
DESY ATLAS

Meeting

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# SUSY TRIGGER MENU

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# Outline

- Supersymmetry
- mSUGRA
- Trigger Studies
- Electron Correction
- Summary and Outlook

# SUPERSYMMETRY

- Standard Model has several problems:
  - not complete (can not include gravity)
  - can't describe nature at high scales as the Planck scale
  - hierarchy problem
  - no explanation for Dark Matter
  - many open questions

➲ Supersymmetry provides a way to solve some problems

# SUPERSYMMETRY

- Features of Supersymmetry
  - SM Particle has a superpartner
  - solves hierarchy problem
  - candidate for Dark Matter
  - additional parameters
  - unification of gauge couplings

➲ Masses between SM – and SUSY Particles are different
→ SUSY has to be broken

# mSUGRA

- Minimal Supergravity
- broken in a hidden sector
- communicated to SM scale via gravitational interactions

- Model with minimal number of parameters
  - $m_0$ : scalar mass
  - $m_{1/2}$: gaugino mass
  - $A_0$: trilinear scalar coupling
  - tan β: ratio of Higgs vacuum expectation values
  - sign μ: sign of Higgsino mass parameter

- LSP: Neutralino
  → R-Parity conserved → LSP stable
  → Dark Matter

# mSUGRA

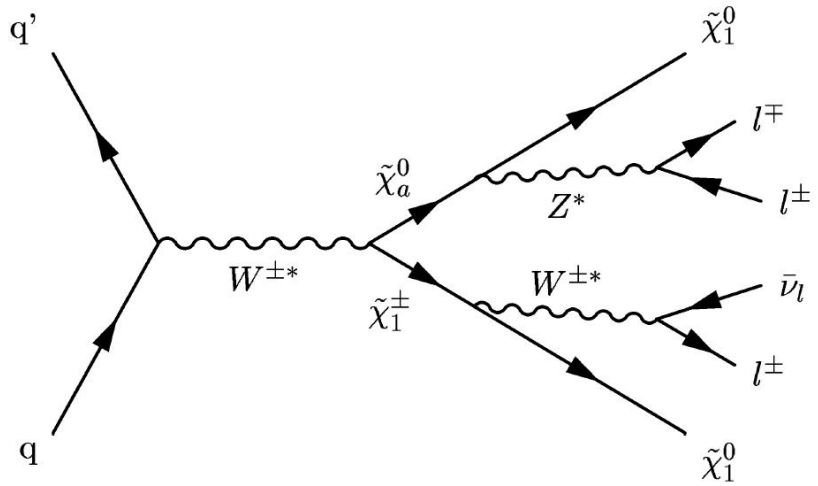
- low $m_0$
  - → squarks are light
    - → high $\tilde{g}\tilde{g}, \tilde{g}\tilde{q}, \tilde{q}\tilde{q}$ production
    - → $\tilde{\chi}_2^0 \to \tilde{\chi}_1^0 h,\ \tilde{\chi}_1^0 Z$ not allowed
- high $m_{1/2}$
  - → high chargino - neutralino production
  - → $\tilde{\chi}_2^0 \to \tilde{\ell}_R \ell$ not allowed
- high tan β
  - → $\tilde{\chi}_2^0 \to \tau^{\pm}\tilde{\tau}^{\mp} \to \tau^{+}\tau^{-}\tilde{\chi}_1^0$ only allowed two-body decay

# mSUGRA

- characteristic signal for events:
  - multiple jets
    - jet trigger
  - dilepton
    - lepton trigger
  - missing energy
    - missing energy trigger
- problems:
  - missing energy trigger is not completly understood
  - no high jet multiplicity in every parameter region (e.g. SU2)

# SU2 (Focus Point)

- largest cross section for direct production of charginos and neutralinos

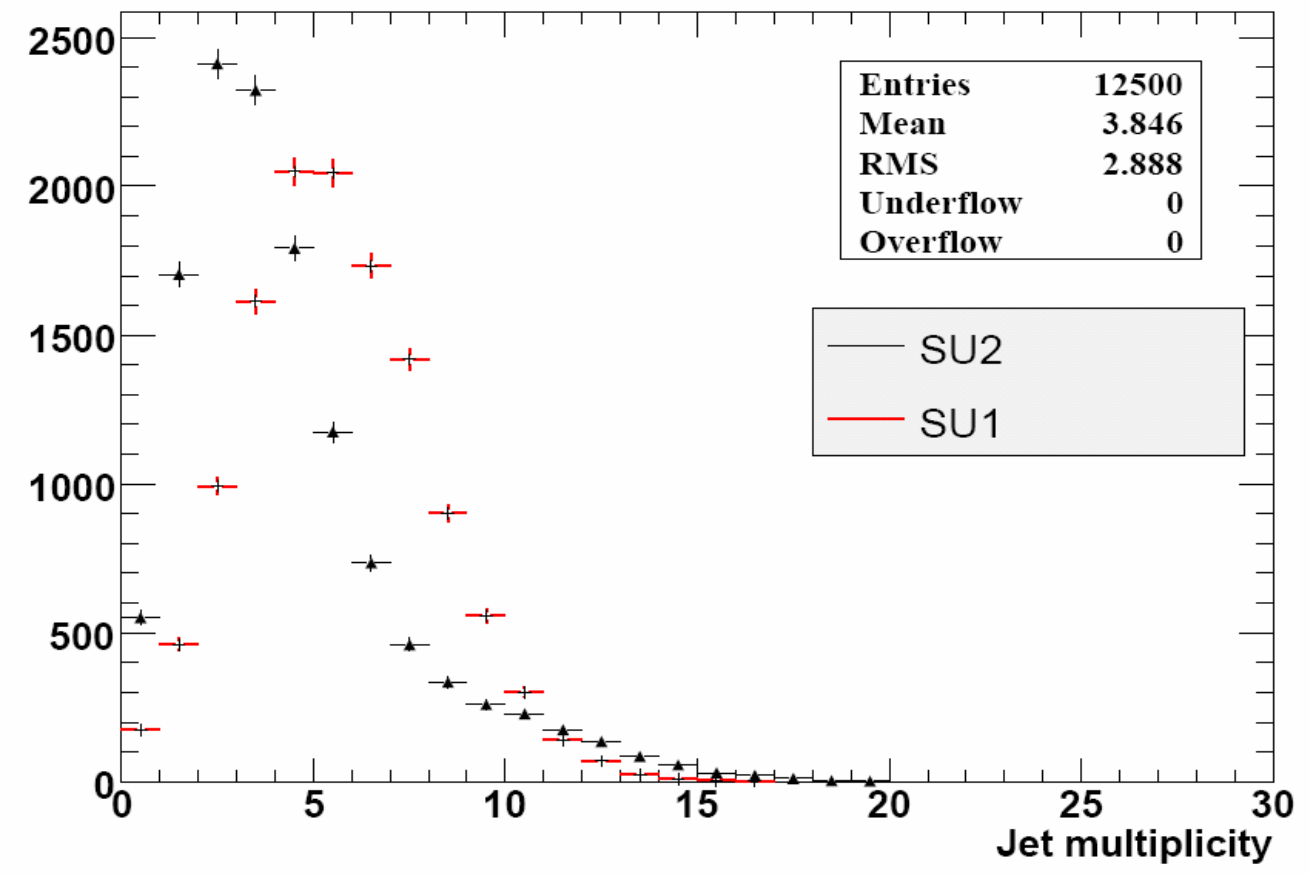



- $Br(\tilde{\chi}_2^0 \rightarrow \tilde{\chi}_1^0 l^+ l^-)$ = 3.3% und $Br(\tilde{\chi}_3^0 \rightarrow \tilde{\chi}_1^0 l^+ l^-)$= 3.8%

- $Br(\tilde{\chi}_1^{\pm} \rightarrow \tilde{\chi}_1^0 l^{\pm} \bar{\nu})$ = 11.1%

# SU2 (Focus Point)

- jet multiplicity in SU2 is lower than SU1



# ATLAS TRIGGER

**Level1:**

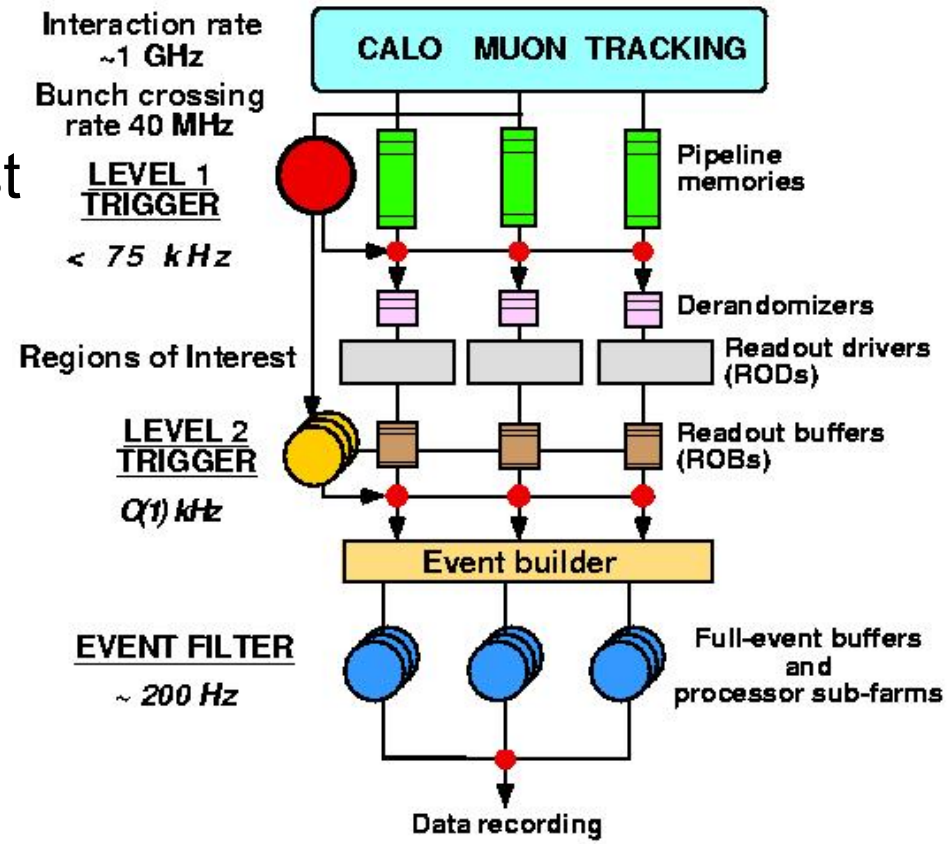
- hardware based
- identifies Region Of Interest

**Level2:**

- software optimized
- full granularity info in ROI

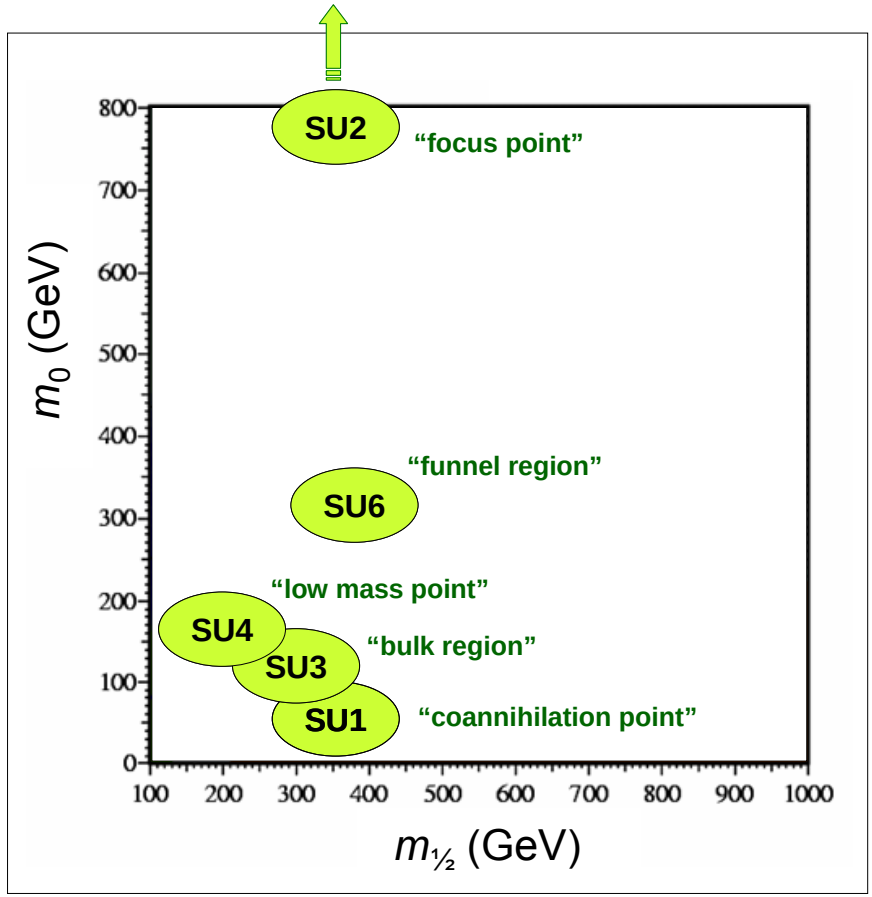
**EventFilter:**

- complex algorithm
- event reconstruction



# TRIGGER STUDIES

- real SUSY-Model is unknown
- mSUGRA parameter space
- Some points fully simulated
- check coverage of trigger in whole this space!!!

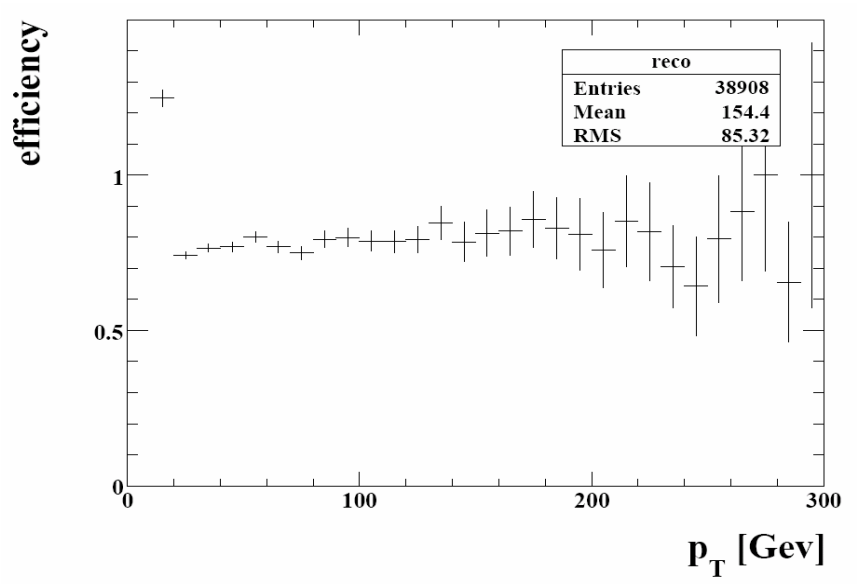


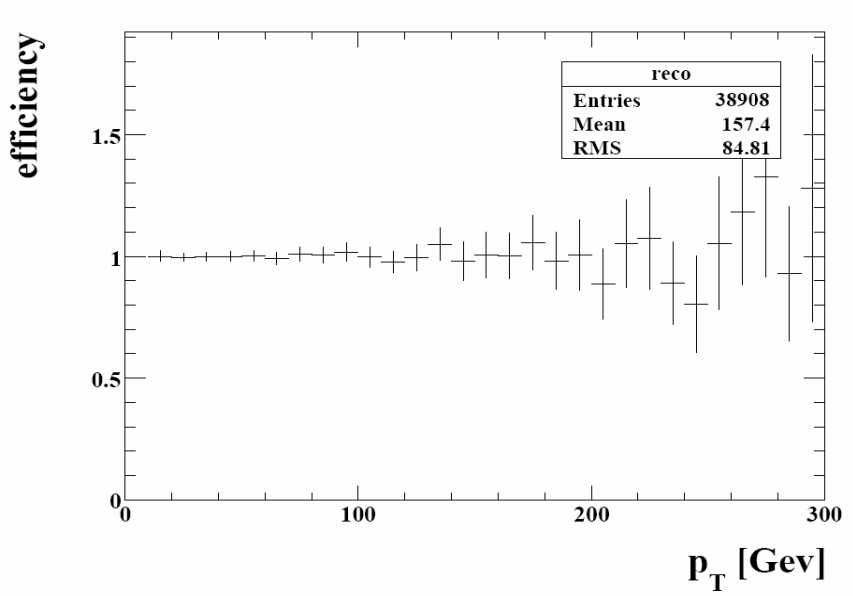
# TRIGGER STUDIES

- full simulation needs ~10 min per event
- solution: simulation with Atlfast
  → problem: no trigger in Atlfast
    → parameterization respect to trigger
- parameterization in two steps
  - Atlfast → offline
    → corrected Atlfast → offline trigger
- Electron parameterization in different bins of
  - $p_T$ : 15-20, 20-30, 30-50, 50-75, 75-100, 100-200, 200-…
  - $|\eta|$ : 0-1.37, 1.52-2.5
  - $\Delta R$ : 0-0.1, 0.1-0.5, 0.5-1.0, 1-2, 2-3, 3-…
- correction factors calculated with ttbar

# Electron Parameterization

- binning for $p_T$ :
  15-20, 20-30, 30-50, 50-75, 75-100, 100-200, 200-…



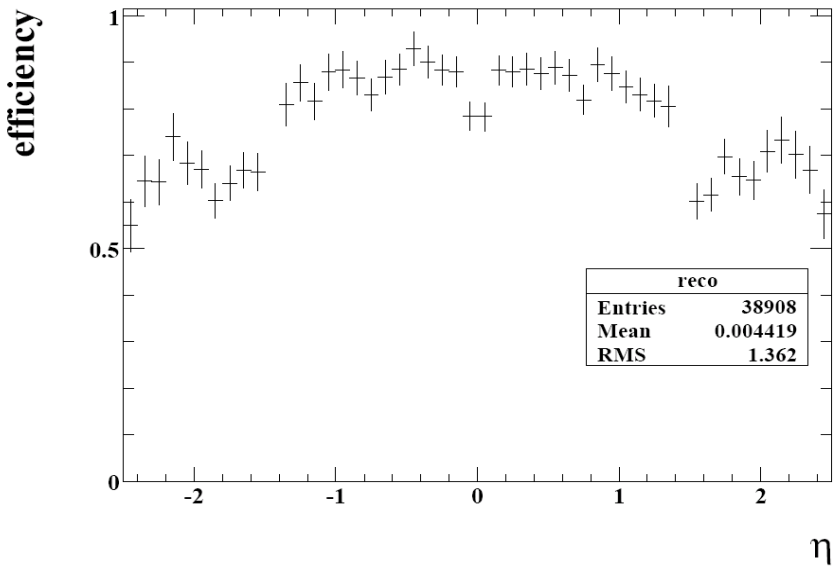

before correction

after correction

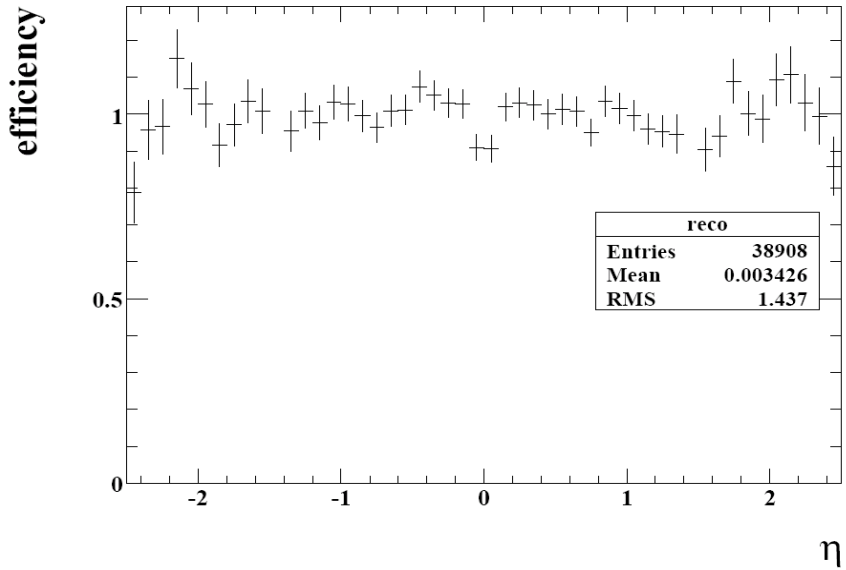
full simulation (offline) / fast simulation (ATLFast)

# Electron Parameterization

- binning for |η| : 0-1.37, 1.52-2.5




before correction

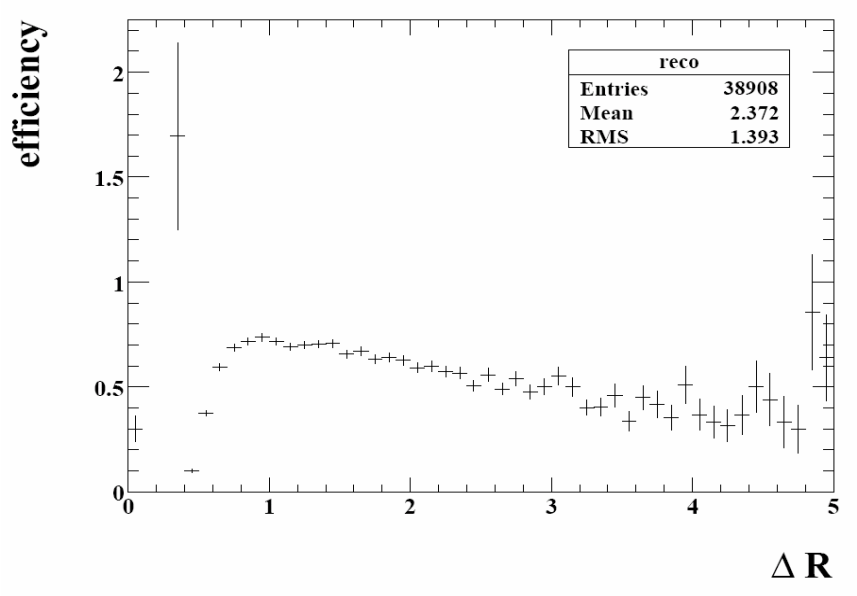



after correction

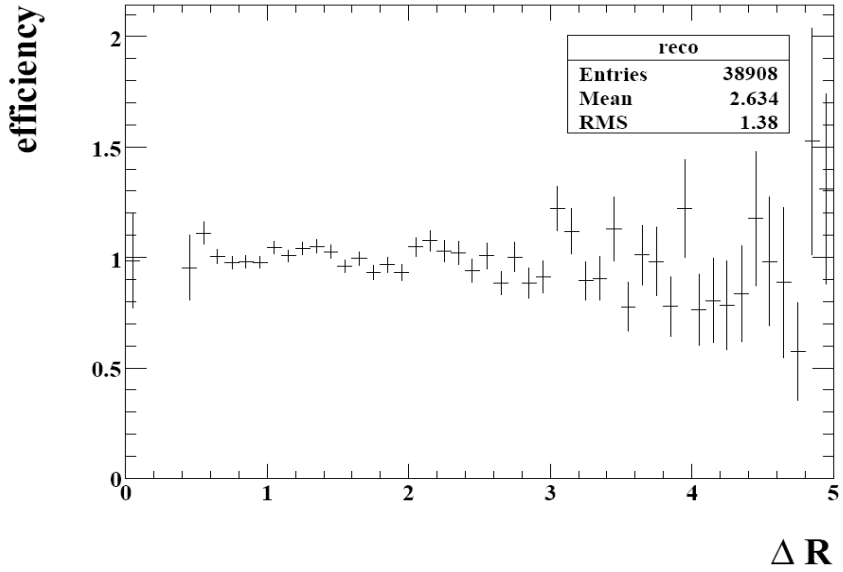
full simulation (offline) / fast simulation (ATLFast)

# Electron Parameterization

- binning for ΔR : 0-0.1, 0.1-0.5, 0.5-1.0, 1-2, 2-3, 3-…



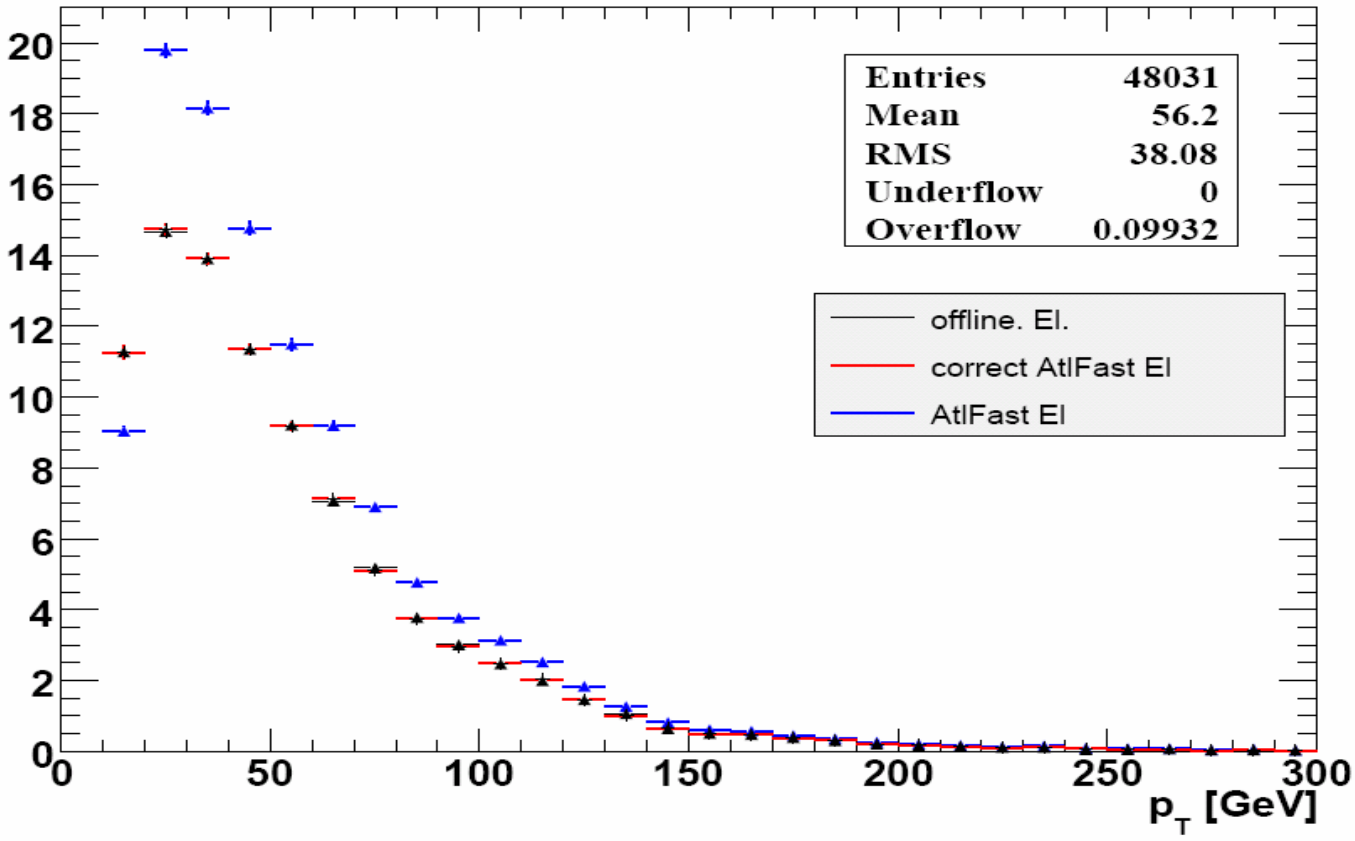

before correction




after correction

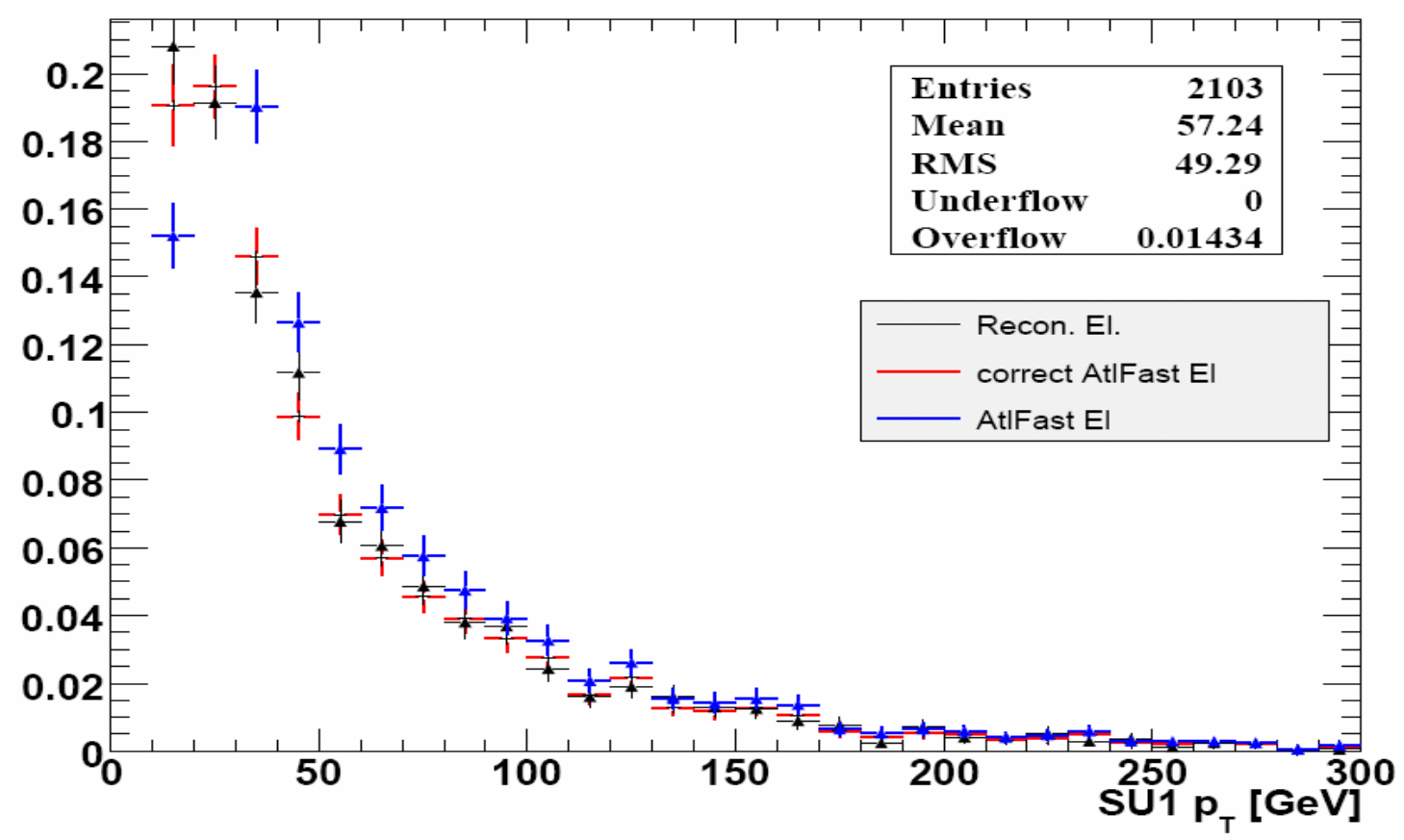
full simulation (offline) / fast simulation (ATLFast)

# Electron Parameterization




Atlfast Electron parameterization respect to offline works well

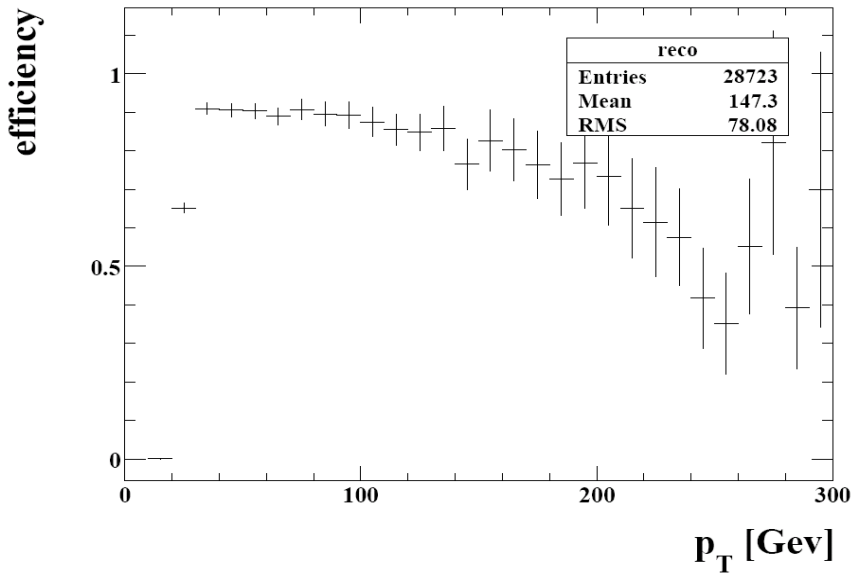
# Electron Parameterization



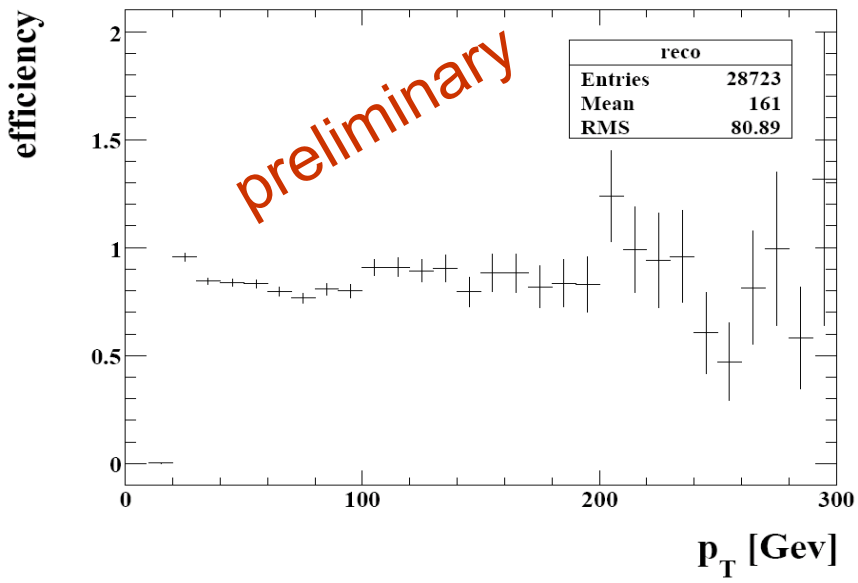

electron parameterization work for SU1

# Electron Parameterization

- binning for $p_T$ :
  15-20, 20-30, 30-50, 50-75, 75-100, 100-200, 200-…




before correction




after 2nd correction

full simulation (trigger) / corrected fast simulation (ATLFast)

# Summary and Outlook

**Summary:**

- Supersymmetry is good model for solving the standard model problem
- Atlfast electron → offline parameterization are understood
- Atlfast electron → trigger parameterization need more work

**Next Step:**

- jet parameterization
- mSUGRA parameter space scan