Two-photon widths of the $\chi_{c0,2}$ states and helicity analysis for $\chi_{c2} \to \gamma\gamma$

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Introduction

- In the lowest order QED, the decay of the fermion-antifermion system into two photons follows

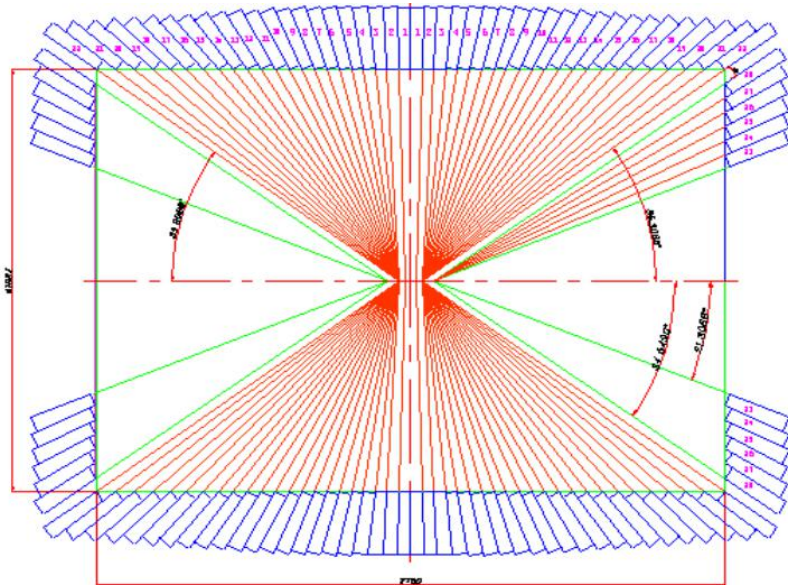
$$\mathcal{R}_{th}^{(0)} \equiv \frac{\Gamma(^3P_2 \to \gamma\gamma)}{\Gamma(^3P_0 \to \gamma\gamma)} = 4/15$$

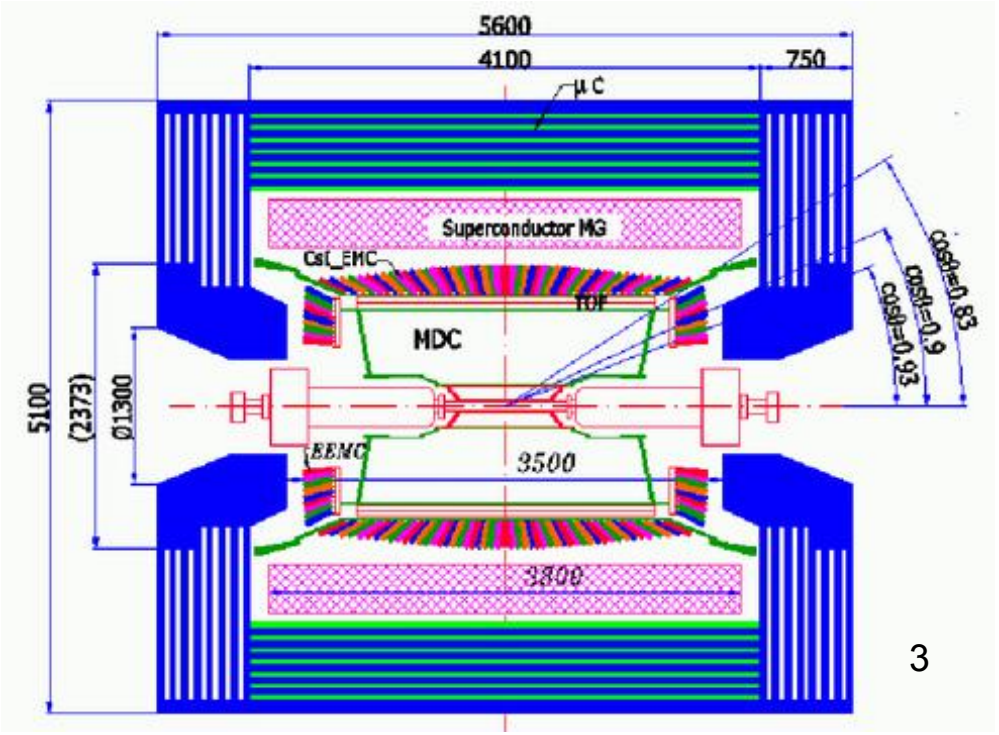
- For the positronium decays to two photon, it's a pure QED process, and already been studied well
- For the corresponding charmonium states ChicJ, if any discrepancy from this prediction can arise due to QCD radiative or relativistic corrections.

Basic Event Selection **track level**

Good Neutral Showers:

- Shower Energy: $E_\gamma > 25$ MeV for the barrel of EMC ($|\cos\theta| < 0.8$), $E_\gamma > 50$ MeV for the endcaps of EMC ($0.86 < |\cos\theta| < 0.92$);
- TDC Window: $|T - T_0| \leq 10$ for events with no charged tracks reconstructed, where T (in unit of 50 ns) is the time information of EMC, T_0 is the time of the most energetic shower;
- Number of good showerss: $N_\gamma \equiv 3$.





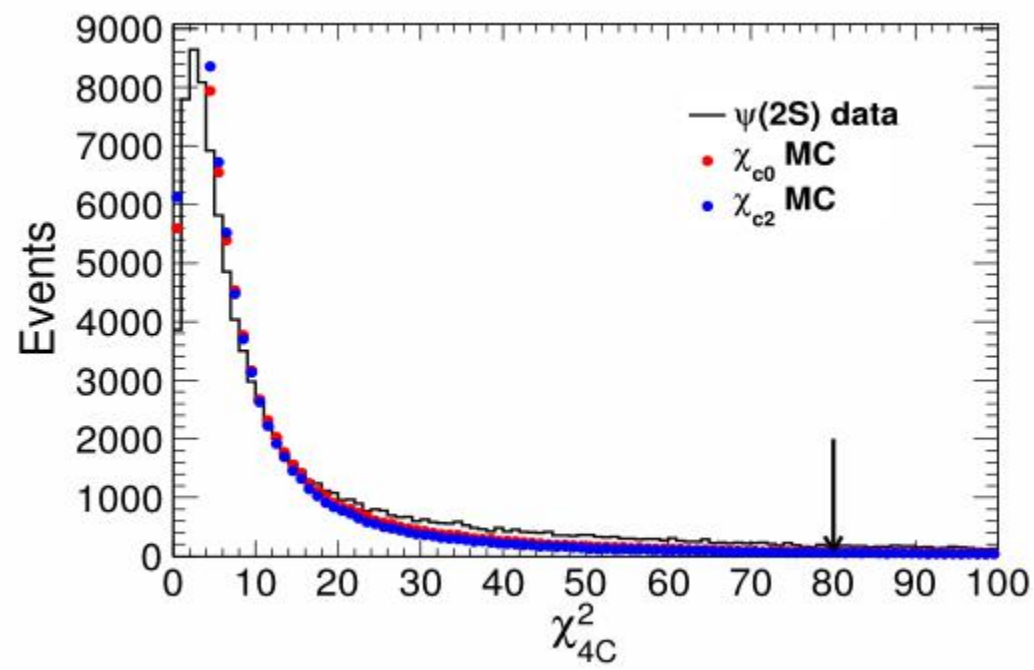
Basic Event Selection track level

- Gamma tag. $\psi' \to \gamma_1 \chi_{c0,2},\ \chi_{c0,2} \to \gamma_2 \gamma_3$
  - The smallest energy photon is selected as the radiated photon.

- No detected Charged track

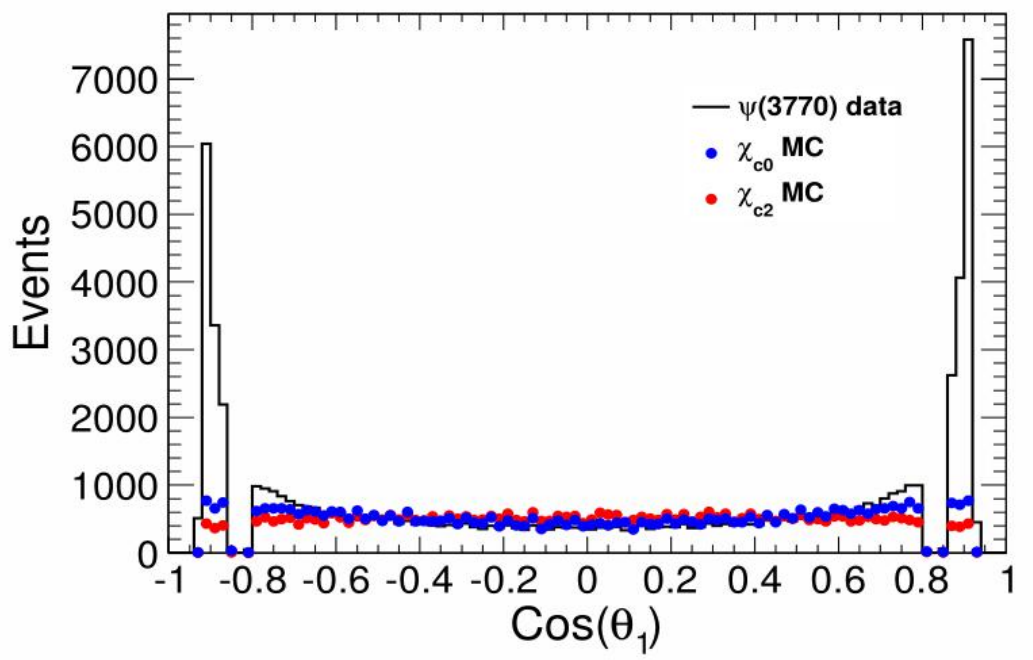
Event Level Selection： 1

- Reconstruct all the final states, hence an energy and momentum conservation constraint fit (4C-fit) is performed.



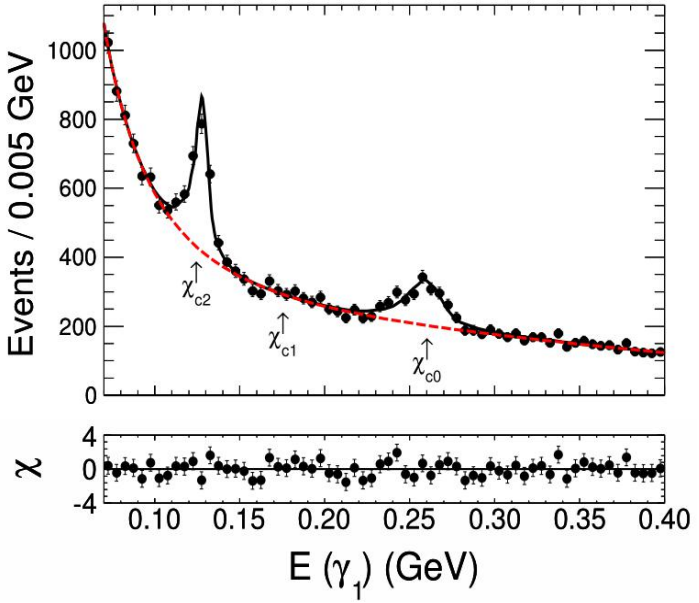
Event Level Selection 2

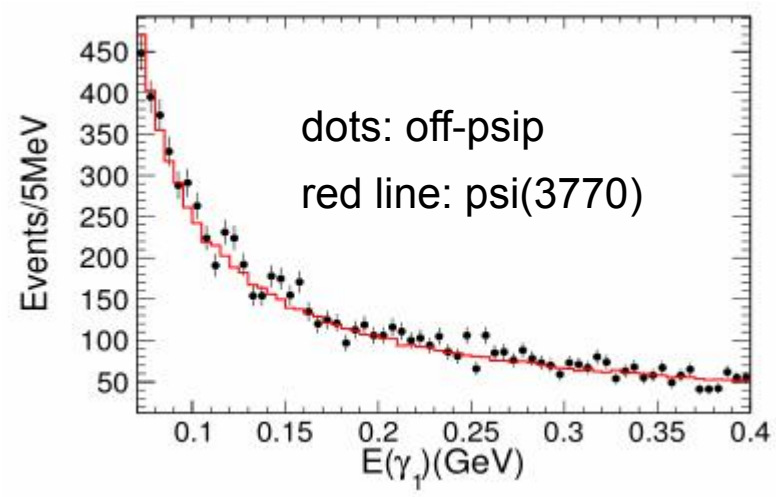
- Suppress the large QED background contribution by simply require the polar angle of each photon candidate.

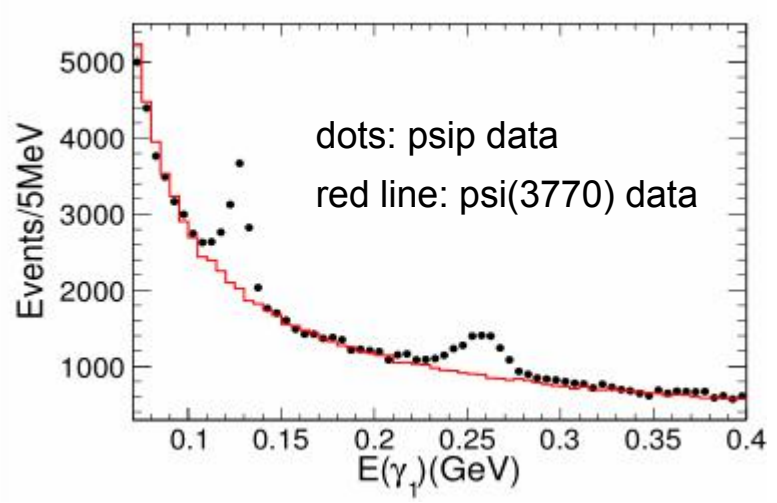


Background Study

- Inclusive MC samples
- QED background
  - The background mainly comes fr
  - use data at **3.650(off-psip data)** and **psi(3770) data**

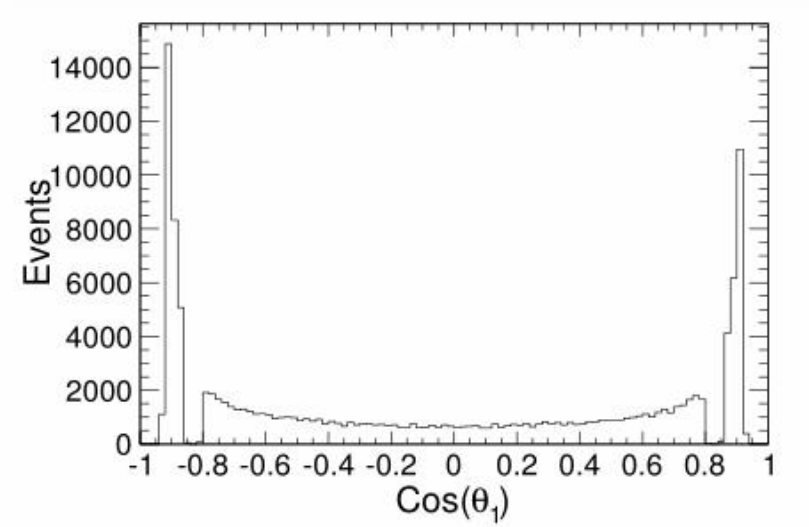






Background Study

- sideband samples



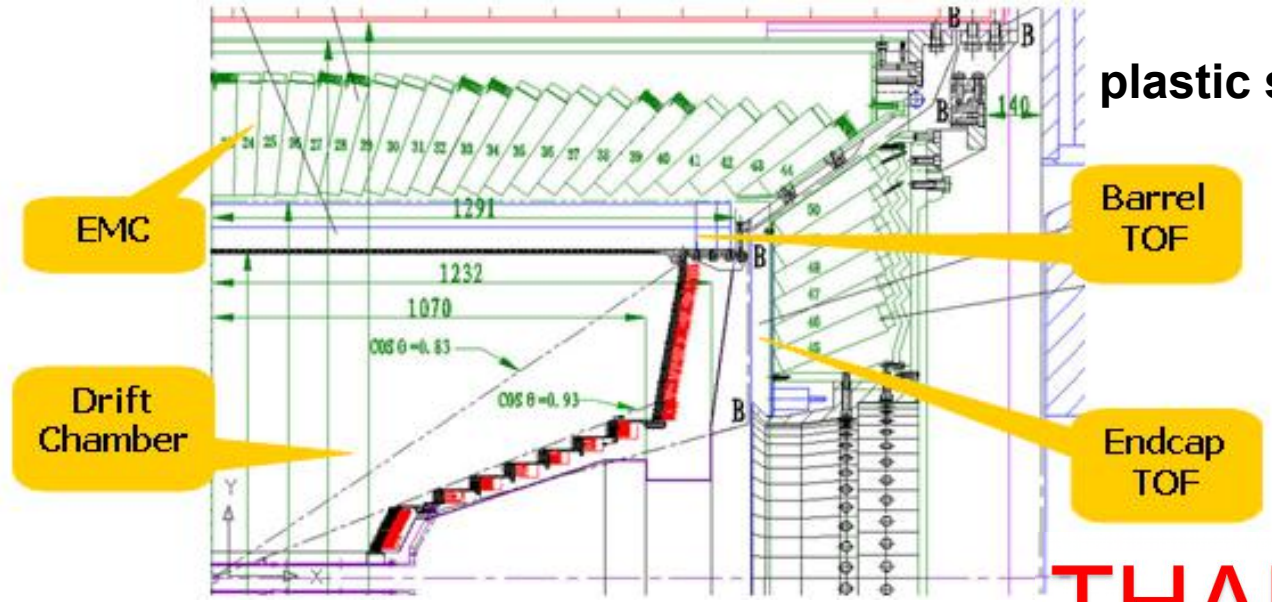
The distribution of $\cos(\gamma_1)$ for the events in the sideband near $\chi_{c0,c2}$ signal region.

Summary of Key Points

- Event selection criteria could be borrowed
- Background study
  - their main background and **especially their signal process** may be our main background process.
  - radiated photon tagging method.
  - basic and most widely used study methods:
    - MC samples
    - sideband samples
    - off-psip data and psi(3770) data.

Summary of Key Points

- The energy deposited in nearby TOF counters is included to improve the reconstruction efficiency and energy resolution.



THANKS