

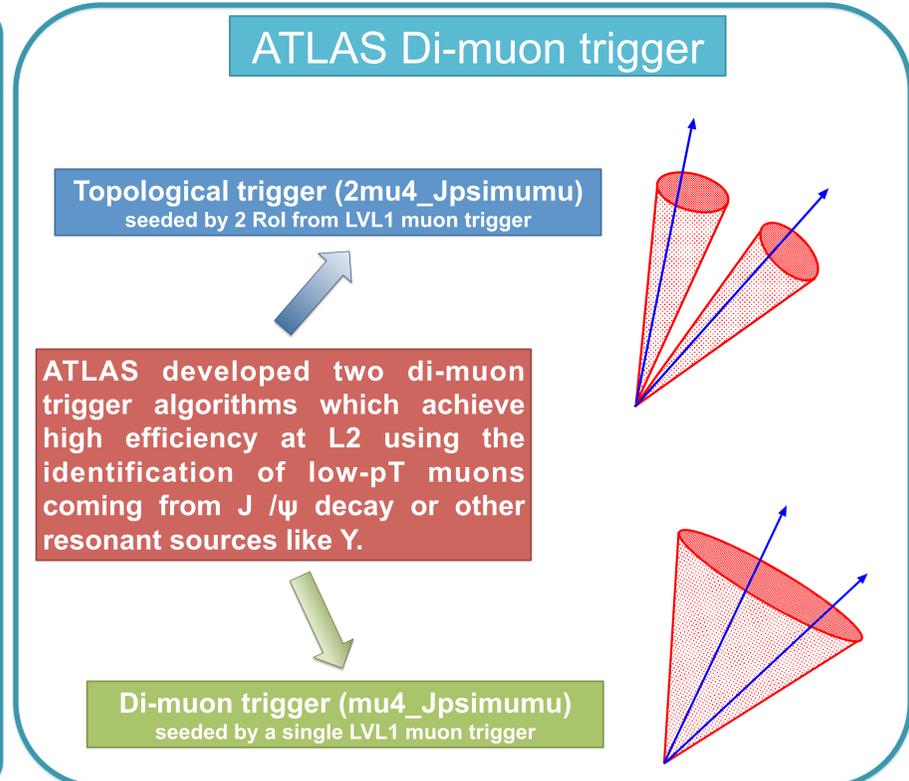
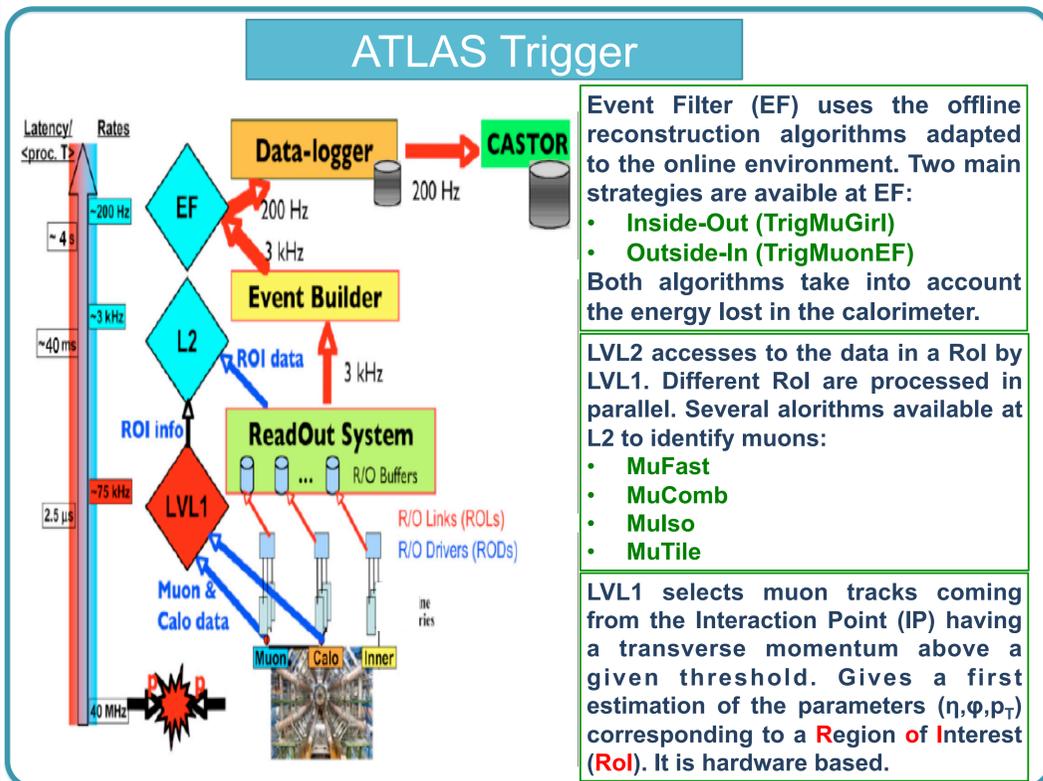


# A Measurement of the ATLAS Di-Muon Trigger Efficiency in Proton-Proton Collisions at $\sqrt{s} = 7$ TeV

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The B physics program of the ATLAS experiment includes the study of the production cross sections, the searches for rare b decay signatures which are sensitive to new physics at the TeV energy scale and the measurements of CP violation effects in B-events, such as  $B_s^0 \rightarrow J/\psi \phi$  and  $B_d^0 \rightarrow J/\psi K_s^0$ . The key to the detection of these B signals in ATLAS is to achieve a high trigger efficiency for low- $p_T$  di-muon events, keeping an acceptable trigger rate. ATLAS developed two separate approaches for triggering on di-muon events from resonances such as a  $J/\psi$  and Upsilon ( $Y$ ). The first approach is to start from a di-muon trigger selected by the Level-1 trigger while the second is based on dedicated Level-2 algorithm. The performance for di-muon trigger has been studied using collision data at  $\sqrt{s}=7$ TeV collected in 2011.



## Efficiency Evaluation

**Basic Idea:** to use the Bayes theorem to measure the di-muon trigger efficiencies

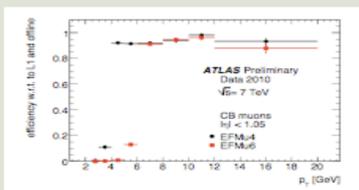
$$P(\text{Trigger}_{2\mu}) = \frac{P(\text{Trigger}_{1\mu}) \otimes P(\text{Trigger}_{2\mu} | \text{Trigger}_{1\mu})}{P(\text{Trigger}_{1\mu} | \text{Trigger}_{2\mu})}$$

Trigger<sub>1μ</sub> = Single-muon trigger item  
Trigger<sub>2μ</sub> = Di-muon trigger item

### $P(\text{Trigger}_{1\mu})$

We use the single-muon trigger results obtained with standard Tag and Probe method\*

\* A measurement of the ATLAS muon reconstruction and trigger efficiency using  $J/\psi$  decays ATLAS-CONF-2011-021



### $P(\text{Trigger}_{2\mu} | \text{Trigger}_{1\mu})$

Ratio between all the events that fired the Trigger<sub>1μ</sub> and the ones that fired the Trigger<sub>1μ</sub> AND the Trigger<sub>2μ</sub>

### $P(\text{Trigger}_{1\mu} | \text{Trigger}_{2\mu})$

Ratio between all the events that fired the Trigger<sub>1μ</sub> AND the Trigger<sub>2μ</sub> and the ones that fired the Trigger<sub>1μ</sub>

## Efficiencies for the topological trigger EF\_2mu4\_Jpsimumu

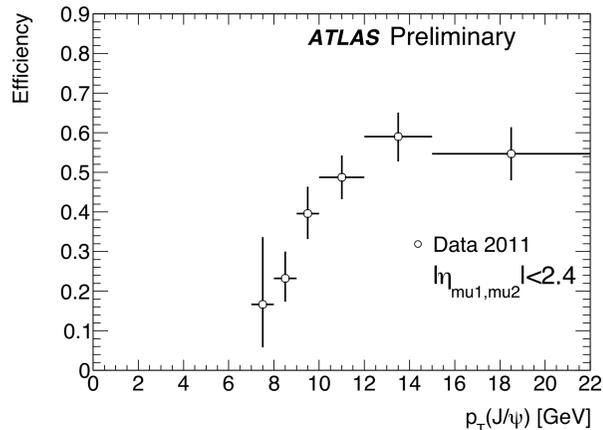


Figure 1: Efficiency of the EF\_2mu4\_Jpsimumu vs  $J/\psi$  candidate  $p_T$ .

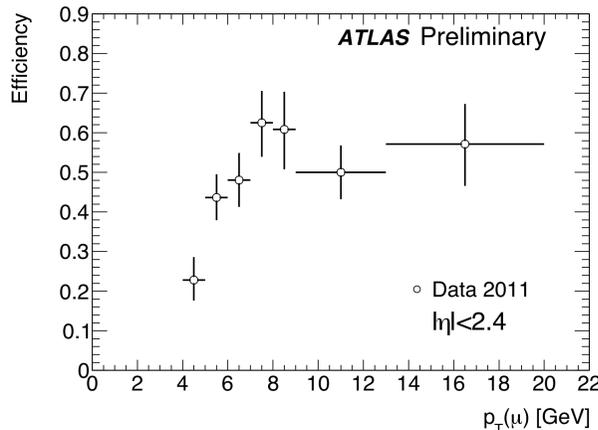


Figure 2: Efficiency of the EF\_2mu4\_Jpsimumu vs  $\mu_1$  reconstructed  $p_T$ .

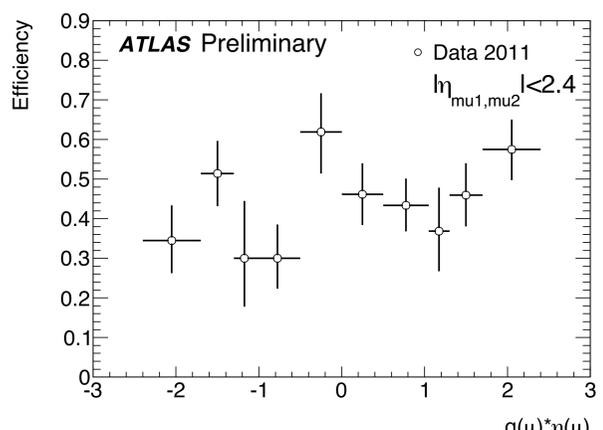


Figure 3: Efficiency of the EF\_2mu4\_Jpsimumu vs  $\mu_1$  reconstructed  $q \cdot \eta$ .

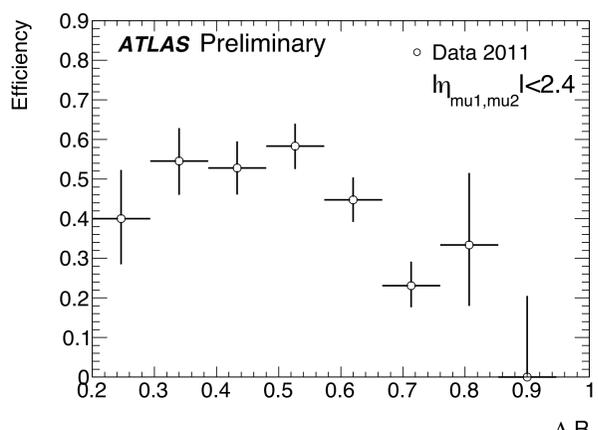


Figure 4: Efficiency of the EF\_2mu4\_Jpsimumu vs  $\Delta R$  between the two muons.

### Data sample:

- Two Opposite sign fully combined muons
- Di-muon invariant mass range (2800-3340 MeV/c<sup>2</sup>)
- Muons  $p_T > 4$  GeV/c
- Muons  $|\eta| < 2.4$

- $\mu_1$  is the muon with higher  $p_T$  inside the di-muon pair
- $\mu_2$  is the muon with lower  $p_T$  inside the di-muon pair