

Tau tagging using impact parameter in

$H_{SUSY} \rightarrow \tau\tau$ in CMS

S. Lehti

Helsinki Institute of Physics

30.5.2002

Motivation:

$c\tau \sim 90 \mu\text{m}$ for tau leptons, can be used to identify them

Large background from W decays and QCD jets - impact parameter only due to measurement errors

Separation of tau leptons from W's efficient using the significance of the impact parameter measurement: $\sigma_{ip} = \frac{ip}{error}$. Two tau's in the event - variable combined quadratically into one variable $\sigma_{ip} = \sigma_{ip}^1 \oplus \sigma_{ip}^2$.

- Impact parameter resolution studied using CMS121, parametrized for fast simulation

- Now studying the tau impact parameter using

CMS123 + ORCA_5_4_1

- No pile-up included (yet)

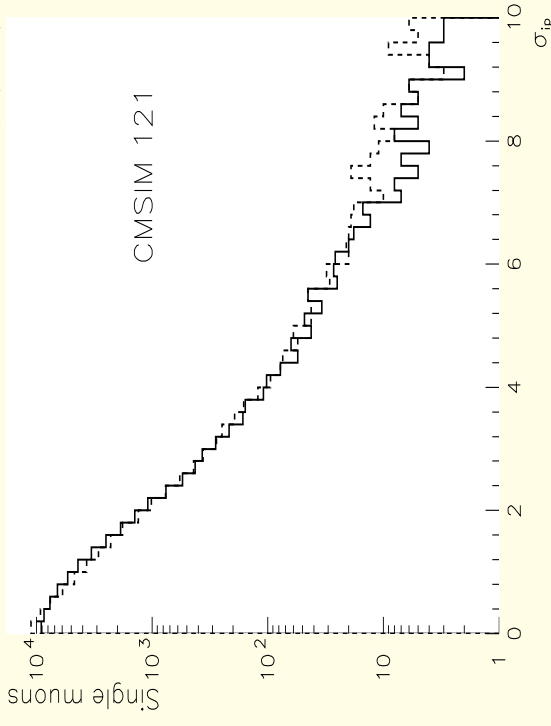
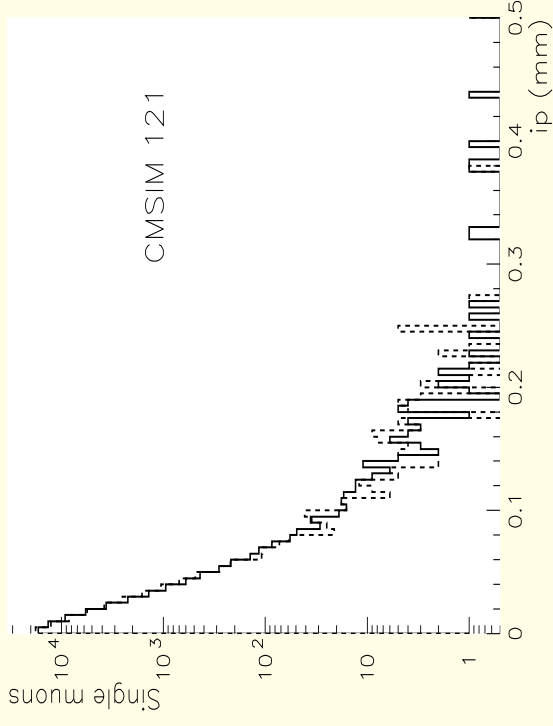
- Signal: $H \rightarrow \tau\tau \rightarrow \mu + jet(+X)$

- Background:

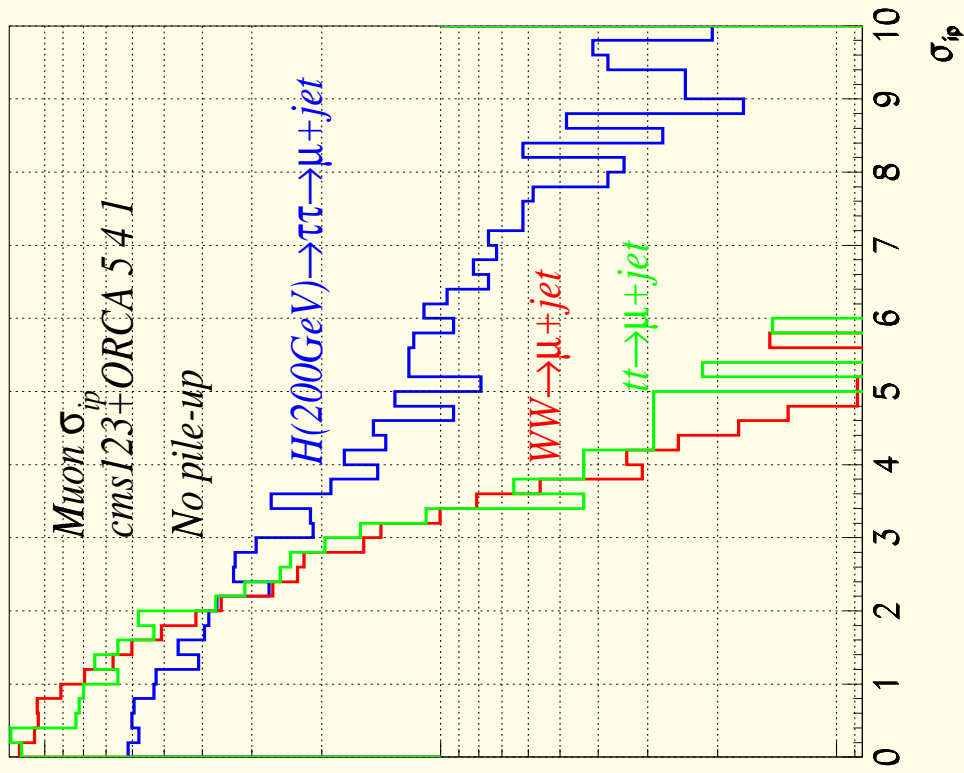
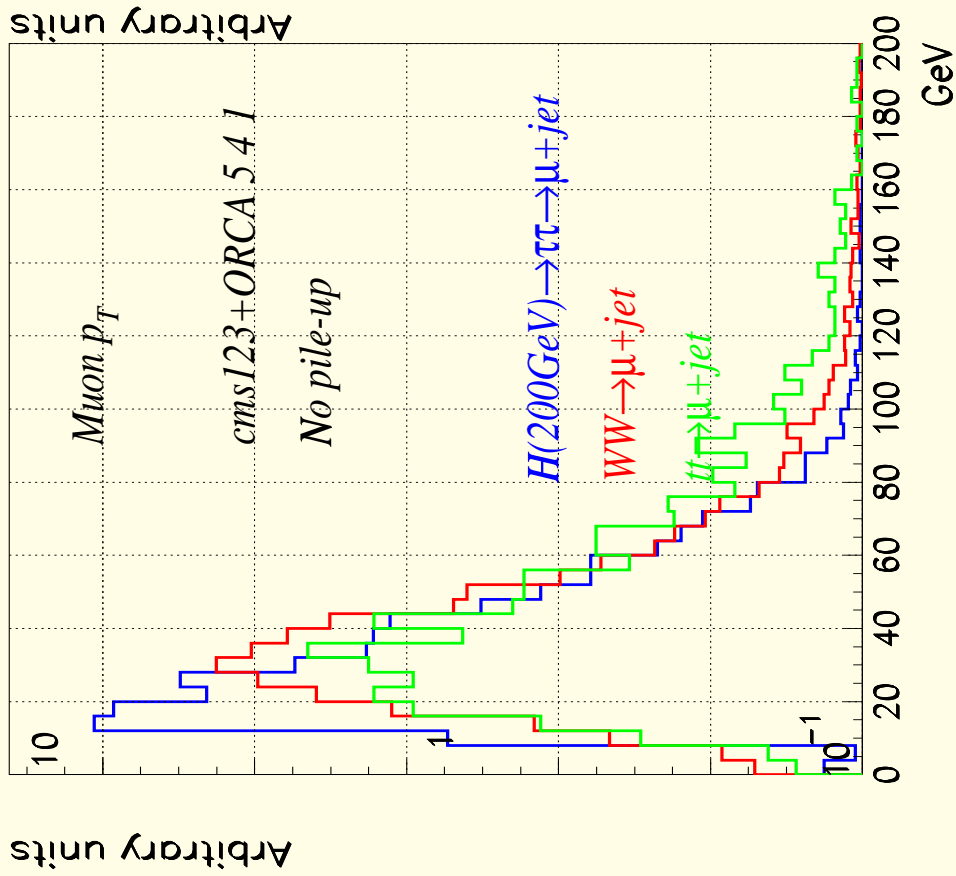
$WW \rightarrow \mu + jet(+X)$

- Small sample of

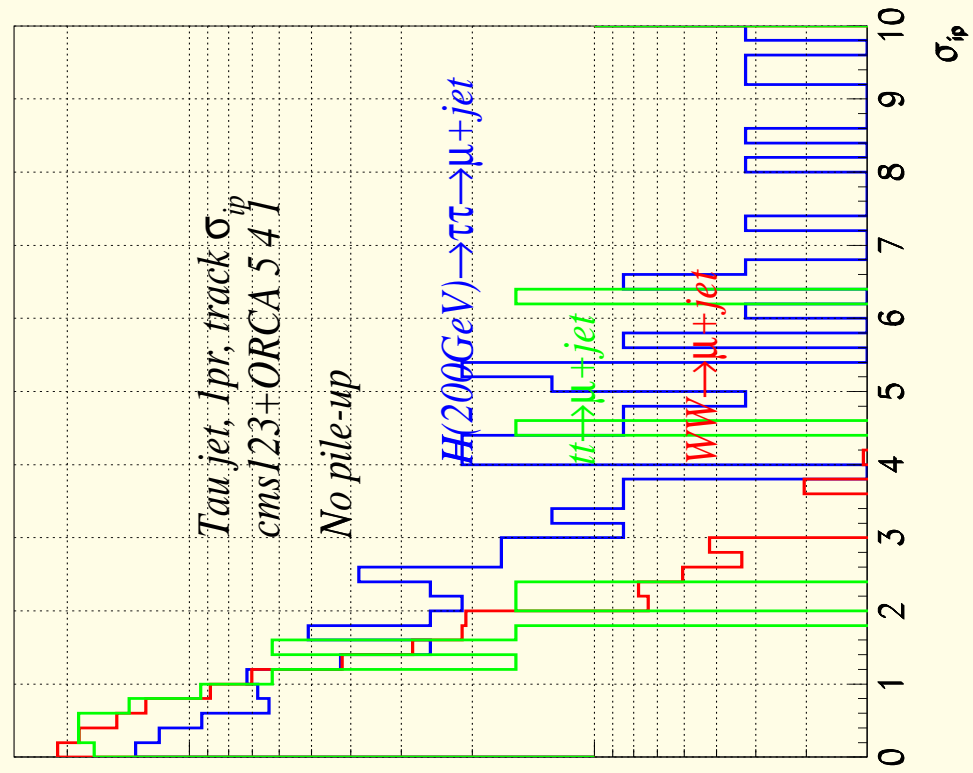
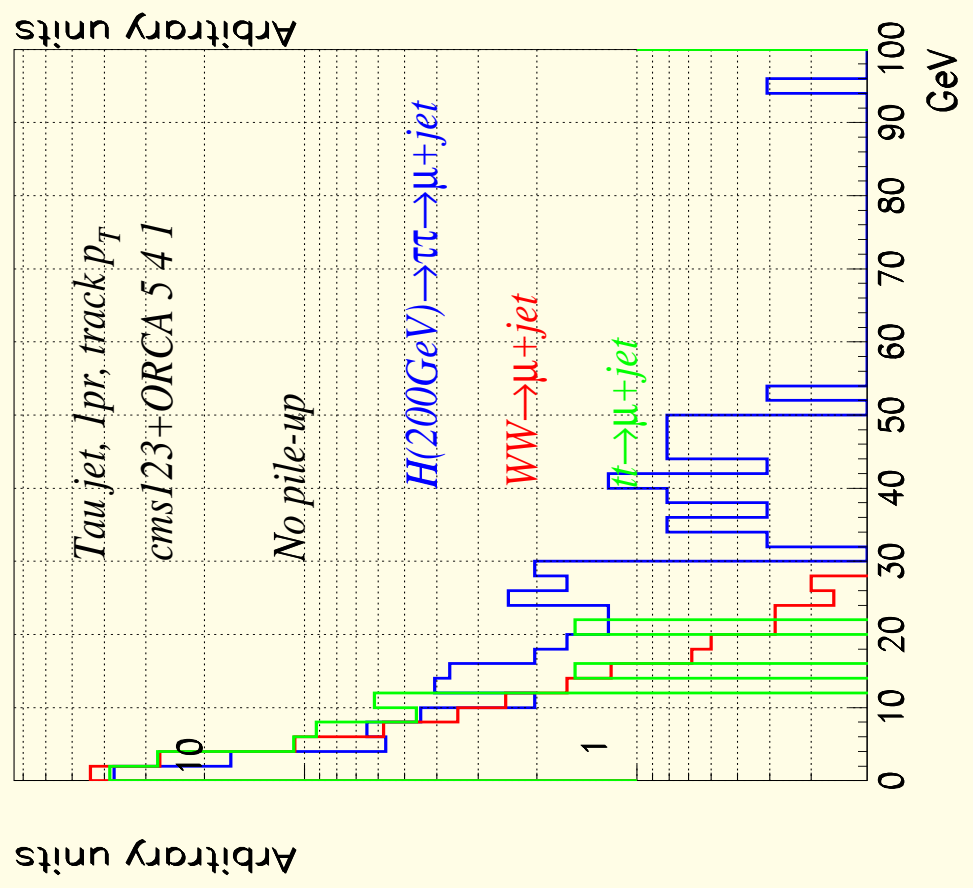
$t\bar{t} \rightarrow \mu + jet(+X)$



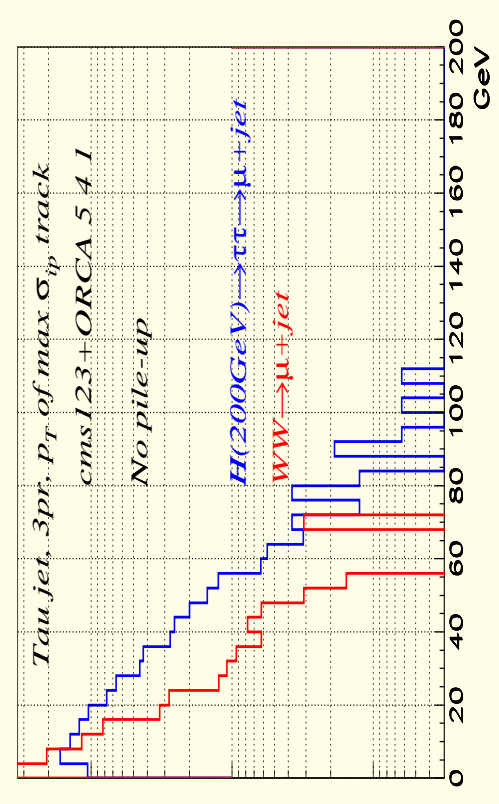
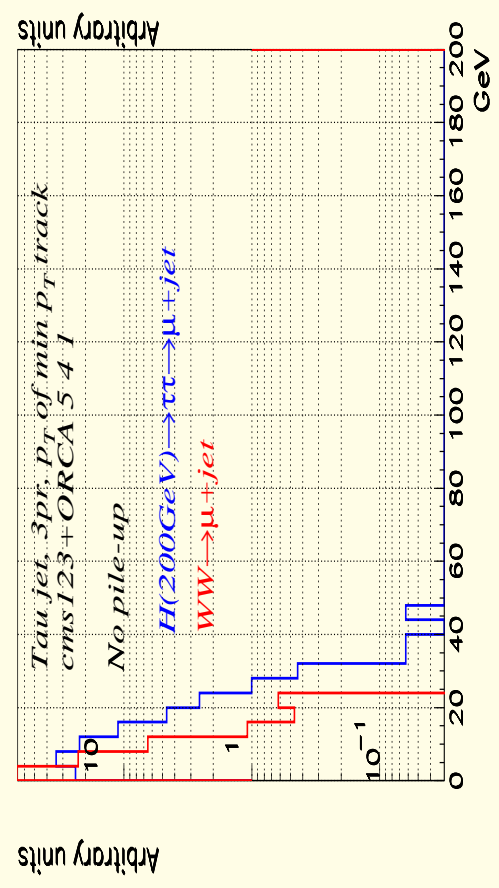
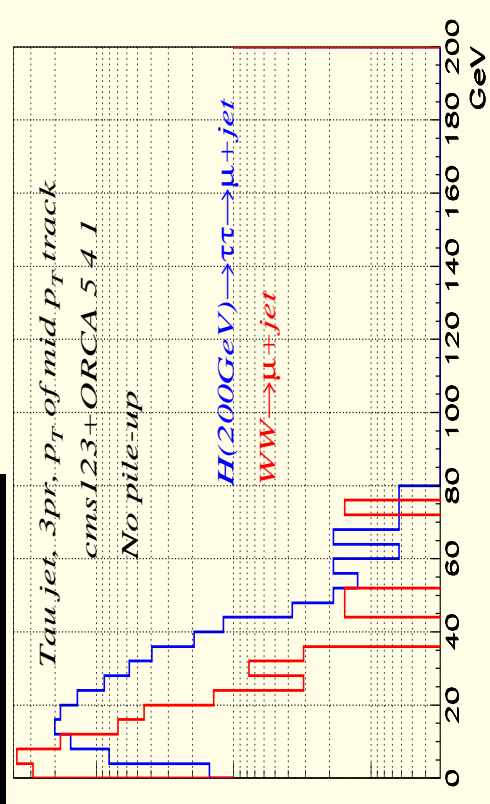
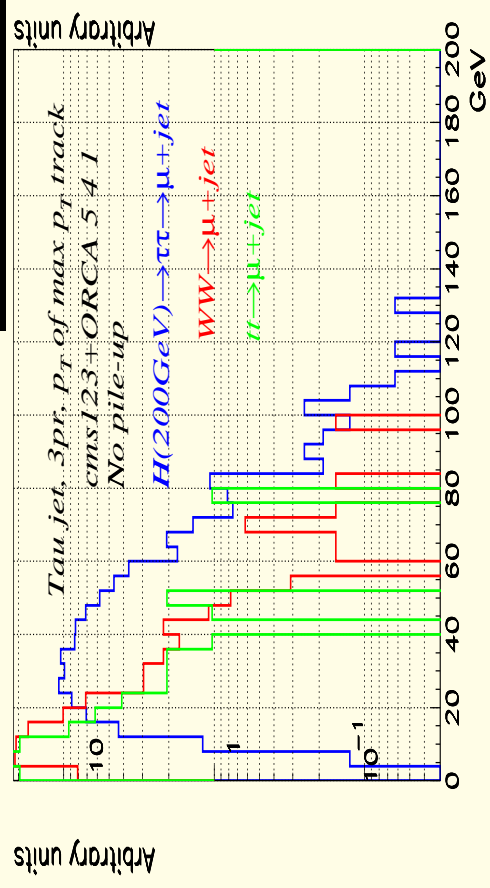
Reconstructed muons



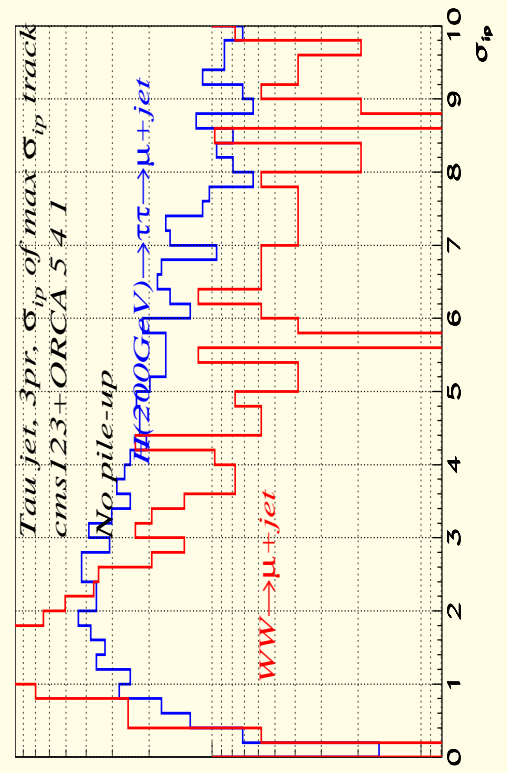
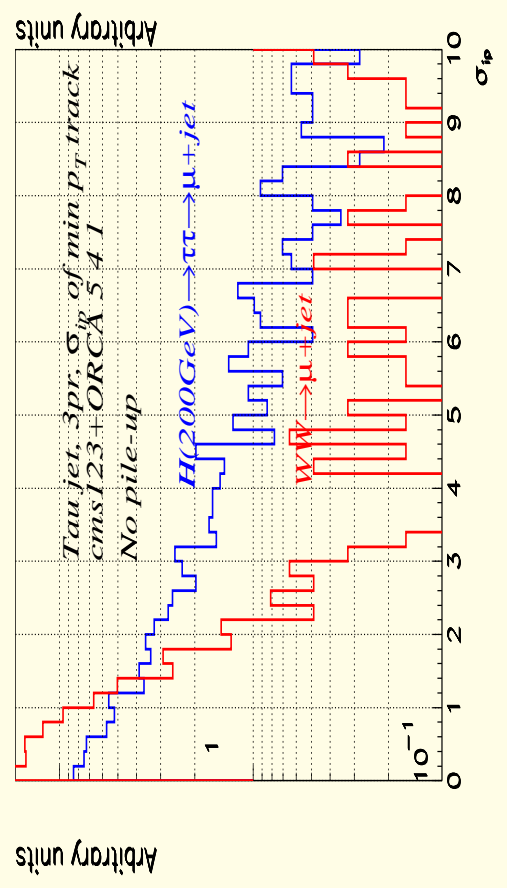
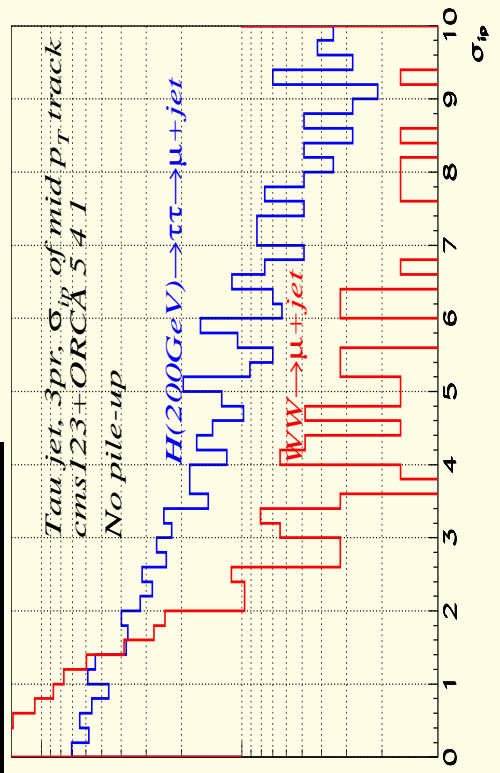
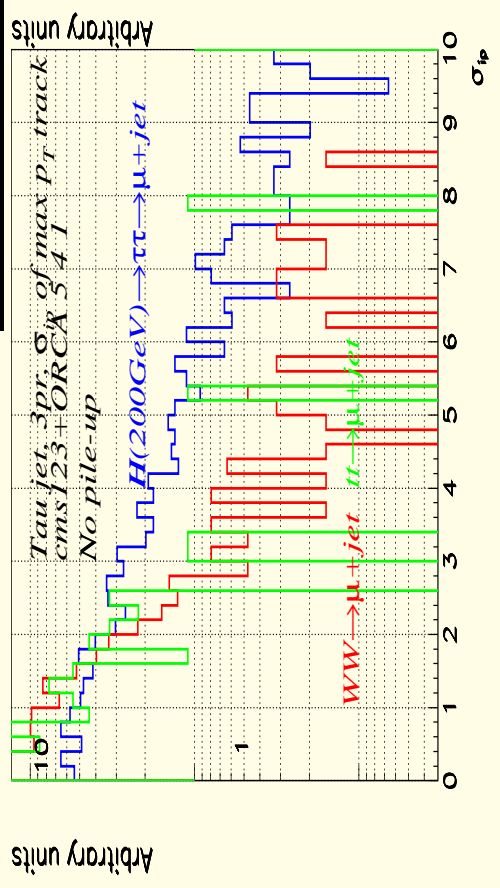
Tau jet, 1 prong



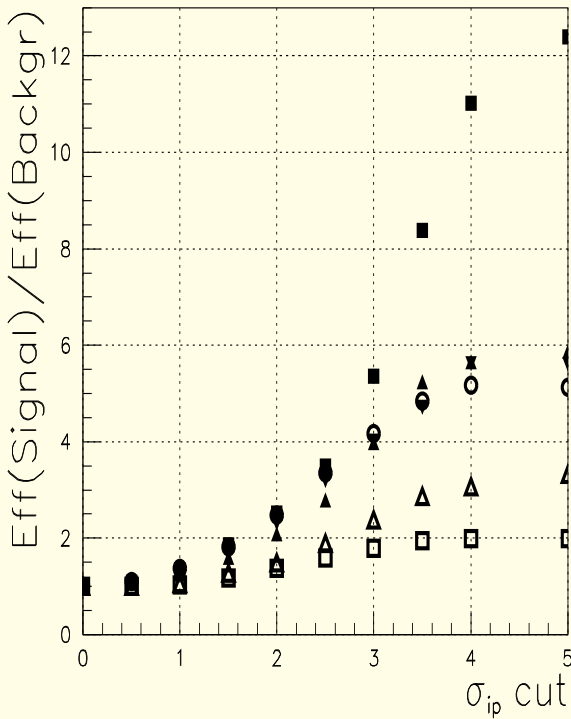
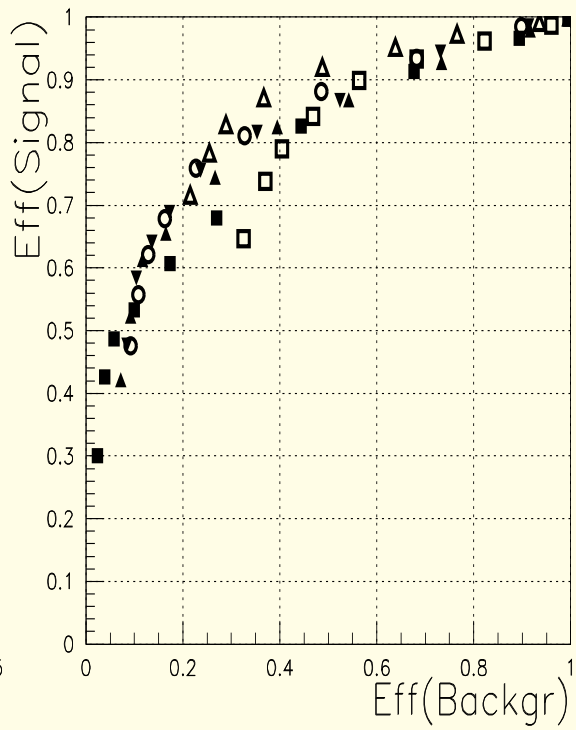
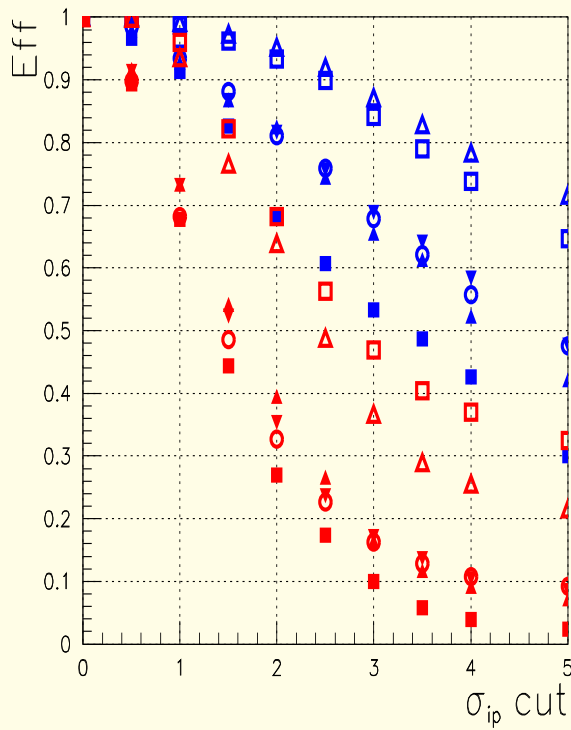
Tau jet, 3 prong, p_T



Tau jet, 3 prong, σ_{ip}



$$\sigma_{ip}^1 \oplus \sigma_{ip}^2$$



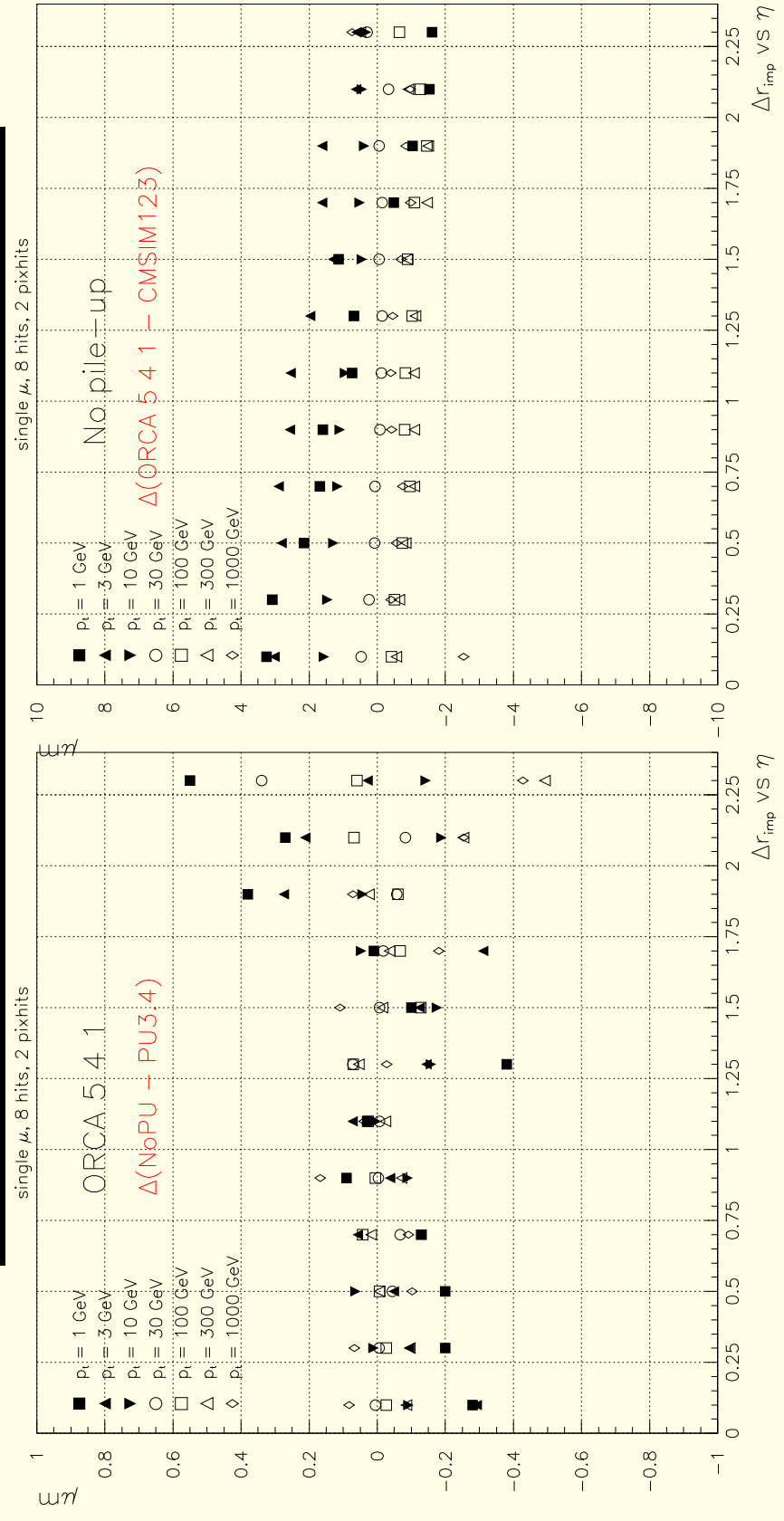
- $\sigma_{ip}(\mu) + \sigma_{ip}(1pr)$
- ▲ $\sigma_{ip}(\mu) + \sigma_{ip}(3pr, maxpt)$
- ▼ $\sigma_{ip}(\mu) + \sigma_{ip}(3pr, midpt)$
- $\sigma_{ip}(\mu) + \sigma_{ip}(3pr, minpt)$
- $\sigma_{ip}(\mu) + \sigma_{ip}(3pr, max\sigma_m)$
- △ $\sigma_{ip}(\mu) + \sigma_{ip}(tr1) + \sigma_m(tr2) + \sigma_m(tr3)$

Signal : $H(200GeV) \rightarrow \tau\tau \rightarrow \mu jet$

Backgr: $WW \rightarrow \mu jet$

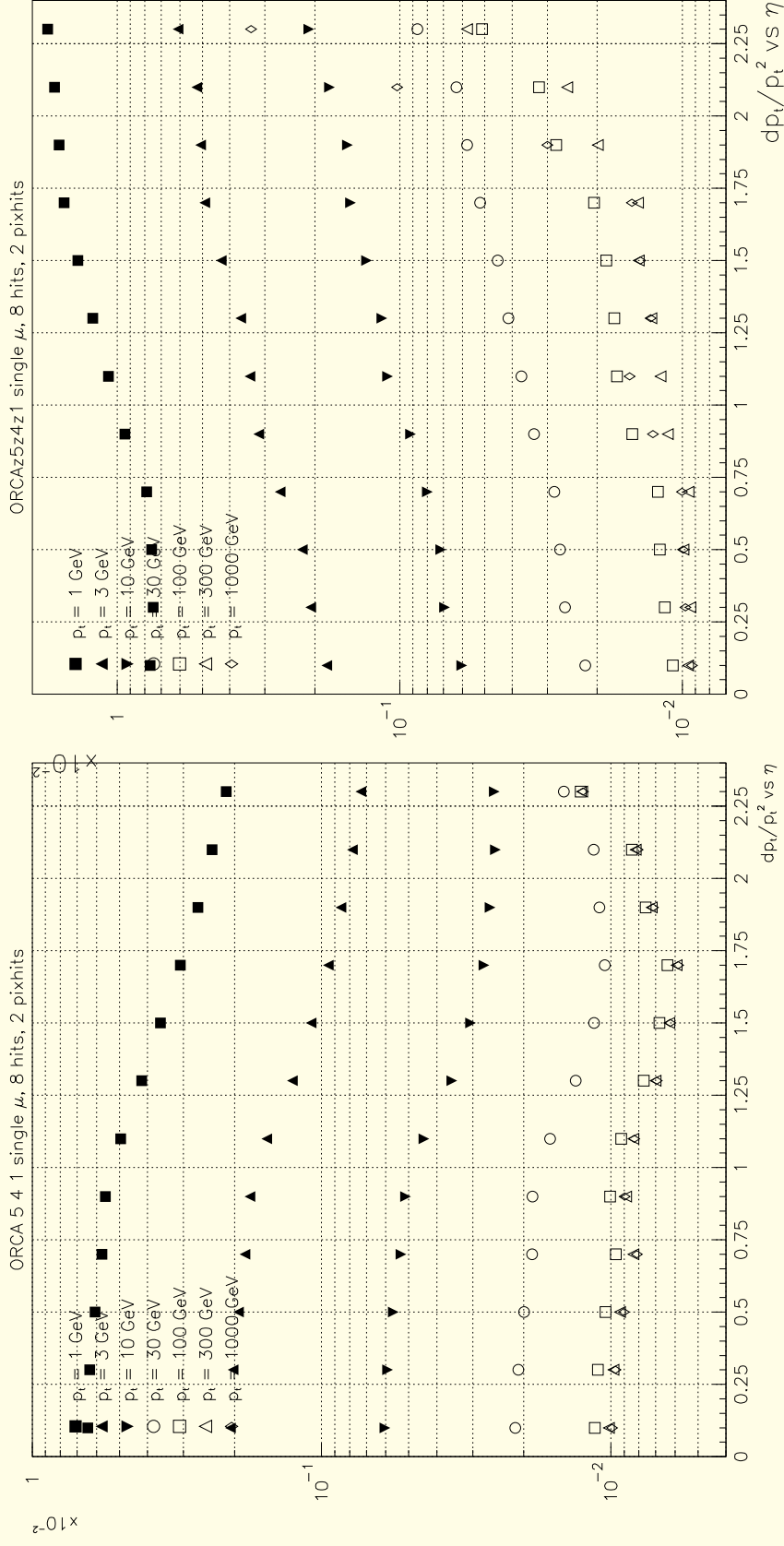
cms123 + ORCA 5 4 1

Comparing with Pile-up and CMSIM



- Single particle performance, single muons, ≥ 8 hits, ≥ 2 pix hits

ORCA k ($\sim 1/p_T$) error



- Left: `impactPointState().curvilinearError().matrix(1,1)`
- Right: `abs(pT(recTrack) - pT(simTrack)) / pT(simTrack)2`

Conclusions

- The $\tau\tau$ channels are most important in searches for the heavy neutral Higgs bosons H/A, tau tagging needed
- Tau impact parameter useful against backgrounds with no real impact parameter, like $t\bar{t}$; $Z, \gamma^* \rightarrow ll$
- Planning to update the results using the new tracker layout CMS125 + ORCA6
- Study the tails of the impact parameter distribution in detail
- Planning to include the sign of the impact parameter in tracks in tau jets
- Compare results using transverse and 3D impact parameters