Measurement of heavy-flavor production in the high-mass dimuon spectrum in pp collisions at $\sqrt{s}$ =13 TeV with ALICE

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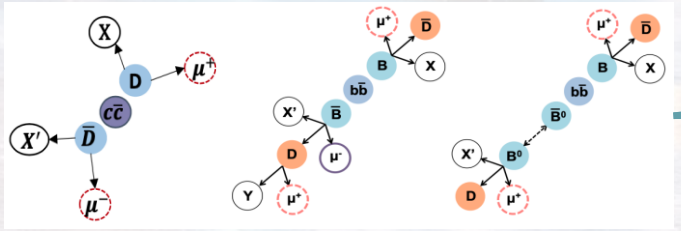
The main purpose of this analysis is to investigate the heavy-quark production in pp collisions and to explore the dimuon invariant mass spectrum in the continuum region beyond $M_{\mu\mu} = 4.0\ \mathrm{GeV/c^2}$

Important probes to study the QCD

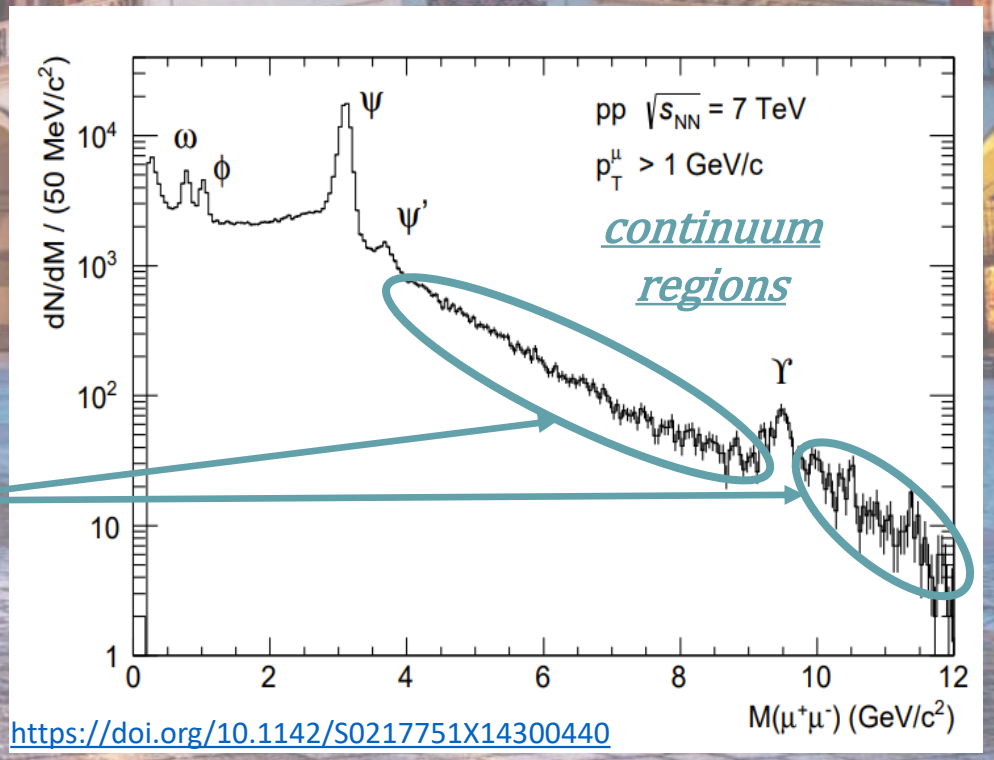
- Heavy quark production can be well described by the perturbative QCD ($\alpha_s \ll 1$)
- Heavy flavour (HF) production is sensitive to initial cold nuclear matter effects

Dimuon production in these continuum regions mainly due to semi-leptonic decay of:

- Pairs of open HF hadrons from the hadronization of $c\bar{c}$ and $b\bar{b}$ pairs



- Light mesons (π/K) pairs



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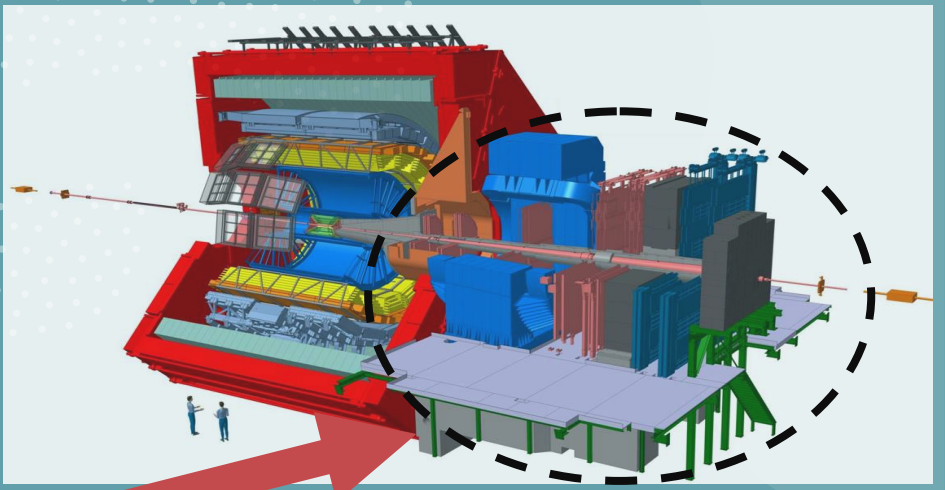
HF dimuon spectra are simulated with PYTHIA8 MC Event Generator

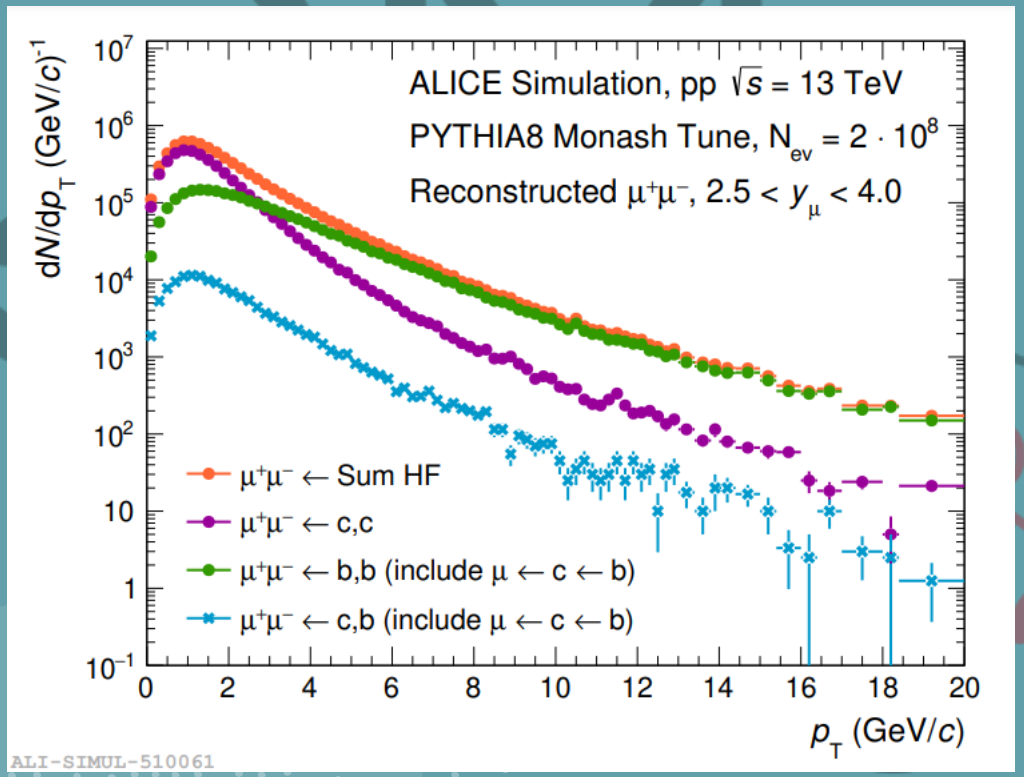
- ❑ **PYTHIA8 Monash Tune**
- ❑ **Embedded in the ALICE simulation framework**

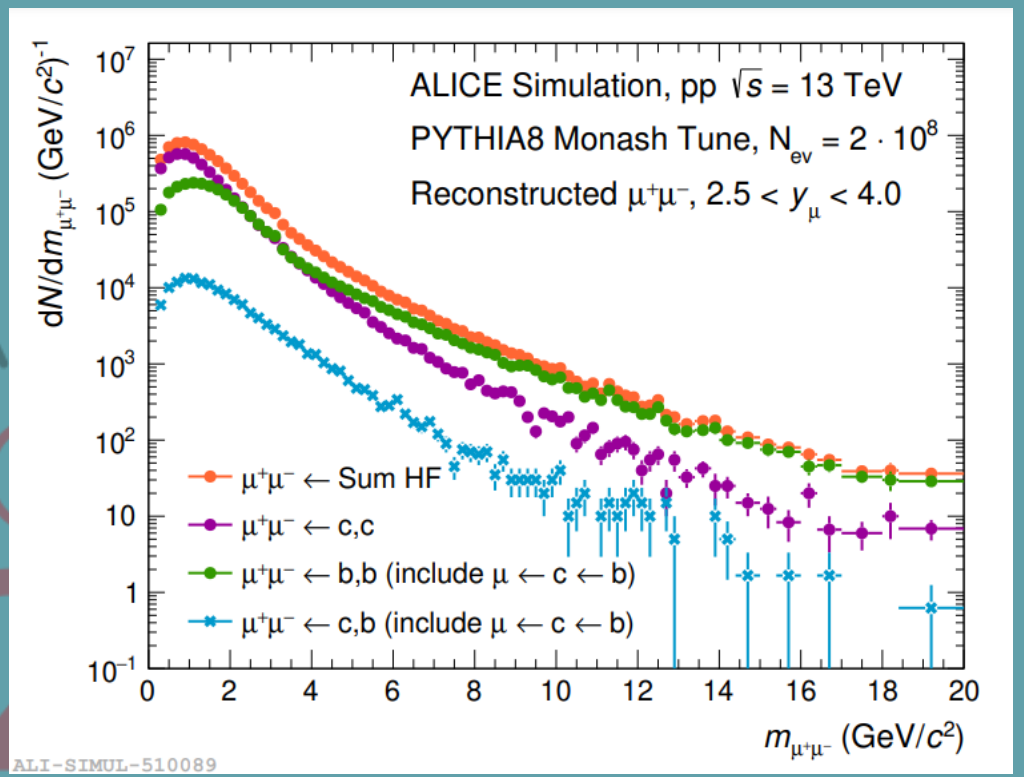
A large MC sample was generated by using the ALICE computing GRID
(200M triggered events corresponding to
$4.2 \cdot 10^{10}$ Minimum Bias events)

The interesting events are selected by the two criteria below:

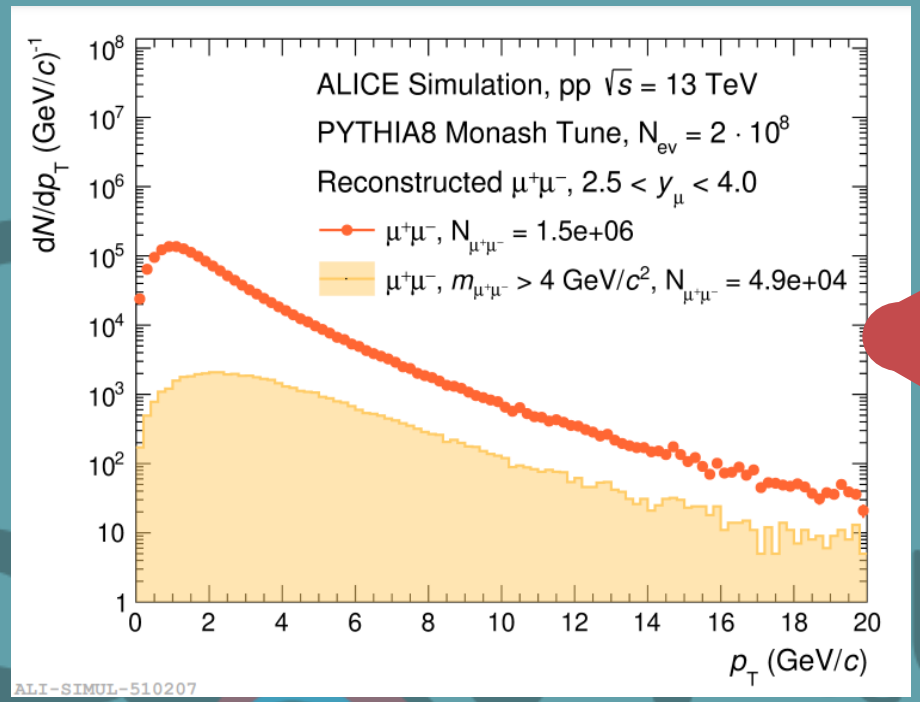
- Events where at least a pair of HF quarks was produced
- Decay muon falls in the rapidity region of the
  ALICE Muon Spectrometer (2.5<y<4.0)

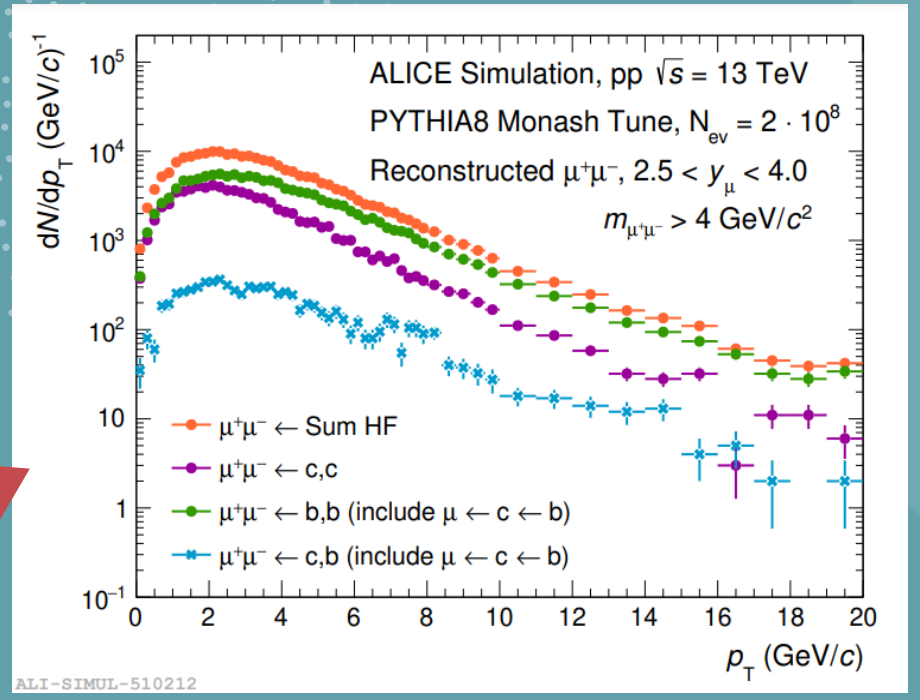


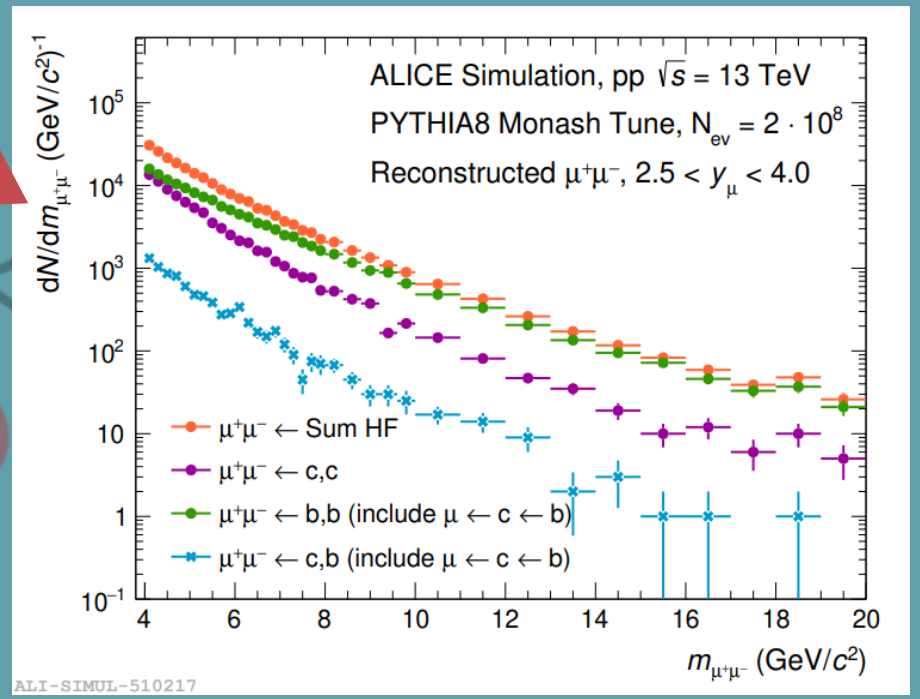




*The selection on the dimuon mass $M_{\mu\mu} > 4\ GeV/c^2$ removes **97%** of the reconstructed dimuon pairs*





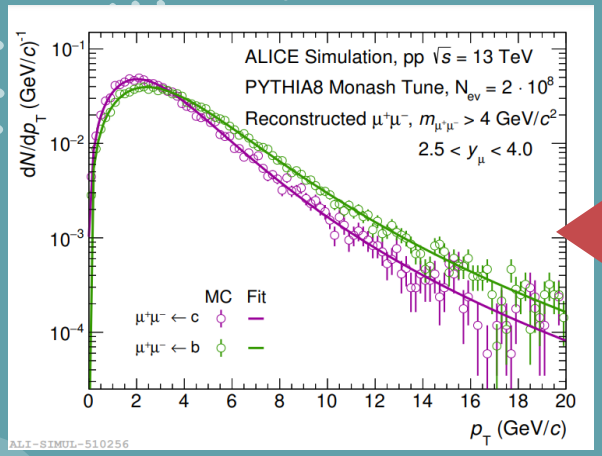


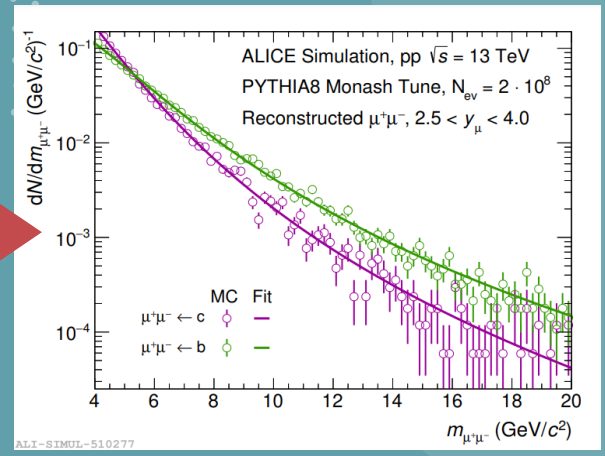
Above $M_{\mu\mu} > 4\ GeV/c^2$:

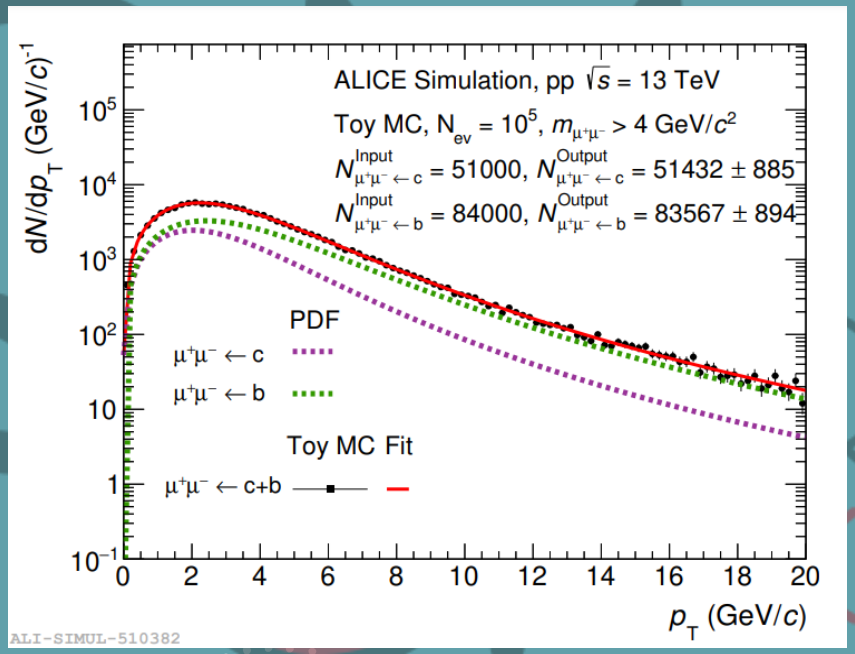
- *The contribution from decays of light flavours (LF)* is expected to become negligible with increasing invariant mass
- ***The decays of beauty hadrons are the main dimuon source***

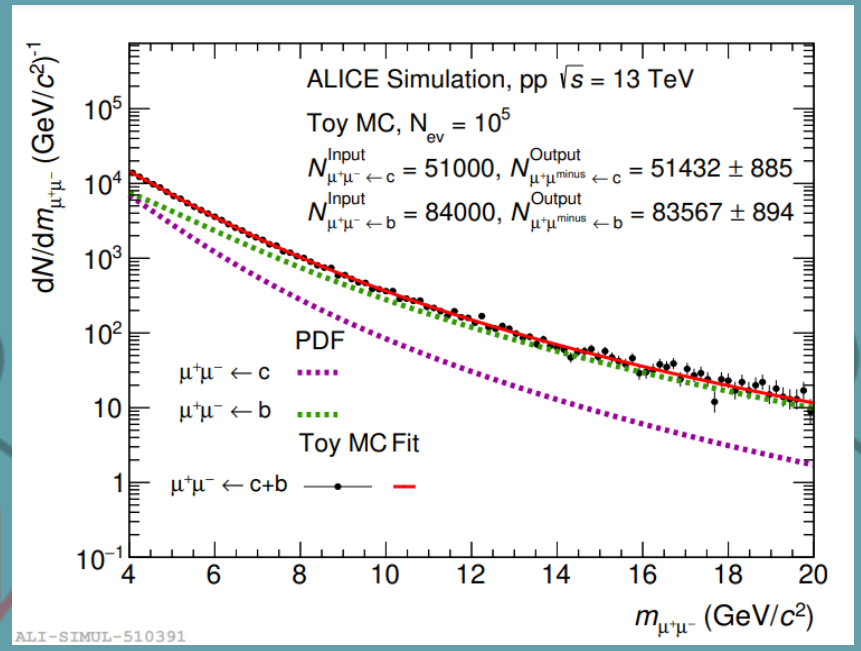
Preliminary test of the analysis procedure via simulation approach:

1) Extraction of the p_T and mass shapes of unlike sign dimuons from charm and beauty hadrons decay is performed via a fit to the MC reconstructed distributions
2) Generation of a toy data sample using ROOFIT with defined yields ($N^{Input}_{\mu^+\mu^-\leftarrow c}$, $N^{Input}_{\mu^+\mu^-\leftarrow b}$)
3) Simultaneous fit of M and p_T distributions with a template, keeping free the normalization of the distributions
4) Extraction of raw yields ($N^{Output}_{\mu^+\mu^-\leftarrow c}$, $N^{Output}_{\mu^+\mu^-\leftarrow b}$)









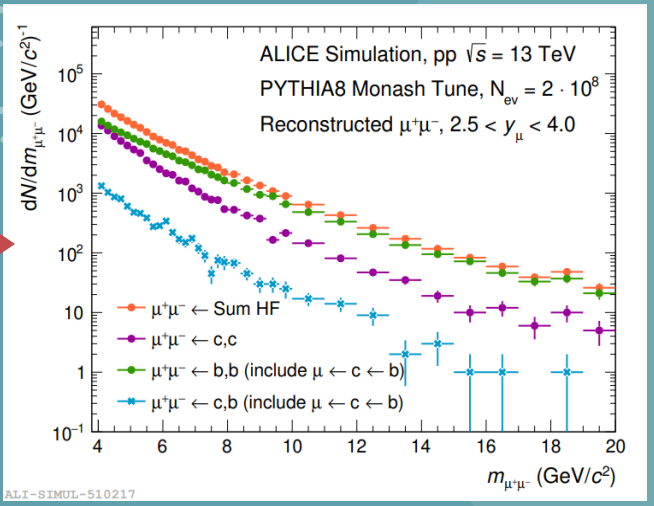
The shapes of dimuon spectra from charm and beauty are rather different above $M_{\mu\mu} > 4\ GeV/c^2$ *:*

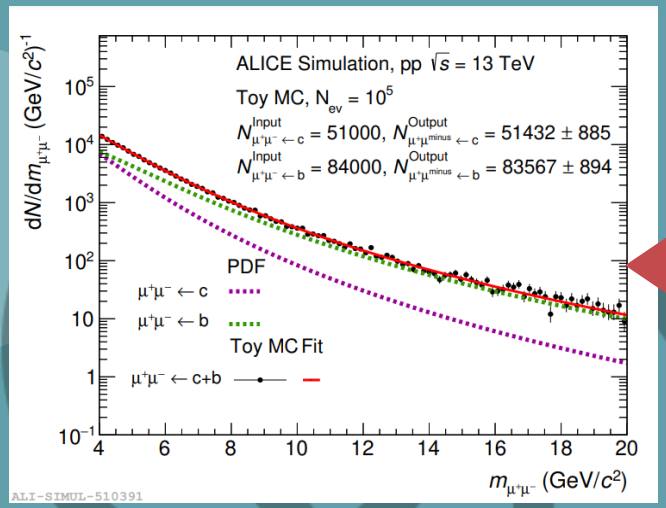
$N^{Input}_{\mu^+\mu^-\leftarrow c,b}$ and $N^{Output}_{\mu^+\mu^-\leftarrow c,b}$ are compatible showing that the foreseen procedure can be attempted on real data!

Summary and outlook: simulation work

- ❑ 200M events with the full detector simulations are produced for this study
- ❑ The HF decayed dimuon p_T and mass shapes are obtained from the simulation
- ❑ The beauty hadrons decay contribution and mass shape-dependent sources are evaluated by the simulations
- ❑ Evaluation of how the cut over the dimuon mass affects the different dimuon sources

Beauty dimuons are the dominant component above $M_{\mu\mu} > 4\ GeV/c^2$





Summary: data analysis procedure

- ❑ Use of an unbinned approach, extracting the p_T and mass shapes of the charm and beauty dimuons
- ❑ Generation of a toy data sample from the charm and beauty shapes from MC
- ❑ Fitting the toy sample with the sum of charm and beauty shapes

The template fit produced will be employed in the comparison with the data

Next Steps

- ❑ Evaluation of the combinatorial background from the decays of light flavour particles using a dedicated MC simulation with a specific trigger
  Above $M_{\mu\mu} > 4\ GeV/c^2$, at the generation level the contribution from LF particles is expected to become increasingly negligible
- ❑ Extraction of the LF PDF using the same unbinned approach
- ❑ Global fit of the continuum dimuon M and p_T distributions with a superposition of the expected sources