

Antiproton Summary

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2nd Project X Physics Workshop
Fermilab
Jan. 26, 2008

2nd Project X Physics Workshop: Antiproton Parallel Session

Jan. 25, 2008, 10:30 am - 3:30 pm

Video connection will be via ES-NET. Passcode will be:

88pbar (or 887227).

If you are connecting by phone, dial

1.510.883.7860 and use the passcode 88pbar followed by the pound sign.

If prompted for a second passcode, dial the pound sign.

List of Talks:

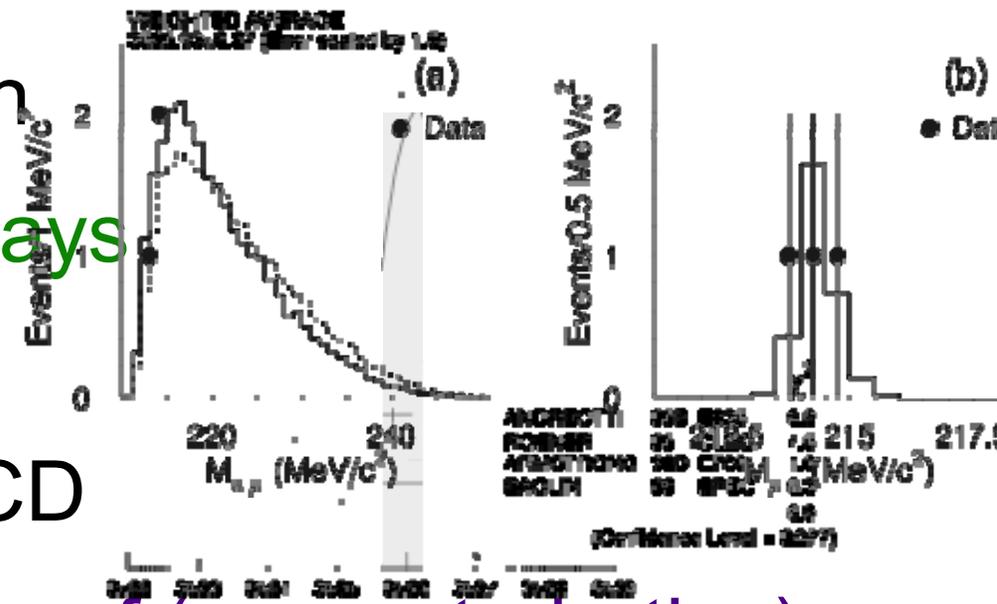
- | | |
|----------------------------------|---|
| Keith Gollwitzer, FNAL | Review of E835 |
| Dan Kaplan, IIT | Reprise of Antiproton Summary Talk from 1st Project X Workshop |
| Ted Barnes, ORNL/U. Tenn. | pbar-p and Charmonium |
| Paolo Lenisa, Ferrara | Polarization Physics |
| Frank Rathmann, Juelich | Towards Polarized Antiprotons |
| Gerry Jackson, Hbar Technologies | Non-Particle Physics Applications of Antimatter |
| All | Discussion of strategic experimental plan and R&D plan |
| Dan Kaplan, IIT | Preview/discussion of Antiproton Summary Talk for this workshop |

Back to [A New pbar Experiment for Fermilab](#) home page

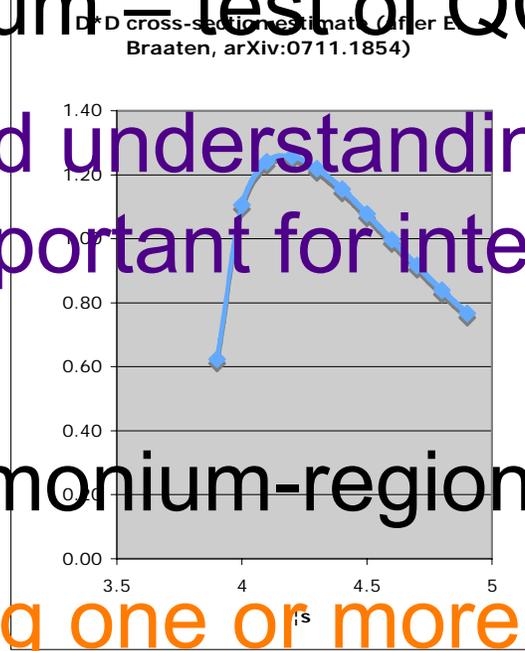
pbar Physics Overview

- Search for new physics in
 - hyperon CP & rare decays
 - charm mixing & CP

- Charmonium – test of QCD

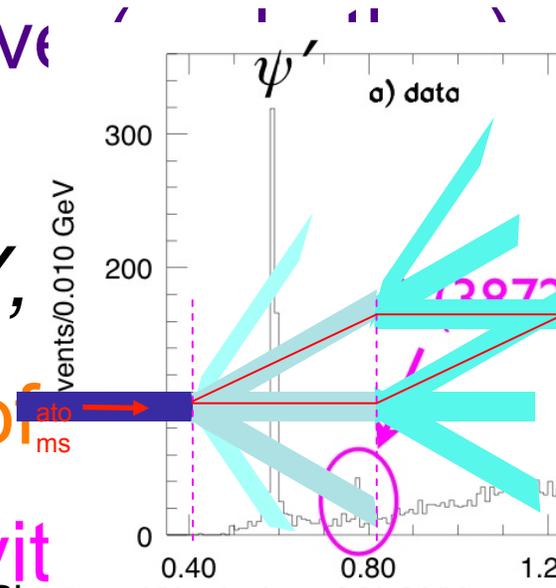


- ▶ improved understanding of (nonperturbative) QCD important for interpreting above physics



- New charmonium-region states (X, Y,

- ▶ glimpsing one or more new forms of



- Antihydrogen: CPT & antimatter-gravit

Charmonium Highlights

- $p\bar{p}$ forms all J^{PC} (unlike e^+e^-) □ good for singlet states
- Superb precision of antiproton beam energy (100 keV) and momentum spread:
 - E760/835 @ FNAL AA made *very* precise measurements of charmonium parameters
 - best measurements of η_c, χ_c, h_c masses, widths, branching ratios,...
 - interference of continuum & resonance signals
- Still more to do!

- e.g. improve η_c, h_c and η' mass and width

New States

- Much interest lately in new states observed in charmonium region

- $X(3872)$ of particular interest b/c may be the first meson-meson ($D^0 \bar{D}^{*0} + \text{c.c.}$) molecule

➡ need very precise mass & width measurements to confirm or refute

➡ $pp \rightarrow X(3872)$ formation *ideal* for this

- CPT tests:
 - making antihydrogen in traps is big ongoing R&D effort at CERN AD (ATRAP, ATHENA, ALPHA)
 - cf. relativistic antihydrogen formed “automatically” in E835 jet target [G. Blanford et al., PRL 80, 3037 (1998)]
 - can test *CPT* in flight (e.g., anti-*H* Lamb shift) thx to Lorentz-shifted *B* field in ≈ 0.7 -T magnet [G. Blanford et al., PRD 57, 6649 (1998)]
- Unknown whether antimatter falls up or down or whether $g - g^- = 0$ or ε
 - in principle a simple interferometric

Antihydrogen

Antiproton Menu

<u>Experiment</u>	<u>Scale</u>	<u>≈Physics Start</u>
• p-pbar annihilation in Accumulator	small	2011
• Antihydrogen-in-flight	tiny	2009
• Stopping-antiproton facility	tiny	2010
• New experiment ring	small	~2015

Impact

- pbar program addresses at least 5 of Quantum Universe “Big Questions”
- Will substantially broaden scope of physics investigated at Fermilab
- Serves an international community of 300+ interested physicists
- Possible because of Fermilab’s world-leading antiproton source – both now and in the future – thanks to many years of investment

Summary

- Fermilab has the best-ever pbar source by orders of magnitude
- Best experiments ever on hyperons, charmonia, charm, and antihydrogen may run a few years from now at Fermilab

Proto-Collaboration

- Drafting LoI and soliciting collaborators

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- See <http://capp.iit.edu/hep/pbar>