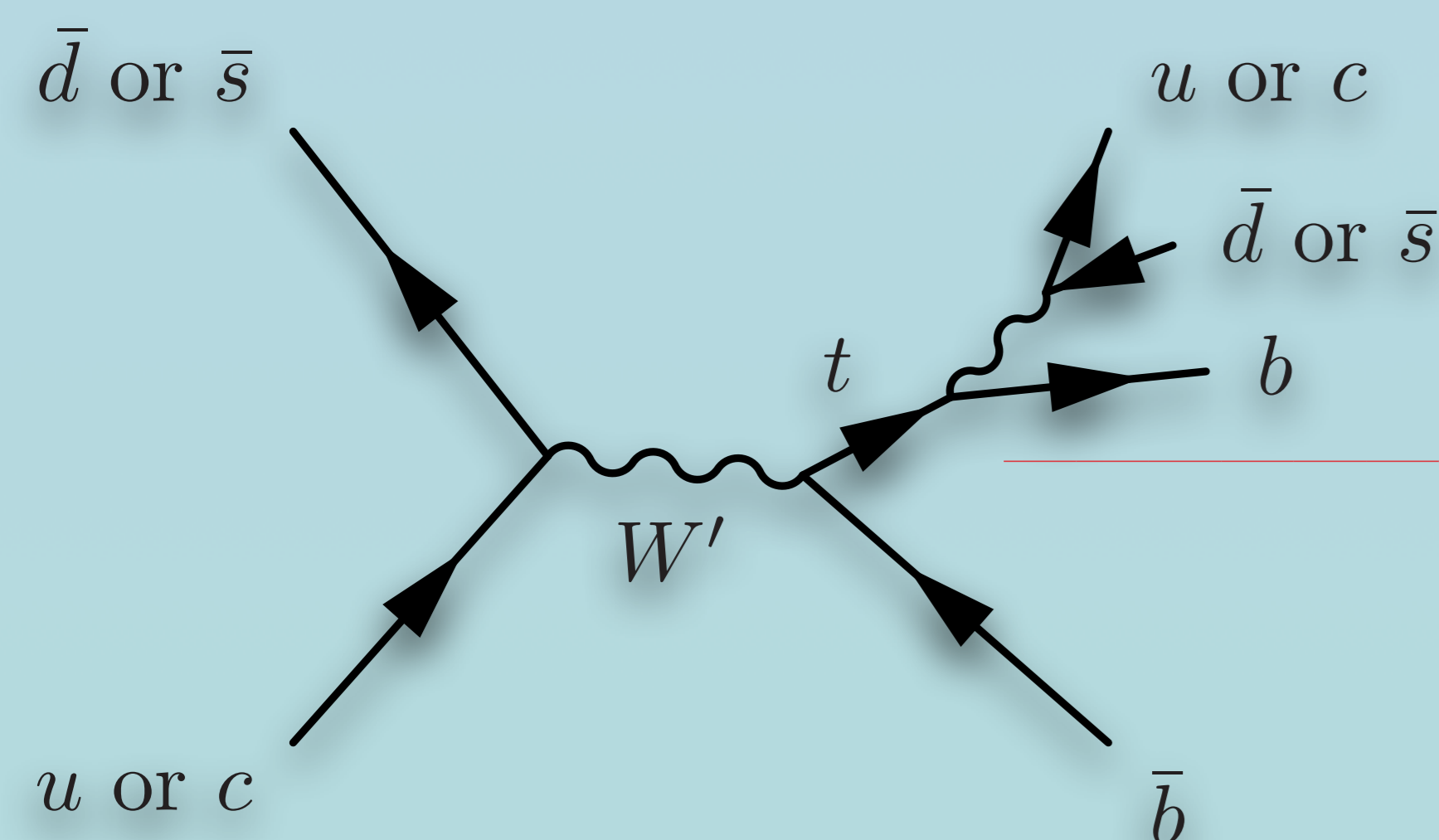


Kuan-Yu Lin (on behalf of the ATLAS collaboration)

## I. $W'$ to $tb$ in p-p collisions

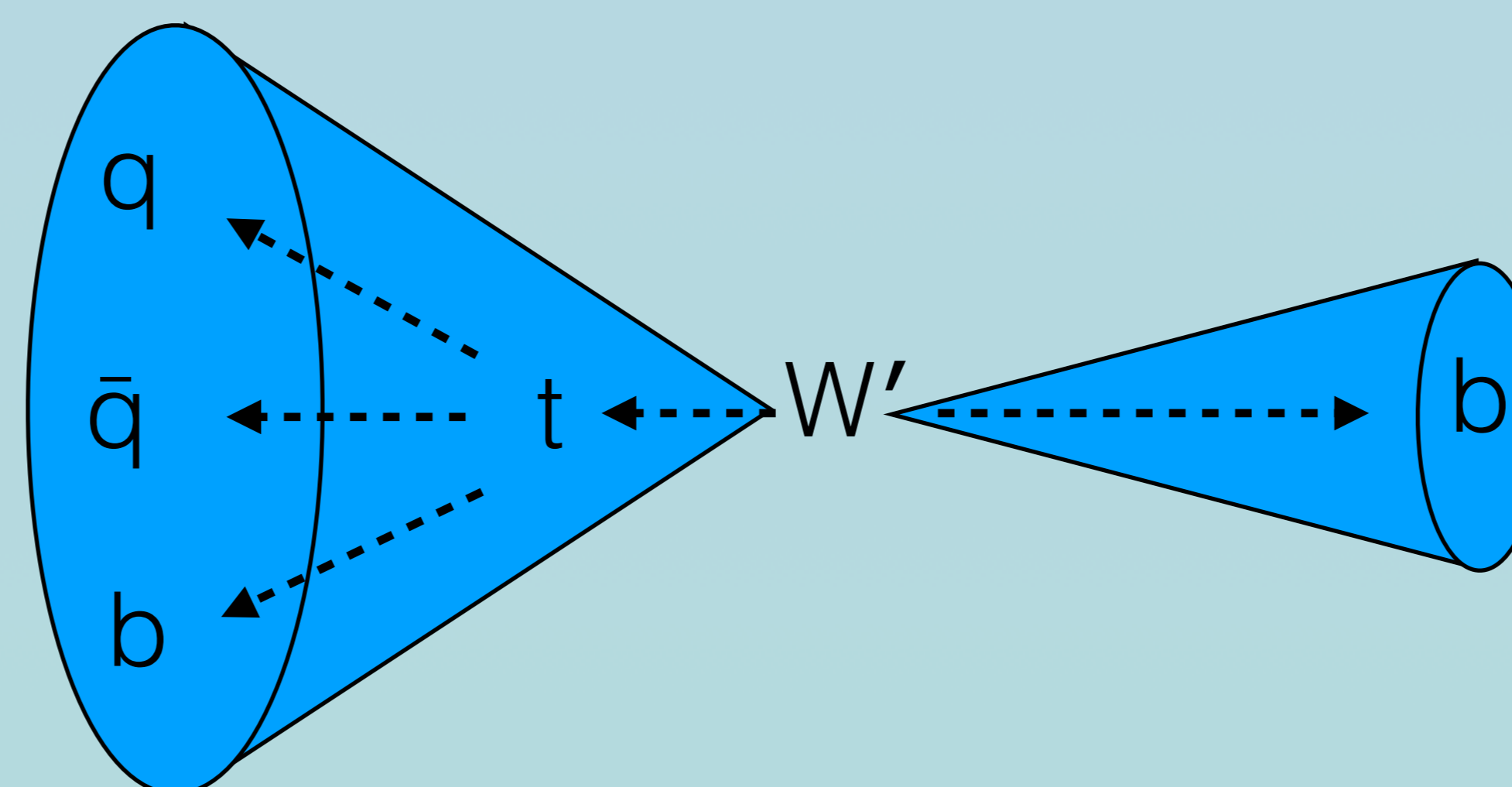
- $W'$  is a charge-1 gauge vector boson predicted by BSM scenarios such as Kaluza-Klein<sup>[1]</sup>, Little Higgs<sup>[2]</sup>, Topflavor<sup>[3]</sup>
- $W'$  with left or right-handed chirality is called  $W'_L$  and  $W'_R$
- Mass and couplings to quarks and leptons are free parameters
- Search for  $W'$  via its decays into a hadronic top-quark and a bottom-quark in proton-proton collisions at the LHC



[1] arXiv:hep-th/0104179  
 [2] arXiv:hep-ph/0512128  
 [3] arXiv:2104.06720 [hep-ph]

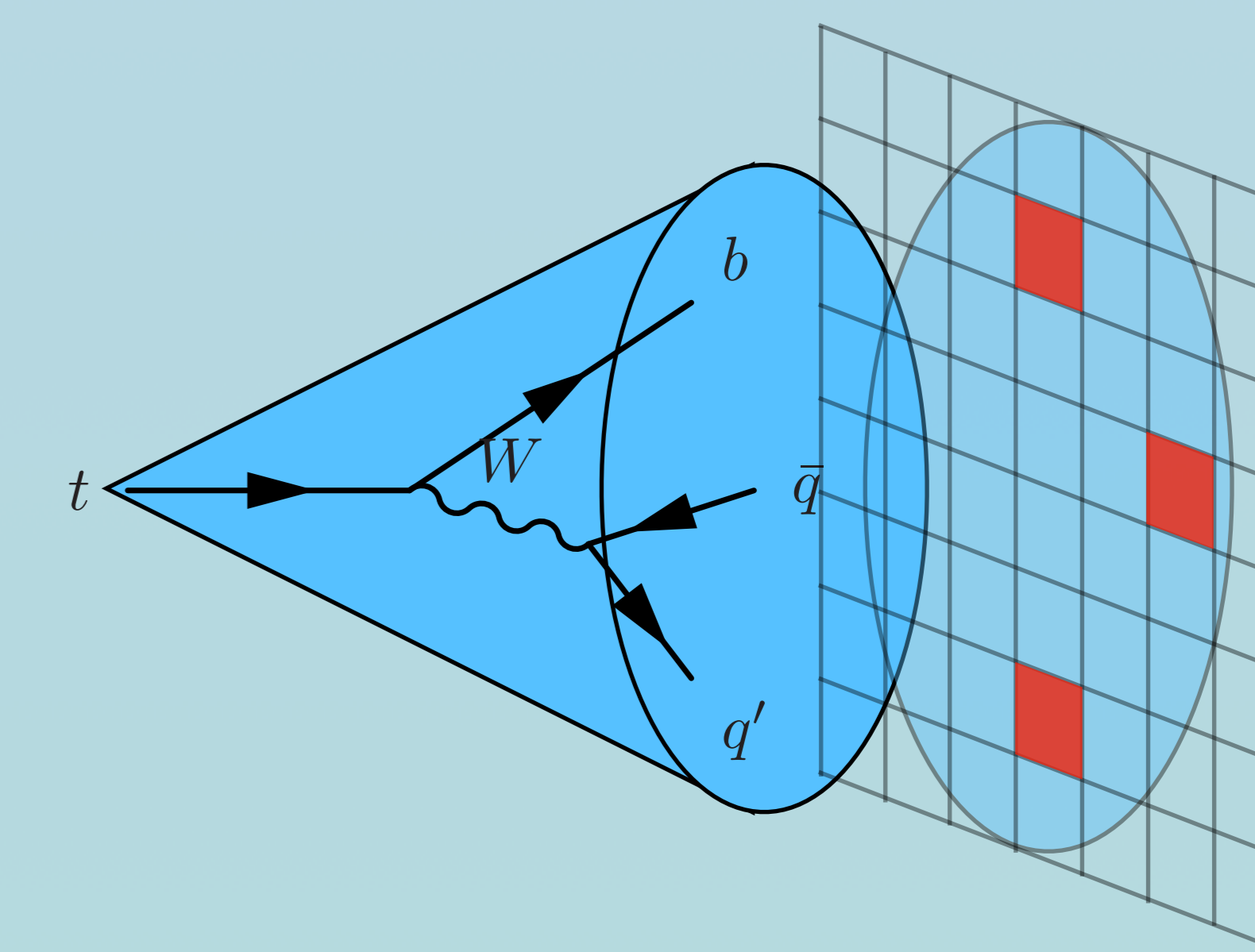
## II. Reconstruct the $W'$

- Parton showers give rise to collimated hadrons
- Jet algorithms cluster hadronic calorimeter clusters
- Top-tagged R = 1 jet as the boosted top-candidate
- Back-to-back R = 0.4 jet as the b-candidate
- The  $W'$  is reconstructed by the four momentum sum of the top-candidate & b-candidate



## III. Top-tagging & b-tagging

- DNN-based top-tagger examines jet substructures inside R=1 jets (arXiv:1910.04482 [hep-ex])
- Three energetic cores are distinguishable from light parton jets



- DNN-based b-tagger searches for the B-hadron decay chain from tracks (arXiv:1907.05120 [hep-ex])

## IV. Data-driven background estimation

- Data outside the signal region used for estimating the multi-jet background produced by QCD

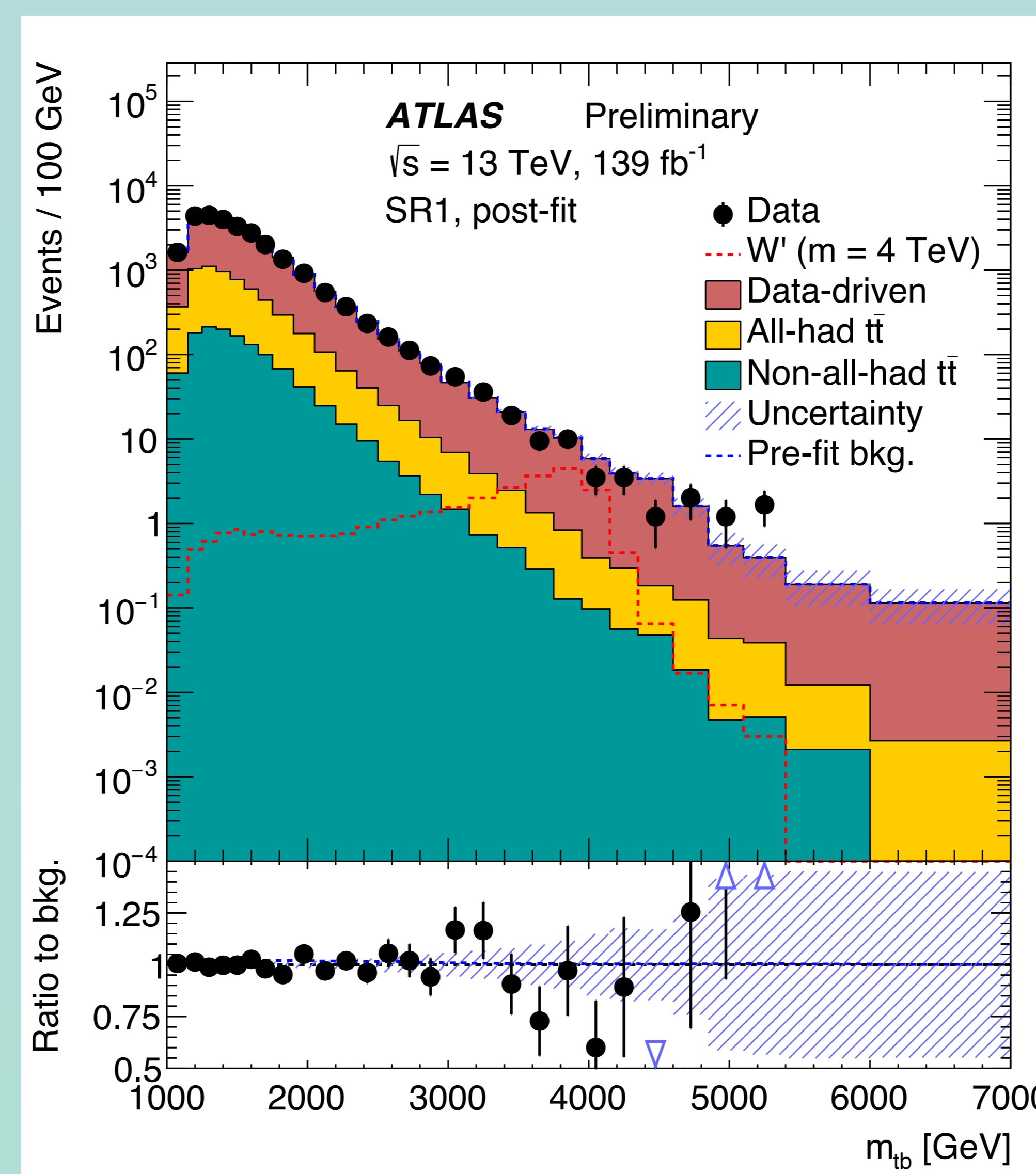
<b>Tight top-tagged</b>	B	A (Signal region)
<b>Medium</b>	D	C (Validation)
<b>Loose</b>	F	E
<b>None</b>	H	G

Not b-tagged (left)      b-tagged (right)

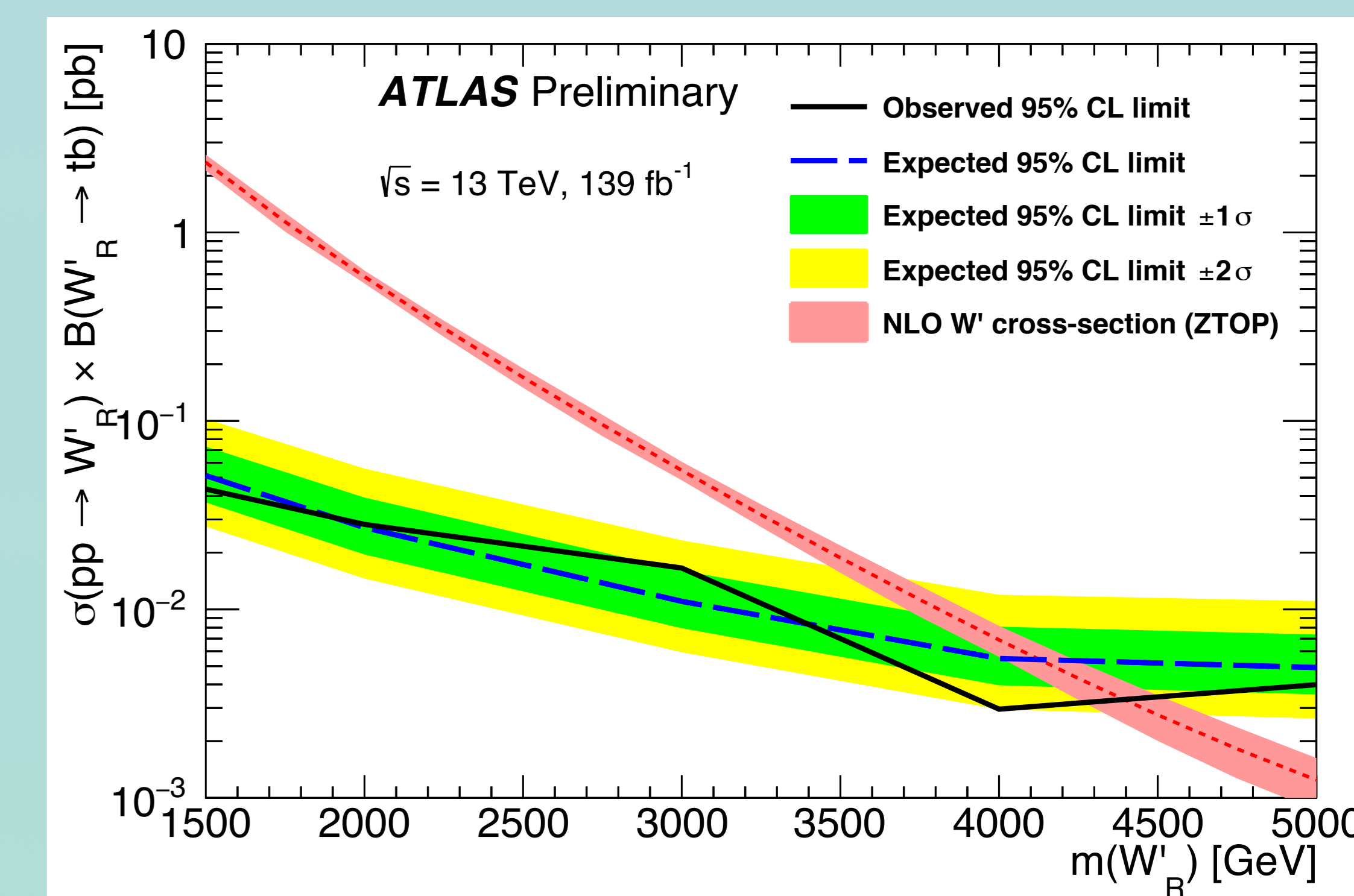
- If top-tagging & b-tagging uncorrelated, then background in region A:  $N_A = N_B \times N_E / N_F$
- Correlation factor =  $(N_A / N_B) / (N_E / N_F)$ . Systematic uncertainty estimated by  $(N_E / N_F) / (N_G / N_H)$

Note: the top-tagging (y-axis) and b-tagging (x-axis) scores are not exact.

## V. Reconstructed $W'$ mass



## VI. Upper limit



- Set upper limit for a leptophobic  $W'_R$  with the SM coupling => mass lower limit 4.4 TeV
- NLO theory curve by ZTOP (arXiv:1208.4858 [hep-ph])
- Conference note: ATLAS-CONF-2021-043