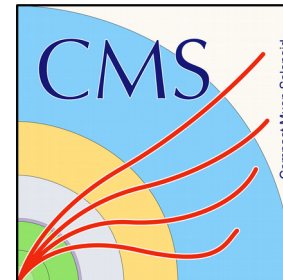# B-jets at the extremes
## Preparation of HL-LHC

March 2, 2018

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B-jets at the TeV scale

- The heaviest quark hadronising
- In current models b-quarks produced only perturbatively (in PS, in hard sub-process)
- Testing heavy-flavour schemes in DGLAP
- B-jets containing B-hadrons are the messengers from pQCD
- The only parton which can be identified with high confidence level
- High-p_T b-jets constrain gluon PDFs at high x and scales

CMS Experiment at LHC, CERN
Data recorded: Sun Aug 14 13:01:17 2016 CEST
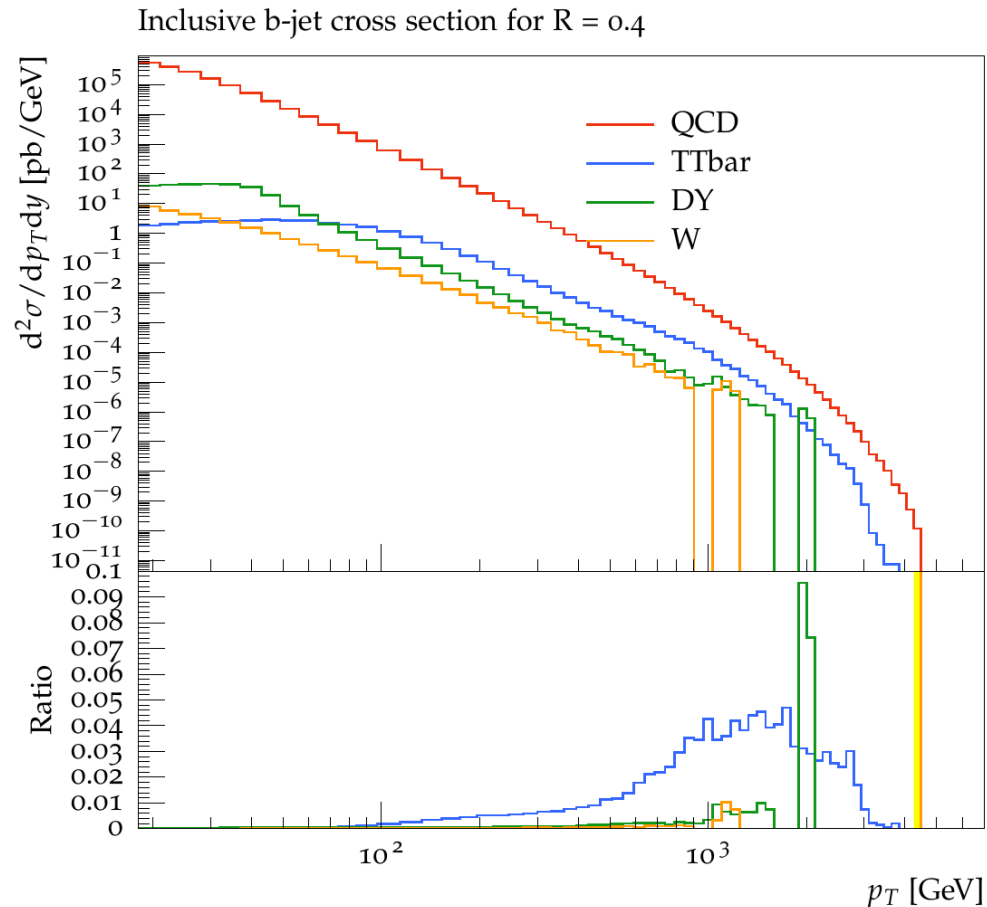Run/Event: 278820 / 21368498
Lumi section: 18

CMS
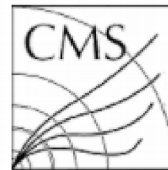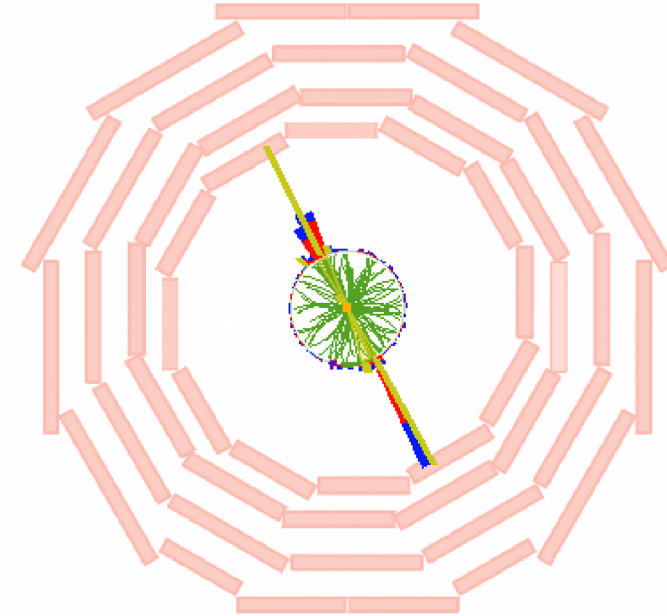
$$p_T = 696\,\mathrm{GeV}, y = 0.24, \phi = 2.04, \mathrm{CSVv2} = 0.967$$
$$p_T = 694\,\mathrm{GeV}, y = 0.57, \phi = -1.07, \mathrm{CSVv2} = 0.965$$
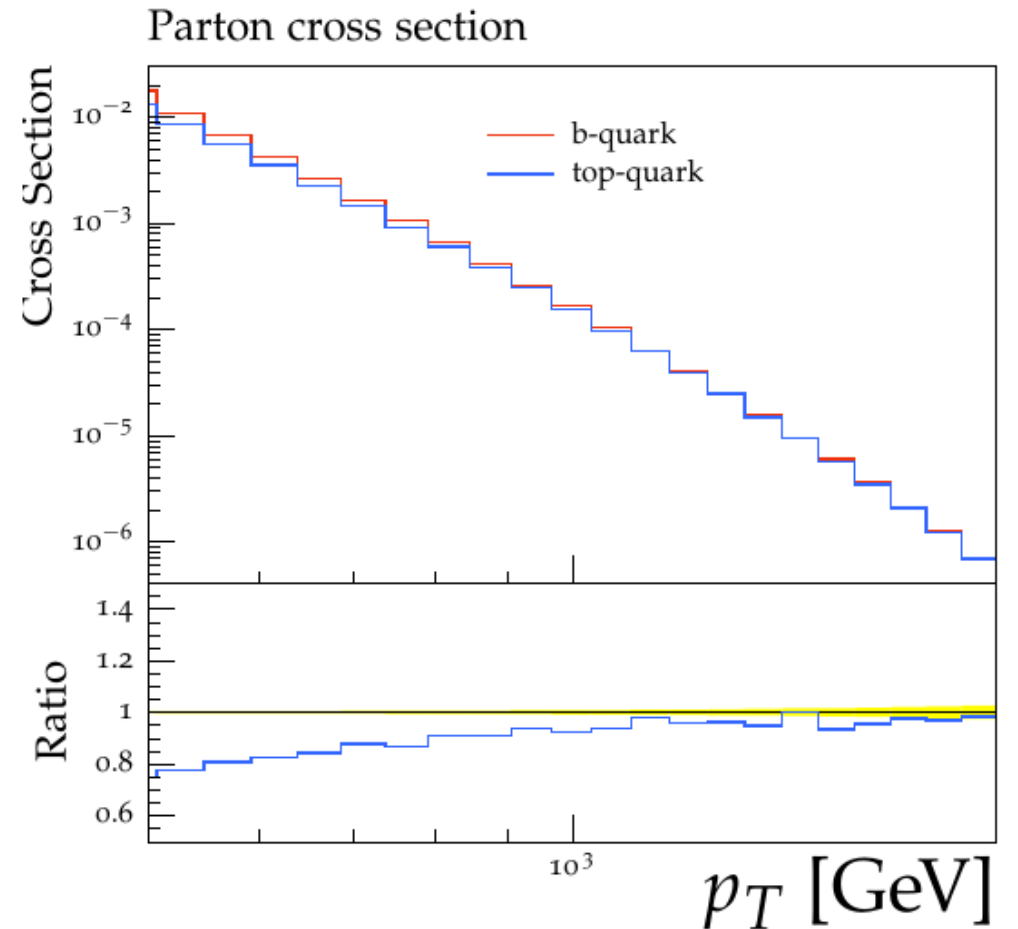$$\Delta\phi = 178\deg$$

40% probability of mis-identification

CSV = Combined Secondary Vertex tagger

EW fraction and Flavour democracy

- At the TeV scale, the b-jets originating from top decay represent ~5% of the cross section

- QCD should not be sensitive to the flavour in the high energy limit $p_T \gg m_q$

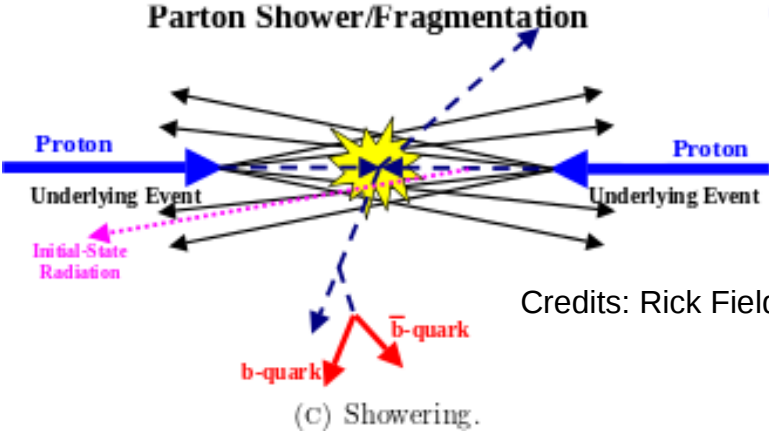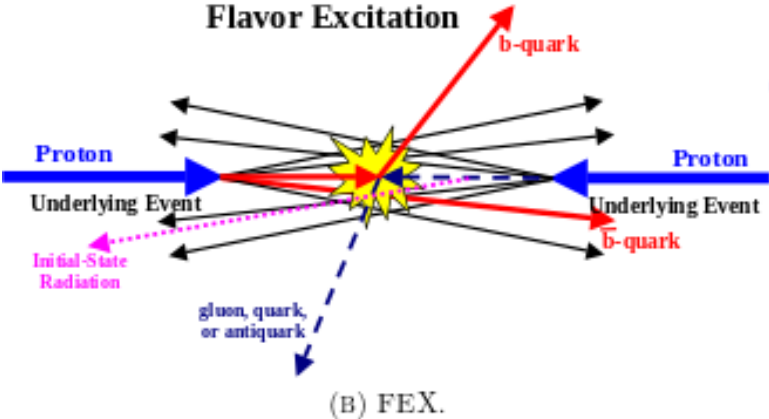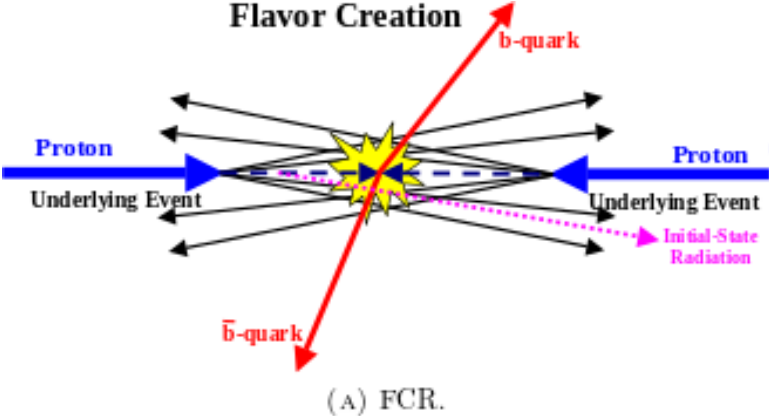Inclusive b-jet cross section for R = 0.4
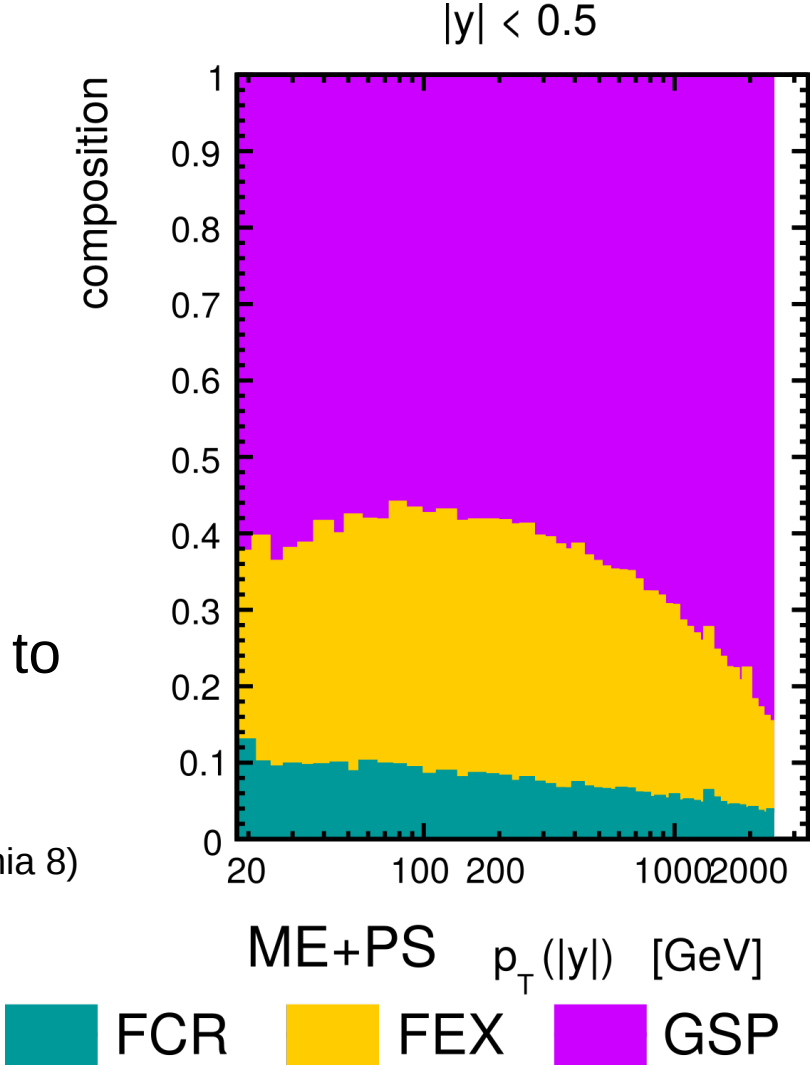

Parton cross section

Composition of inclusive B-jet production

Defined at LO:
- **FCR**: Flavour Creation
- **FEX**: Flavour Excitation
- **GSP**: gluon splitting in showering

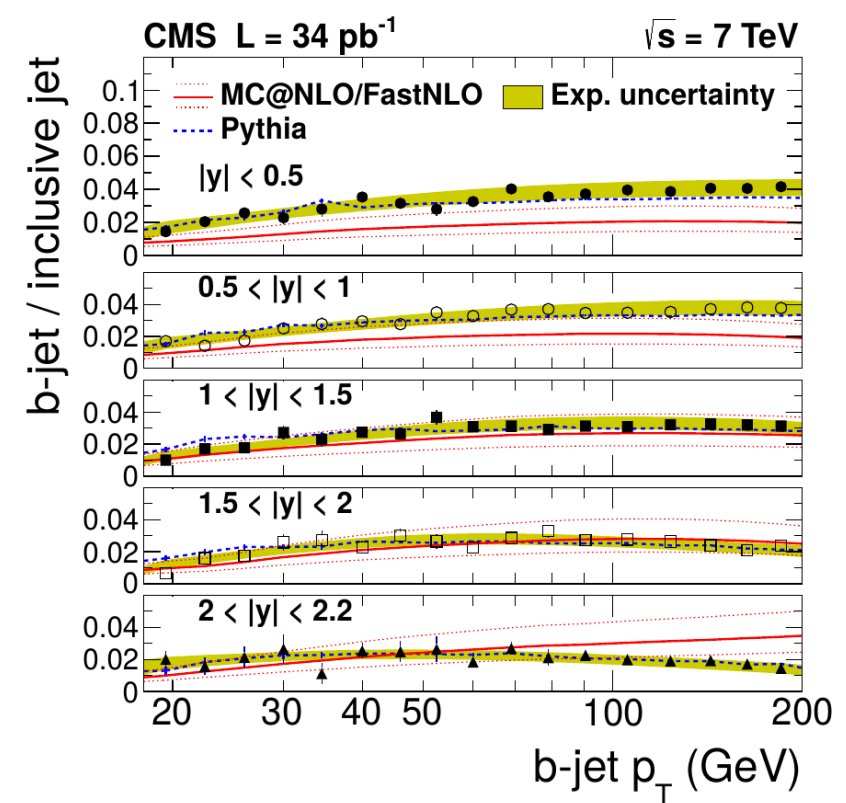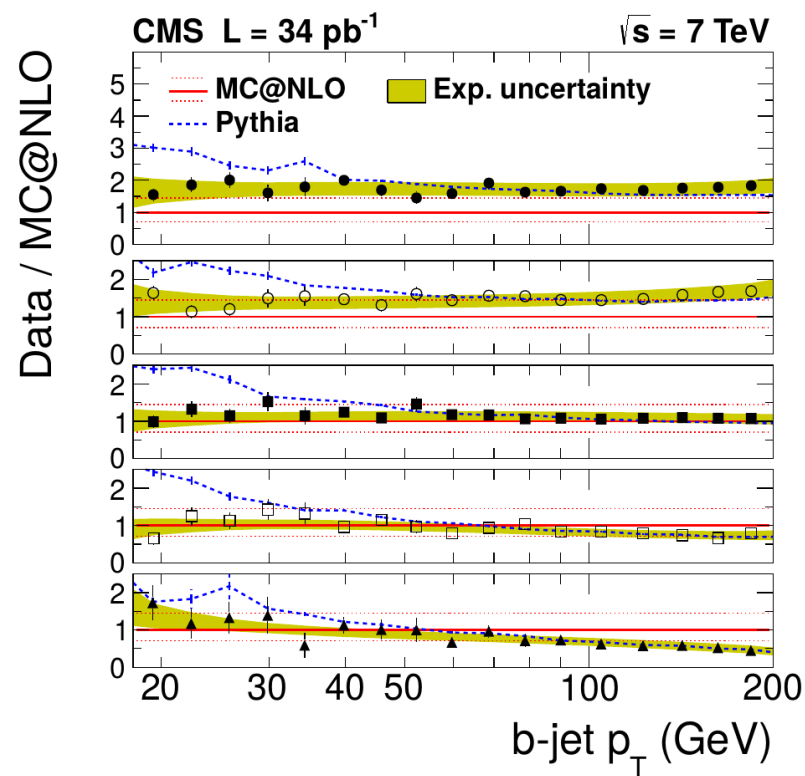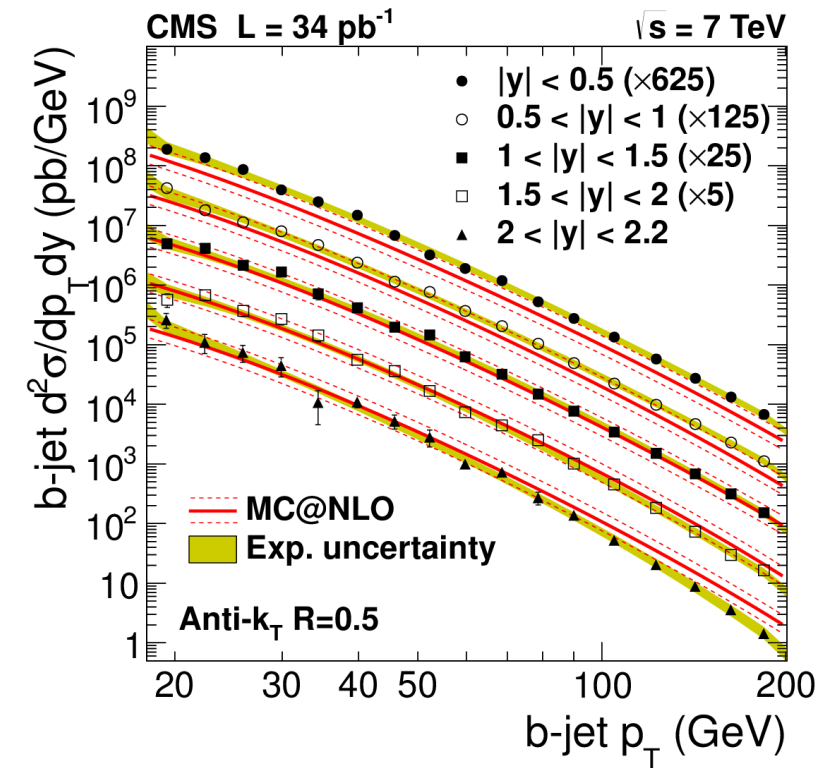B-jets are highly sensitive to extra radiations.

(studies performed with Pythia 8)

|y| < 0.5

ME+PS p_T (|y|)   [GeV]

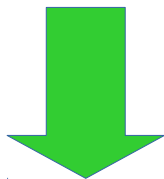FCR   FEX   GSP

Credits: Rick Field

Current status at CMS

- Only 7 TeV analysis limited to low pt
- The p_T was limited by b-tagging systematics, not by luminosity
- The high pile-up will close low p_T region

Challenges & Prospects

- High pile-up environment
- High-pt events with high-track multiplicity

- Challenging track and vertex reconstruction (needed for B-tagging)
- Dedicated JECs for B-jets

Jet zoology at HL-LHC
- g-jets
- C-jets
- **B-jets**
- T-jets
- W-jets
- Z-jets
- h-jets
- Etc.

DeepFlavour !!

Thank you for your attention