

Measuring tau polarisation in stau decays

Peter Wienemann

University of Bonn

SUSY Working Group Meeting
Atlas Trigger & Physics Week
June 04-08, 2007

Tau polarisation

Polarization of taus from stau decay is a probe of the neutralino composition (Nojiri, hep-ph/9412374) and can be used to discriminate between different models of SUSY breaking (Godbole, Guchait, Roy, hep-ph/0109096, hep-ph/0205015, hep-ph/0411306)

- Universal SUGRA models: $P_\tau \simeq +1$
- For most non-universal SUGRA models: $P_\tau \simeq \cos^2 \theta_\tau - \sin^2 \theta_\tau$
- AMSB models: $P_\tau \simeq -1$
- For many GMSB models: $P_\tau = \sin^2 \theta_\tau - \cos^2 \theta_\tau$

Polarisation dependent observable:

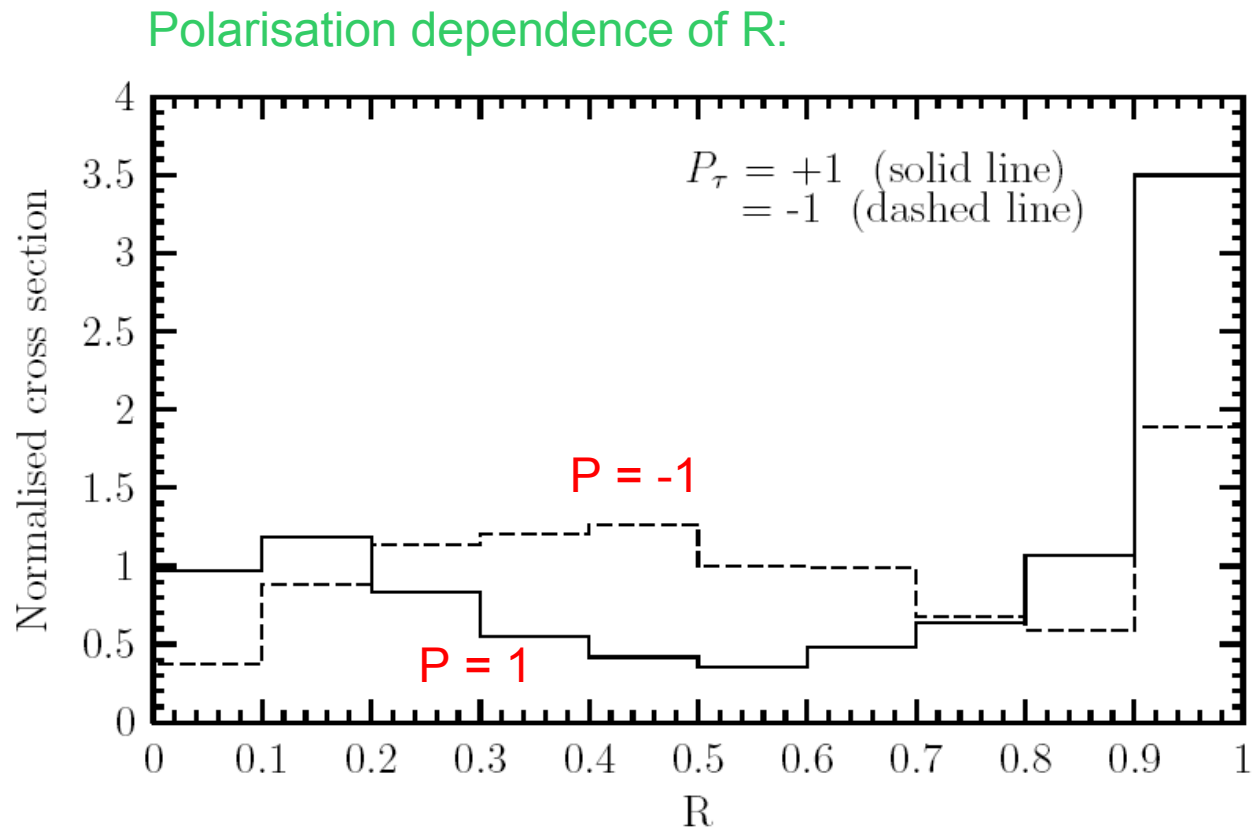
Guchait and Roy proposed to use (hep-ph/0109096)

Ratio of charged and total tau jet momentum R :

$$R = p_{\pi^\pm} / p_{\tau\text{-jet}}$$

\sim boost invariant

Polarisation sensitive observable



Data samples

Produced small SU3 data samples for feasibility study:

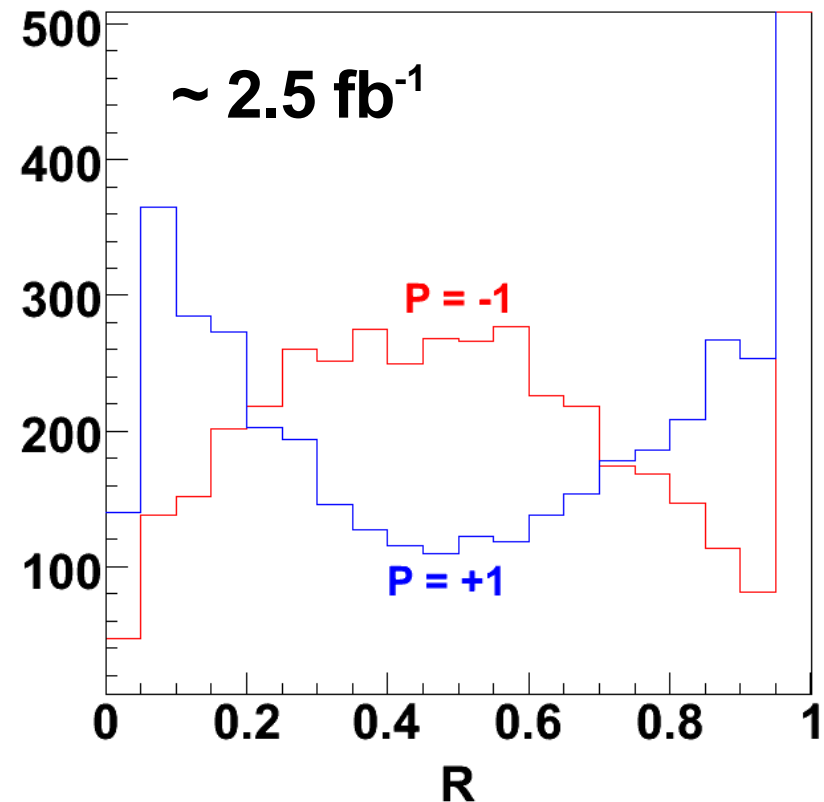
- **Generation:** Athena 12.0.4 with modified Herwig to manipulate tau polarisation of taus from staus ($P_{\tau} = +1$, $P_{\tau} = -1$, $P_{\tau} = \text{nominal}$)
- **Simulation, Digitisation, Reconstruction:** Athena 12.0.6.5

MC truth (from produced sample):

(plot shows only taus from staus with χ_2^0 mother)

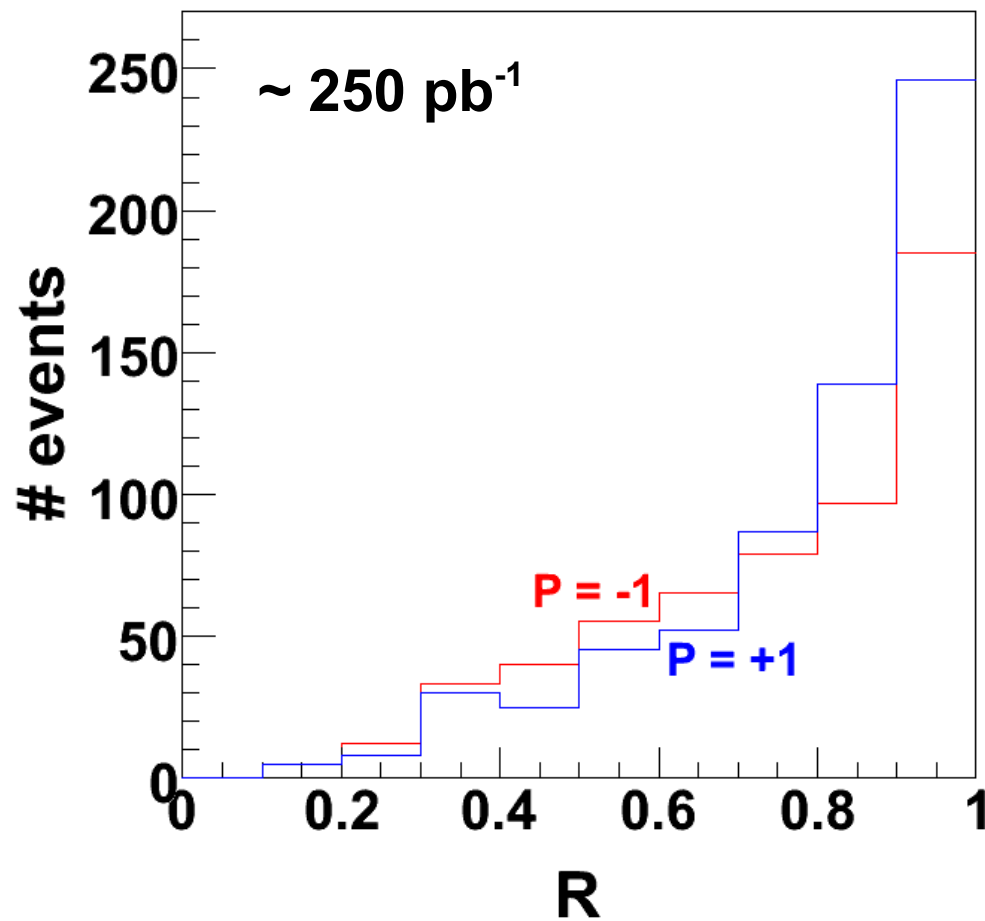
Main source of staus in SU3:

χ_2^0 and χ_1^{\pm} decays



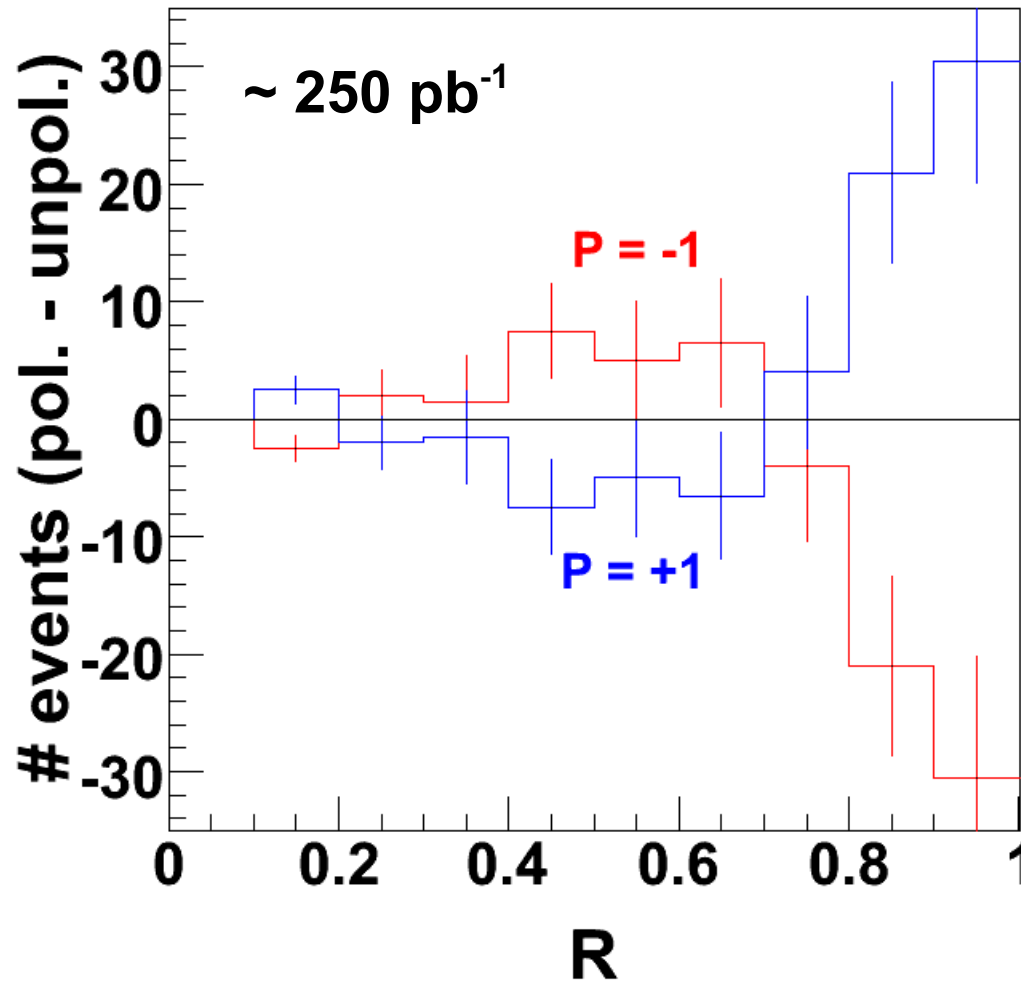
Reconstructed R

tau1P3P, requiring ≥ 1 tau, 1 associated track, no further cuts



Reconstructed R

tau1P3P, requiring ≥ 1 tau, 1 associated track, no further cuts

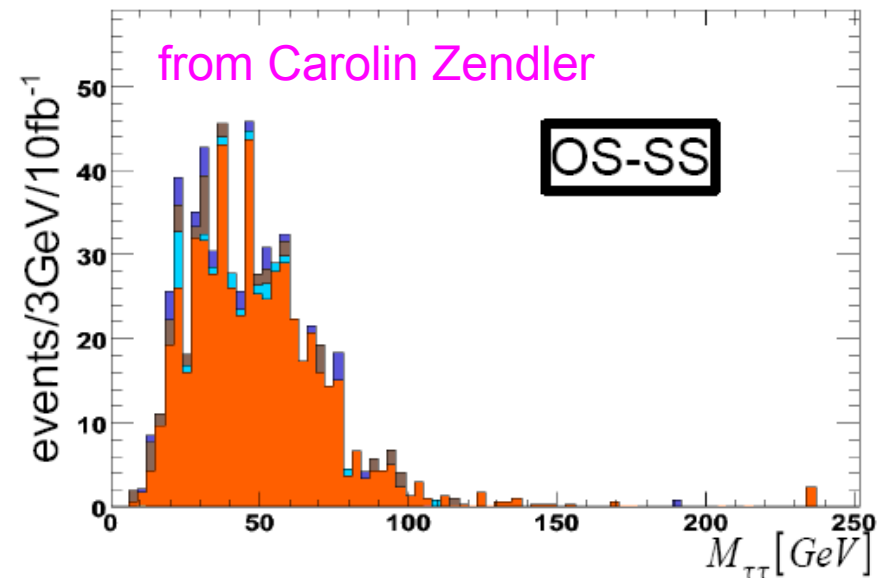


Expected impact of background

Looking at Carolin Zender's Atlfast results:

Typical SU3 cuts:

- $p_{T,miss} > 230$ GeV
- at least 4 jets: $p_T > 30$ GeV
- at least 3 jets: $p_T > 50$ GeV
- at least 1 jet: $p_T > 220$ GeV
- $\Delta R(\tau\tau) < 2$



Do not expect that background poses a problem

But: Applying background reduction cuts reduces statistics by a factor of ~ 3 to 4

→ Running out of statistics in available test sample

Summary and outlook

- Polarisation of taus from staus carries valuable information about underlying SUSY model.
- Tried ratio of charged and total visible tau energy as polarisation dependent variable.
- First results for favourable SU3 point look promising.
- Production of larger test samples with manipulated tau polarisation seems worthwhile.