

# ATLAS Position on LHC Operation Strategy in 2009

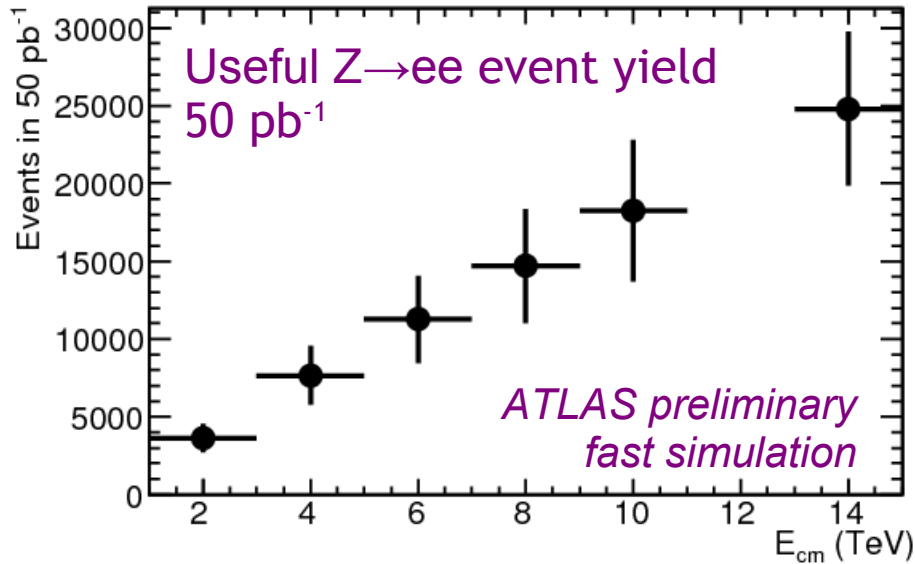
ATLAS wishes to run in 2009 with pp collisions at the highest possible centre-of-mass energy at which operation is safe

The following slides indicate the physics loss as the centre-of-mass energy falls

- $2 < E_{\text{cm}} < 14 \text{ TeV}$  - wider than the range being discussed for 2009

Cautions: analyses not reoptimised below 10 TeV  
integ. luminosity numbers refer to good data usable for analysis

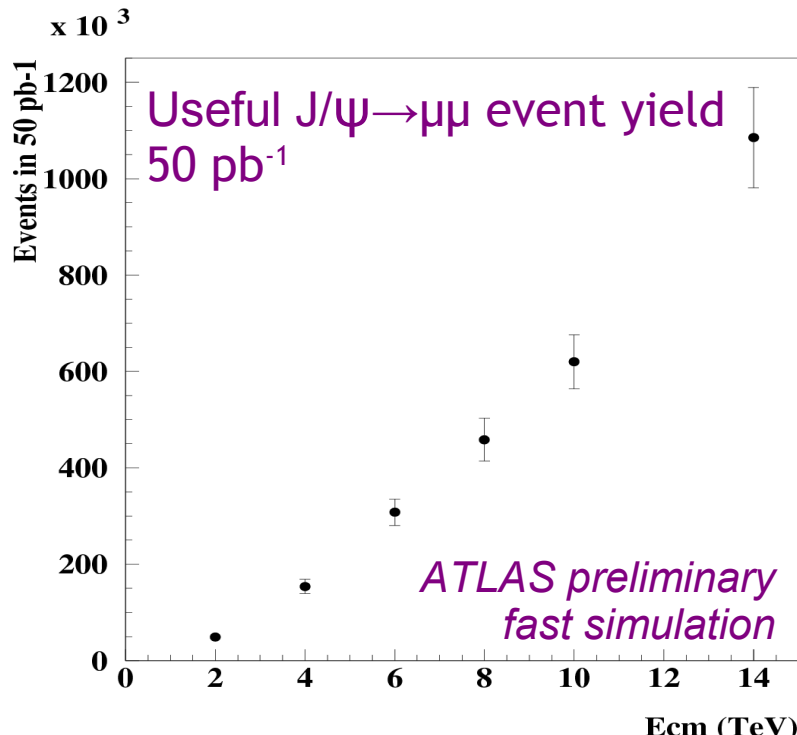
# Calibration Samples



$Z \rightarrow \ell\ell$  is a crucial calibration channel

EM calo. inter-calibration ( $0.2 \times 0.4$  in  $\eta$ - $\phi$ )  
to 0.7%(stat) with 25k  $Z \rightarrow ee$  decays,  
scales with  $1/\sqrt{N}$

20k  $Z \rightarrow \mu\mu$  events test the  $p$  scale,  
alignment and  $E$ -loss corrections, for  
muon system to  $<1\%$



$J/\psi \rightarrow \mu\mu$  and  $ee$  are also important for  
early understanding of detector  
e.g. detailed alignment studies

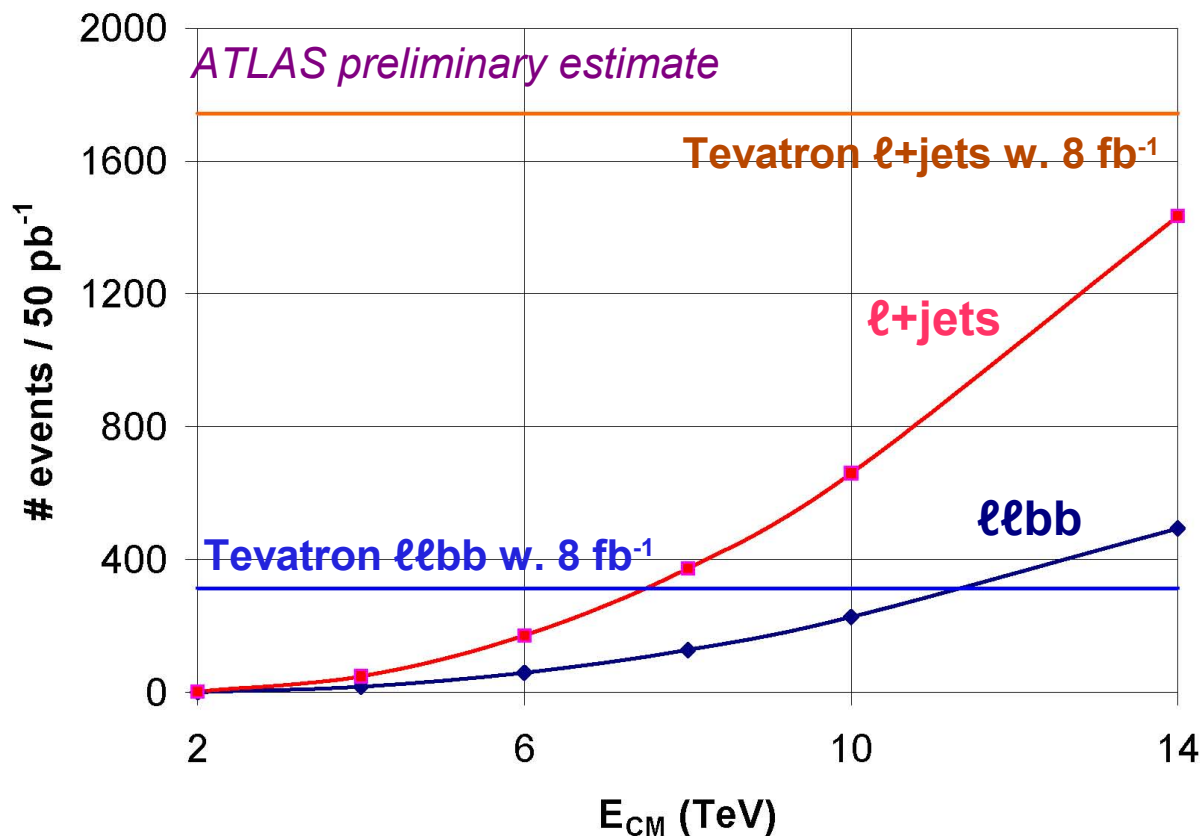
Plot shows  $J/\psi \rightarrow \mu\mu$  yield within fiducial  
acceptance  
 $p_{\text{T}}(\mu_1) > 6 \text{ GeV}$ ,  $p_{\text{T}}(\mu_2) > 4 \text{ GeV}$ ,  $|\eta(\mu)| < 2.5$

# Top Quarks

Background to new physics searches - must measure cross-section & properties in data

Expected Tevatron statistics provide a benchmark:

- Cross-section statistical precision will then be comparable to other uncertainties
- High-precision top physics will be underway



~50  $\text{pb}^{-1}$  @ 14 TeV would match full Tevatron sample

- lose ~factor 2 in cross-section dropping to 10 TeV
- lose ~another factor 2 dropping to 8 TeV

Below 8 TeV samples will be rather small, with a few tens of  $\text{pb}^{-1}$

# Z' or W' Resonance

Z': Heavy partner of the Z (SSM)  
Very clean experimental signal:  $Z' \rightarrow \ell\ell$

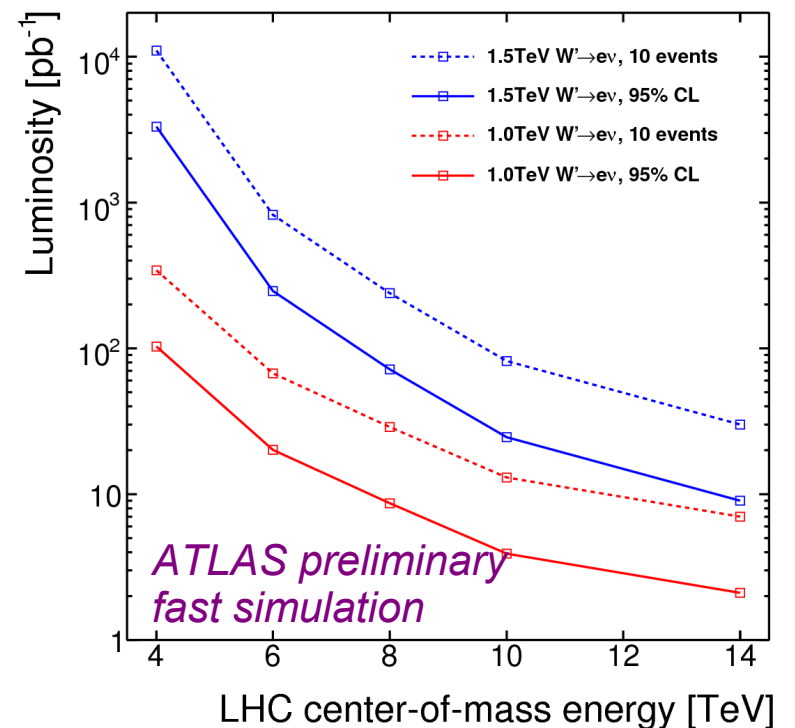
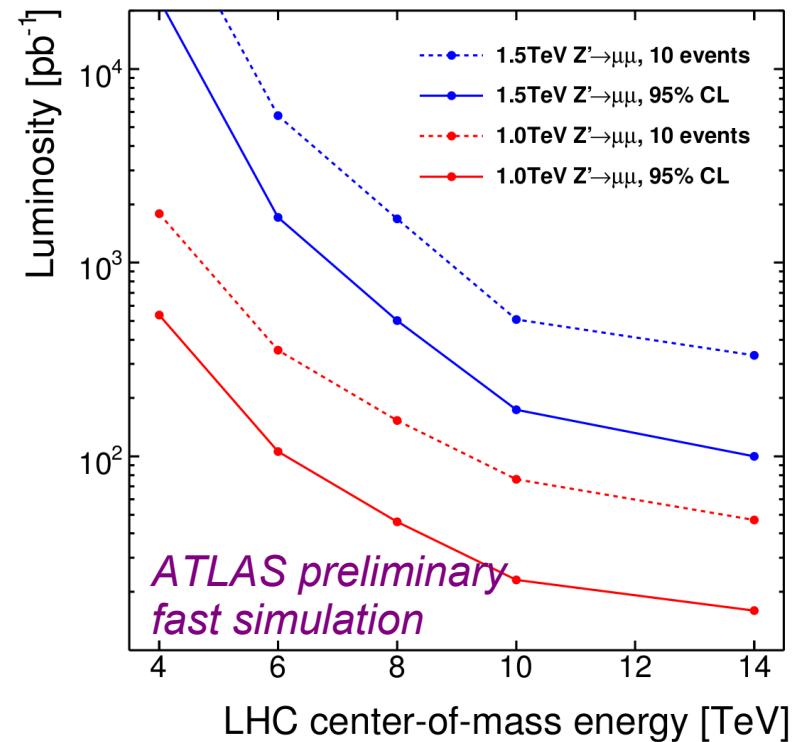
Tevatron 95% CL limit at  $m=1$  TeV

Discovery (10 events,  $>5\sigma$ ) just above,  
with  $100 \text{ pb}^{-1}$ , possible at  $E_{\text{cm}}=10$  TeV

W':  
Tevatron 95% CL limit also at  $m=1$  TeV

Discovery (10 events,  $>5\sigma$ ) at  $m=1$   
TeV, possible with  $\sim 20 \text{ pb}^{-1}$  at 10 TeV

We will be sensitive to the region just  
beyond the Tevatron reach, where  
they might accumulate hints of a  
signal in 2009/10



# Supersymmetry

l+jets+missing- $E_T$  channel

- Not most sensitive, but will be usable before inclusive jets+missing- $E_T$  analysis

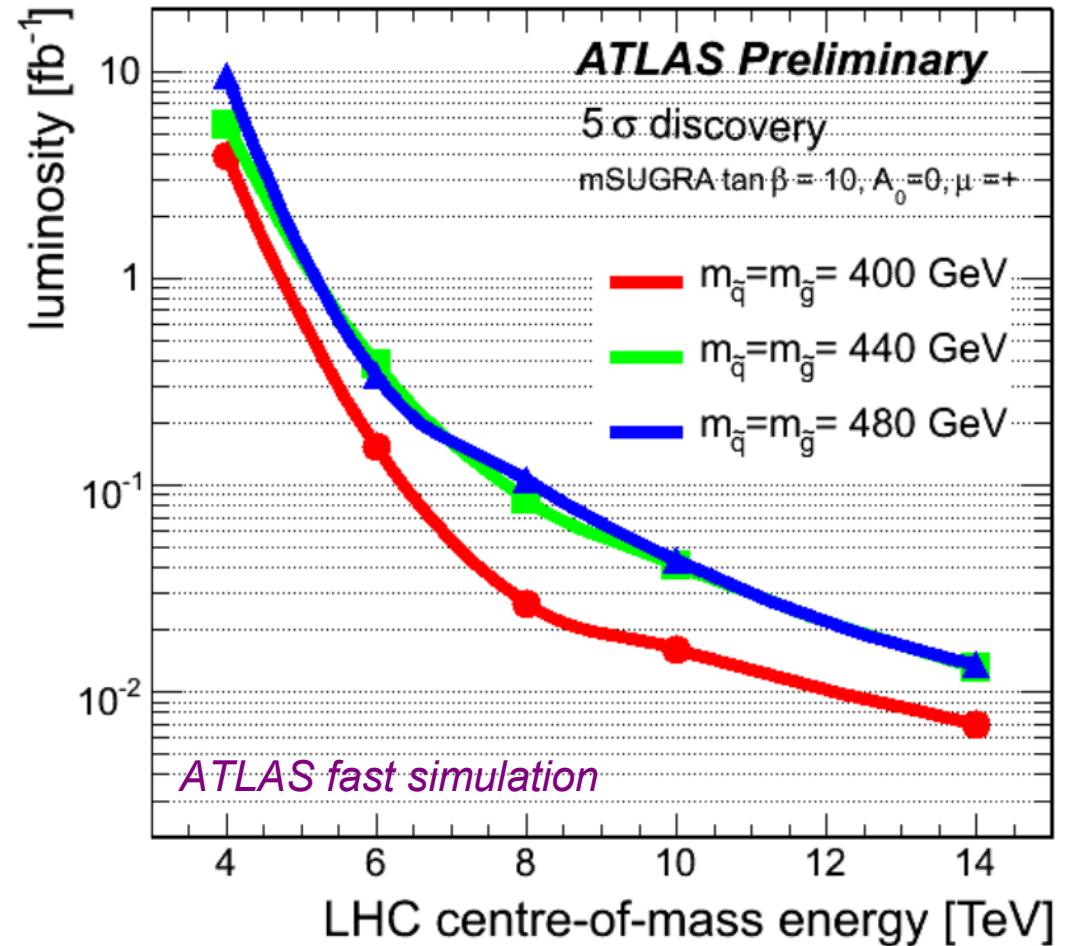
Tevatron limit currently is 380 GeV in this model ( $m_{\tilde{q}}=m_{\tilde{g}}$ )

- plot shows 3 masses above this

$5\sigma$  discovery beyond current Tevatron limits possible with  $\sim 20 \text{ pb}^{-1}$  at 10 TeV

Again we will be sensitive to the region just beyond the Tevatron reach, where they might accumulate hints of a signal in 2009/10

Below  $E_{\text{cm}} \approx 8 \text{ TeV}$ , the sensitivity collapses



# Standard Model Higgs

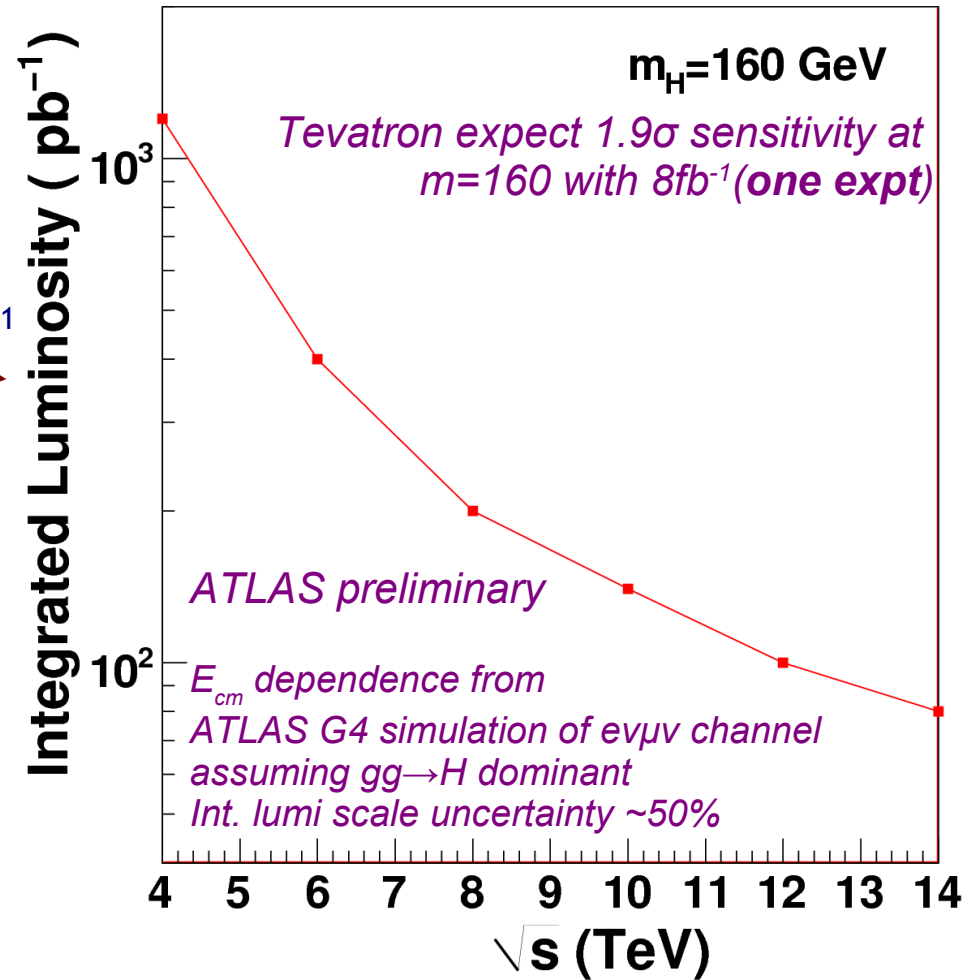
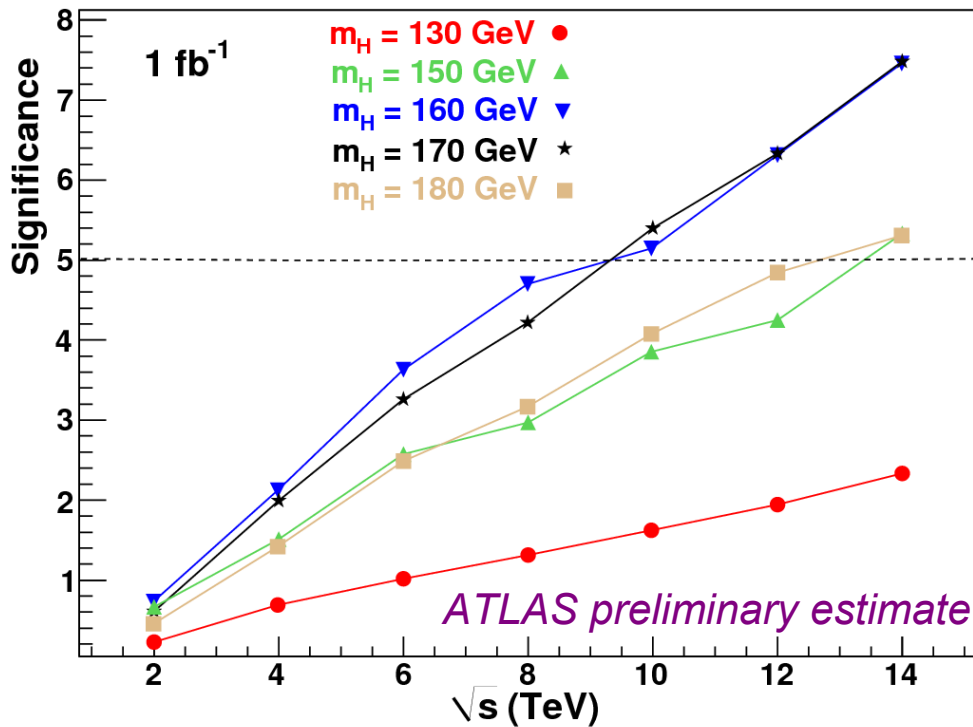
$H \rightarrow WW \rightarrow \ell\nu\ell\nu$  only

Compare sensitivity to Tevatron with  $8 \text{ fb}^{-1}$

To match Tevatron with  $E_{\text{cm}}$  of 10 TeV, need 100-200  $\text{pb}^{-1}$

Massive loss of sensitivity below 6 TeV

Combination of 0j and 2j, H to WW to ll



With  $1 \text{ fb}^{-1}$ ,  $5\sigma$  discovery reach opens, provided  $E_{\text{cm}}$  above 8 TeV

# Summary

ATLAS wishes to run in 2009 with pp collisions at the highest possible centre-of-mass energy at which operation is safe

We would consider  $E_{\text{cm}} \leq 6$  TeV to be an engineering run

Good discovery reach opens up with a few 10's of  $\text{pb}^{-1}$  at 8 TeV or higher

- Higher is always better
- Typical equivalence for 8-10 TeV: factor  $\sim 2$  in luminosity for 2 TeV in  $E_{\text{cm}}$

To beat the Tevatron on the Higgs/Z'/W'/SUSY, it is important to

- get as close to 10 TeV - or higher - as possible
- several 10's to 100-200  $\text{pb}^{-1}$  of integrated luminosity
- SM Higgs is hardest:  $\sim$  match Tevatron with 100-200  $\text{pb}^{-1}$

Cautions: analyses not reoptimised below 10 TeV  
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