Top quark mass measurement using the 13 TeV data of the ATLAS experiment

Study of the radiation damage effect on the Inner Detector

Jad Zahreddine (LPNHE - Sorbonne Université)

Supervisor: Frédéric Derue

Biennale LPNHE, Montpellier, 15-18 April 2019

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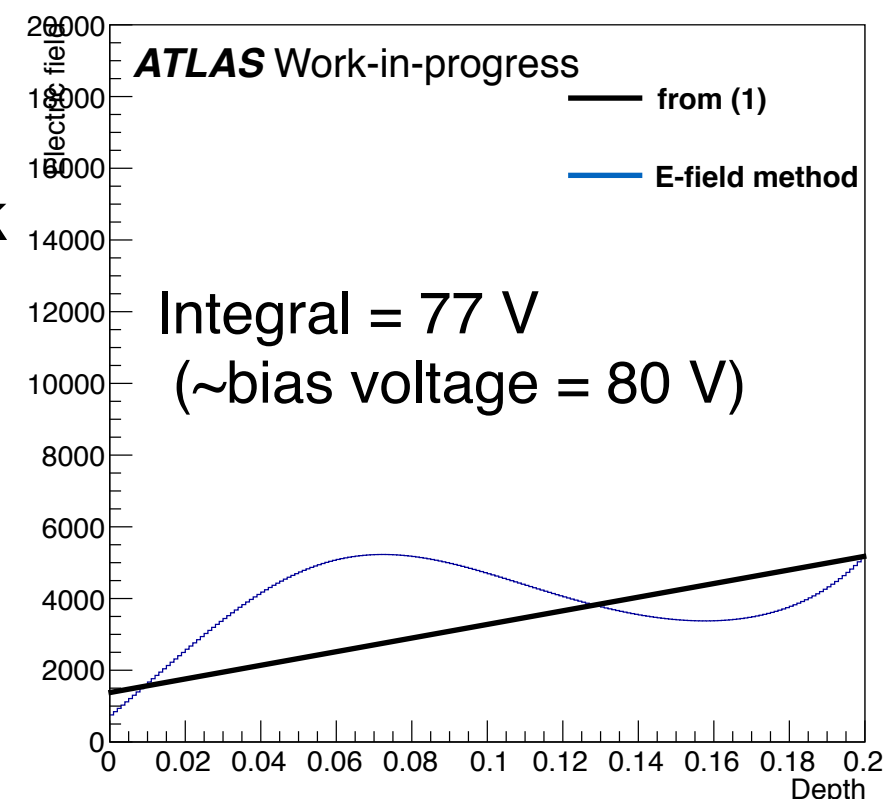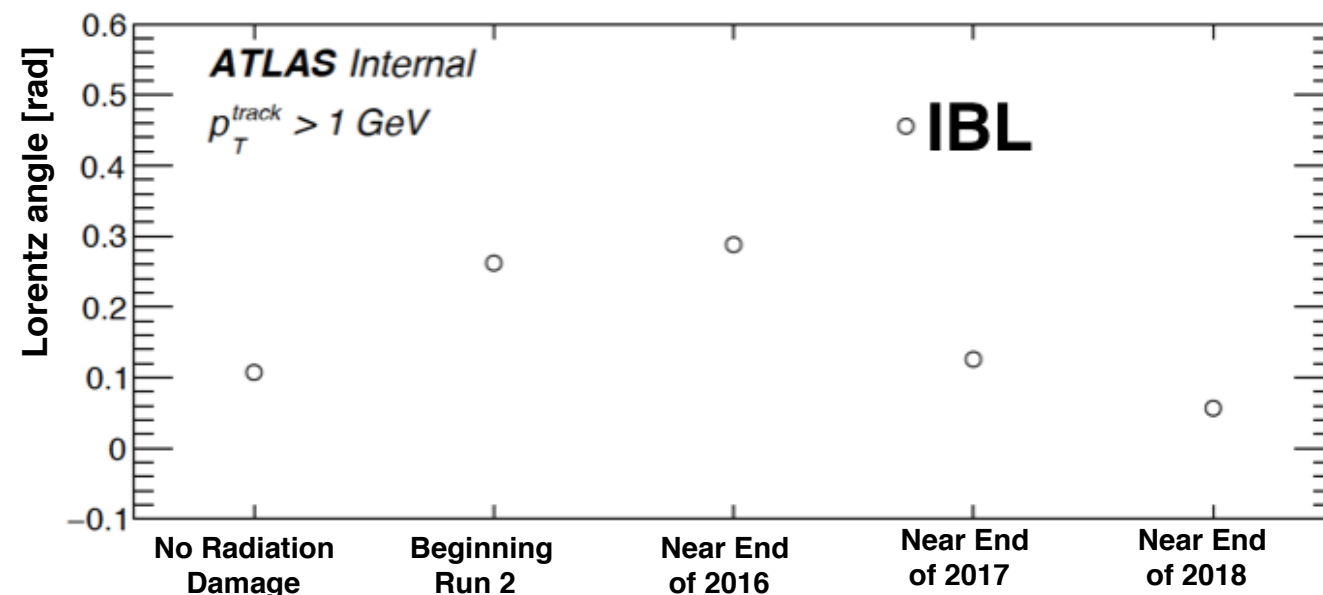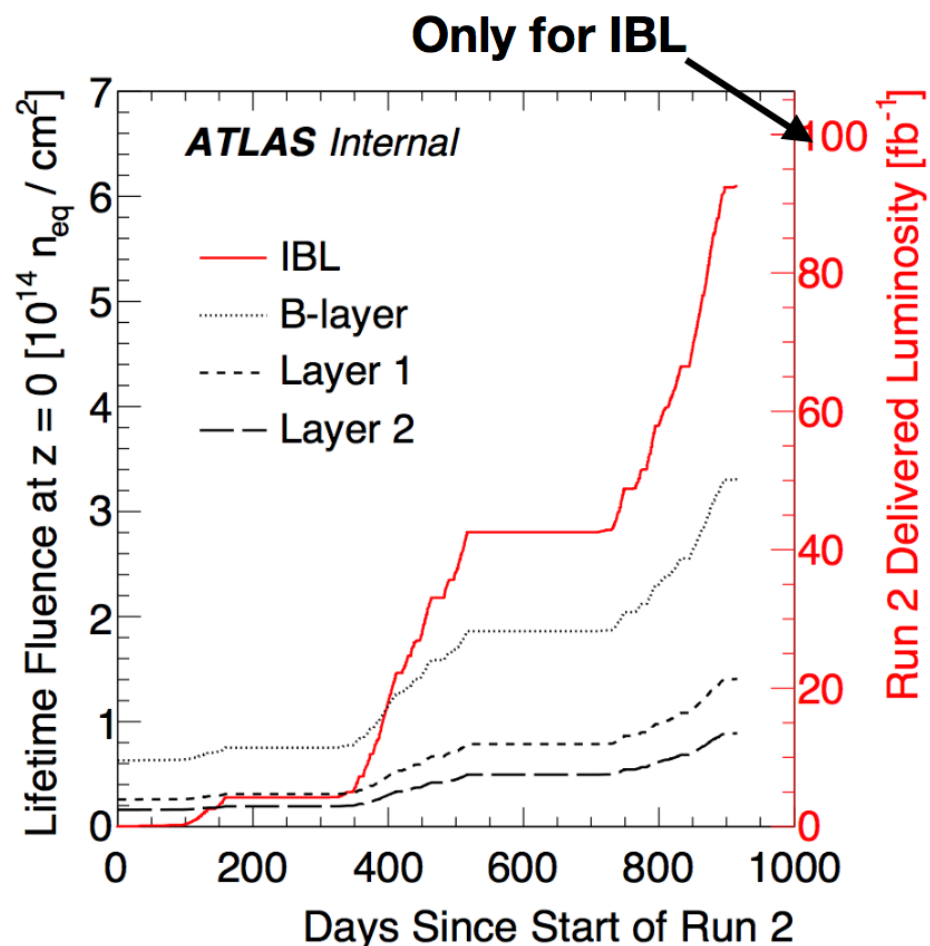Jad Zahreddine (LPNHE - Sorbonne Université)

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Apparently I have 5 minutes, so let's go !

The pixel detector is the innermost part of the ATLAS detector

⟶ Important flux of particles ⟶ high dose of radiation on the pixels

Only for IBL

- Radiation damage introduces defects in the sensor bulk

- Validation of digitizer (now officially part of athena)

- Lorentz angle dependencies on luminosity, geometrical variables, etc.

- E-field calibration in situ

- Performance: effect of radiation damage on tracks and jets

Study of tt pairs with a B-hadron decaying in J/ψ⟶μμ or D mesons offers alternative methods to measure mtop using its sensitivity to m(lJ/ψ), or m(lD)
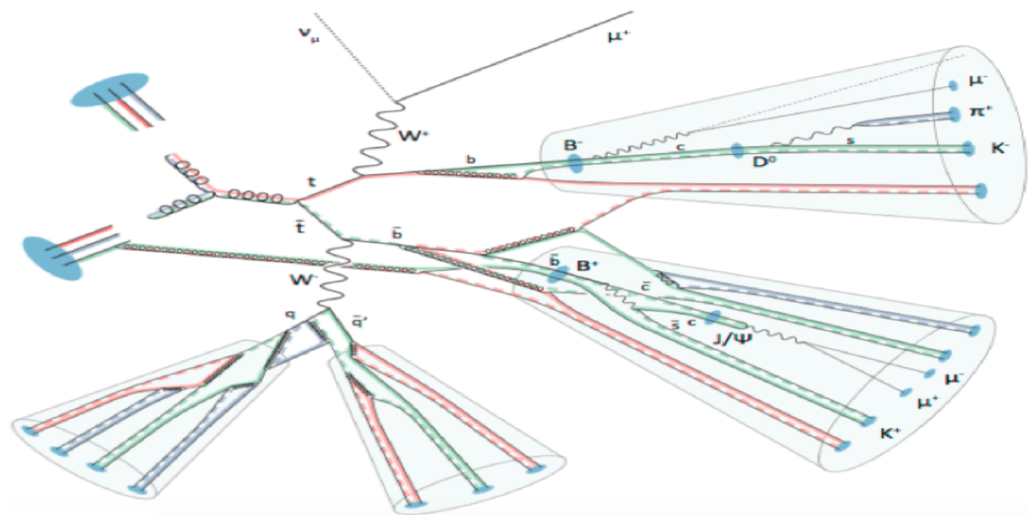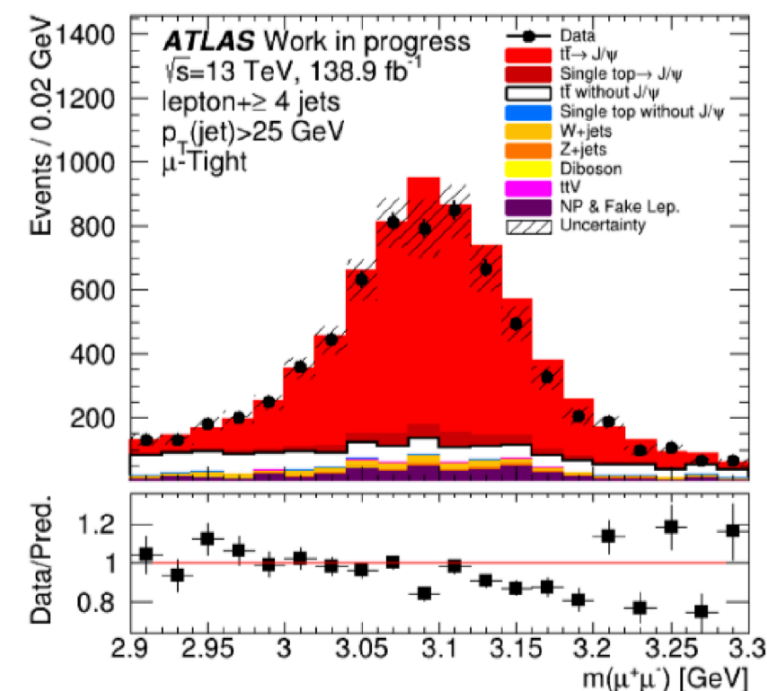
Low statistics channel:

$$BR(b \to J/\psi \to \mu^+\mu^-) \sim 7 \cdot 10^{-4}$$

$$BR(b \to \mu D^0 \to \mu K\pi) \sim 5.9 \cdot 10^{-3}$$

$$BR(b \to D^*(2010)^+ \to D^0\pi) \sim 2.2 \cdot 10^{-2}$$

Full Run 2 analysis 140 fb^{-1} (ongoing)

Motivation for m(top)
test the coherence of the SM
sensitive to vacuum stability

Motivation for these channels
- purely leptonic/tracking observables
less sensitive to Jet Energy Scale than the
ones from jet reconstruction
- still sensitive to parton shower, hadronization,
b-fragmentation effects..
- will help to reduce the final uncertainty in
combination of all measurements

Prospects for HL-LHC 3000 fb^{-1}
   only ATLAS measurement
   part of CERN Yellow report
   σ(stat.)~0.14 GeV
   σ(syst.)~0.5 GeV dominated by tt
modeling (b-production and b-
fragmentation)
                    arXiv:1902.04070v2 [hep-ph]

b-fragmentation studies

Obtain clean sample of b-jets from tt → J/ψ events

Identify J/ψ candidates using "standard" techniques
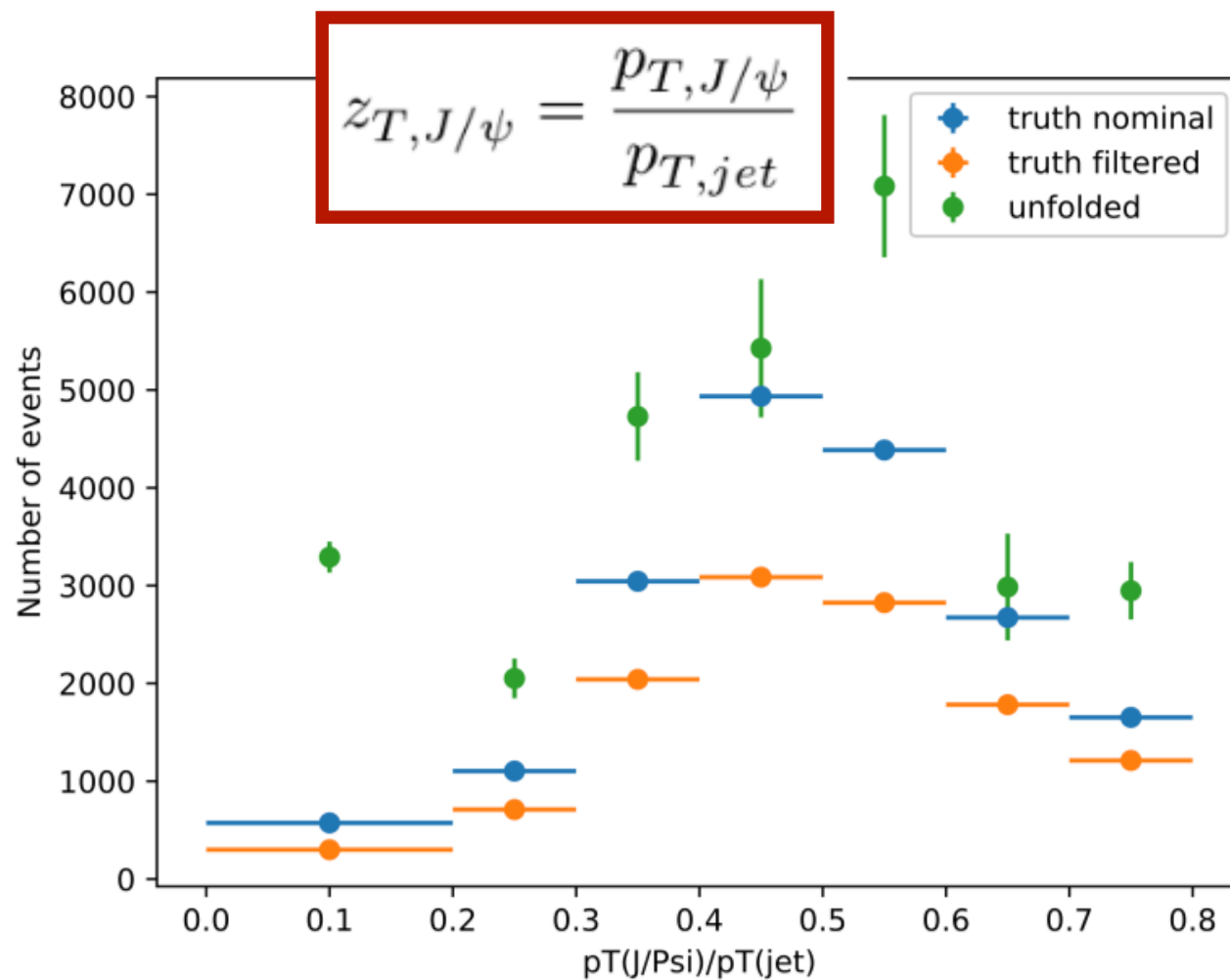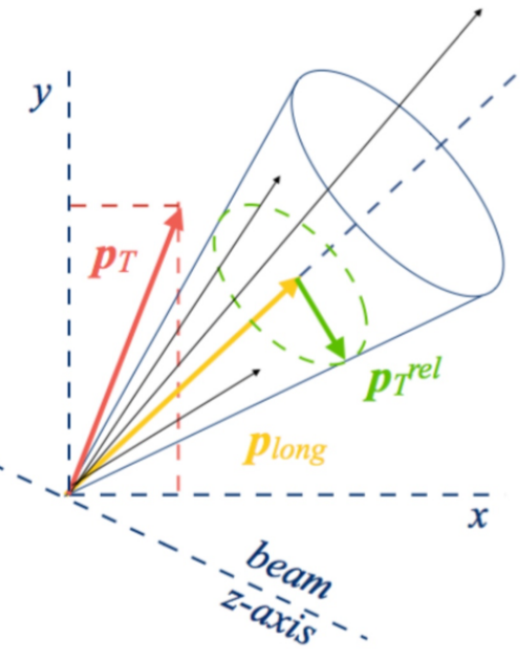
Construct moments of the J/ψ w.r.t. the b-jet

We only use the J/ψ – all the remaining momentum is lost.

$$z_{T,J/\psi} = \frac{p_{T,J/\psi}}{p_{T,jet}}$$

$$z_{L,J/\psi} = \frac{\vec{p}_{J/\psi} \cdot \vec{p}_{jet}}{|p_{jet}|^2}$$

$$z_{J/\psi}^{rel} = \frac{|\vec{p}_{J/\psi} \times \vec{p}_{jet}|}{|p_{jet}|^2}$$

$$z_{T,J/\psi} = \frac{p_{T,J/\psi}}{p_{T,jet}}$$

Legend:
- truth nominal
- truth filtered
- unfolded

Number of events vs pT(J/Psi)/pT(jet)

Unfolding is not closing…

C. Helsens' presentation

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