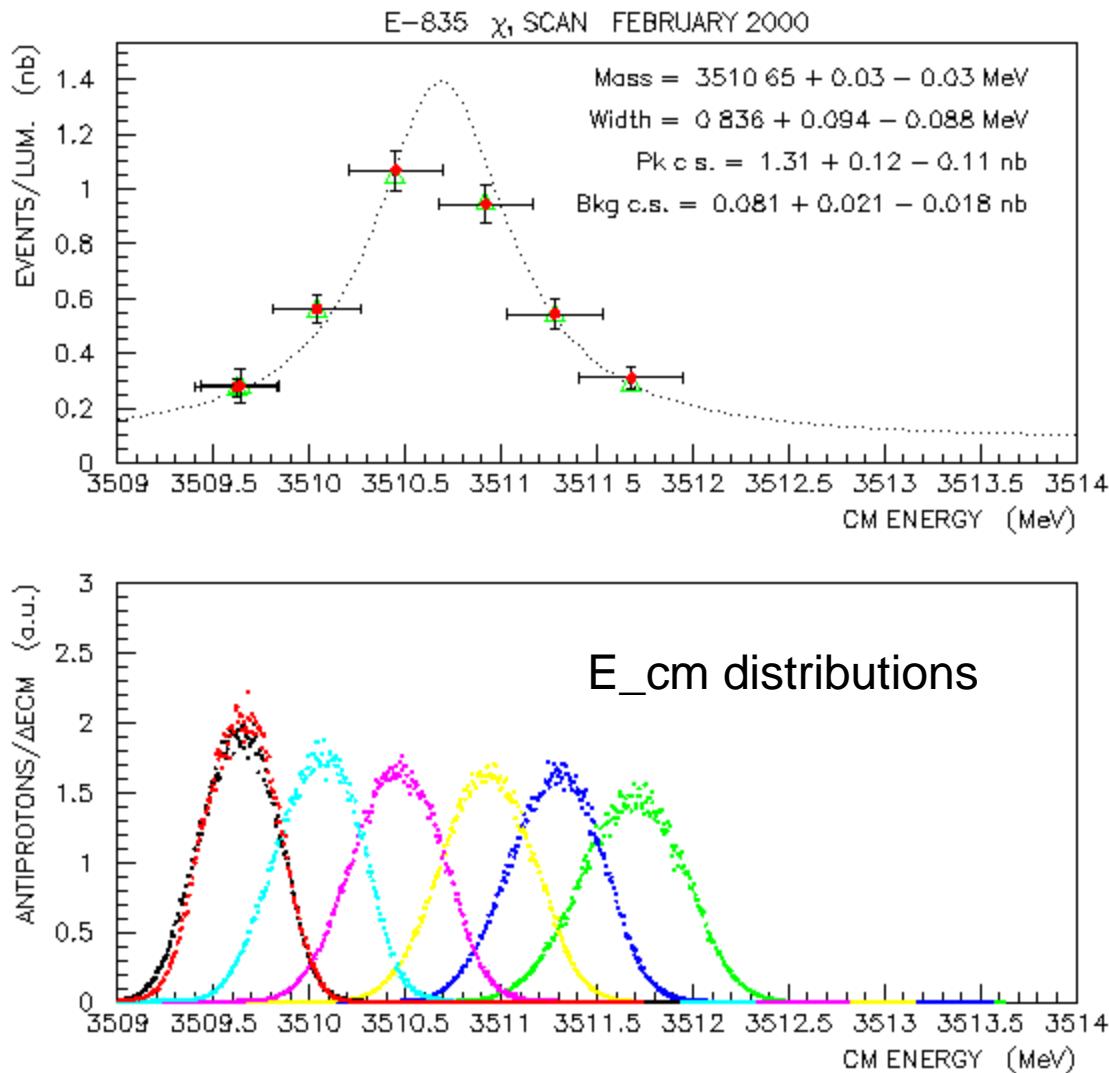
Narrow Resonance $\psi' = 0.35$ MeV



G. Stancari

E835 Status - 2/26/03 - FNAL

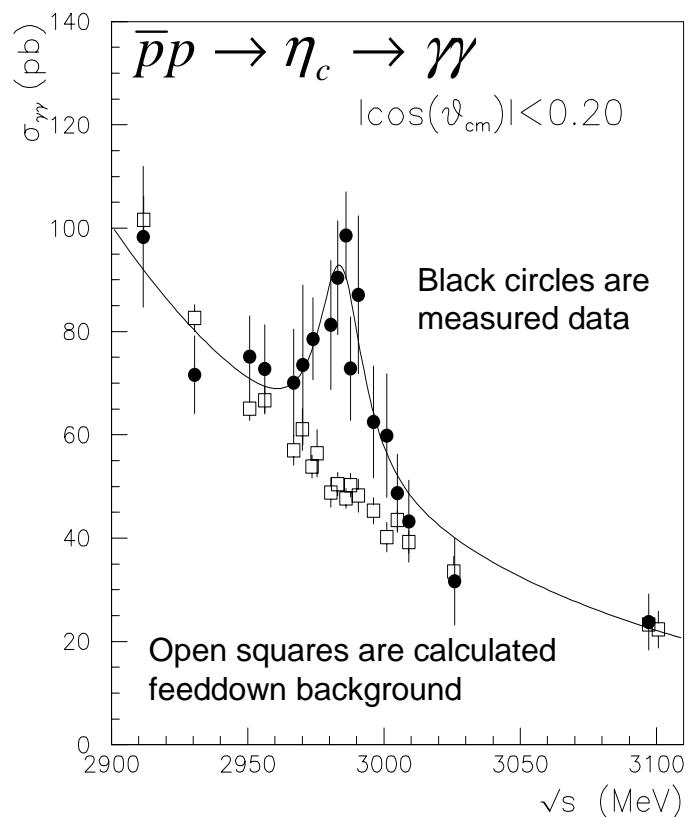
Broader Resonance $\chi_1 = 0.8$ MeV



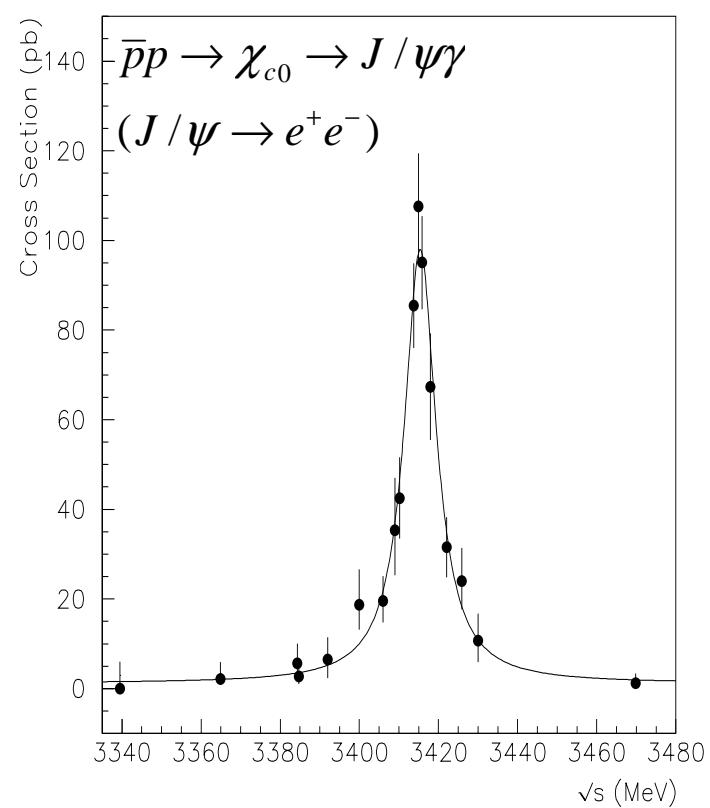
G. Stancari

E835 Status - 2/26/03 - FNAL

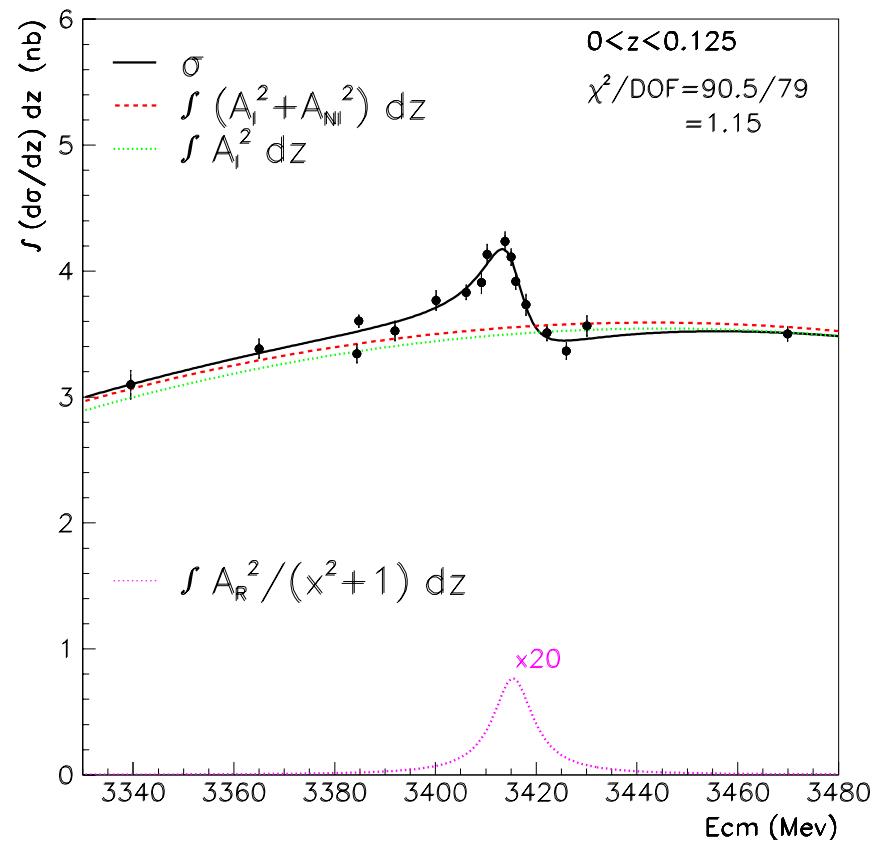
Wider $\eta_c = 20$ MeV



Wider $\chi_{c0} = 10$ MeV



$\bar{p}p \rightarrow \chi_{c0} \rightarrow \pi^0\pi^0$ interferes with $\bar{p}p \rightarrow \pi^0\pi^0$

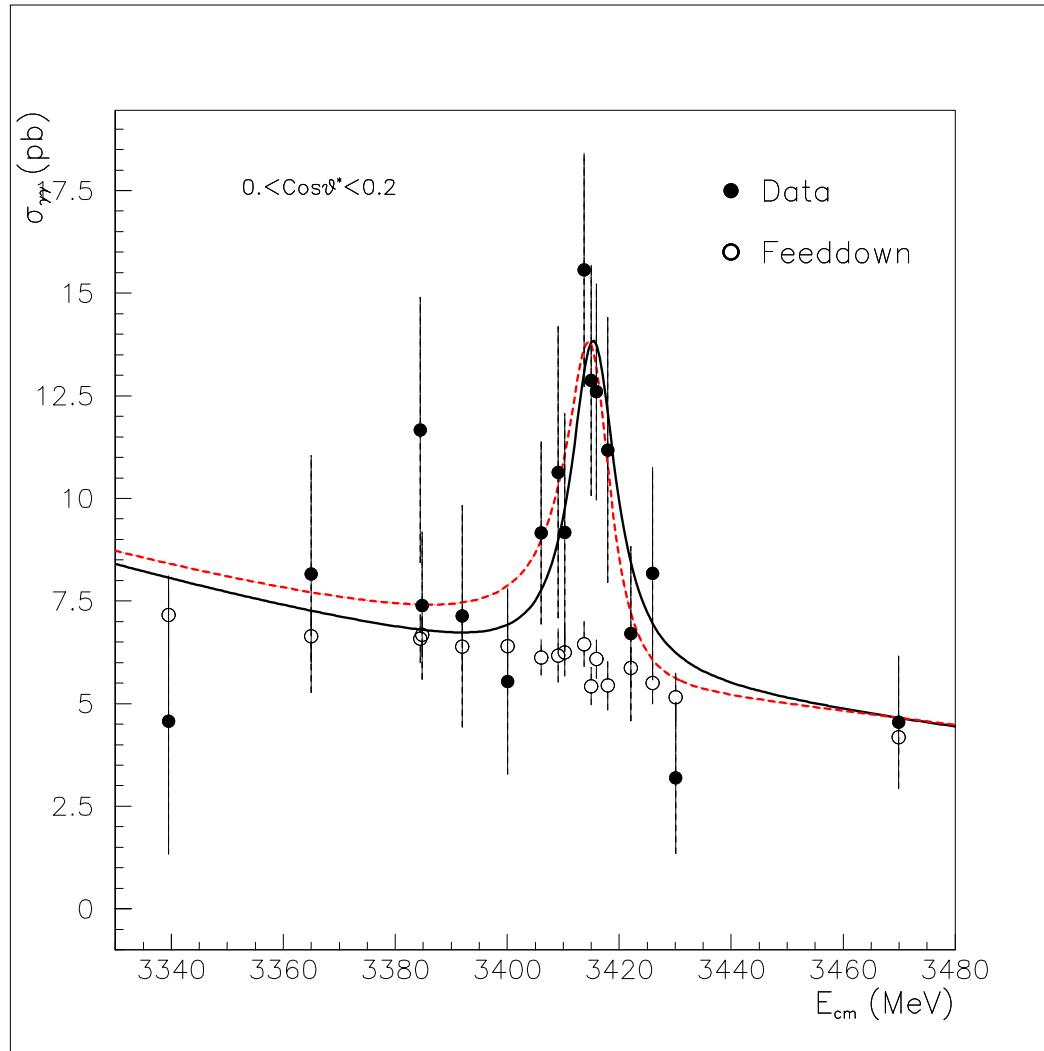


J. Rosen, P. Rumerio,
T. Vidnovic

$\eta\eta$ channel is coming

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$$\bar{p}p \rightarrow \chi_{c0} \rightarrow \gamma\gamma$$



red line includes a term for
Interference with the continuum

M. Graham

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Papers in preparation:

$\eta_c \rightarrow \gamma\gamma$: η_c mass, total width, $B(\eta_c \rightarrow \gamma\gamma) \times B(\eta_c \rightarrow \bar{p}p)$

$\Gamma(\eta_c \rightarrow \gamma\gamma)$ cf $\Gamma(\eta_c \rightarrow \text{hadrons})$

$\chi_o \rightarrow \gamma\gamma$: $B(\chi_o \rightarrow \gamma\gamma) \times B(\chi_o \rightarrow \bar{p}p)$ (mass & width from $J/\psi\gamma$ channel)

$\Gamma(\chi_o \rightarrow \gamma\gamma)$ cf $\Gamma(\chi_o \rightarrow \text{hadrons})$

$\bar{p}p \rightarrow \chi_o \rightarrow \pi^0\pi^o$ interference with direct $\bar{p}p \rightarrow \pi^0\pi^o$

Topics under analysis

$\psi' \rightarrow e^+e^-$ angular distribution

$\psi' \rightarrow \psi\pi\pi$ & $\psi\eta$ branching ratios

χ_1, χ_2 & ψ' widths

$\psi' \rightarrow \psi\gamma\gamma$ branching ratios ($\chi \rightarrow J/\psi\gamma$ branching ratios)

search for $\phi\phi$ resonances

1P_1 confirmation search

List of Physics Papers from E835 as of February 2003

MEASUREMENTS OF THE MAGNETIC FORM FACTOR OF THE PROTON
IN THE TIMELIKE REGION AT LARGE MOMENTUM TRANSFER

Fermilab E835 Collaboration (M. Andreotti et al.) to be published in Phys. Lett. B.
NEW MEASUREMENTS OF THE RESONANCE PARAMETERS OF THE
CHI_C0(1 3P0) STATE OF CHARMONIUM.

Fermilab E835 Collaboration (S. Bagnasco et al.). 2002. Phys.Lett.B533:237-242,2002
STUDY OF THE ANGULAR DISTRIBUTIONS OF THE REACTIONS
ANTI-P P --> CHI/C1, CHI/C2 --> J / PSI GAMMA --> E+E- GAMMA.

E835 Collaboration (M. Ambrogiani et al.). Phys.Rev.D65:052002,2002
SEARCH FOR THE ETA(C)-PRIME (2 1S0) CHARMONIUM RESONANCE.

E835 Collaboration (M. Ambrogiani et al.) Phys. Rev. D64, 052003 (2001).
STUDY OF THE GAMMA-GAMMA DECAYS OF THE CHI_C2(1 3P2) AND
CHI_C0(1 3P0) CHARMONIUM RESONANCES

E835 Collaboration (M. Ambrogiani et al.) Phys. Rev. D 62, 052002 (2000).
MEASUREMENT OF THE BRANCHING RATIOS PSI[PRIME]-->E+E-,
PSI[PRIME]-->J/PSI PI0 PI0 AND PSI[PRIME]-->J/PSI ETA

E835 Collaboration (M. Ambrogiani et al.) Phys. Rev. D 62, 032004 (2000).
STUDY OF THE CHI_C0 (1 3P0) STATE OF CHARMONIUM FORMED IN
ANTIPROTON-PROTON ANNIHILATIONS

E835 Collaboration (M. Ambrogiani et al.) Phys. Rev. Lett. 83, 2902 (1999)
MEASUREMENTS OF THE MAGNETIC FORM FACTOR OF THE PROTON
IN THE TIMELIKE REGION AT LARGE MOMENTUM TRANSFER

E835 Collaboration (M. Ambrogiani et al.) Phys. Rev. D 60, 032002 (1999)

Degrees awarded

12 Ph. D's and 18 Laureas;

6 people (4 in U.S., 2 in Italy) are writing Ph. D theses;

FNAL provides:

financial, computing and moral support for 2 scientists

weekly video conferencing with Minnesota, Genoa, Torino and Ferrara.

venue for group meetings (every 3 months or so)