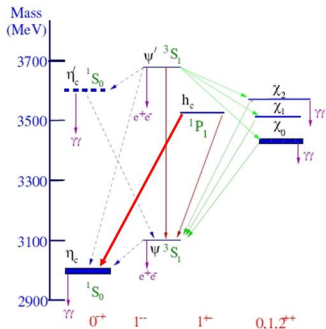


Status of $\bar{p}p \rightarrow h_c \rightarrow \eta_c + \gamma$ analysis

D. Melnychuk, NCBJ Warsaw

09.05.2014

Reaction for study



Advantages of decay mode

- Narrow ϕ resonance ($\Gamma = 4$ MeV) in the final state allows tight constraint on its invariant mass.
- Relatively low background due to the fact that $K^+K^-K^+K^-$ final state have 4 s quarks.

$$p\bar{p} \rightarrow h_c \rightarrow \eta_c + \gamma \rightarrow \phi\phi\gamma \rightarrow K^+K^-K^+K^-\gamma$$

Decay mode of η_c

$$\eta_c \rightarrow \phi\phi, BR = 2.6 \cdot 10^{-3},$$

$$\phi \rightarrow K^+K^-, BR = 0.49$$

Background channels

- $p\bar{p} \rightarrow K^+K^-K^+K^-\pi^0$
- $p\bar{p} \rightarrow K^+K^-\phi\pi^0$
- $p\bar{p} \rightarrow \phi\phi\pi^0$

Cross-section estimation

Signal cross-section

$$\sigma_{p\bar{p} \rightarrow h_c \rightarrow \eta_c + \gamma} = 40 \text{ nb (E835)}$$

Background cross-section

Estimates done for Physics Book study. DPM event generator was used to estimate cross-section for background channels with 10^7 generated events.

decay mode	N events	σ
$p\bar{p} \rightarrow K^+ K^- K^+ K^- \pi^0$	60	360 nb
$p\bar{p} \rightarrow K^+ K^- \phi \pi^0$	6	37 nb
$p\bar{p} \rightarrow \phi \phi \pi^0$	0	<6 nb

Analysed events:

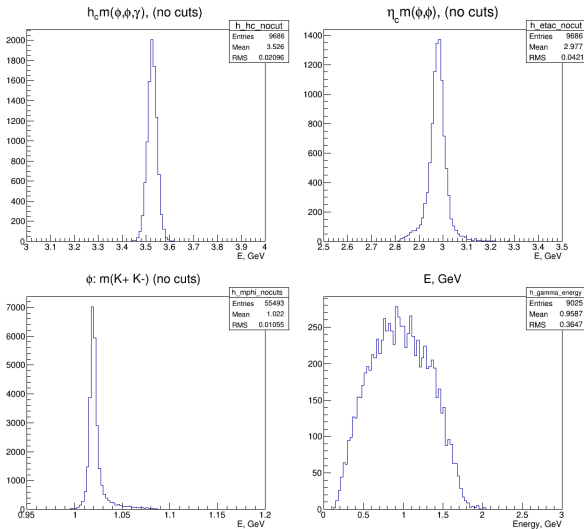
- 20 k - $p\bar{p} \rightarrow h_c \rightarrow \phi\phi\gamma$
- 200 k - $p\bar{p} \rightarrow K^+K^-K^+K^-\pi^0$

Selection:

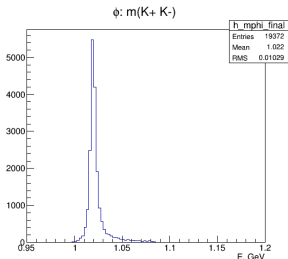
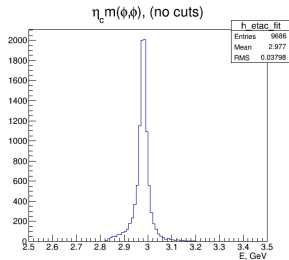
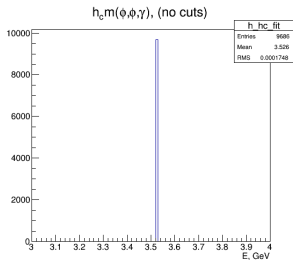
- 4C-fit to beam energy and momentum, $CL > 0.05$
- η_c post-fit selection [2.93:3.03] GeV
- $m(\phi)$ within [0.99;1.05] GeV
- Cut to implement: no π^0 candidates in event

- Figure of merit is the precision of width reconstruction, which depends on signal to background ratio. Studies for Physics Books demonstrated reasonable precision with $S/B=8$ and 200 reconstructed h_c .
- Efficiency in fast simulation - 42% (vs 24% for Physics Book study)
- Estimated event rate - 18 events/day at $L = 2 \times 10^{31} \text{ cm}^{-2} \text{ s}^{-1}$.
- Signal to background ratio from one of the two most significant channels ($p\bar{p} \rightarrow K^+ K^- K^+ K^- \pi^0$) $>5:1$.

Results



Results (after 4C-fit)



- The split-off option was not used in fast simulation yet.
- No cut on no π^0 used yet.
- No PID was used in analysis so far.