Central Exclusive Production at LHCb

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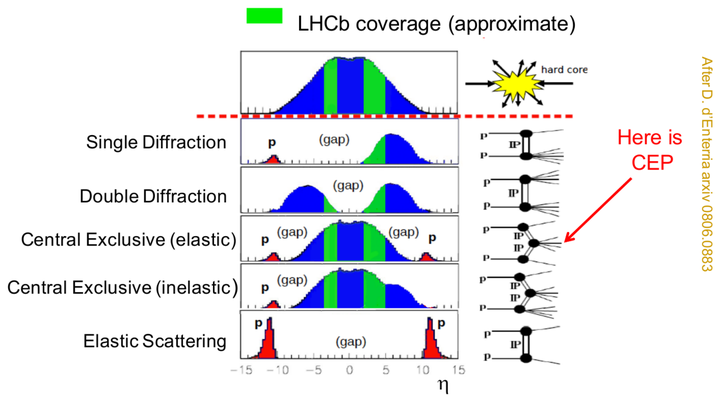
on behalf of the LHCb Collaboration

What do we look for?

pp → p + X + p (rapidity gaps and protons intact)

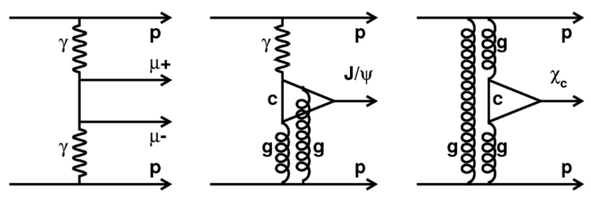
Colourless objects in QCD
Very low PT objects
Clean experimental environment



After D. d'Enterria arxiv 0806.0883

Rich Physics

Photon-Pomeron, Double-Pomeron, Photoproduction, Glueballs, Exotica



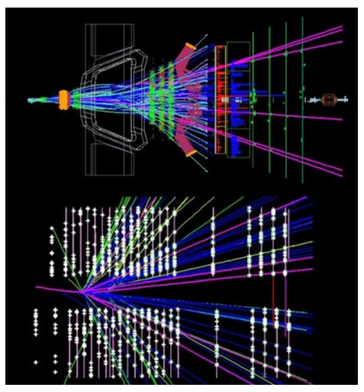
(Note: $J/\psi \to \mu\mu$ and $\chi_c \to J/\psi\gamma$)

Related phenomena where the colourless object creates a particle

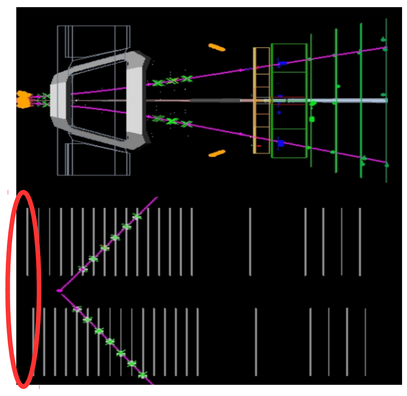
How do we look for it?

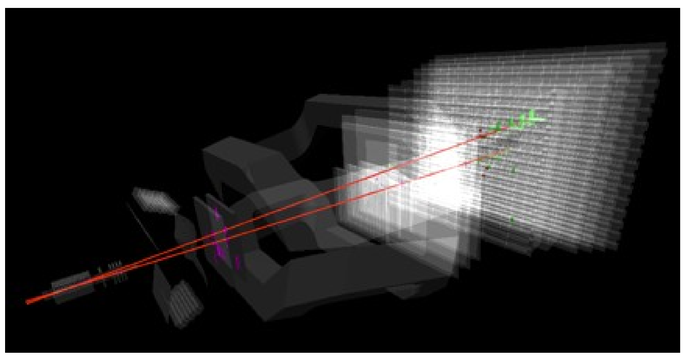
- Look for "empty events"
- Protons → escape in the beampipe
- Events with low activity in detector
- Look at backwards tracks in the VELO
- Size of detectable gaps is critical

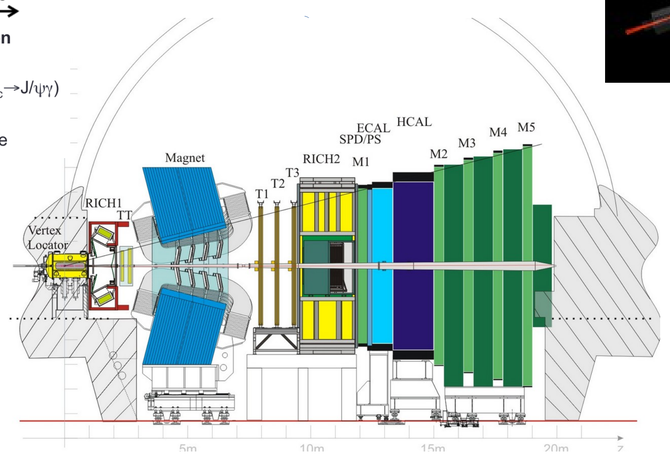
- Typical Event



- CEP-like event: 2muons





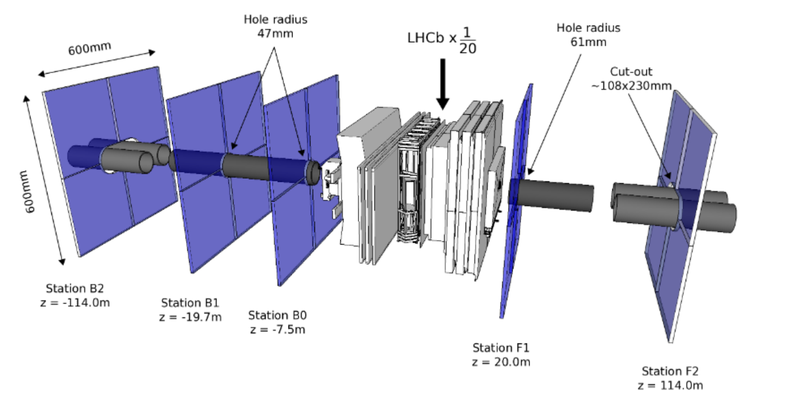


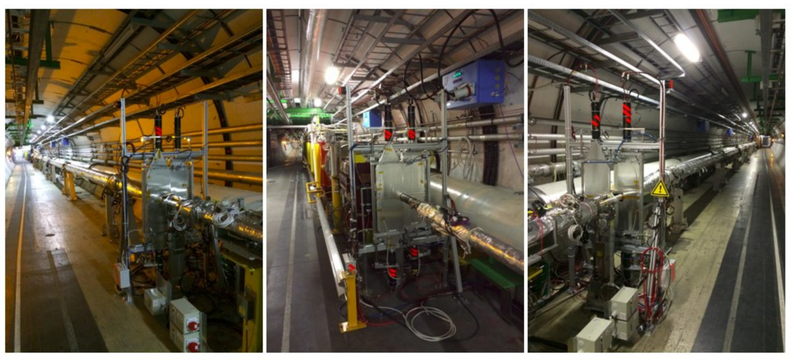
The HeRSCheL detector

JINST 13 (2018) P04017

- Forward spectrometer
- Good Vertex measurements
- Precise Tracking
- Excellent PID up to 100GeV
- Versatile Trigger (L0+Hlt)

- Idea: scintillators in the tunnel where beampipe is accessible
- High Rapidity Shower Counters for LHCb: HeRSCheL
- Five planes of scintillators: 4 quadrants, 20mm thick
- Built in 2014 and installed at the beginning of 2015.
- Use same electronics of Preshower Detector
- Can be used to veto forward and backward activity





Recent Physics Results

Central exclusive production of J/ψ and $\psi(2S)$ mesons in pp collisions at $\sqrt{s} = 13$ TeV

LHCb collaboration[1]

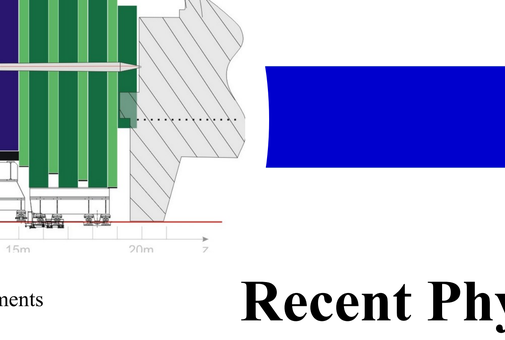
Abstract

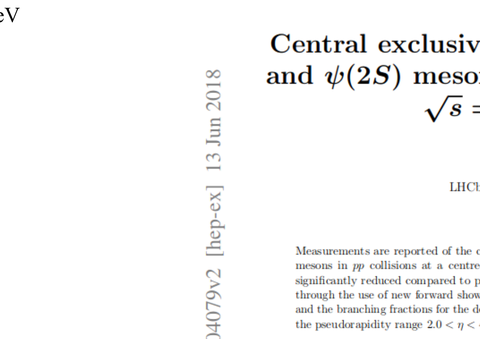
Measurements are reported of the central exclusive production of J/ψ and $\psi(2S)$ mesons in pp collisions at a centre-of-mass energy of 13 TeV. Backgrounds are significantly reduced compared to previous measurements made at lower energies through the use of new forward shower counters. The products of the cross-sections and the branching fractions for the decays to dimuons, where both muons are within the pseudorapidity range $2.0 < \eta < 4.5$, are measured to be

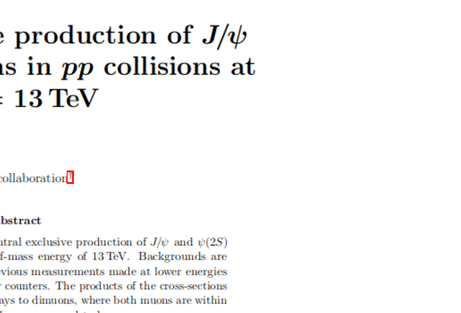
$\sigma_{J/\psi \to \mu^+\mu^-} = 399 \pm 16 \pm 10 \pm 16$ pb,
$\sigma_{\psi(2S) \to \mu^+\mu^-} = 10.2 \pm 1.0 \pm 0.3 \pm 0.4$ pb.

The first uncertainties are statistical, the second are systematic, and the third are due to the luminosity determination. The cross-sections are also measured differentially for meson rapidities between 2.0 and 4.5. Good agreement is observed with theoretical predictions. Photoproduction cross-sections are derived and compared to previous experiments, and a deviation from a pure power-law extrapolation of lower energy data is observed.

arXiv:1806.04079v2 [hep-ex] 13 Jun 2018







$$\frac{d\sigma_{\psi\to\mu^+\mu^-}}{dy}(2.0 < \eta_\mu < 4.5) = \frac{\mathcal{P}N}{\epsilon_{rec}\epsilon_{sel}\Delta y \epsilon_{single}\mathcal{L}_{tot}}$$

$$\sigma_{J/\psi\to\mu^+\mu^-}(2 < \eta < 4.5) = 399 \pm 16 \pm 10 \pm 16 \text{ pb},$$
$$\sigma_{\psi(2S)\to\mu^+\mu^-}(2 < \eta < 4.5) = 10.2 \pm 1.0 \pm 0.3 \pm 0.4 \text{ pb}$$