

# Dedicated Triggers for Displaced Jets using Timing Information from Electromagnetic Calorimeter at HL-LHC

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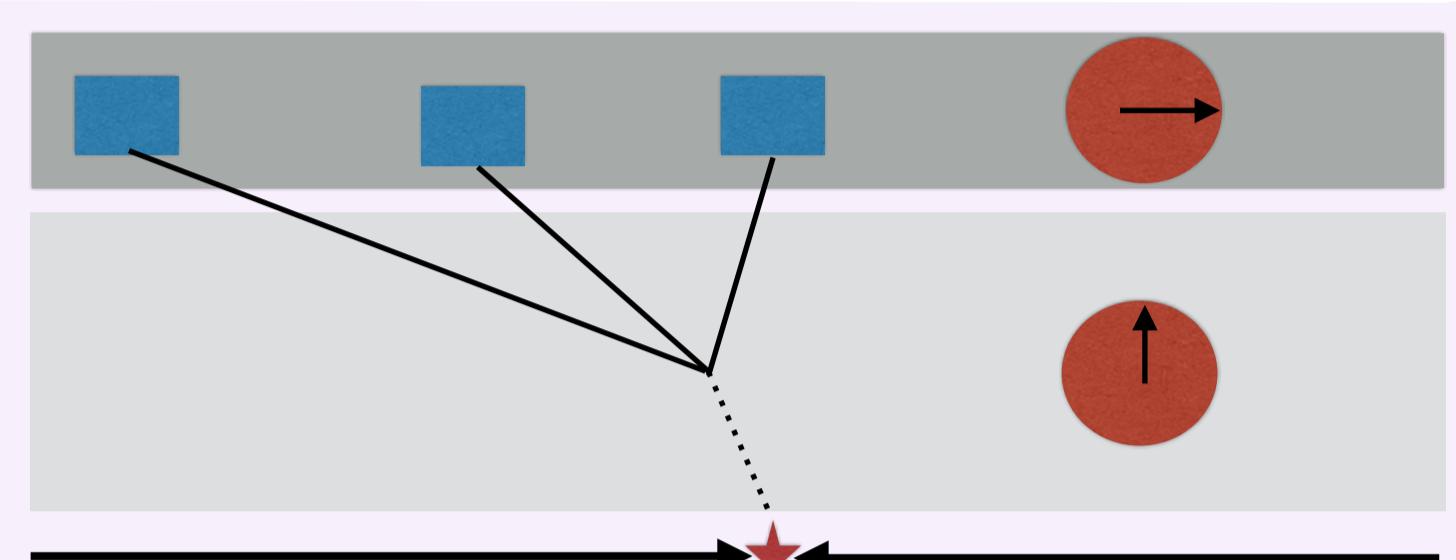
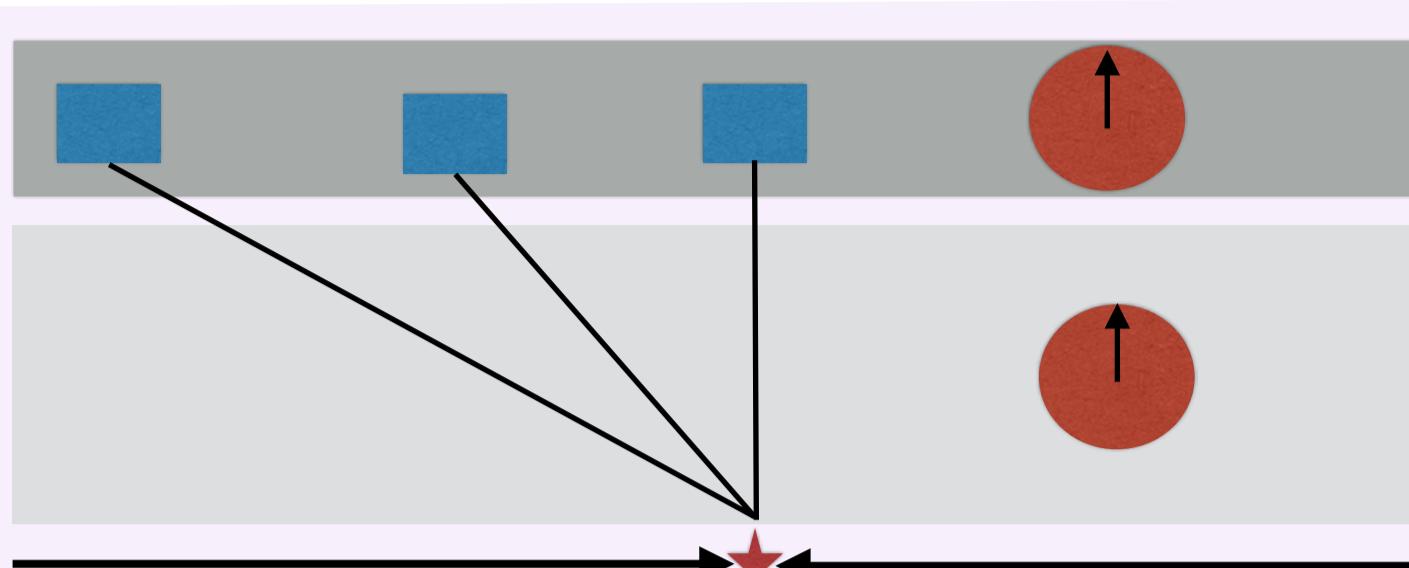
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## Motivation

Many BSM theories predict LLPs but

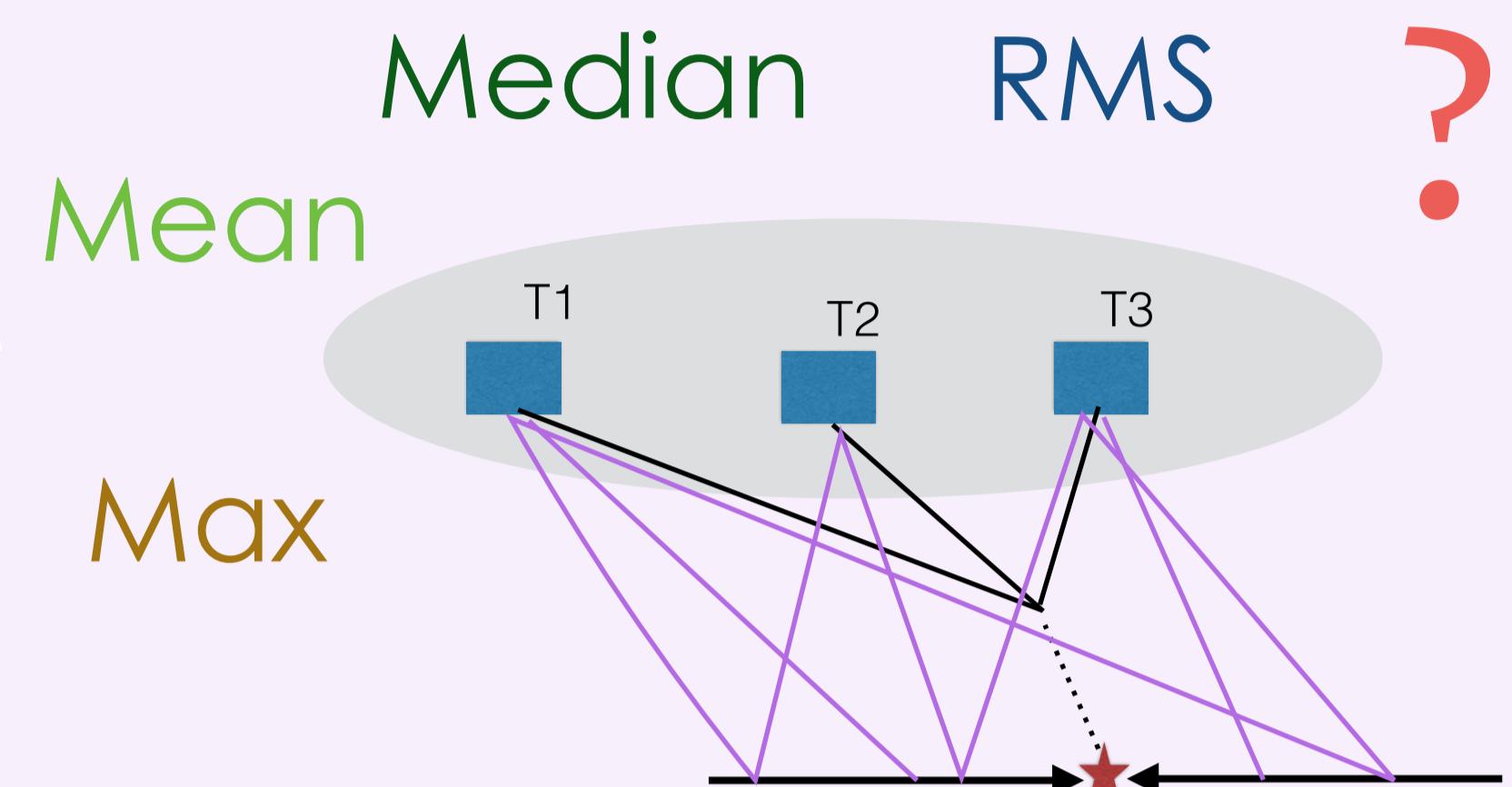
Most of the experimental searches focus on BSM particles decaying promptly.



Availability of ECAL timing at L1 can be effectively utilised to trigger on LLP events.

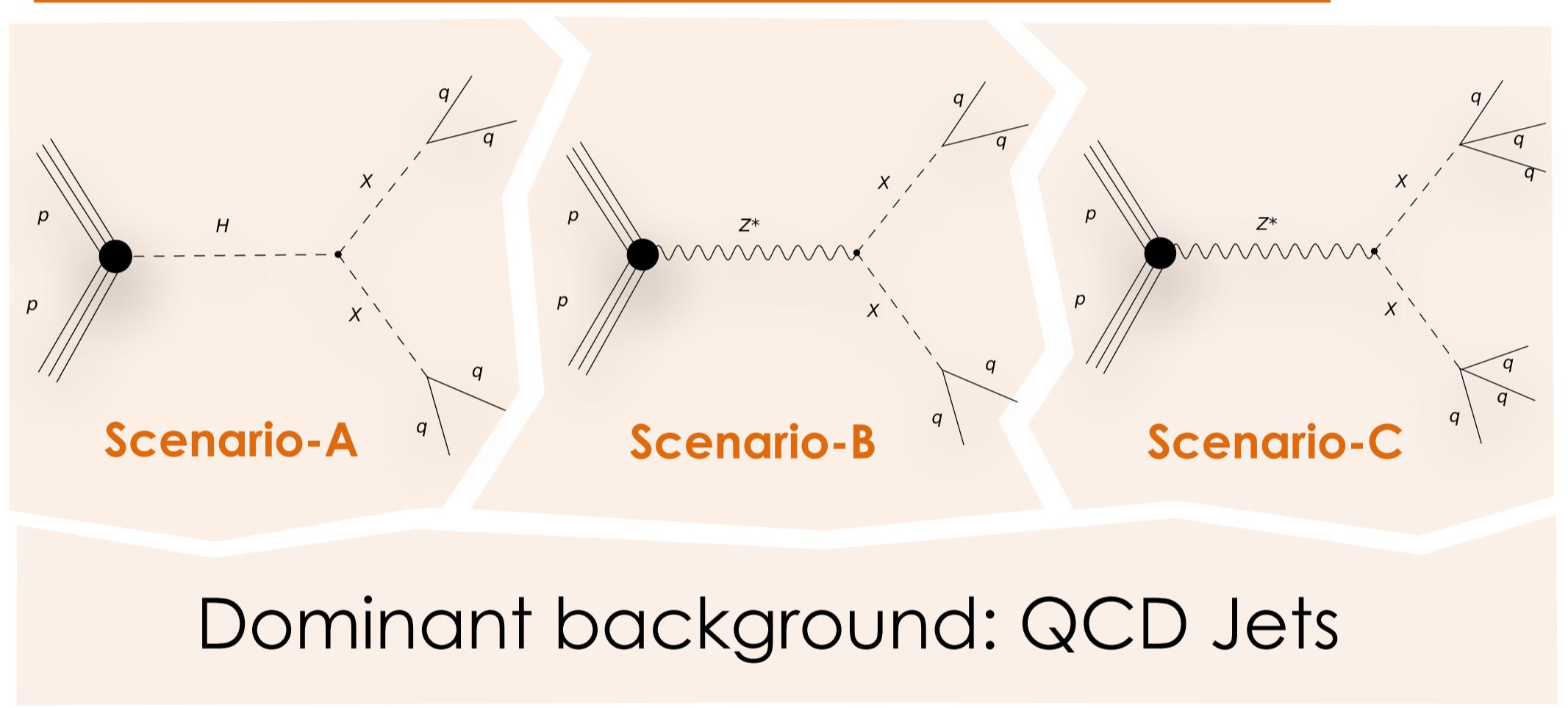
- How can we make use of ECAL timing to its full potential to trigger on various LLP scenarios and can trigger efficiencies be improved?
- Can we combine displaced track information from L1 with ECAL timing to trigger on various LLP scenarios?

PU being an issue at HL-LHC requires us to construct efficient timing variables to maximise signal efficiency along with minimising adverse effects of PU.



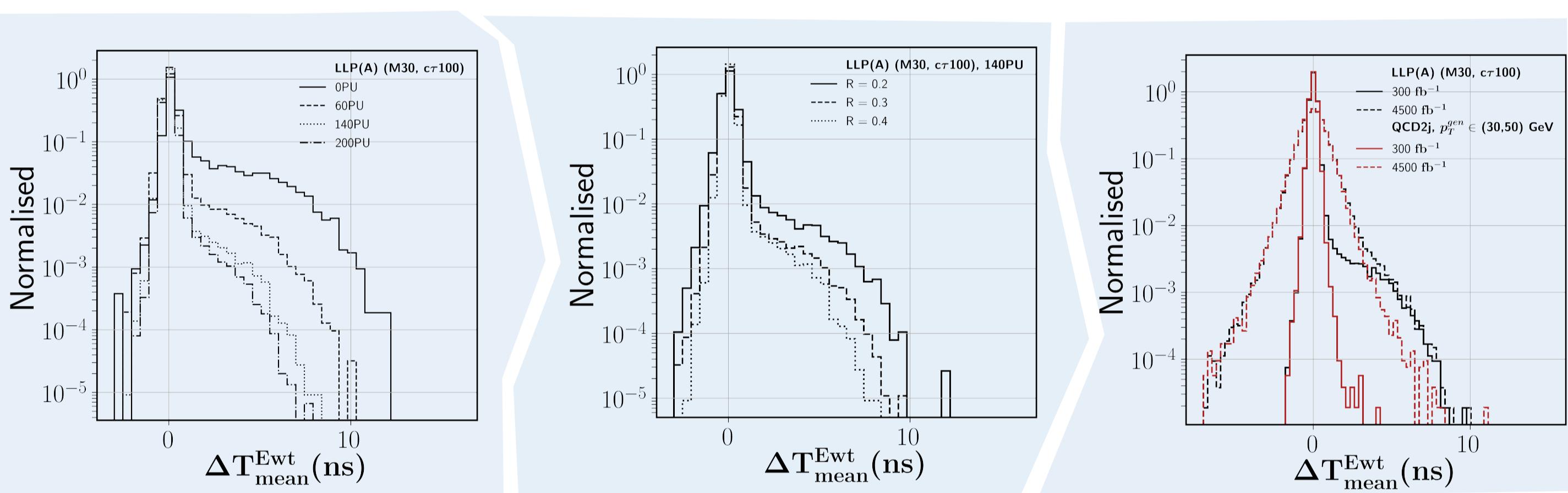
- Can we use same timing variable globally for all LLP scenarios?

## Signal and Background



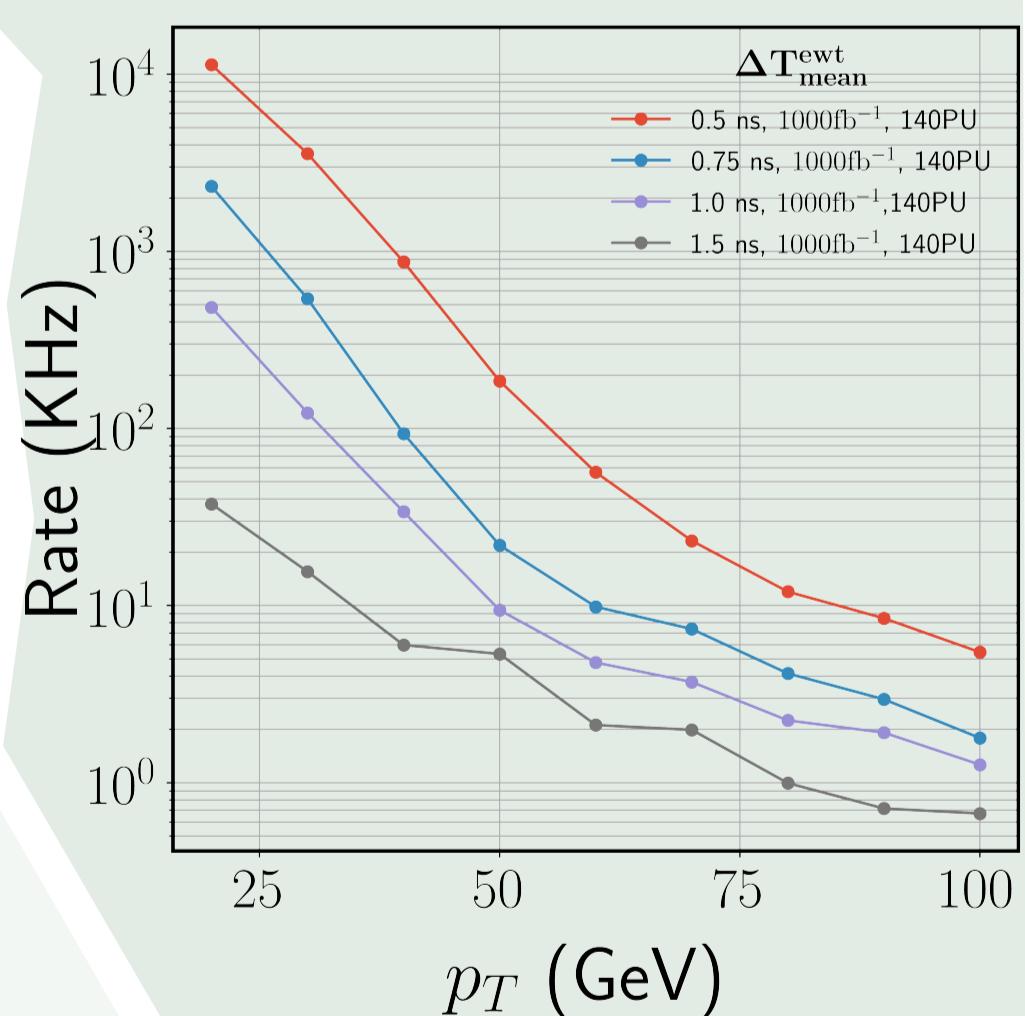
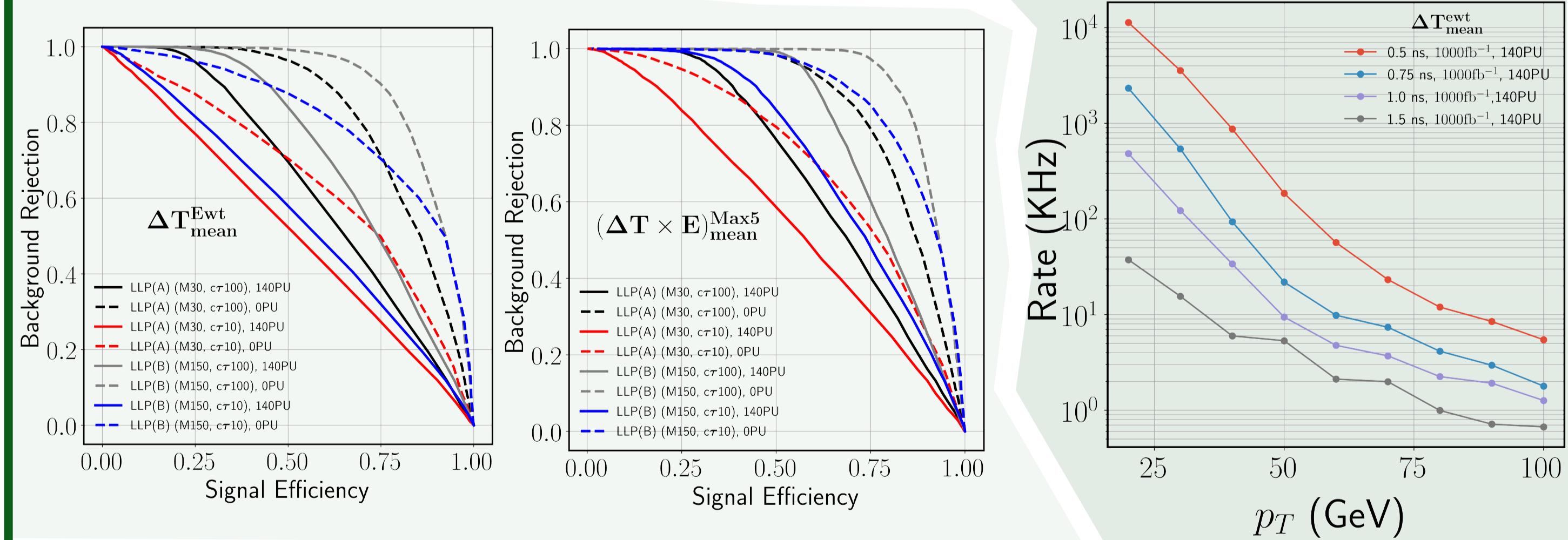
Dominant background: QCD Jets

## PU, cone size & resolution

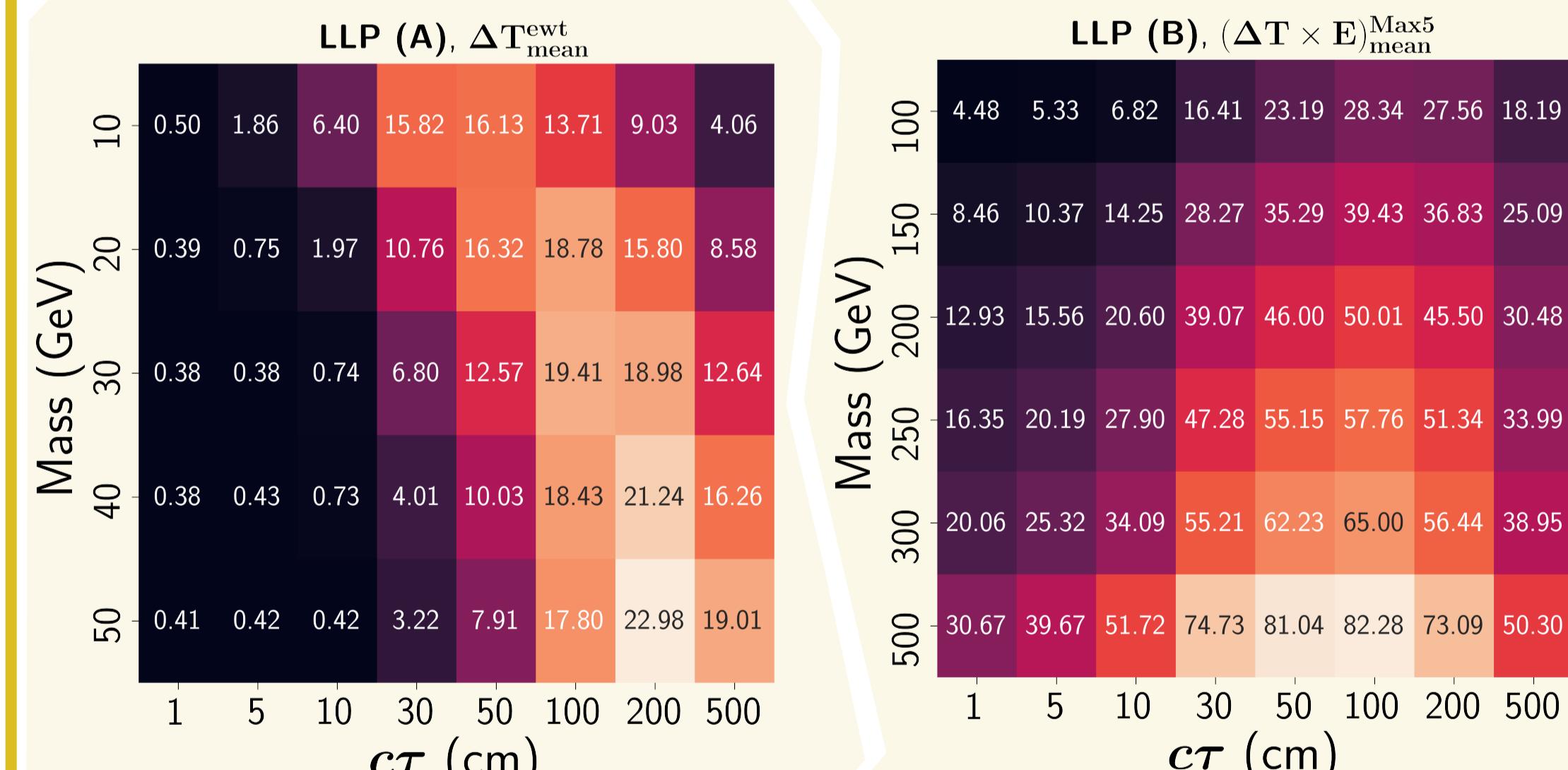


## Timing variables & background rate

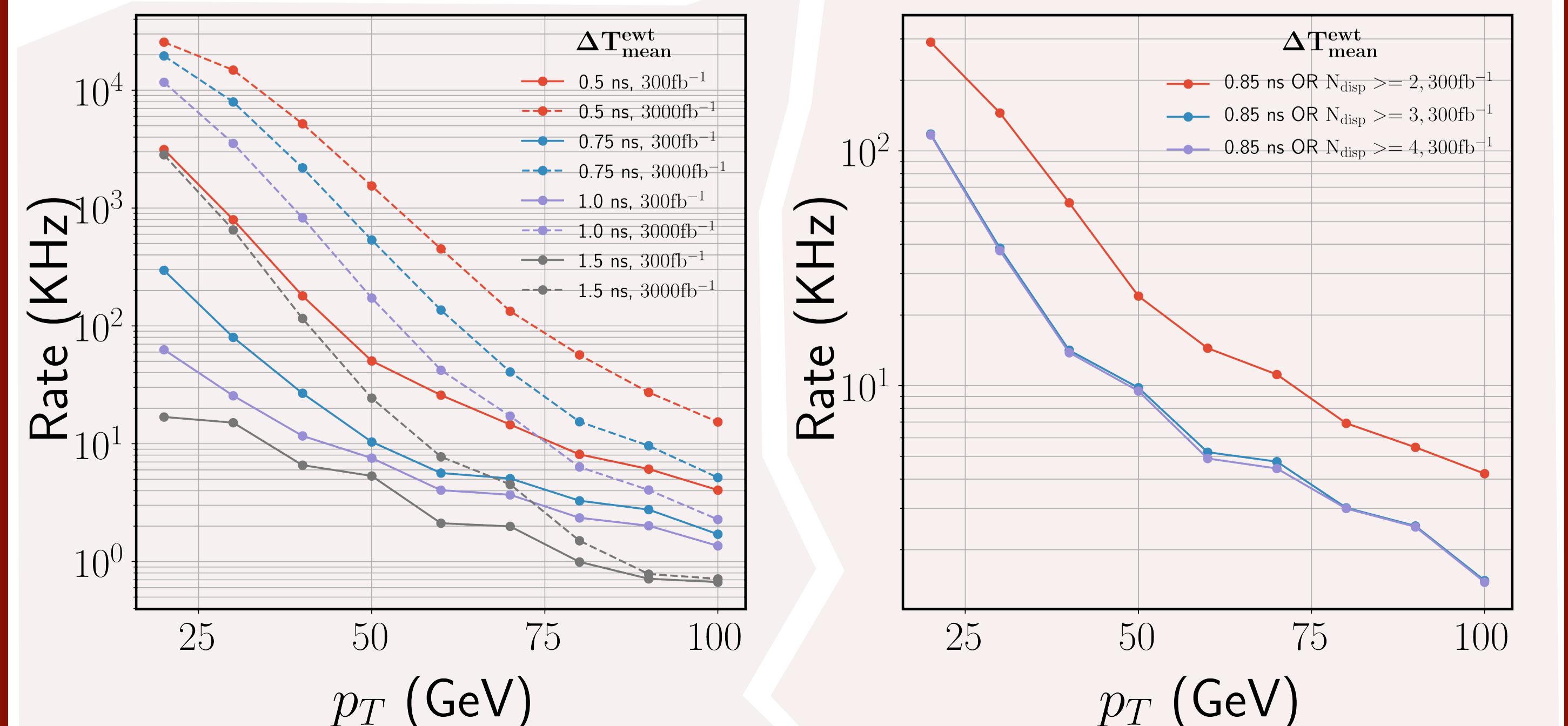
Different QCD bins are “stitched” together to accurately calculate background rate



## Signal efficiency



## Improvements



## Summary

- At HL-LHC, high PU will have adverse effect on the timing of the displaced jets. Effect of the PU can be reduced by considering smaller cone size.
- Timing resolution will play a very important role constructing triggers based on L1 ECAL timing.
- We find three efficient timing variables to be used at L1 for constructing timing of the jet which are more PU resistant.
- Background rate coming from QCD jets is accurately calculated using “stitching method”.
- Signal efficiency for three LLP scenarios with various mass and decay length is calculated keeping background rate under 30 kHz.
- Timing based triggers will work best during initial runs of HL-LHC when ECAL has better timing resolution.
- Performance of timing based triggers can be improved by including displaced track information where both will compliment each other.

For detailed study, kindly have a look at: Dedicated Triggers for Displaced Jets using Timing Information from Electromagnetic Calorimeter at HL-LHC  
B. Bhattacherjee<sup>1</sup>, T. Ghosh<sup>2</sup>, R. Sengupta<sup>1</sup>, P. Solanki<sup>1</sup>  
arXiv: <https://arxiv.org/abs/2112.04518>