$B \to \phi$ checks/LHCb comparison

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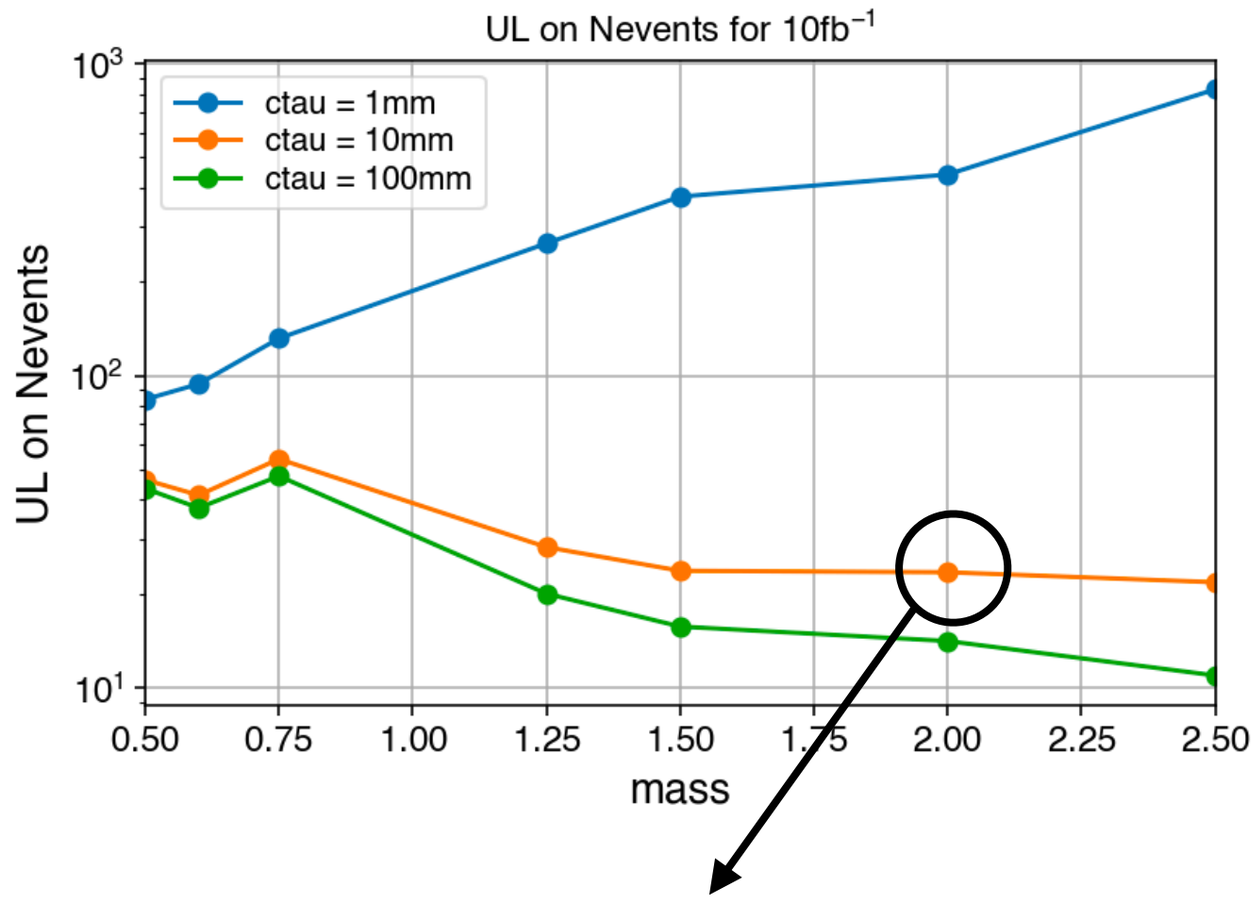
Ingredient 1

- Asked Hardik to run fit machinery and give me N_UL values from combine for our current BToPhi MC
- Then try to follow Claudio's procedure for translating this into an UL on BR(B->phi)
  - https://github.com/claudiocc1/Bphi/raw/master/pptx/Bphi_Proposal_summary.pptx



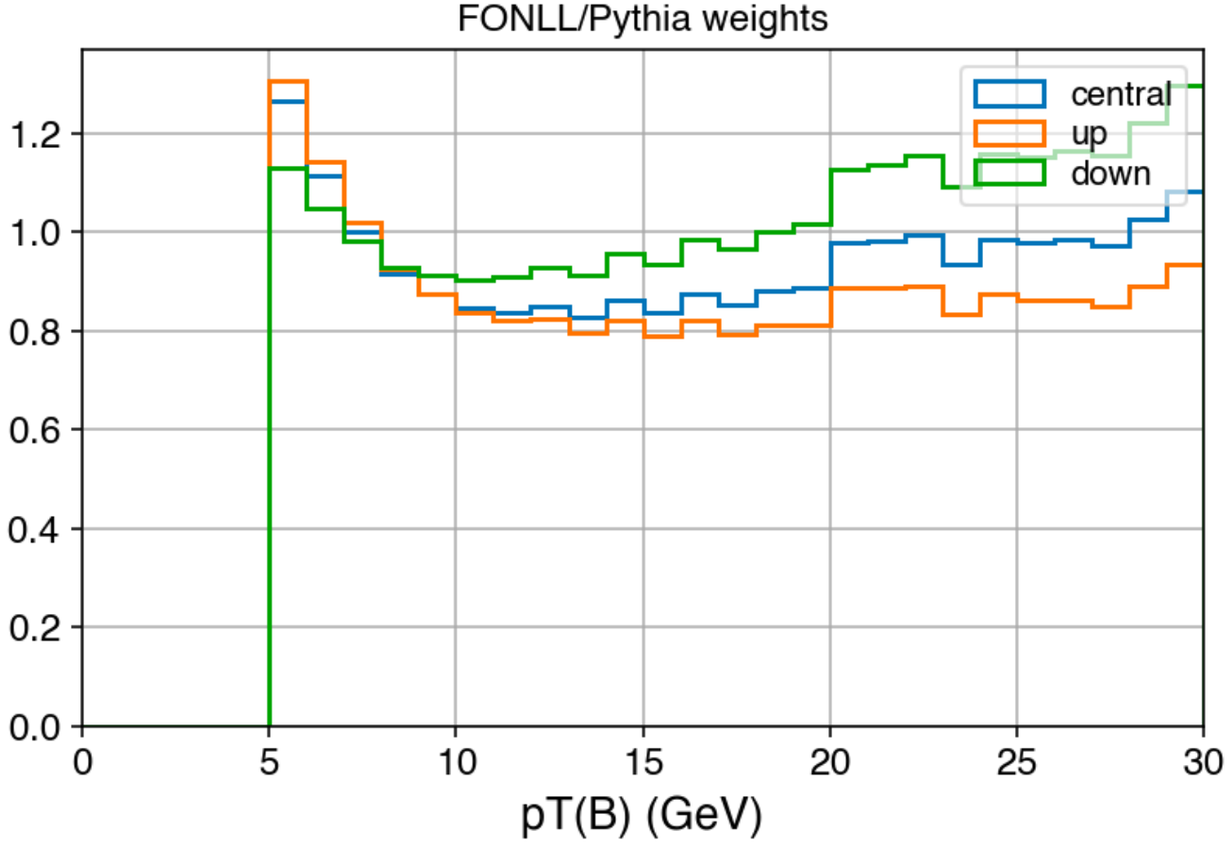
Pick mPhi=2GeV, ctau=10mm for further tests

UL of ~23 events

Ingredient 2

- From now on everything requires ==1 Phi in the event with pT(B)>5GeV, |eta(B)|<2.8

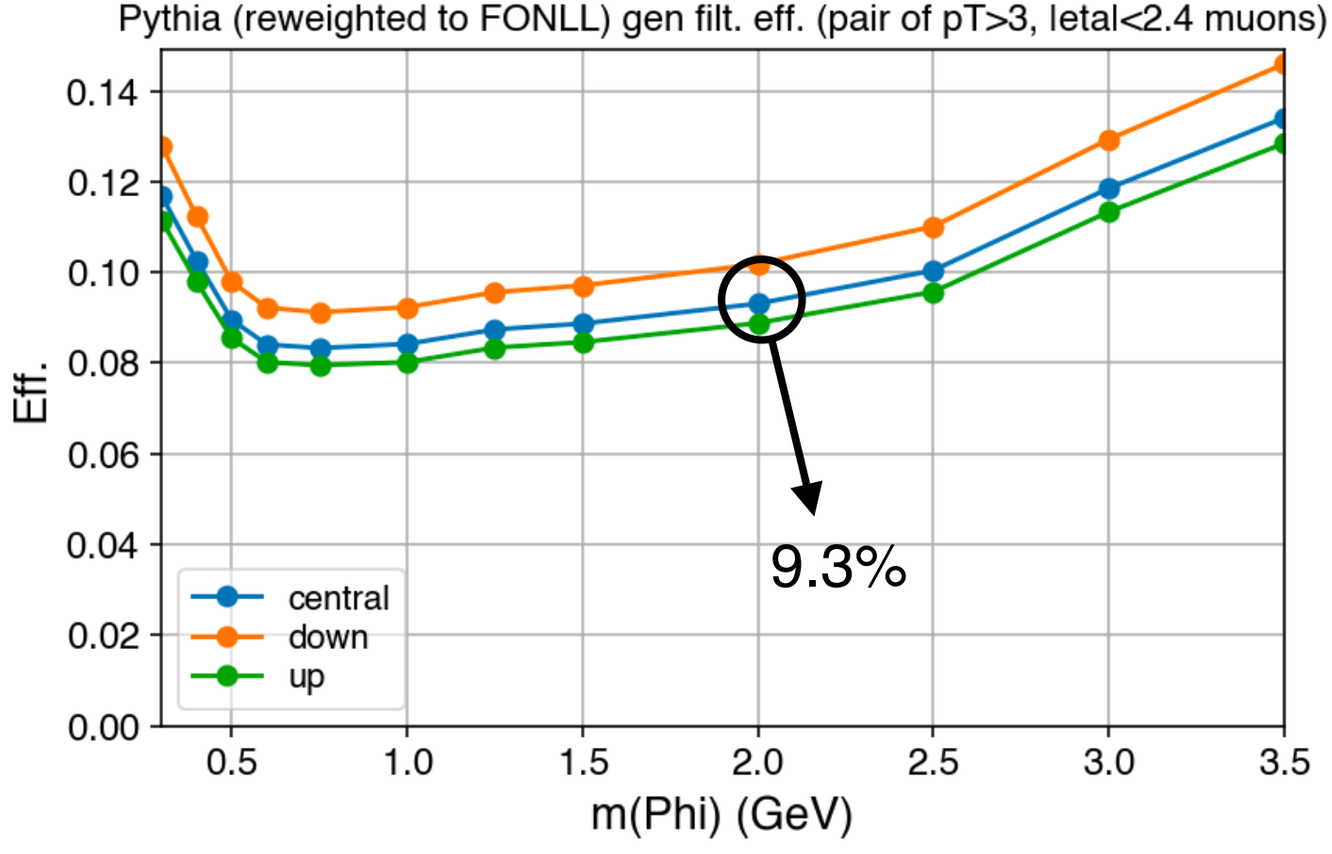
- pT reweighting functions from Claudio to go from the Pythia to FONLL spectrum.
  - Clipped at pT(B)=30GeV to avoid fluctuations



https://github.com/claudiocc1/Bphi/blob/master/results/weights_shapeOnly_2.8.txt

Ingredient 3

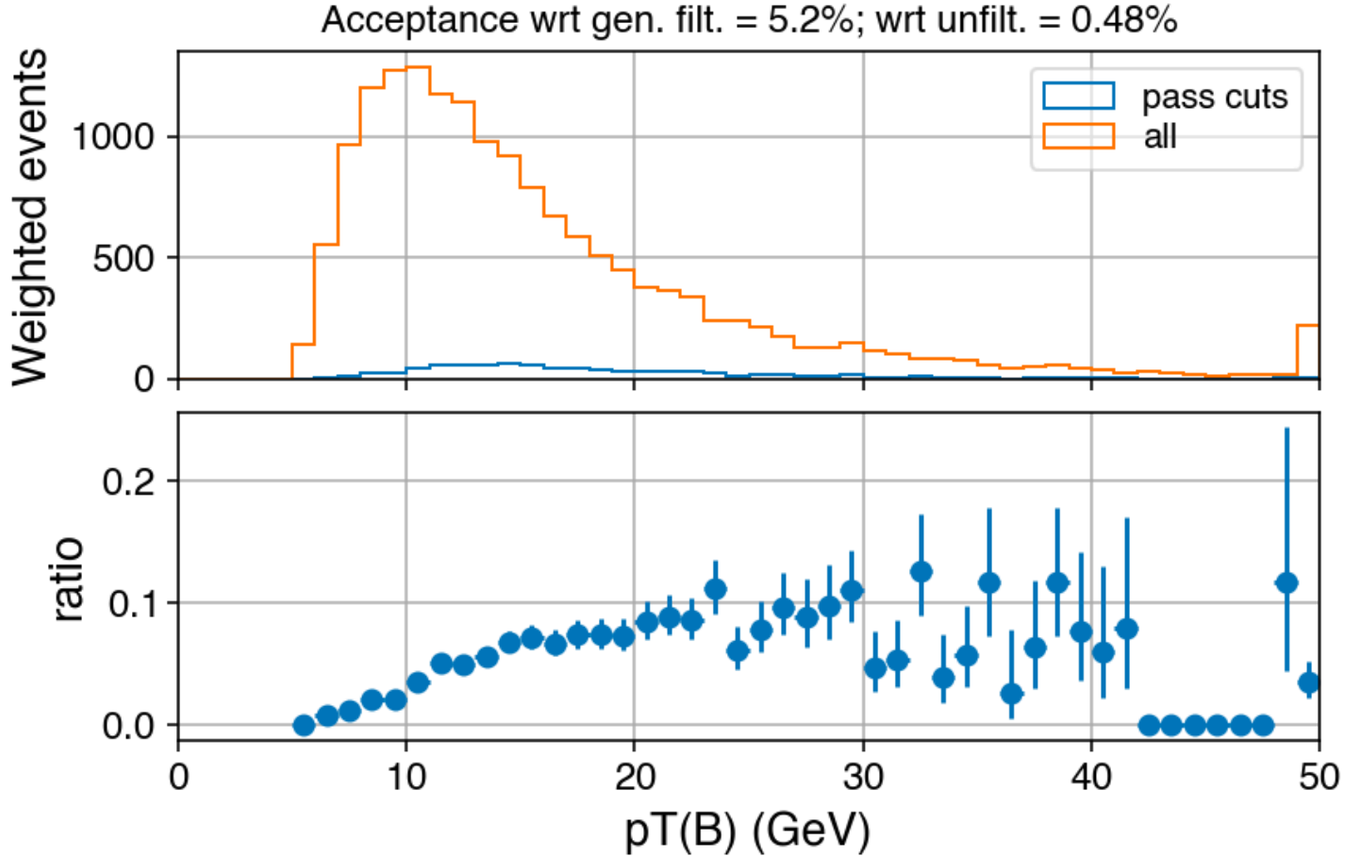
- From Claudio: Filter efficiency starting from Pythia pT(B)>5GeV, |eta(B)|< 2.8 with the pT(B) distribution reshaped to FONLL
- Filter requires two gen. muons with pT>3GeV and |eta|<2.4



https://github.com/claudiocc1/Bphi/blob/master/results/filter_efficiency_FONLL_shape.txt

Calculating acceptance

- Now look at the filtered Pythia sample
- Plot the
  - pT(B) spectrum (reweighted by slide 2)
  - and again for events passing analysis cuts
- Acceptance with respect to the gen. filtered sample of 5.2%. Dividing this by the 9.3% from the previous slide gives an acceptance of 0.48% with respect to the unfiltered re-weighted sample



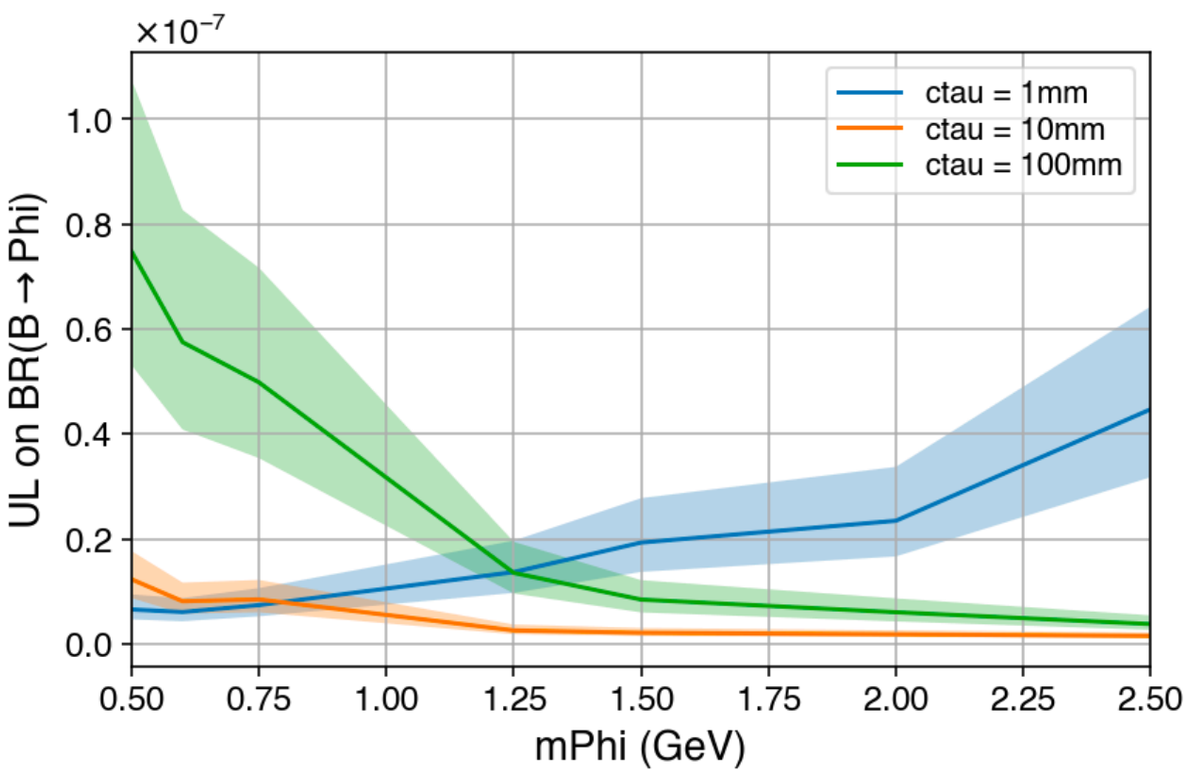
Calculating UL on BR

- UL on BR = 0.5 * N_{UL} / (acceptance-wrt-unfiltered * lumi * xsec)
  - lumi = 10.1fb^{-1}
  - acceptance-wrt-unfiltered = 0.48%
  - xsec = 1.33e+08 + 5.42e+07 - 4.05e+07 pb
    - FONLL pT(B)>5GeV, |eta(B)|<2.8

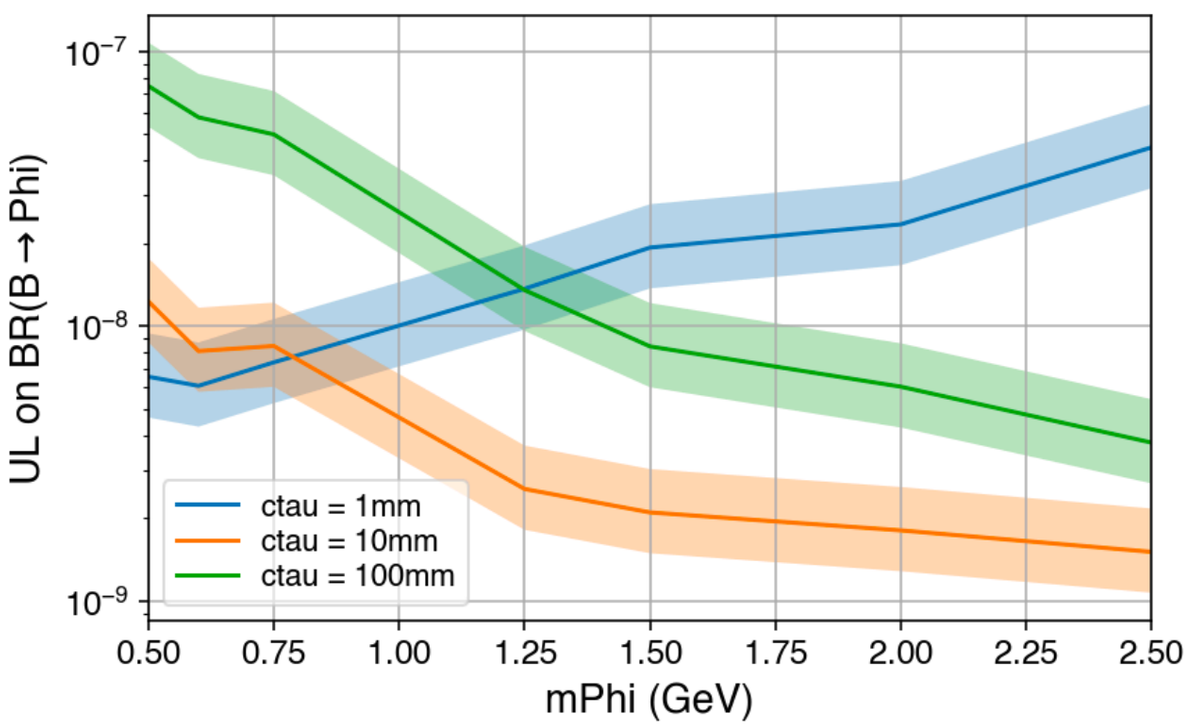
- → UL on BR of **1.81e-09 +44% -29%**
  - This uncertainty considers only variation on xsec
  - Variation on acceptance value due to pT reweighting envelopes translated into a **+7 -11% uncertainty on BR**

UL on BR(B→X Phi)

- Repeating this for the other model points from slide 2, plotting just the xsec uncertainty in the band



linear



log

LHCb 1

- https://journals.aps.org/prl/pdf/10.1103/PhysRevLett.115.161802
  - $B^0 \rightarrow K^0\mu^+\mu^-$

τ=100ps → cτ=30mm

★ **Reference point from slide 6 (cτ=10mm)**

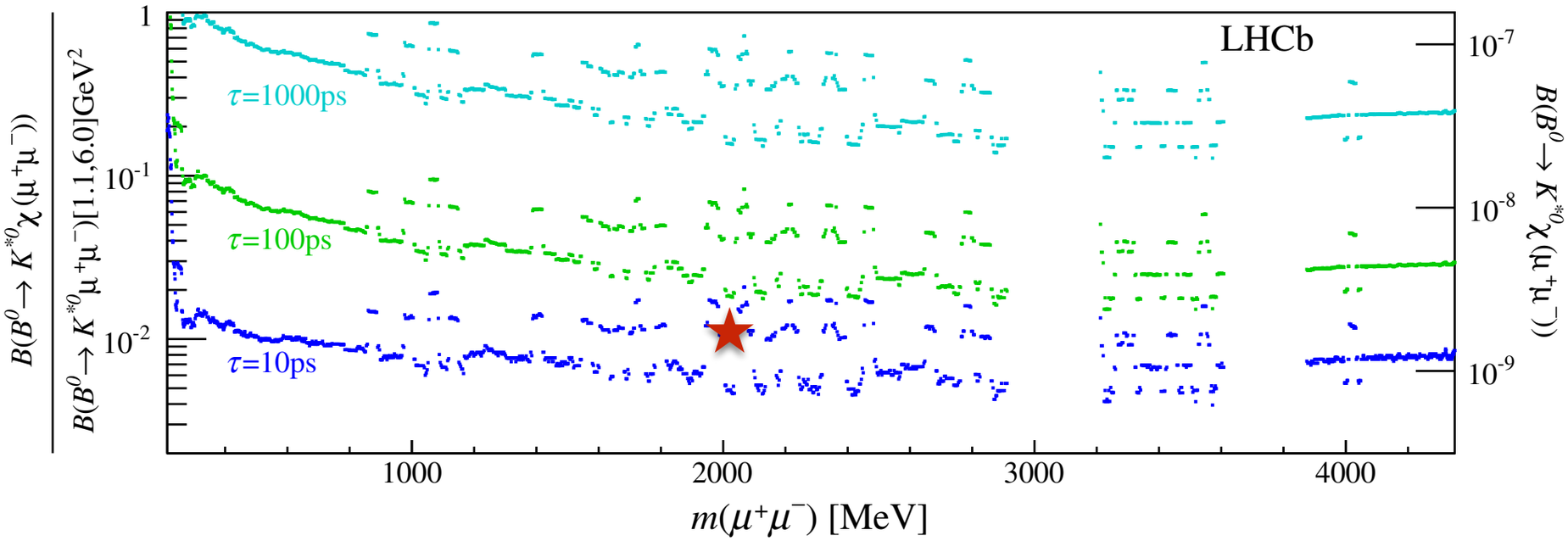


FIG. 4 (color online). Upper limits at 95% C.L. for (left axis) $\mathcal{B}(B^0 \rightarrow K^{*0}\chi(\mu^+\mu^-))/\mathcal{B}(B^0 \rightarrow K^{*0}\mu^+\mu^-)$, with $B^0 \rightarrow K^{*0}\mu^+\mu^-$ in $1.1 < m^2(\mu^+\mu^-) < 6.0$ GeV^2, and (right axis) $\mathcal{B}(B^0 \rightarrow K^{*0}\chi(\mu^+\mu^-))$. The sparseness of the data leads to rapid fluctuations in the limits. Excluding the region near $2m(\mu)$, the relative limits for $\tau < 10$ ps are between 0.005–0.05 and all relative limits for $\tau \leq 1000$ ps are less than 1.

LHCb 2

- https://journals.aps.org/prd/pdf/10.1103/PhysRevD.95.071101
  - $B^+ \rightarrow K^+\mu^+\mu^-$

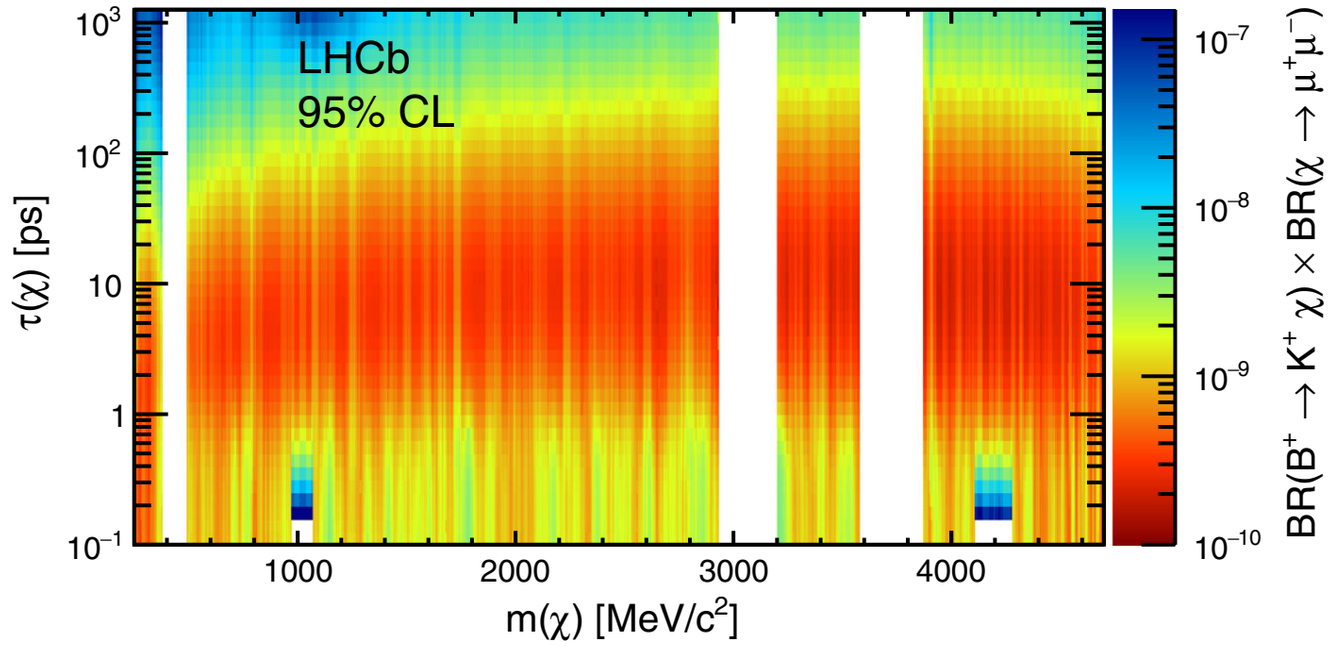


FIG. 4. Excluded branching fraction for the $B^+ \rightarrow K^+\chi(\mu^+\mu^-)$ decay as a function of $m(\chi)$ and $\tau(\chi)$ at 95% C.L. Regions corresponding to the fully vetoed K^0_S, J/ψ, $\psi(2S)$ and $\psi(3770)$ and to the partially vetoed ϕ and $\psi(4160)$ are excluded from the figure. All systematic uncertainties are included in the calculation of the upper limit.