Central exclusive J/ψ production cross-section in PbPb collisions at $\sqrt{s_{NN}} = 5$ TeV with LHCb

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student session

Outline

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7. Summary

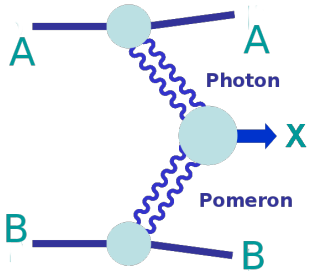
About me

- Third-year undergraduate student of Tsinghua University, China.
- Major: engineering physics

Tsinghua University

Central exclusive production(CEP)

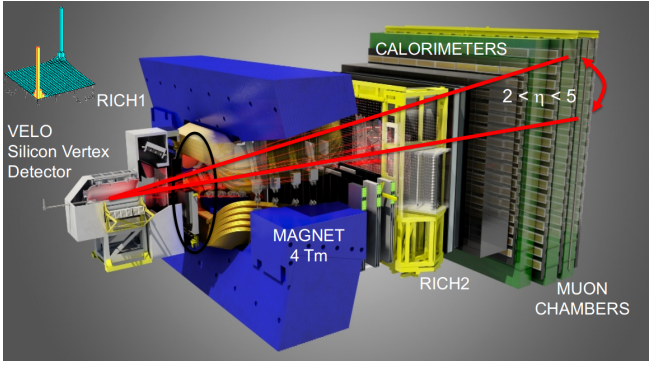
- Definition:
  - $A + B \rightarrow A + X + B$
  - Fusion of photons and pomerons (a colourless strougly-coupled object)
- Physics motivation:
  - Perturbative QCD
  - Gluon parton distribution function
- Features:
  - Low multiplicity
  - Low transverse momentum(p_{T})



CEP process

LHCb detector

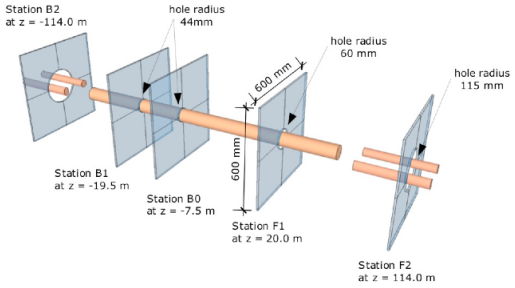
- Single arm spectrometer in the forward direction
  - Coverage: $2 < \eta < 5$
  - Fully instrumented in acceptance range



LHCb detector

Herschel detector

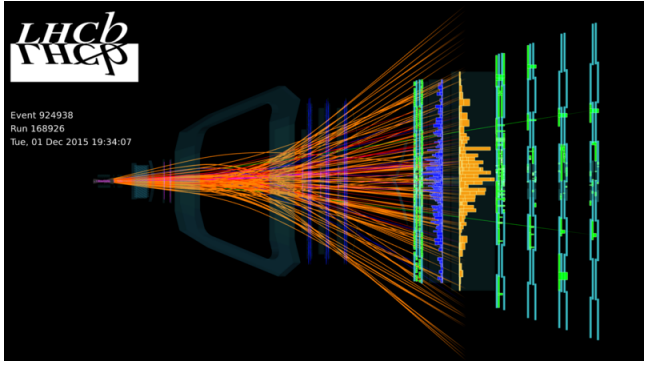
- HeRSCheL: High Rapidity Shower Counters for LHCb
- -114 m, -19.7 m, -7.5 m, +20 m, +114 m



herschel detector

Heavy ion in LHCb

- Participation in PbPb running in 2015



PbPb event display

Analysis strategy

- Decay channel : $J/\psi \to \mu^+\mu^-$
- Differential cross-section :

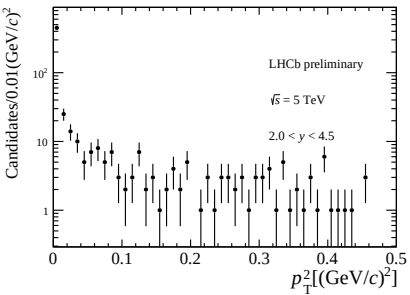
$$\frac{\mathrm{d}\sigma}{\mathrm{d}y} = \frac{N(J/\psi \to \mu^+\mu^-)}{\mathscr{L} \times \varepsilon_{\mathrm{tot}} \times \mathscr{B}(J/\psi \to \mu^+\mu^-) \times \Delta y}$$

- Fiducial range : $2.0 < y < 4.5$
- The efficiencies include geometrical acceptance, reconstruction and selection efficiency and trigger efficiency.

Data sample and selection

- PbPb data collected in 2015 at $\sqrt{s_{NN}} = 5\,\mathrm{TeV}$ with $\mathscr{L} \approx 5\,\mathrm{fb}^{-1}$
- Trigger lines: L0Muon, Hlt1DiMuonHighMass, Hlt2DiMuonPassthrough

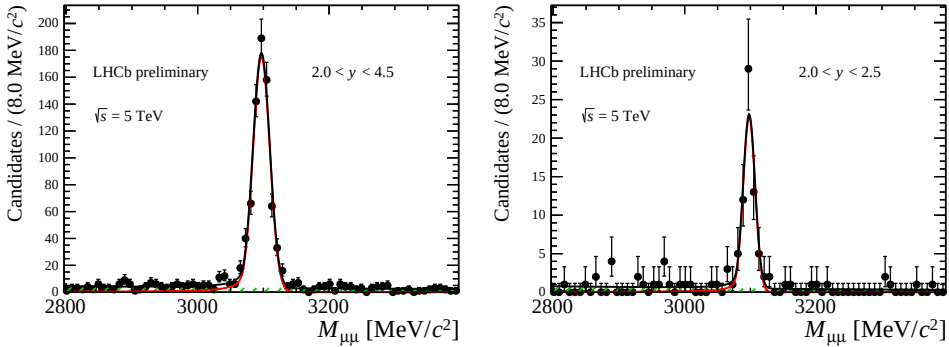
Variable	Value
number of PV	$== 0$
track χ^2/ndf	< 3
muon identification	isMuon
track ghost probability	< 0.3
mass window	$3096.9 \pm 150\,\mathrm{MeV}/c^2$
nLongTracks	$== 2$
nDownstreamTracks	$== 0$
nUpstreamTracks	$== 0$
nTTracks	$== 0$



$p_{\mathrm{T}}{}^2$ distribution after selection

Mass distribution

- Signal: Crystal Ball (CB) function.
- Background: exponential function.

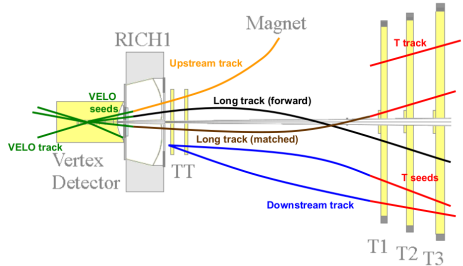


Invariant mass distribution of the data in LHCb acceptance (left) and in a typical bin (right)

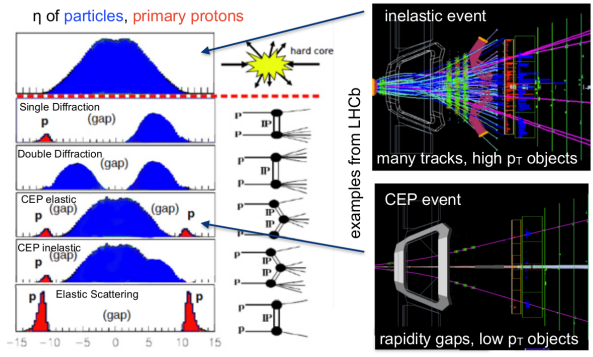
Summary

- Finished:
  - Signal yields determination
- Ongoing and next to do:
  - MC sample
  - Estimation of efficiencies

Thanks



Long tracks	⇒	highest quality for physics (good IP & p resolution)
Downstream tracks	⇒	needed for efficient K_s finding (good p resolution)
Upstream tracks	⇒	lower p, worse p resolution, but useful for RICH1 pattern recognition
T tracks	⇒	useful for RICH2 pattern recognition
VELO tracks	⇒	useful for primary vertex reconstruction (good IP resolution)



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Herschel impact on backgrounds