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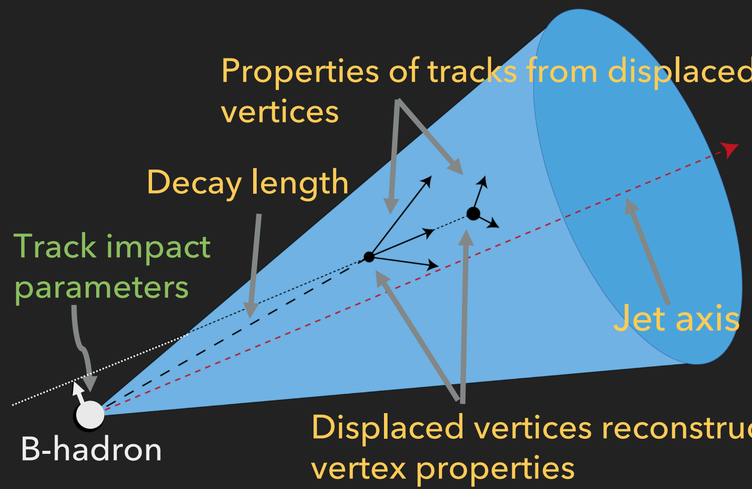
EFFICIENCY CALIBRATION FOR ATLAS B-JET IDENTIFICATION ALGORITHMS

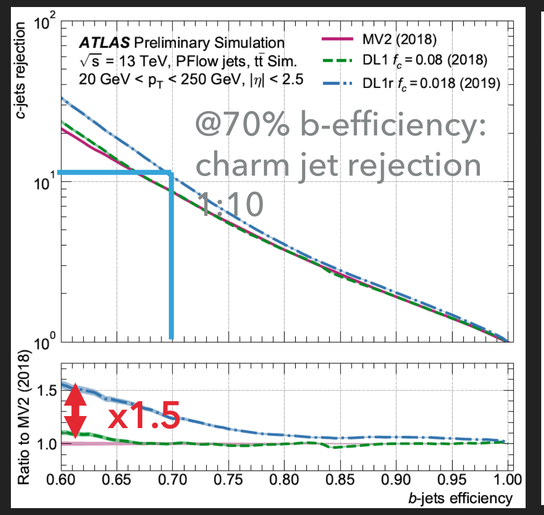
THE ATLAS B-TAGGING ALGORITHMS

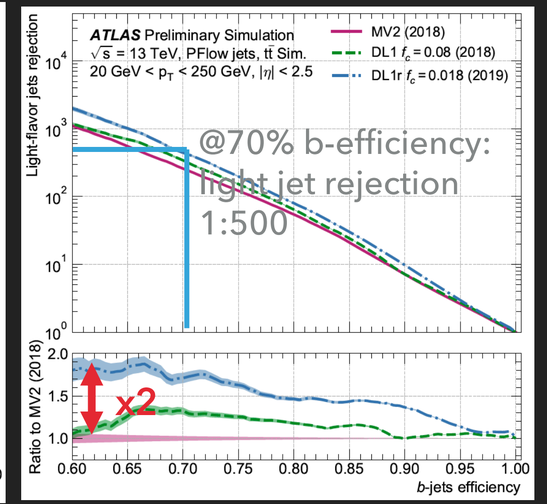
- ATLAS analyses rely on the identification of jets containing b-hadrons with high efficiency while rejecting more than 99% of non-b-jets
- Algorithms rely on decay properties of the b-hadron
- The output of two types of low-level taggers (Impact parameter and displaced vertices reconstruction based) are combined using Deep neural networks

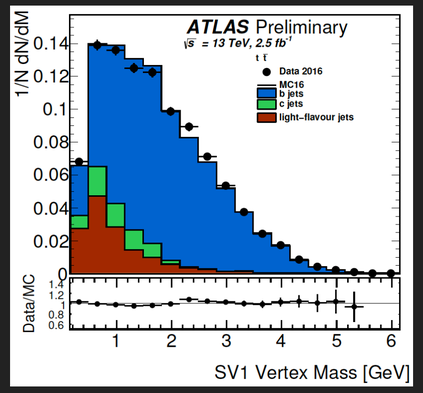


Deep neural network

- create powerful discriminator against charm and light jets







Mismodeling of algorithm input variables can cause differences in efficiencies between data and MC simulation

- Measure algorithm efficiencies in data and MC and derive correction factors

Recent improvements of algorithm:

- Use of Deep neural network
- Recurrent neural network exploits correlations between tracks
  ➔ improvements to Impact parameter based low-level tagger

Improvements in charm and light jet rejection up to a factor of 2

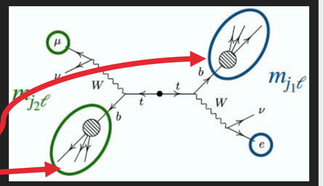
ATLAS EXPERIMENT

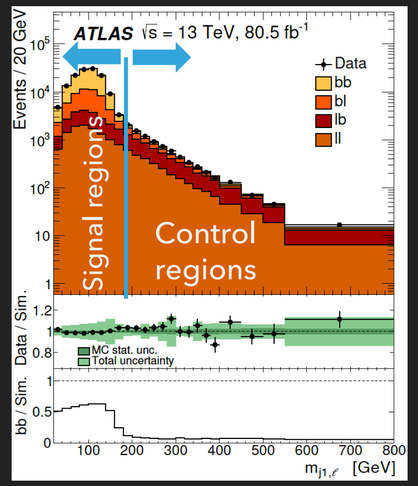
CALIBRATION OF THE B-TAGGING ALGORITHMS

- Measure b-tagging efficiency and charm and light jet mistag efficiency in data and MC
- Measure in sample dominated by b, charm or light jets
- Compare results from data and MC

B-tagging efficiency: Dileptonic ttbar PDF method

- Select ttbar di-lepton events with exactly 2 jets
- Perform measurement on 2 jets in event

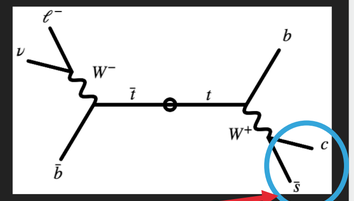


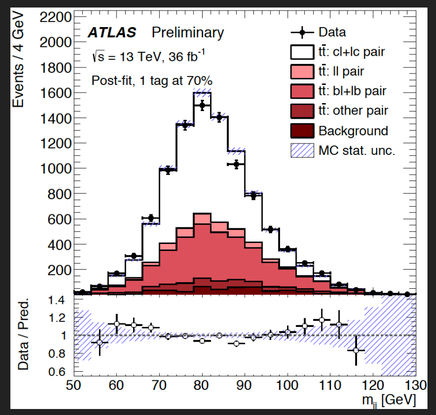


- Data-driven correction to non-b jet background reduces uncertainty to percent level

Charm jet mistag efficiency: Single lepton ttbar method

- Exploit large W→cX branching ratio
- Perform measurement on jets assigned to hadronically decaying W-boson in ttbar lepton+jets events

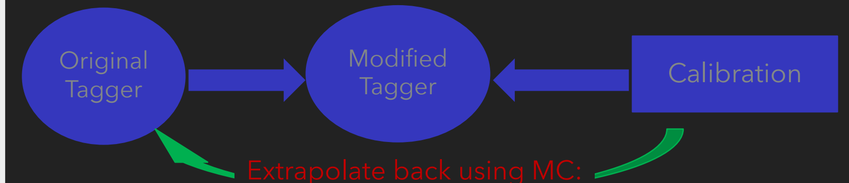




- Extract charm mistag efficiency in combined likelihood fit

Light jet mistag efficiency: Negative tag method

- Challenging due to high light jet rejection
- Solution: Calibrate modified tagger
  - Reduce tagging rate of b-jets at unchanged light jet response



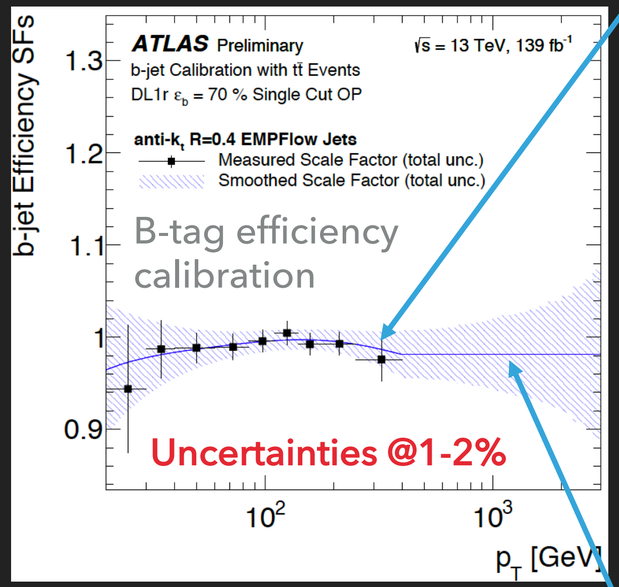
- Calibration using Z(->ll)+jets events
- Reduce uncertainty by constraining non-light flavor contribution in fit

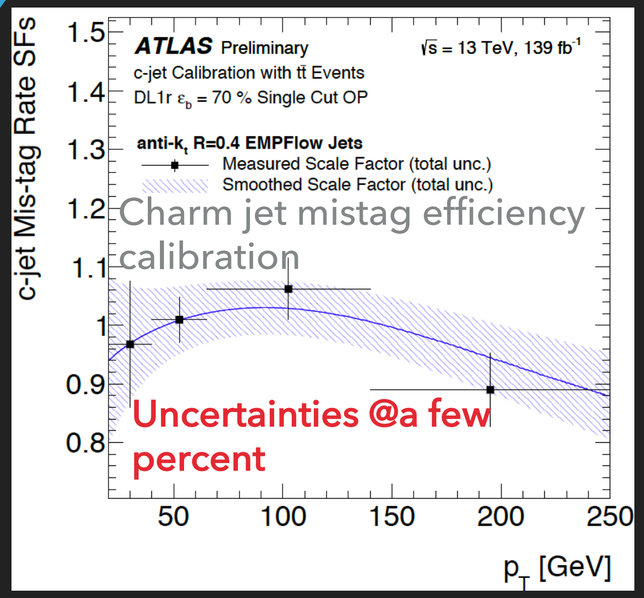
RESULTS

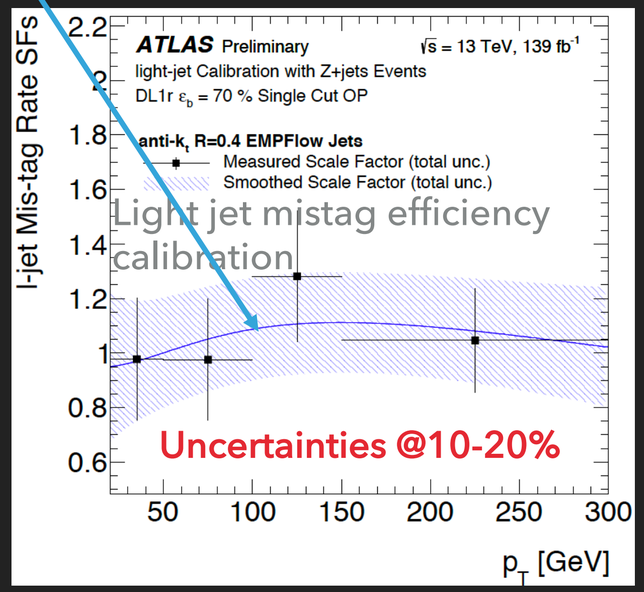
- Efficiencies are measured as functions of jet pT and for different tagger operating points (corresponding to fixed average b-tagging efficiencies)
- MC-to-data correction factors are derived (Scale Factors, "SF"), which are used by ATLAS analyses

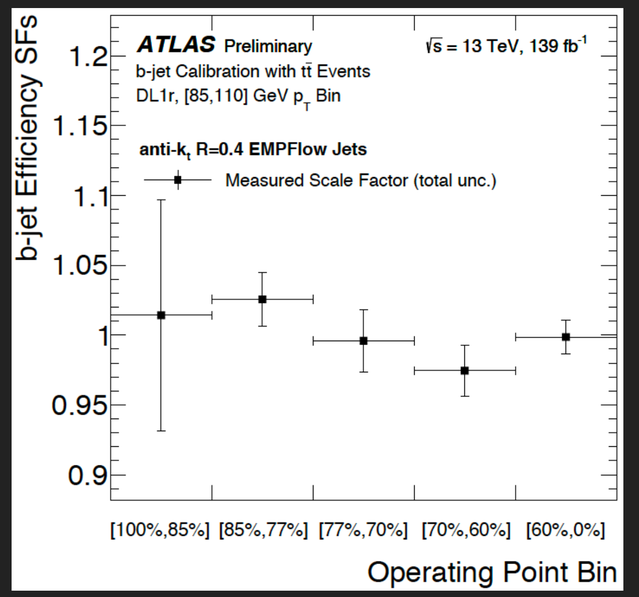
Smoothing of results removes discontinuities at bin boundaries

Scale Factors also derived in pseudo-continuous bins of the tagging efficiency









Extrapolation to high jet pT using simulation

- Data and MC tagging efficiencies are in good agreement and MC-to-data correction factors are compatible with 1
- Constant work in ATLAS on improvements on the b-tagging algorithms, calibrations and post-processing methods (smoothing, high jet pT extrapolation and combinations of different measurements of the same Scale Factors)