

# DISCOVERY OF THE DOUBLY CHARMED BARYON $\Xi_{cc}^{++}$ AT LHCb

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on behalf of the LHCb collaboration

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# SUMMARY

Narrow structure in the  $\Lambda_c^+ K^- \pi^+ \pi^+$  mass spectrum.

Significant displacement consistent with a weakly decaying particle.

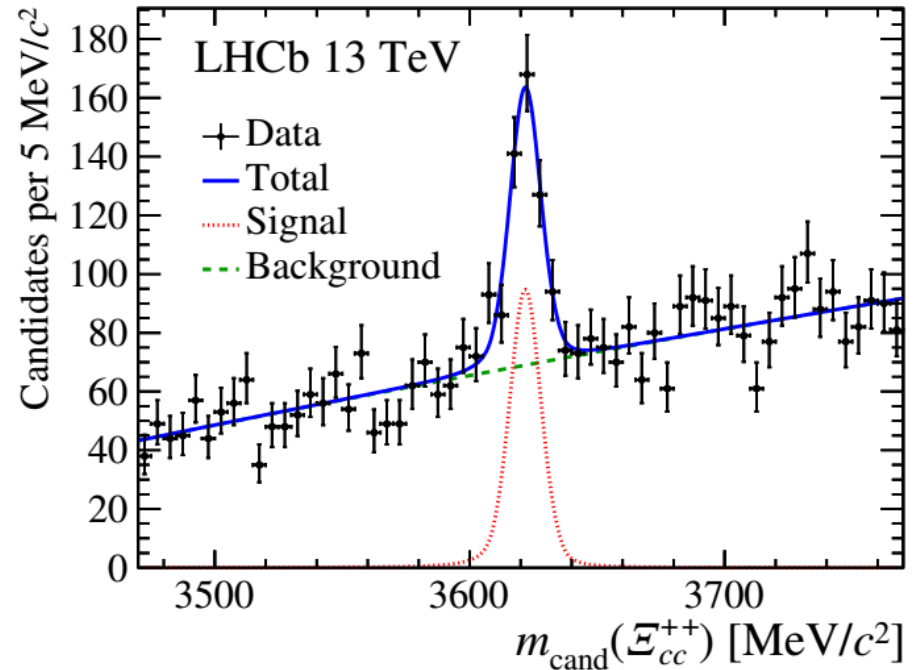
Observed in two LHCb data sets.

Consistent with  $\Xi_{cc}^{++}$  (ccu).

Mass:  $m(\Xi_{cc}^{++}) = 3621.40 \pm 0.72$  (stat)  $\pm 0.27$  (syst)  $\pm 0.14(\Lambda_c^+)$  MeV

Many follow-up analyses are in progress

- Lifetime and production rate measurements,
- Searches in additional decay modes,
- Searches for isospin partner.



# References to theoretical predictions

- S. S. Gershtein, V. V. Kiselev, A. K. Likhoded, and A. I. Onishchenko, *Spectroscopy of doubly heavy baryons*, Phys. Atom. Nucl. **63** (2000) 274, arXiv:hep-ph/9811212. ★
- S. S. Gershtein, V. V. Kiselev, A. K. Likhoded, and A. I. Onishchenko, *Spectroscopy of doubly charmed baryons:  $\Xi_{cc}^+$  and  $\Xi_{cc}^{++}$* , Mod. Phys. Lett. **A14** (1999) 135, arXiv:hep-ph/9807375. ★
- C. Itoh, T. Minamikawa, K. Miura, and T. Watanabe, *Doubly charmed baryon masses and quark wave functions in baryons*, Phys. Rev. **D61** (2000) 057502.
- S. S. Gershtein, V. V. Kiselev, A. K. Likhoded, and A. I. Onishchenko, *Spectroscopy of doubly heavy baryons*, Phys. Rev. **D62** (2000) 054021. ★
- K. Anikeev et al., *Workshop on B physics at the Tevatron: Run II and beyond, Batavia, Illinois, September 23-25, 1999, 2001*. arXiv:hep-ph/0201071.
- V. V. Kiselev and A. K. Likhoded, *Baryons with two heavy quarks*, Phys. Usp. **45** (2002) 455, arXiv:hep-ph/0103169. ★
- D. Ebert, R. N. Faustov, V. O. Galkin, and A. P. Martynenko, *Mass spectra of doubly heavy baryons in the relativistic quark model*, Phys. Rev. **D66** (2002) 014008, arXiv:hep-ph/0201217.
- D.-H. He et al., *Evaluation of the spectra of baryons containing two heavy quarks in a bag model*, Phys. Rev. **D70** (2004) 094004, arXiv:hep-ph/0403301.
- C.-H. Chang, C.-F. Qiao, J.-X. Wang, and X.-G. Wu, *Estimate of the hadronic production of the doubly charmed baryon  $\Xi_{cc}$  in the general-mass variable-flavor-number scheme*, Phys. Rev. **D73** (2006) 094022, arXiv:hep-ph/0601032. ★