

Measurement of the branching fraction of $\eta_c \rightarrow 2(\pi^+\pi^-\pi^0)$

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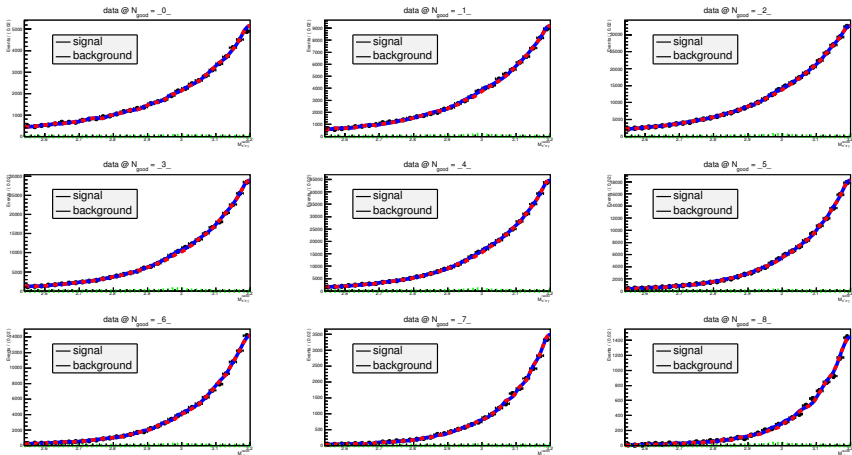
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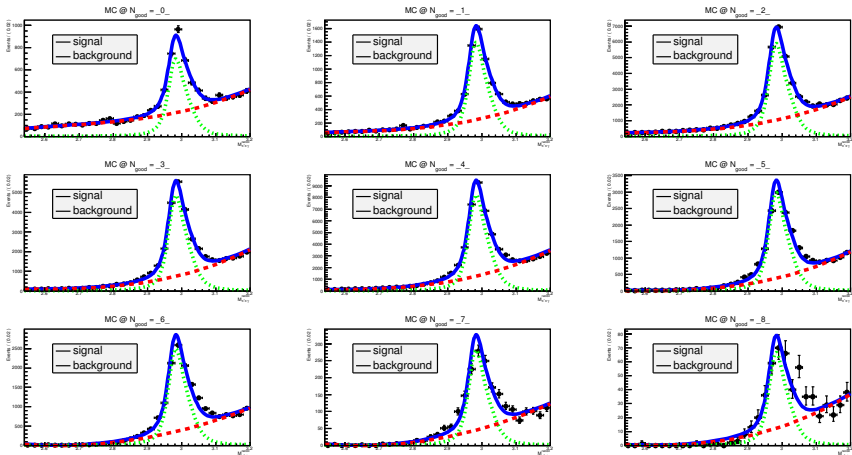
Overview

- 1 Introduction
- 2 Measurement of multiplicity of the inclusive decay of η_c decay
- 3 Data Set
- 4 Fit simultaneously
- 5 Branching Fraction
- 6 Summary

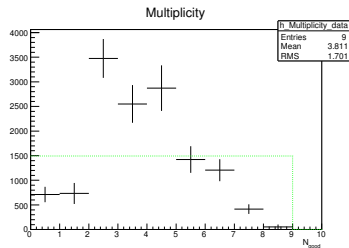
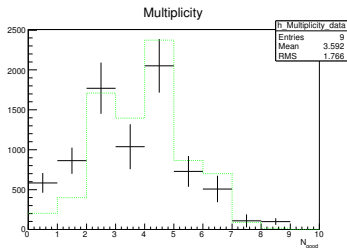
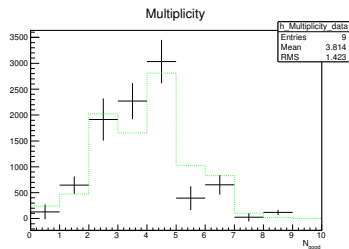
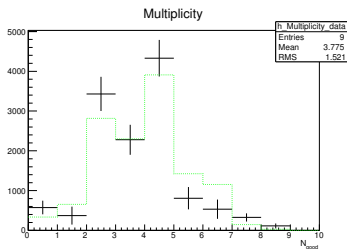
Fit data @ 4260 MeV simultaneously



Fit MC @ 4260 MeV simultaneously



Multiplicity @ 4.23, 4.26, 4.36, 4.42 GeV



Methods to measure the branching fraction

- We measure the branching fraction of $\eta_c \rightarrow 2(\pi^+\pi^-\pi^0)$ via the decays
 - $e^+e^- \rightarrow \pi^+\pi^-h_c, h_c \rightarrow \gamma\eta_c, \eta_c \rightarrow 2(\pi^+\pi^-\pi^0)$ (exclusive mode)
 - $e^+e^- \rightarrow \pi^+\pi^-h_c, h_c \rightarrow \gamma\eta_c, \eta_c \rightarrow X$ (inclusive mode)
- The Branching fraction is

$$Br(\eta_c \rightarrow 2(\pi^+\pi^-\pi^0)) = \frac{N_{\text{signal}}^{\text{exclusive}}}{N_{\text{signal}}^{\text{inclusive}}} \cdot \frac{\epsilon^{\text{inclusive}}}{\epsilon^{\text{exclusive}}} \cdot \frac{1}{Br(\pi^0 \rightarrow \gamma\gamma) * Br(\pi^0 \rightarrow \gamma\gamma)}.$$

- And via this method we can also cancel parts of the system errors.
- However it is a little bit hard to determine the efficiency of inclusive process. So far we have not known all η_c decays well.

Data Sets and Monto Carlo Samples

BOSS version

6.6.4.p01

Data Sets

We currently used the *XYZ* data at the energy points of

4.23GeV , 4.26GeV , 4.36GeV , 4.42GeV

Monto Carlo Samples

200K Monto Carlo Samples are generated at each of the four energy points of 4.23GeV , 4.26GeV , 4.36GeV and 4.42GeV .

Event Selections

Good Charged tracks selections

- $V_{xy} < 1cm$, $|V_z| < 10cm$ (except for the two tracks from K_S^0)
- $|\cos \theta| < 0.93$
- $N_{good} \geq 6$

Good photon selections($1 \leq N_\gamma \leq 20$)

- $E_\gamma > 25MeV$ for $|\cos \theta| < 0.8$
- $E_\gamma > 50MeV$ for $0.86 < |\cos \theta| < 0.92$
- $0 \leq TDC \leq 14$ (in unit of $50ns$)

Event Selections

π^0 Reconstruction($N_{\pi^0} \geq 2$)

- $0.12\text{GeV} < M_{\gamma\gamma} < 0.15\text{GeV}$;
- 1-C Kinematic Fit

preliminary $\gamma\pi^+\pi^-$ list

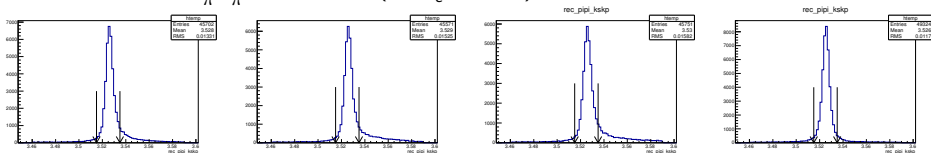
- $3.46 < m_{\pi^+\pi^-}^{\text{recoil}} < 3.59\text{GeV}$ (h_c mass region)
- $2.5 < m_{\pi^+\pi^-\gamma}^{\text{recoil}} < 3.4\text{GeV}$ (η_c mass region)

$3\pi^+$, $3\pi^-$, at least 1 $\gamma\pi^+\pi^-$ list and at least $2\pi^0$ are required.

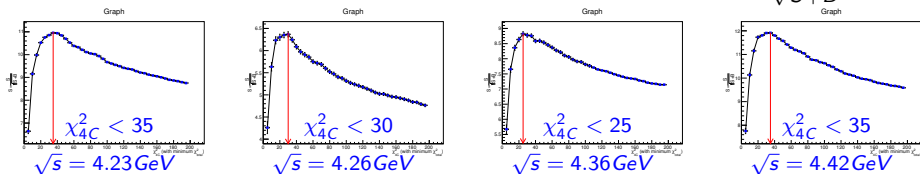
Combination with the minimum $\chi^2 = \chi_{4C}^2 + \sum_{i=1}^N \chi_{PID}^2(i) + \sum_{i=1}^2 \chi_{\pi^0}^2(i)$ is kept

Optimized Selections

- $3.515 < M_{\pi^+\pi^-}^{recoil} < 3.535$ ($M_{h_c} \pm 3\sigma$)



- The χ^2_{4C} cut is optimized with the figure of merit (FOM) $\frac{S}{\sqrt{S+B}}$



Results after optimized selections

