Simulation Results for Recoil-Mass-Measurement on h'_c

PANDA XLV. Collaboration Meeting

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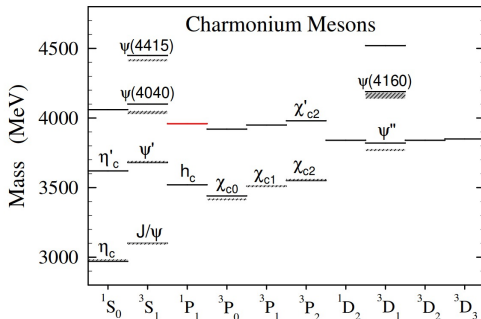
Simulation Results for Recoil-Mass-Measurement on h_c'

Motivation

- $h_c'(2^1P_1)$ is the last unknown singlet $c\bar{c}$-state below 4 GeV and L<2.

- mass measurement of the h_c' is a test of the potential model

$$m(h_c') = \frac{1}{9}\left[m(\chi_{c0}') + 3m(\chi_{c1}') + 5m(\chi_{c2}')\right]$$

which is testing the tensor term wich is zero for $S = 0$, but non-zero for $S = 1$

mass estimate for h_c': 3.934 GeV
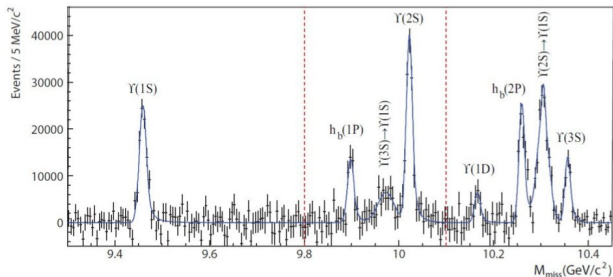
Simulation Results for Recoil-Mass-Measurement on h_c'

Motivation

- similar precise states of Bottomonium were already found with recoil mass method at Belle

- h_c', h_c suppressed at B-Factories:

$$0^{-+} \to 0^{-+}1^{+-}(B \to K\, h_c')$$

is forbidden in factorisation limit

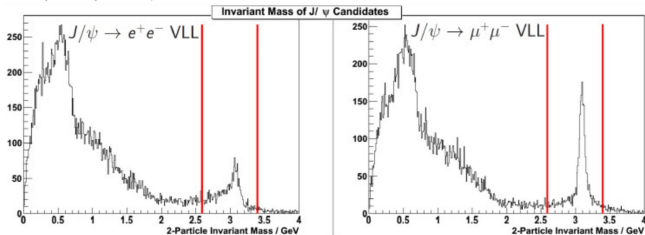- h_c', h_c suppressed at BESIII:
in 1^{--} decays, 1^{+-} can only be produced by $1^{--} \to 1^{+-} \pi^0$, but this is isospin-violating (BR $\sim 10^{-3}$ or less)

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Method
Example: $p\bar{p} \to X(3872) \to J/\Psi \pi^+ \pi^-$

Invariant Mass of J/ψ Candidates

$\Rightarrow$ recoil mass about 10 times better resolution than invariant mass

$$p\bar{p} \to h'_c + \pi^+ + \pi^-$$

- invariant mass requires knowledge of $h'_c(2P)$-decays
- recoil mass method
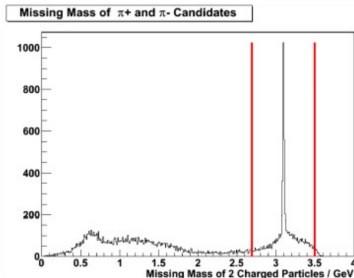$$m^2_{\text{recoil}} = (E_{\bar{p}} + m_p - E_{\pi^+} - E_{\pi^-})^2 - |\vec{p}_{\bar{p}} - \vec{p}_{\pi^+} - \vec{p}_{\pi^-}|^2$$
- upperlimit for $\sigma(h_c(1P))$:
2775.6 ± 0.4nb
Ref: Talk, tomorrow at 12.00 by Martin J. Galuska

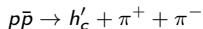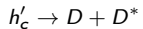

Missing Mass of π+ and π- Candidates

Simulation Results for Recoil-Mass-Measurement on h'_c

Simulation

- momentum of $\bar{p}$ beam: 15 GeV/c
- main decay

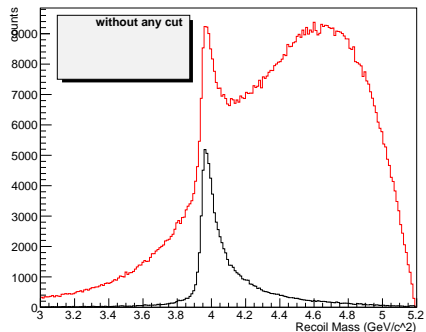$$p\bar{p} \rightarrow h'_c + \pi^+ + \pi^-$$

- possible h'_c decays for simulation

$$\boxed{h'_c \rightarrow D + D^*}$$

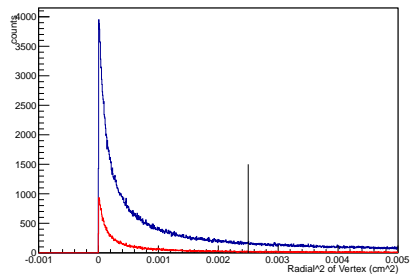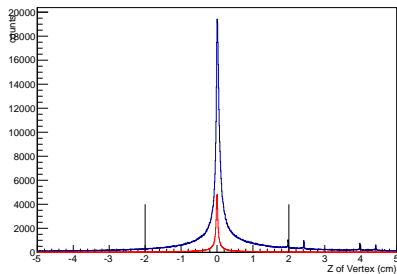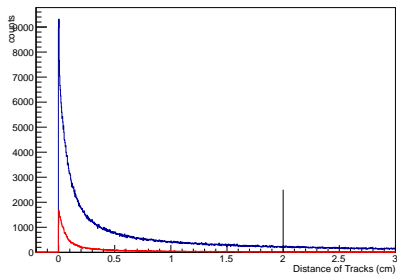$\rightarrow$ nonrelevant for recoil mass but for secondary pion generation

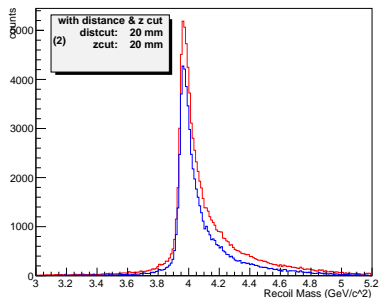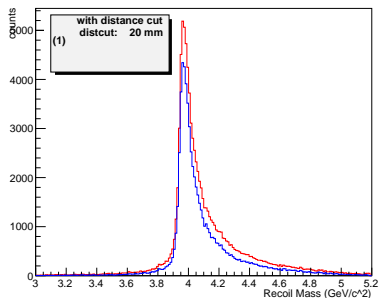- POCA Fitter used to supress background from secondary pions

recoil mass of all charged pions (red)
to recoil mass of primary pions (black)

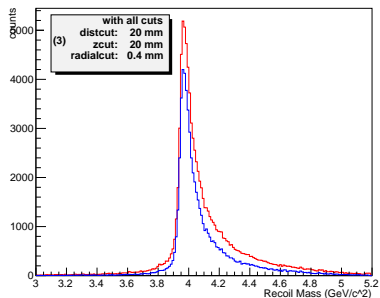# Simulation Results for Recoil-Mass-Measurement on h'_c

Vertex Cut Analysis
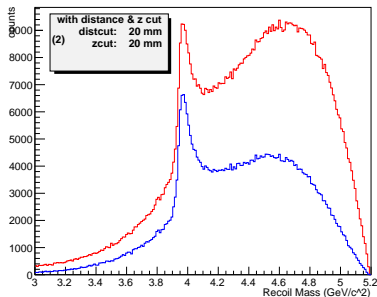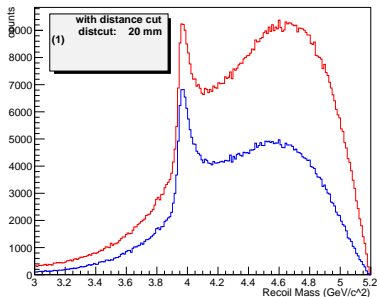
Simulation Results for Recoil-Mass-Measurement on h_c'

Analysis

- red: recoil mass of primary pions
- blue (1): with cut on distance of tracks
- blue (2): with cut of (1) and z-cut of vertex position
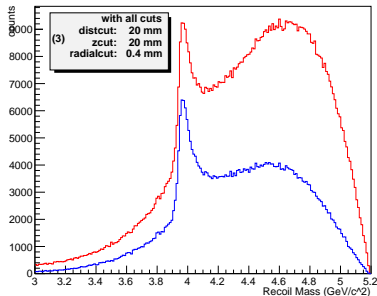- blue (3): with cut of (2) and radial-cut

Simulation Results for Recoil-Mass-Measurement on h_c'

Analysis

- ▸ red: recoil mass of all pions (MCT)
- ▸ blue (1): with cut on distance of tracks
- ▸ blue (2): with cut of (1) and z-cut of vertex position
- ▸ blue (3): with cut of (2) and radial-cut

Simulation Results for Recoil-Mass-Measurement on h_c'

Summary

- h_c' full PandaRoot simulation with release apr13 and external packages sep12
- Barrel: SttMvdGemGenTrack; Forward: FtsIdealGenTrack
- $p\bar{p} \to \pi^+ + \pi^- + h_c'$
  $h_c' \to D + D^*$
- study of recoil mass of two charged pions
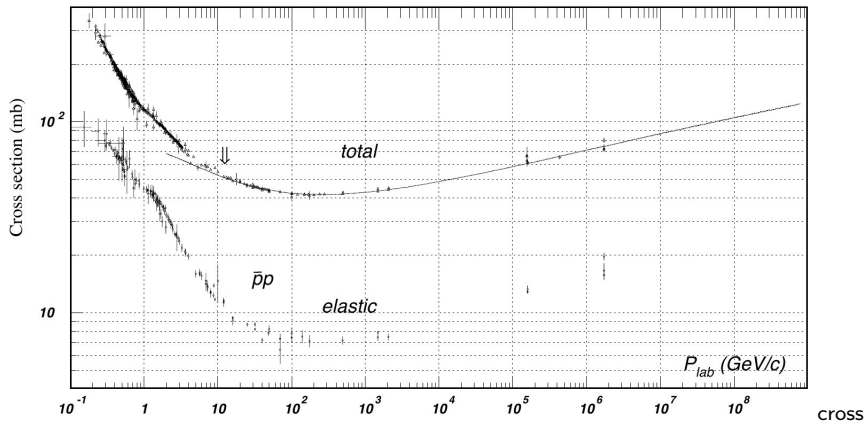- study of POCA fitter for suppression of combinatorial background

Outlook

- realistic PID
- further background studies
- further deacys studies
  $h_c' \to \eta_c + \gamma$
  $h_c' \to \eta_c' + \gamma$
- efficiency studies

Backup Slide
Background Estimation

section for inelastic processes for $p\bar{p}$ at 15 GeV: ~ 40 mb