Data-driven corrections to ATLAS electron trigger simulation

The future of particle physics in the Post-Higgs Landscape: Student-led conference 3-5th April 2019

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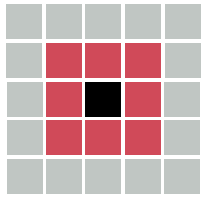
Why should we consider this?

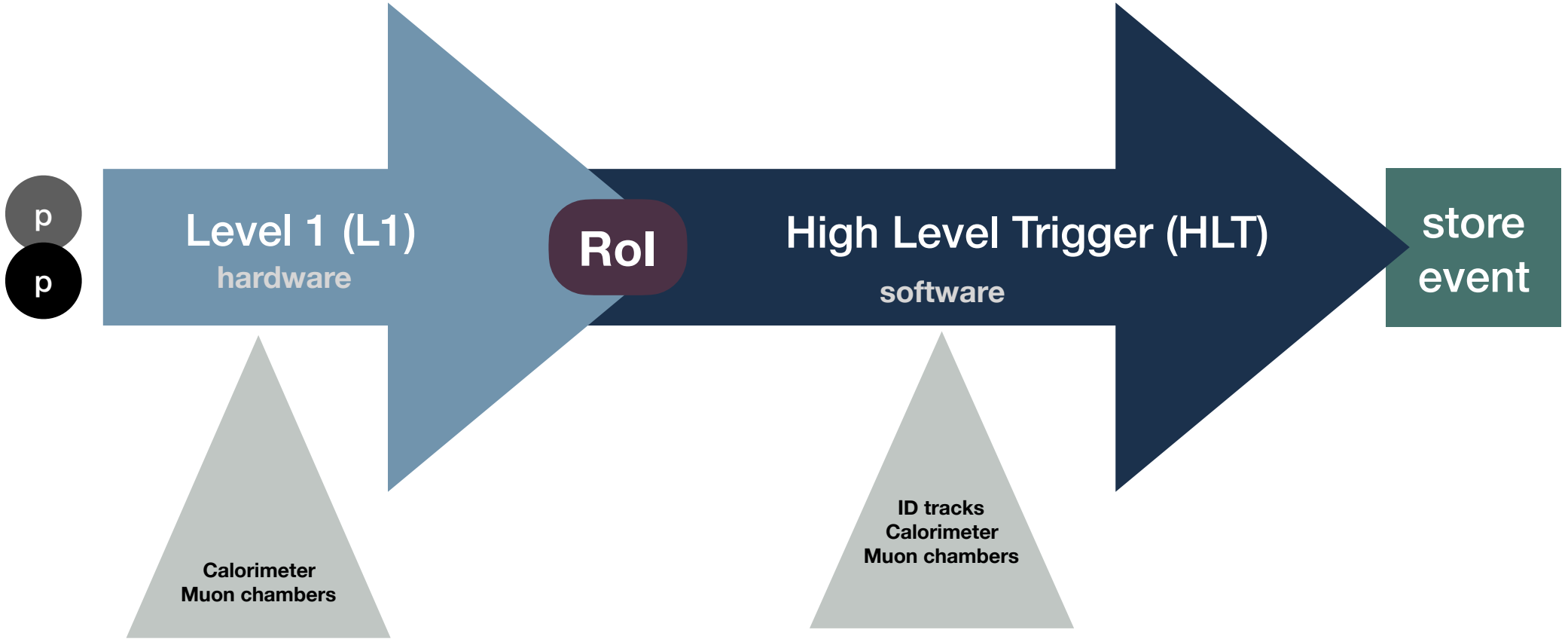
electrons are an important signature for ATLAS analyses (SM as well as BSM)



trigger is a source of inefficiency in analyses

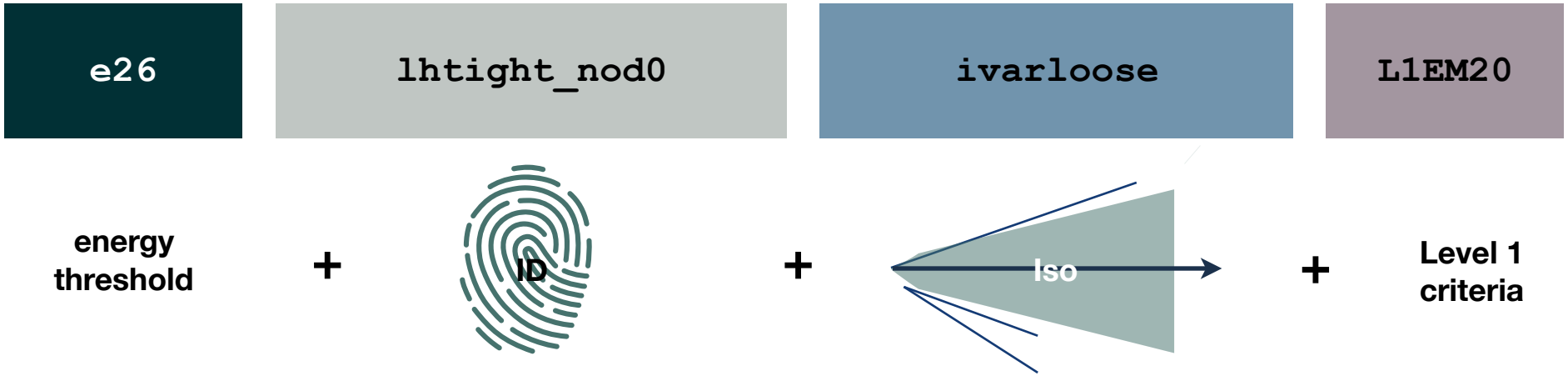
understanding differences in simulation and data of trigger efficiencies is crucial!

The ATLAS trigger system in a nutshell

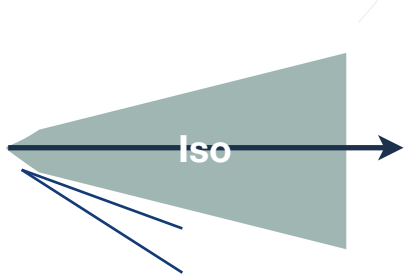


40 MHz proton proton collisions → 1 kHz on tape

electron trigger in ATLAS



online identification via a likelihood procedure (simplified reconstruction)



online isolation criteria

Measuring trigger efficiencies

Z

Tag electron

ID

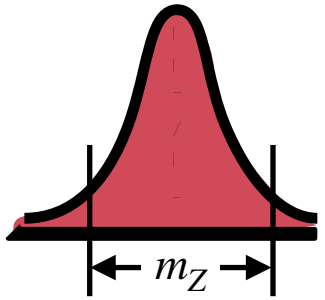
Tight offline identification requirement fulfilled

Fired lowest unprescaled single electron trigger

Probe electron

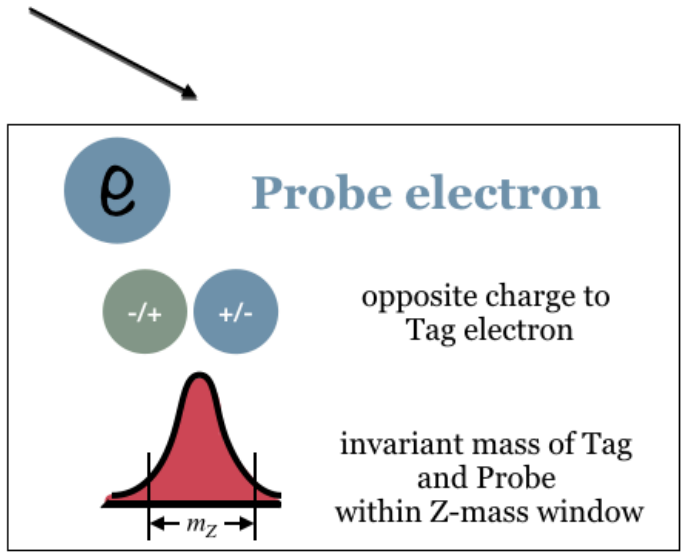
-/+ +/-

opposite charge to Tag electron



invariant mass of Tag and Probe within Z-mass window

Measuring trigger efficiencies



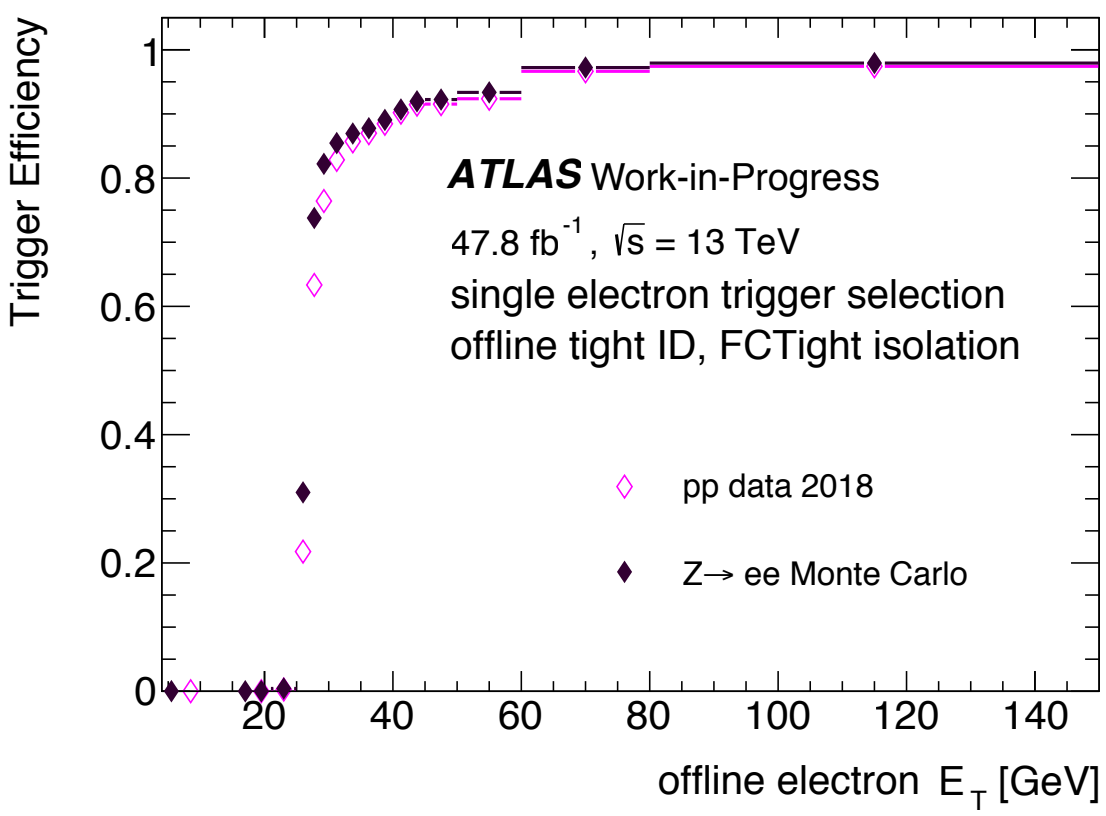
electron efficiency = (offline efficiency) x (trigger/online efficiency)

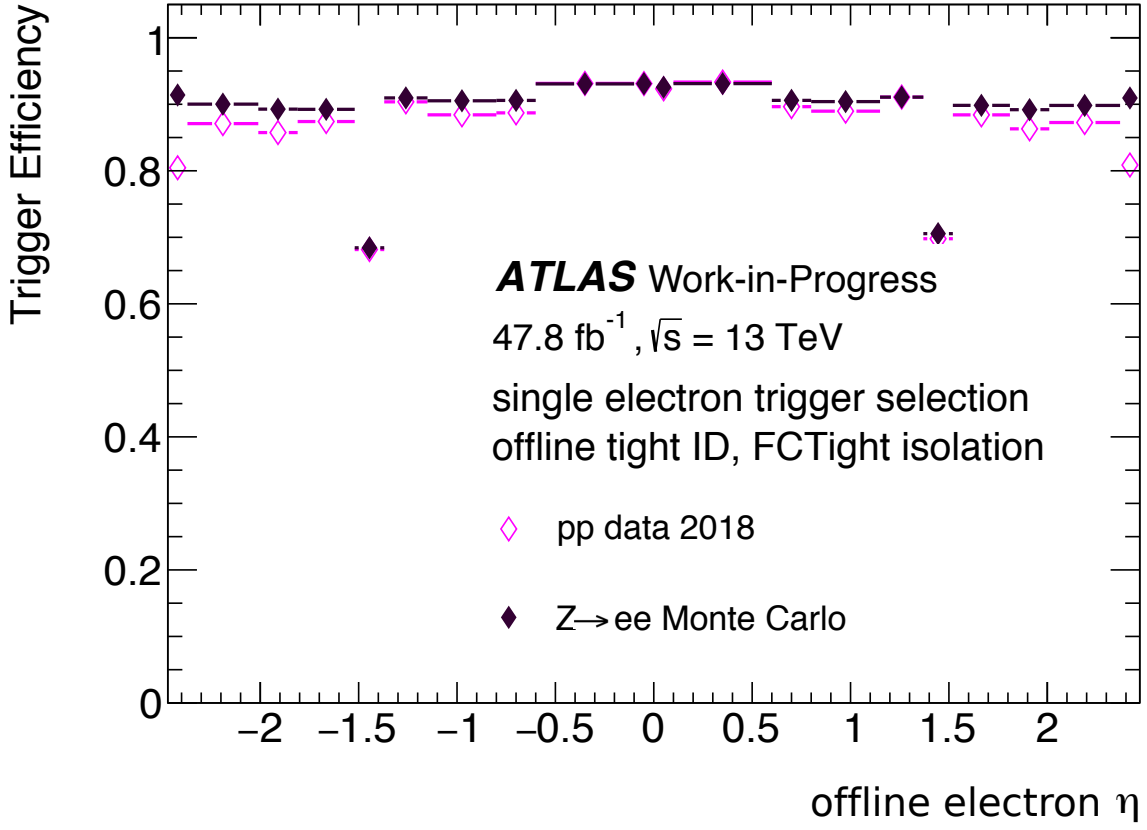
need to evaluate the trigger efficiency in terms of offline properties

$$\text{trigger efficiency} = \frac{\text{Probe}(\text{ID} + \text{Iso} +)}{\text{Probe}(\text{ID} + \text{Iso})}$$

The single electron OR in 2018

`e26` `lhtight_nod0` `ivarloose` **OR** `e60` `lhmedium_nod0` **OR** `e140` `lhloose_nod0`

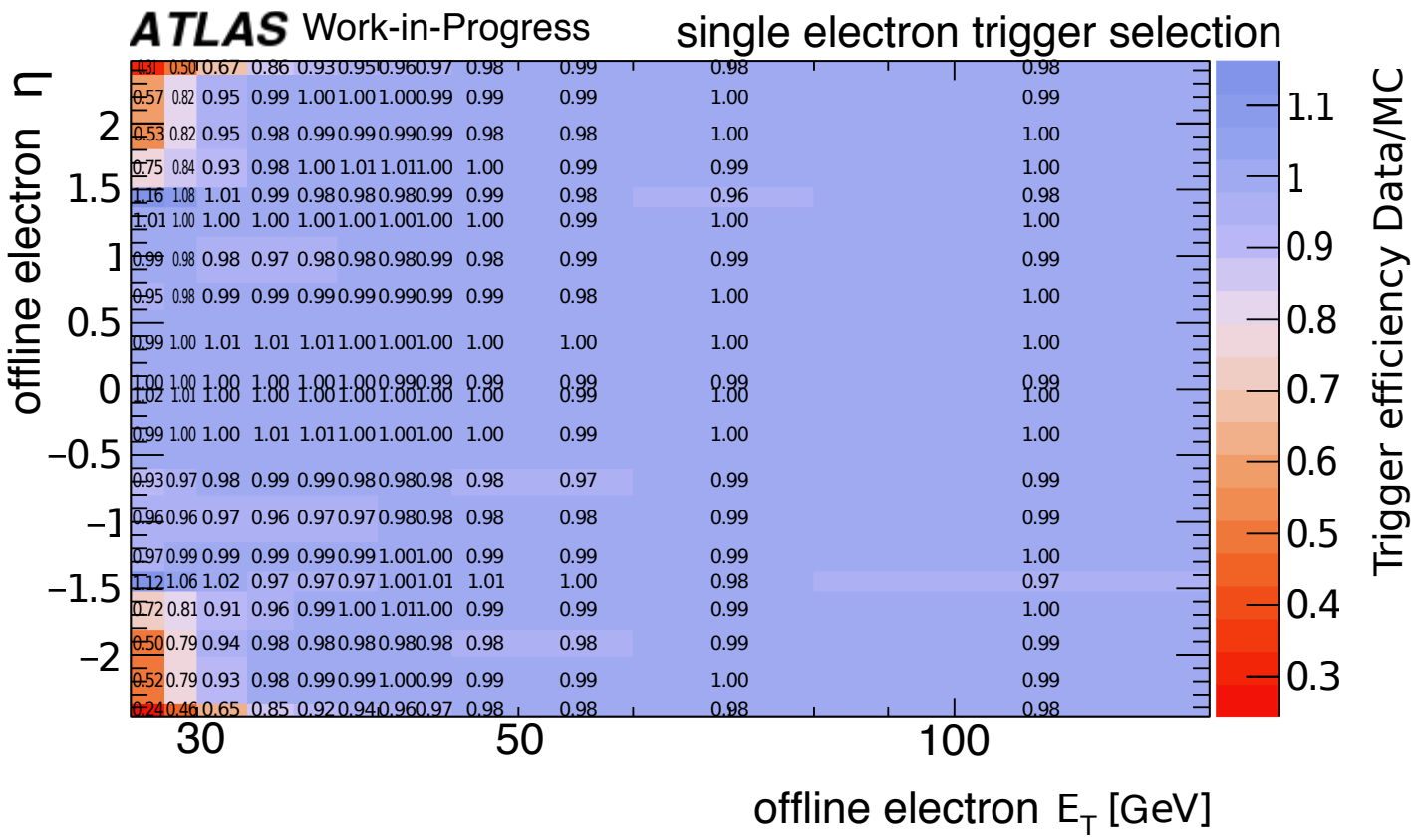




deriving correction factors

$$SF = \frac{\text{efficiency in data}}{\text{efficiency in simulation}}$$

mimic trigger behaviour in data

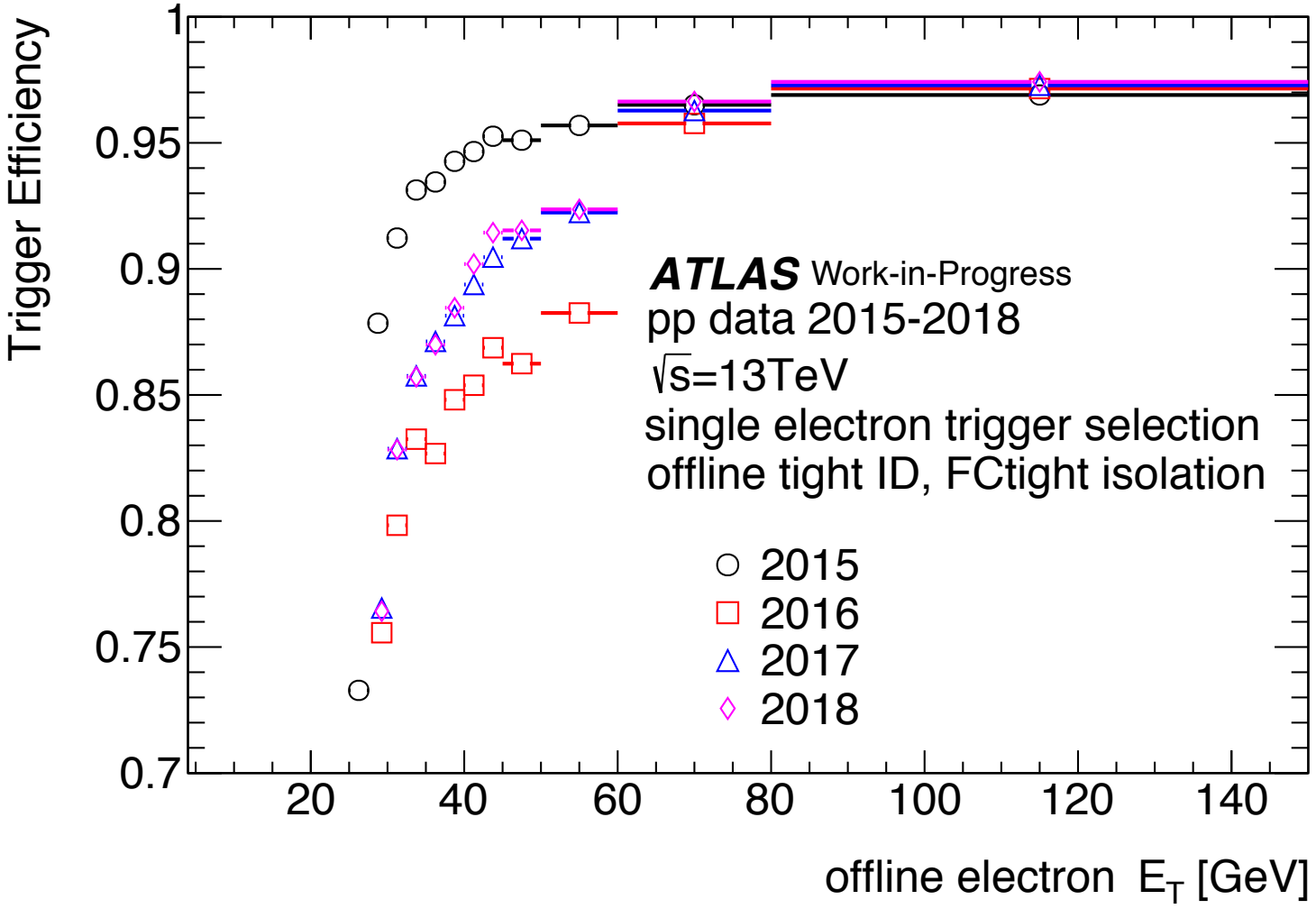


the single electron trigger in Run-2

Year	Single electron trigger		
2015	`e24_lhmedium_L1EM20VH`	`e60_lhmedium`	`e120_lhloose`
2016	`e26_lhtight_nod0_ivarloose`	`e60_lhmedium_nod0`	`e140_lhloose_nod0`
2017	`e26_lhtight_nod0_ivarloose`	`e60_lhmedium_nod0`	`e140_lhloose_nod0`
2018	`e26_lhtight_nod0_ivarloose`	`e60_lhmedium_nod0`	`e140_lhloose_nod0`

- raise threshold from 24 GeV to 26 GeV
- remove d0 information from likelihood
- introduction of Ringer algorithm in 2017

Performance of the single electron trigger



- raise threshold from 24 GeV to 26 GeV in 2016
  → **slower turn-on than in 2015**
- introduction of Ringer algorithm in 2017
  → **higher efficiencies in 2017 and 2018**

Conclusions

- understanding the trigger as source of inefficiency in an analysis is crucial

- correcting simulation to efficiency behaviour in data is an important preliminary to any physics analysis

—> can use to study inefficiencies and improve electron trigger for years to come!