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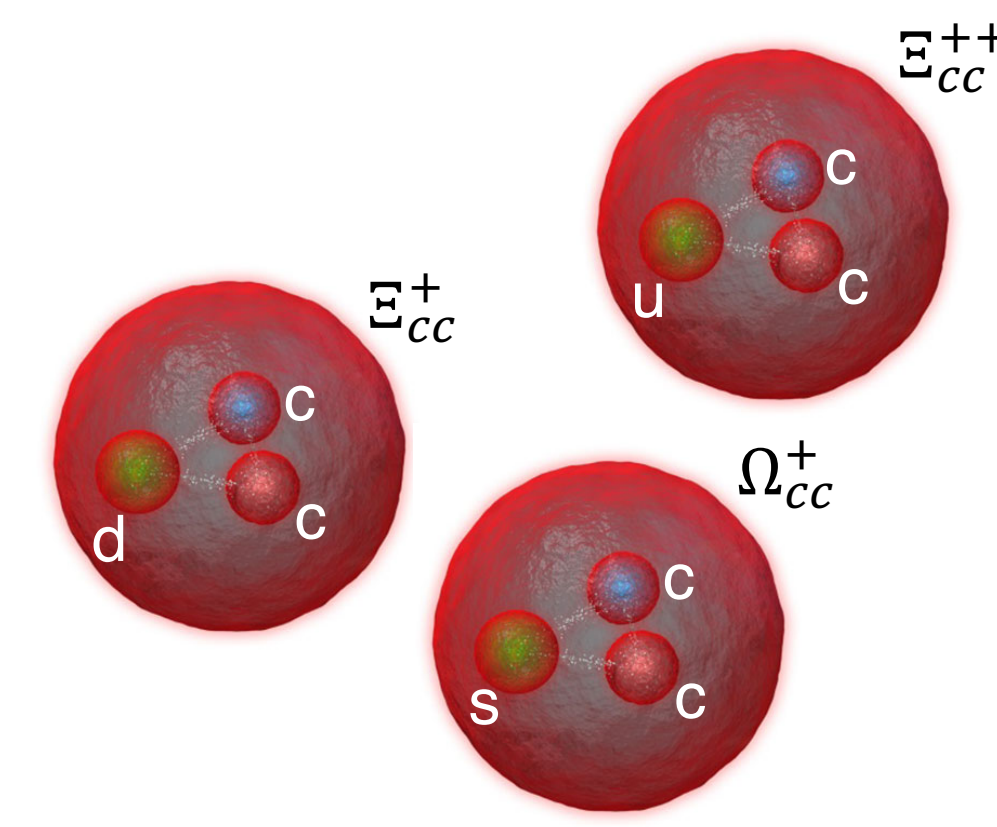


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Ξ_{cc}^{++} baryon studies

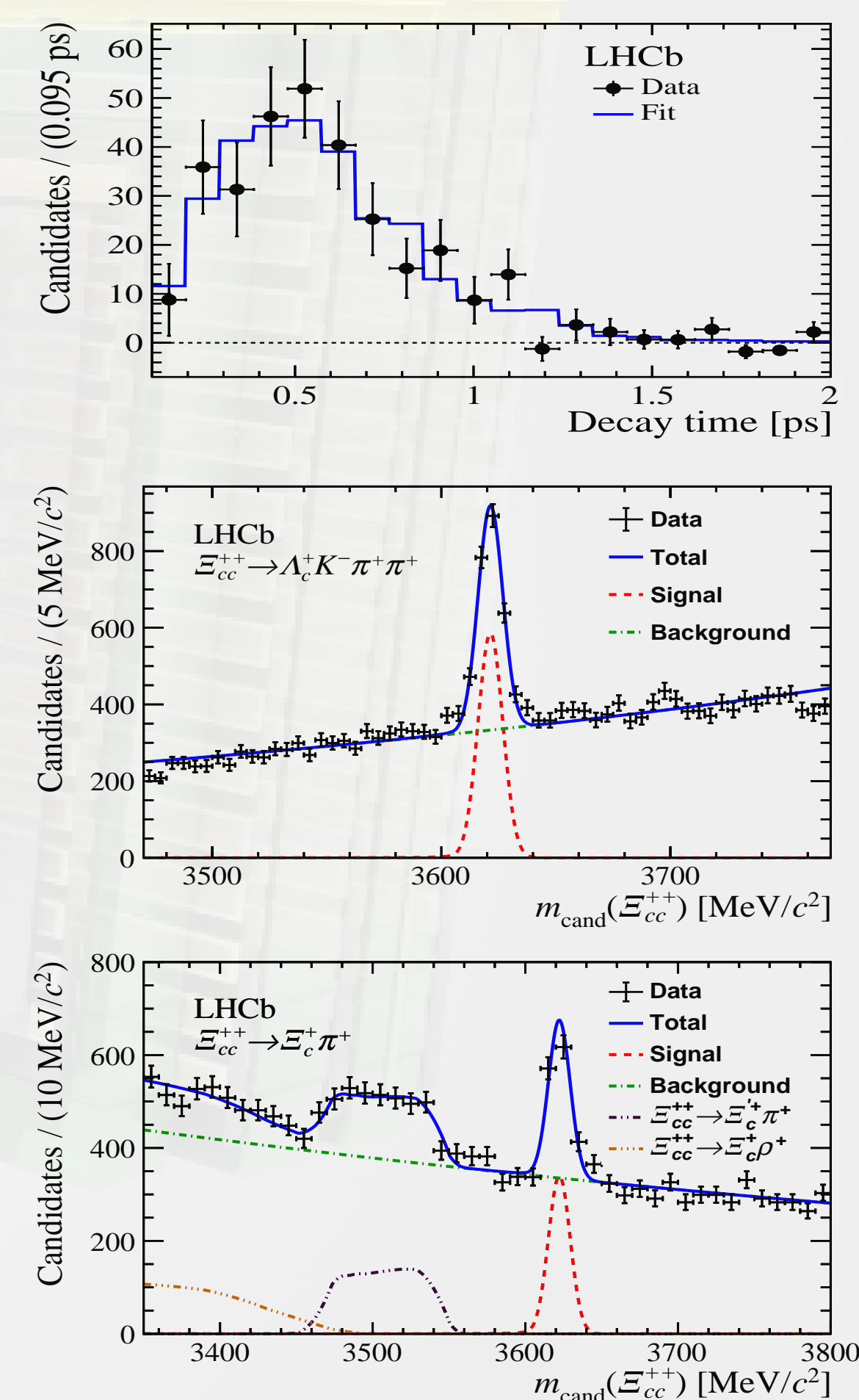
LHCb is building a comprehensive picture of the doubly charmed baryon Ξ_{cc}^{++} :

- Observation of the Ξ_{cc}^{++} baryon state in $\Lambda_c^+ K^- \pi^+ \pi^+$ final state [1]
- Subsequent confirmation in $\Xi_{cc}^{++} \rightarrow \Xi_c^+ \pi^+$ decays [2] and upper limit on the branching fraction (BF) ratio of $\Xi_{cc}^{++} \rightarrow D^+ p K^- \pi^+$ decays [3]
- Precise recent studies of Ξ_{cc}^{++} baryon properties:

– **production** [4]: $\frac{\sigma(\Xi_{cc}^{++}) \times \mathcal{B}(\Xi_{cc}^{++} \rightarrow \Lambda_c^+ K^- \pi^+ \pi^+)}{\sigma(\Lambda_c^+)} = (2.22 \pm 0.27 \text{ (stat)} \pm 0.29 \text{ (syst)}) \times 10^{-4}$

– **lifetime** [5]: $\tau(\Xi_{cc}^{++}) = 0.256_{-0.022}^{+0.024} \text{ (stat)} \pm 0.014 \text{ (syst)} \text{ ps}$

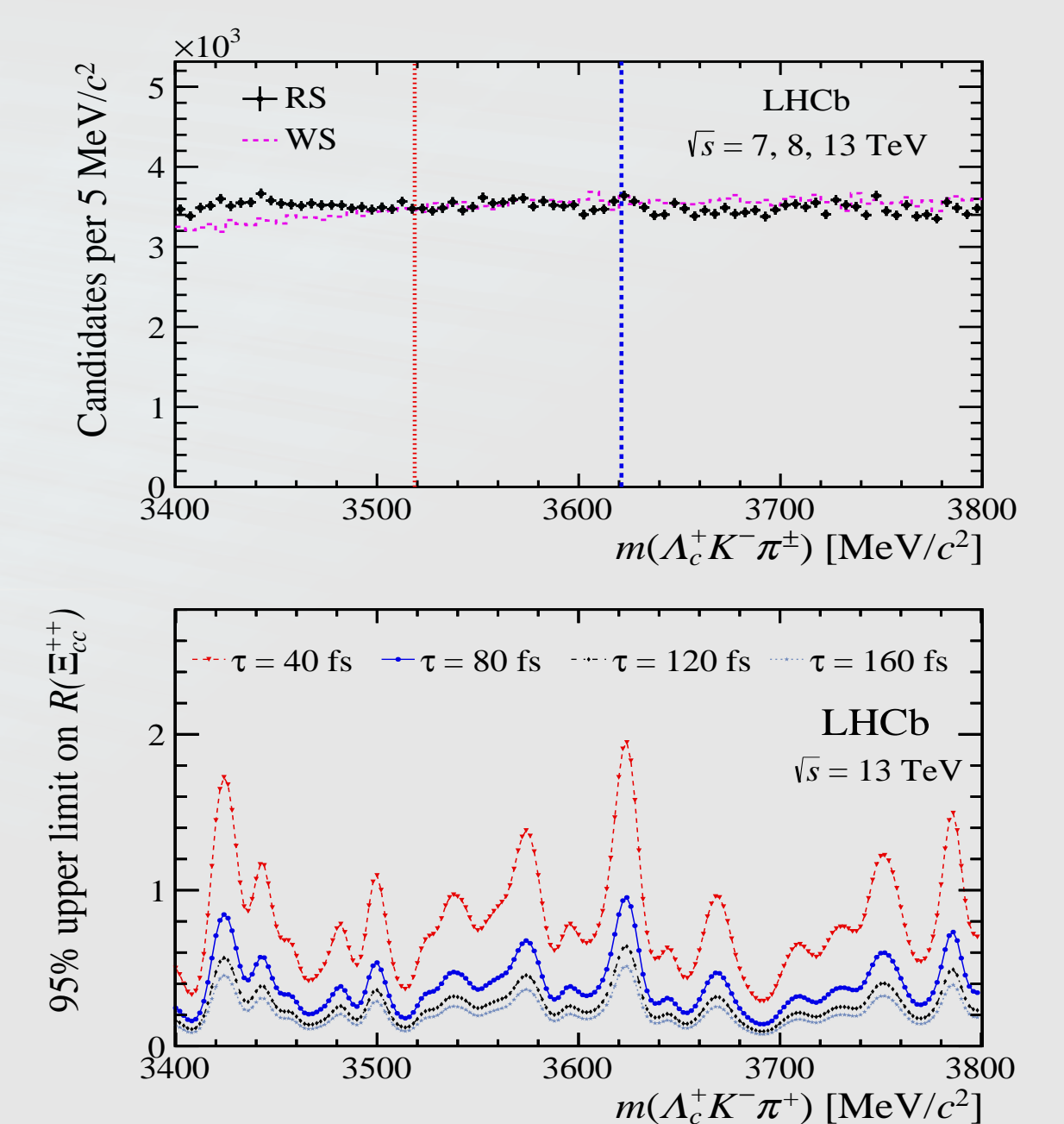
– **mass** [6]: $m(\Xi_{cc}^{++}) = 3621.55 \pm 0.23 \text{ (stat)} \pm 0.30 \text{ (syst)} \text{ MeV}/c^2$



Ξ_{cc}^+ baryon searches

Search for the Ξ_{cc}^+ baryon in the $\Lambda_c^+ K^- \pi^+$ decay channel using full Run1+Run2 dataset [7]:

- No significant signal observed:
 - the largest local significance, corresponding to 2.7σ , occurs around $3620 \text{ MeV}/c^2$
 - global significance (evaluated in the $3.5 - 3.7 \text{ GeV}/c^2$ mass range) 1.7σ
- Upper limits on the ratio of production cross-section times branching fraction to Λ_c^+ and Ξ_{cc}^{++} baryons has been set as a function of lifetime and mass hypotheses



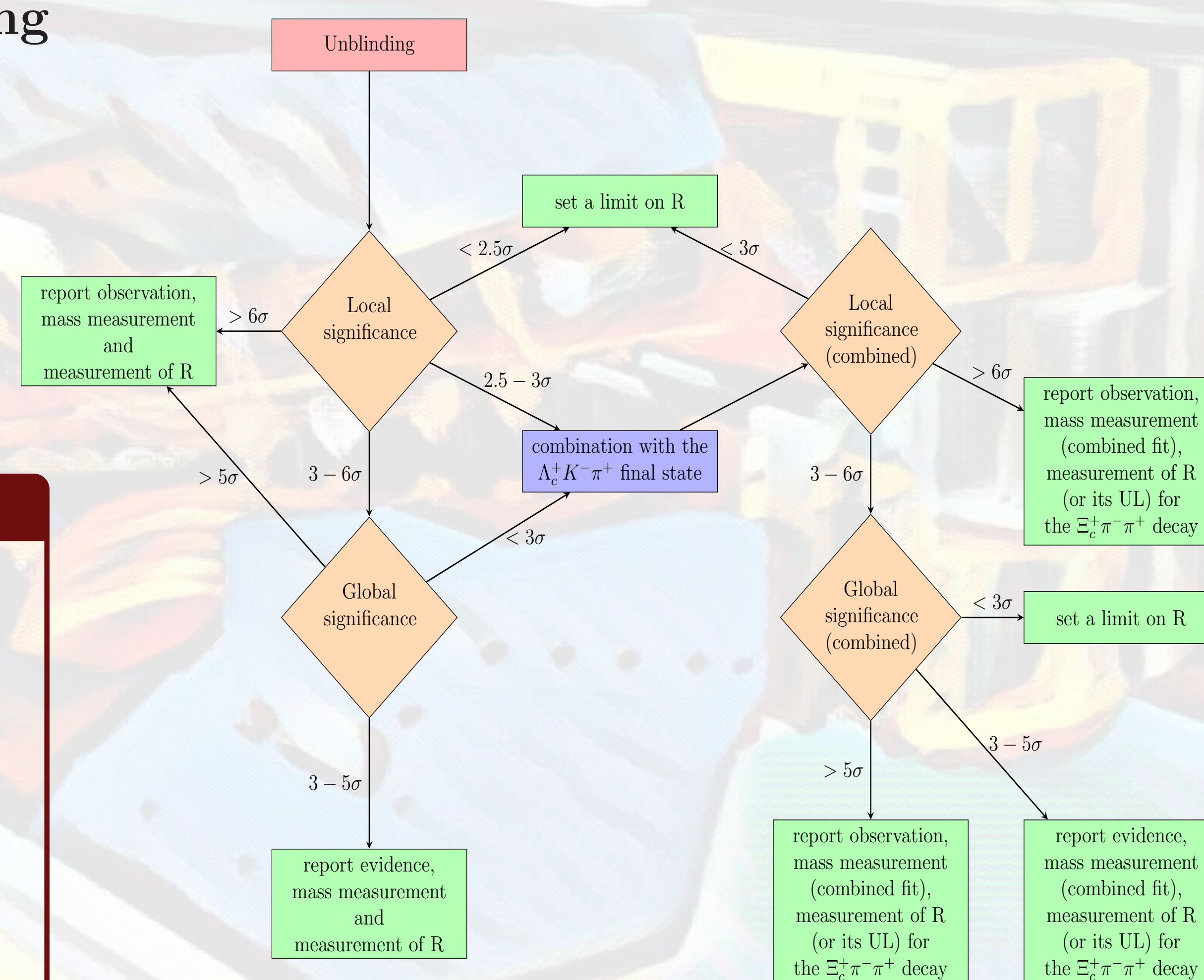
Ongoing analyses

Adding more decay channels to search for the Ξ_{cc}^+ and Ω_{cc}^+ baryons using Run 2 data:

- $\Xi_{cc}^+ \rightarrow (\Xi_c^+ \rightarrow p K^- \pi^+) \pi^- \pi^+$
- $\Xi_{cc}^+ \rightarrow (\Xi_c^0 \rightarrow p K^- K^- \pi^+) \pi^+$
- $\Omega_{cc}^+ \rightarrow (\Xi_c^+ \rightarrow p K^- \pi^+) K^- \pi^+$

More to do with a future Run 3 dataset

Trigger studies ongoing to ensure full potential for doubly charmed baryons searches and studies is in place for Run 3 data taking - searches for the Ξ_{cc}^+ and Ω_{cc}^+ baryons, excited states, measurement of quantum numbers, and many more!



Analysis strategy

- Blinded analysis - decisions, strategies and procedures defined and developed for all cases prior to unblinding
- Efficient MVA-based selection for the mass measurement in case of a signal observation/evidence
- Efficiency studies for the measurement of the production cross section times BF relative to the normalisation channel $\Xi_{cc}^{++} \rightarrow \Xi_c^+ \pi^+$ or its upper limit in case a non-significant signal is observed

References

- [1] R. Aaij et al. Observation of the doubly charmed baryon Ξ_{cc}^{++} . *Phys. Rev. Lett.*, 119(11):112001, 2017.
- [2] R. Aaij et al. First observation of the doubly charmed baryon decay $\Xi_{cc}^{++} \rightarrow \Xi_c^+ \pi^+$. *Phys. Rev. Lett.*, 121(16):162002, 2018.
- [3] R. Aaij et al. A search for $\Xi_{cc}^{++} \rightarrow D^+ p K^- \pi^+$ decays. *JHEP*, 10:124, 2019.
- [4] R. Aaij et al. Measurement of Ξ_{cc}^{++} production in pp collisions at $\sqrt{s} = 13 \text{ TeV}$. *Chinese Physics C*, 44(2):022001, 2020.
- [5] R. Aaij et al. Measurement of the lifetime of the doubly charmed baryon Ξ_{cc}^{++} . *Phys. Rev. Lett.*, 121(5):052002, 2018.
- [6] R. Aaij et al. Precision measurement of the Ξ_{cc}^{++} mass. 2019. arXiv:1911.08594.
- [7] R. Aaij et al. Search for the doubly charmed baryon Ξ_{cc}^+ . *Sci. China Phys. Mech. Astron.*, 63(2):221062, 2020.