PROCEEDINGS OF SCIENCE

Measurement of b-quark jet production at $\sqrt{s} = 7$ TeV with the CMS experiment

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We describe a measurement of the inclusive b-jet production in pp collisions at $\sqrt{s}$ =7 TeV. The analysis has been done on the first physics data collected by the CMS experiment at the Large Hadron Collider at CERN. We are using a simple secondary vertex high purity tagger, which is one of the most reliable b-taggers for this early measurement, for selecting a jet sample with high b-jet purity.
To measure the b-fractions in the tagged jet data sample, we make a template fit to the secondary vertex mass. Our estimation of the b-tagging efficiency is taken from Monte Carlo simulation. We find an overall good agreement between data and Pythia in the jet transverse momentum range $30 < p_T < 150$ GeV and rapidity $|y| < 2.0$. We also observe a reasonable agreement between the MC@NLO calculation and the measured overall b-jet fraction, but observe significant shape differences in p_T and y.

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1. Introduction

The expected cross section for producing bottom quarks in proton-proton collisions at the LHC can be computed in QCD next-to-leading order calculations [1]. There is great interest in verifying the results at the higher center of mass energies provided by the LHC.
In this paper we report the first measurement of the inclusive b-quark production cross section [2] with the Compact Muon Solenoid (CMS) experiment [3] based on identifying the b-hadron decay vertex. The inclusive b-jet transverse momentum spectrum has been measured in the p_T range 18-300 GeV and for rapidities $|y| < 2.0$. We used about 60 nb^{-1} of data recorded by CMS from the initial proton-proton collisions delivered by the LHC at a center of mass energy of $\sqrt{s}$=7 TeV.

2. Event and jet selections

The inclusive jet data is collected using a combination of Minimum Bias and single jet triggers, which are consecutively used in the lowest p_T range where the triggers are fully efficient. Event based data quality selections are applied to clean the data. The jets are Particle Flow jets [4] which are reconstructed with the anti-kT algorithm (R=0.5). The jet energies are corrected with estimates based on simulation for the absolute scale and for the p_T dependence, while data corrections are used for the rapidity dependence. The p_T spectra are unfolded using the ansatz method [5], with the jet p_T resolution obtained from simulation.

3. b-tagging

The b-jets are tagged using a secondary vertex high-purity tagger (SSVHP [6]). The b-tagging efficiency is taken from the simulation and constrained by a scale factor determined from data. For the b-tagged sample purity a fit to the secondary vertex mass distribution is performed, taking the shapes for b- and non b-jets from simulation (fig. 1). Also it is calculated using the mistag rates from c-jet and light jet flavors from simulation.

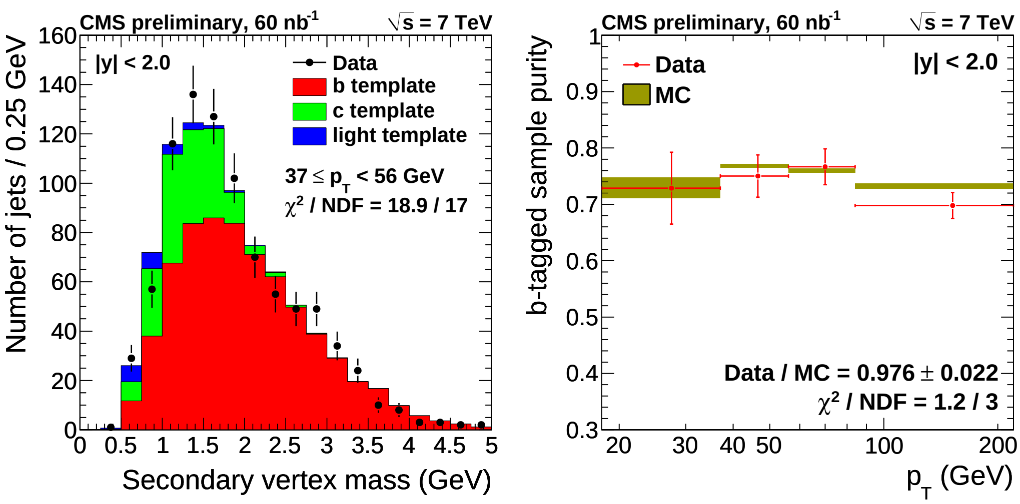

Figure 1: Template fits (left) in different p_T-bins are performed to extract b-purity of the tagged jets (right).

4. Measurement

To reduce the experimental uncertainties the ratio to the inclusive jet production cross section [5] is measured (fig. 2). There the 11% luminosity uncertainty [7] cancels completely and the JEC uncertainty produces only a small residual uncertainty due to differences in p_T spectra and jet fragmentation between inclusive jets and b-jets. The leading remaining uncertainties for the ratio are the b-tagging efficiency and the charm mistag rate. The light quark mistag rate has a significant contribution to the total uncertainty at high p_T and forward rapidities.
We also measured the b-jet cross section as a stand-alone measurement [2].

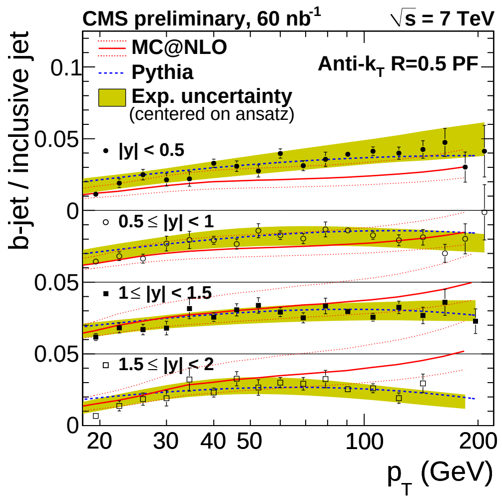

Figure 2: Measured b-jet cross section as a ratio to inclusive jet cross section. The NLO theory and Pythia MC predictions are shown for comparison.

5. Conclusions

We have measured the ratio of b-jet to inclusive jet production in pp collisions at $\sqrt{s}$=7 TeV center-of-mass energy for an integrated luminosity of 60 nb^{-1}. We find an overall good agreement between data and Pythia in the jet transverse momentum range $30 < p_T < 150$ GeV and rapidity $|y| < 2.0$, within about 2% statistical uncertainty and 21% systematic uncertainty. We also observe a reasonable agreement between the MC@NLO calculation and the measured overall b-jet fraction, within the 21% systematic uncertainty, but observe significant shape differences in p_T and y. As part of the analysis, the b-tagged sample purity was estimated from data, using template fits to the secondary vertex mass distribution, and the results were found to be in good agreement with expectations from simulation, well within the 3% statistical uncertainty. This constrains the charm mistag rate to within 20% of the expectation from simulation.

References

[1] S. Frixione, M. L. Mangano, P. Nason et al., *Heavy quark production*, *Adv. Ser. Direct. High Energy Phys. 15* **1998** 609-706, [arXiv:hep-ph/9702287].

[2] CMS Collaboration, *Inclusive b-jet production in pp collisions at $\sqrt{s}$=7 TeV*, CMS PAS BPH-10-009.

[3] CMS Collaboration, *The CMS experiment at the CERN LHC*, JINST 3:S08004,2008.

[4] CMS Collaboration, *Particle-Flow Event Reconstruction in CMS and Performance for Jets, Taus, and Missing ET*, CMS PAS PFT-09-001.

[5] CMS Collaboration, *Measurement of the Inclusive Jet Cross Section in pp Collisions at 7 TeV using the CMS Detector*, CMS PAS QCD-10-011.

[6] CMS Collaboration, *Commissioning of b-jet identification with pp collisions at $\sqrt{s}$=7 TeV* CMS PAS BTV-10-001.

[7] CMS Collaboration, *Measurement of CMS Luminosity*, CMS PAS EWK-10-004.