Calibration of the light jet mis-tag rate of the ATLAS b-tagger using Z+jets events

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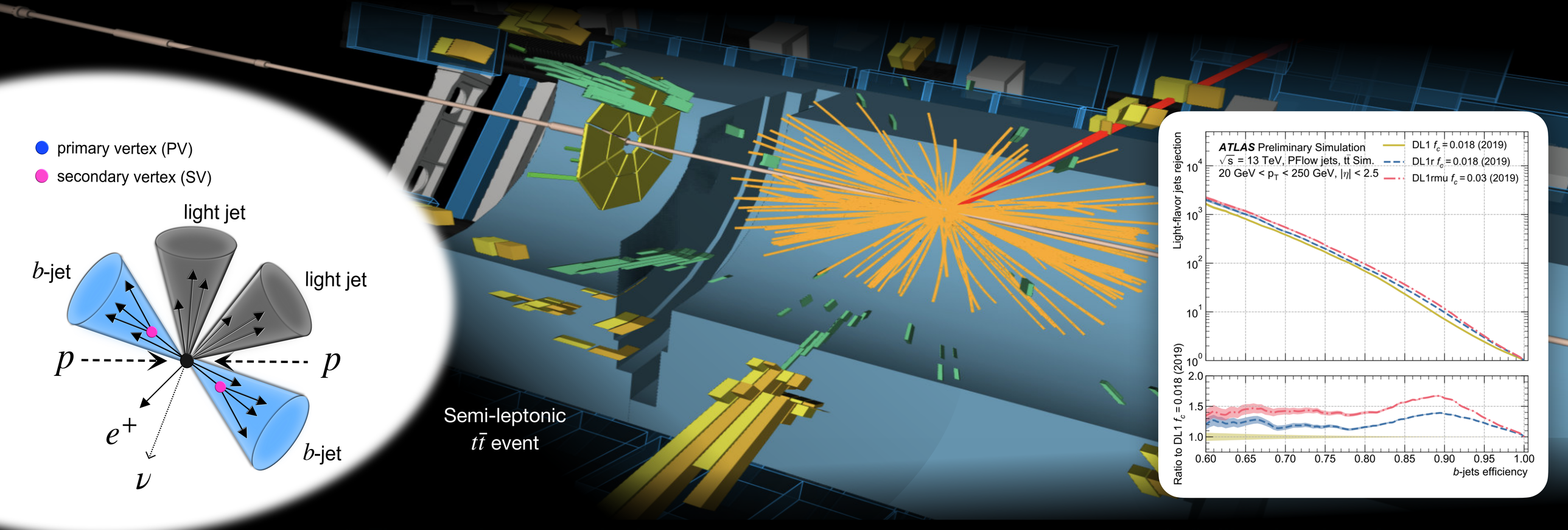
1. Introduction

The correct identification of jets containing b-hadrons is essential for searches involving Higgs bosons and top quarks, among others.
b-hadrons have a larger invariant mass and a relatively long lifetime → the presence of high impact parameter tracks and displaced secondary vertex (SV) inside the jets can be used for identification. The DL1r b-tagging algorithm combines these characteristic features in a Neural Network to maximise the algorithm's performance.

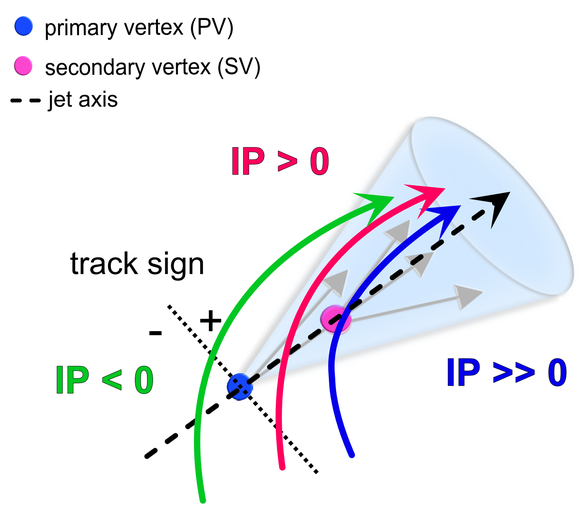
Calibrations of the DL1r b-tagging algorithm are performed to account for (expected) differences in algorithm behaviour between simulation and real data. Scale factors (SF_i) are derived to correct the MC selection efficiency (ϵ_i) for each flavour $i = b, c$ or $light$ and are applied assuming that they are independent of the physics process. This poster presents the calibration of the mis-tag rate (ϵ_{light}).

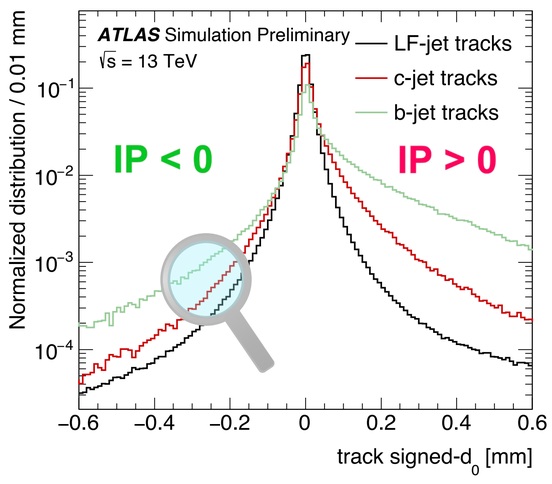
$$SF_i = \frac{\epsilon_i^{\text{data}}}{\epsilon_i^{\text{MC}}} \qquad \epsilon_i = \frac{\#\text{ tagged } i\text{-jets}}{\#\ i\text{-jets}}$$



2. The negative tag method

- **Problem**: Due to the large light jet rejection of the b-tagging algorithms, very few light jets pass the DL1r cut (contrary to the large b/c-jet background) and a direct fit to data does not give meaningful results.



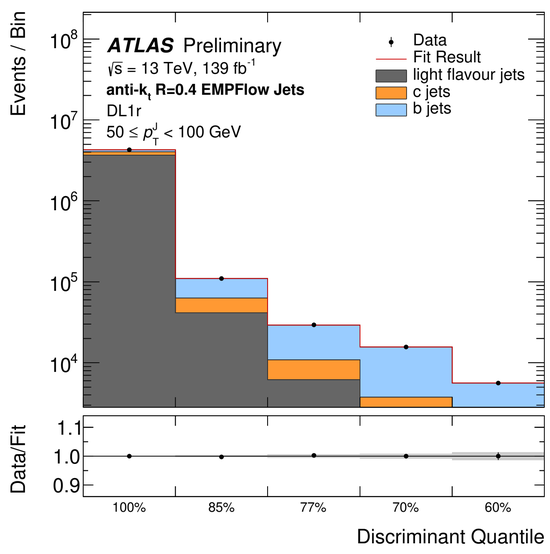


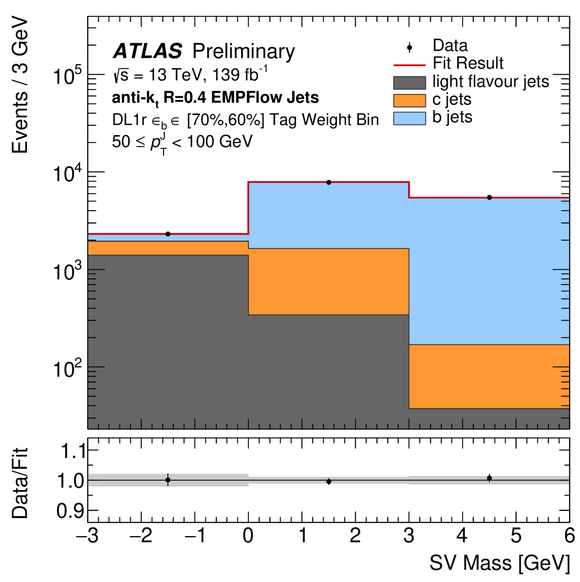
IP: Closets distance between track and PV

- **Solution**: To select a sample with more similar fractions of light- and heavy-flavour jets, a 'flipped' tagger (i.e. DL1rFlip) is defined inverting the sign of track impact parameters and the decay length of the SV.

3. Calibrating the mis-tag rate

- The SF_{light} is obtained from Z+jets events in a final state with two oppositely charged leptons and at least one jet, which is enriched on light jets.
- A simultaneous fit to the DL1rFlip discriminant and the secondary vertex mass, which is sensitive to the jet flavour, is then performed to extract SF_{light} in bins of the jet p_T.

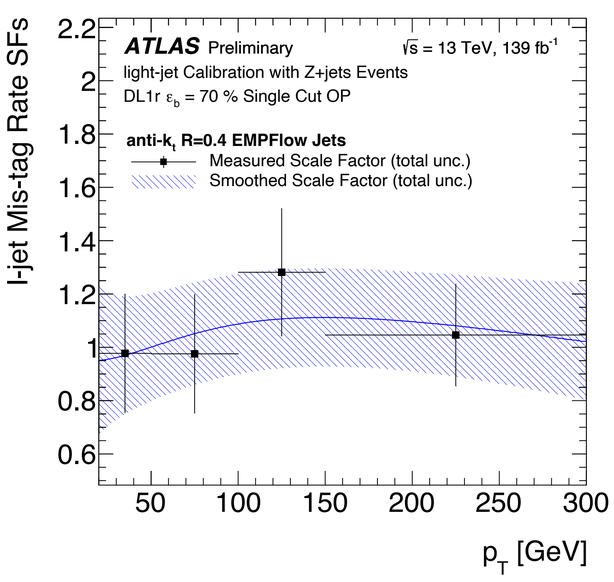


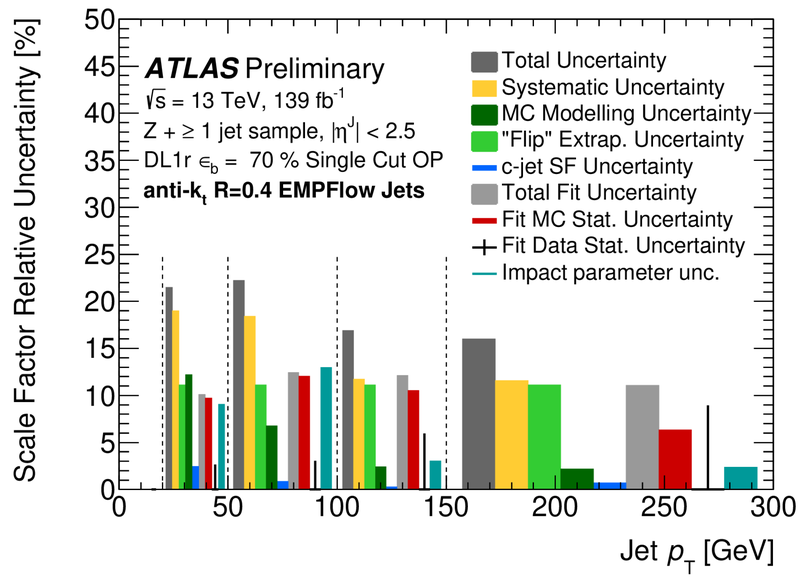


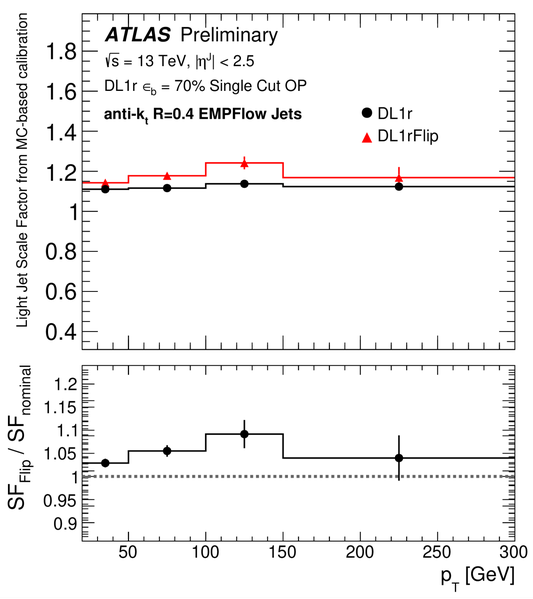
- To cover any discrepancies in SF_{light} between the DL1rFlip and DL1r taggers, an extrapolation uncertainty estimated from simulation is included.

4. Results

- SF_{light} ~ 1 within uncertainties, indicating a good prediction of ϵ_{light} by the MC simulation being calibrated.







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