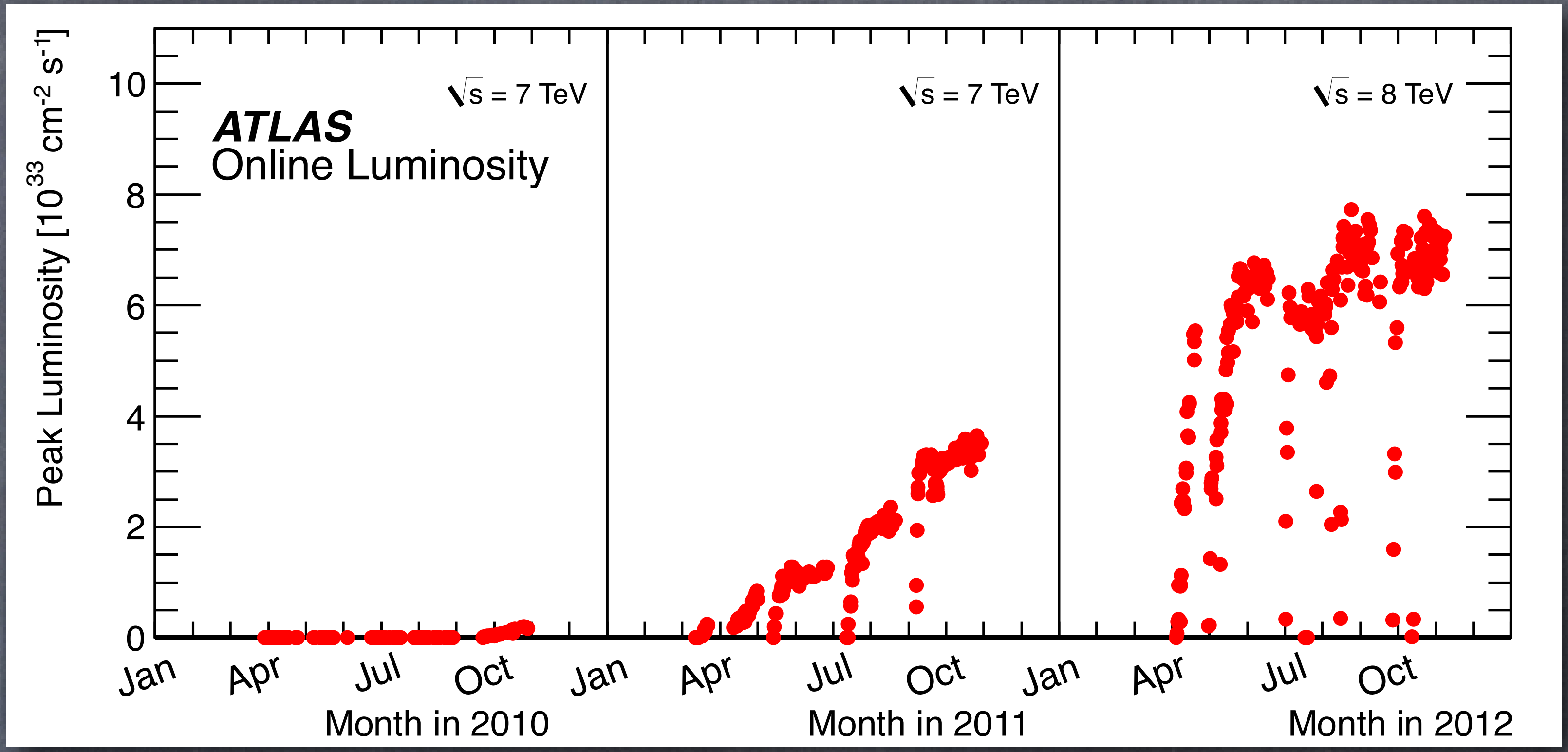
Discovery Center: ATLAS Physics

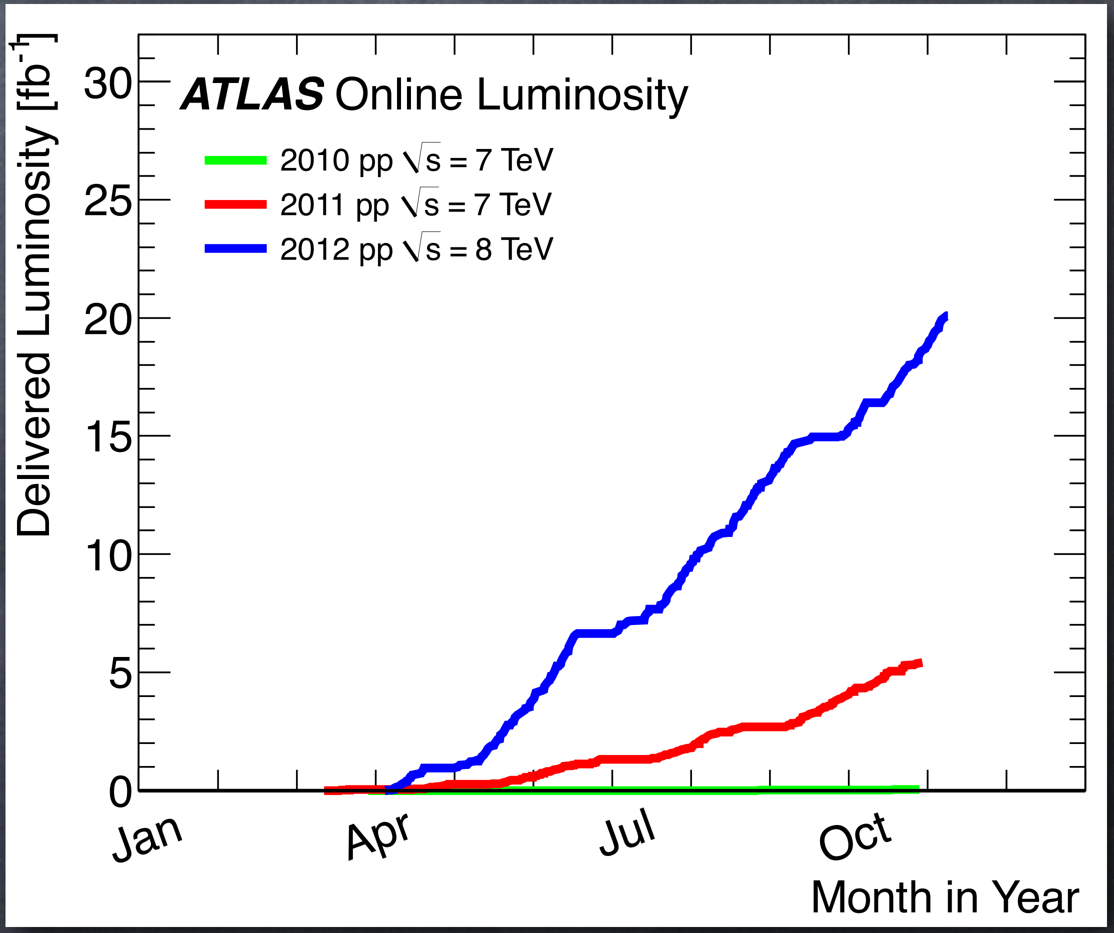
Mogens Dam

LHC Performing very well

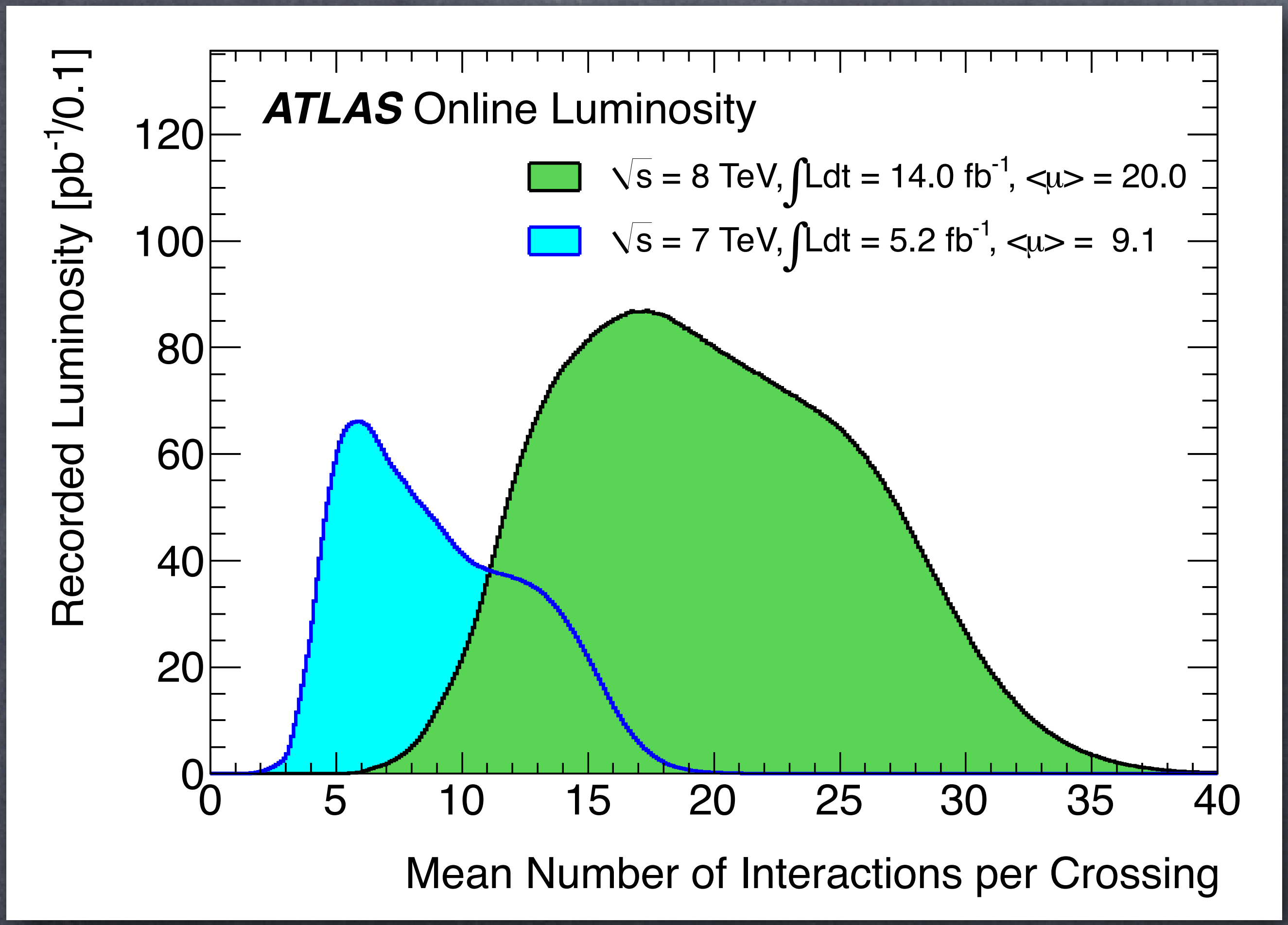
Rapidly approaching design luminosity of 10^{34}



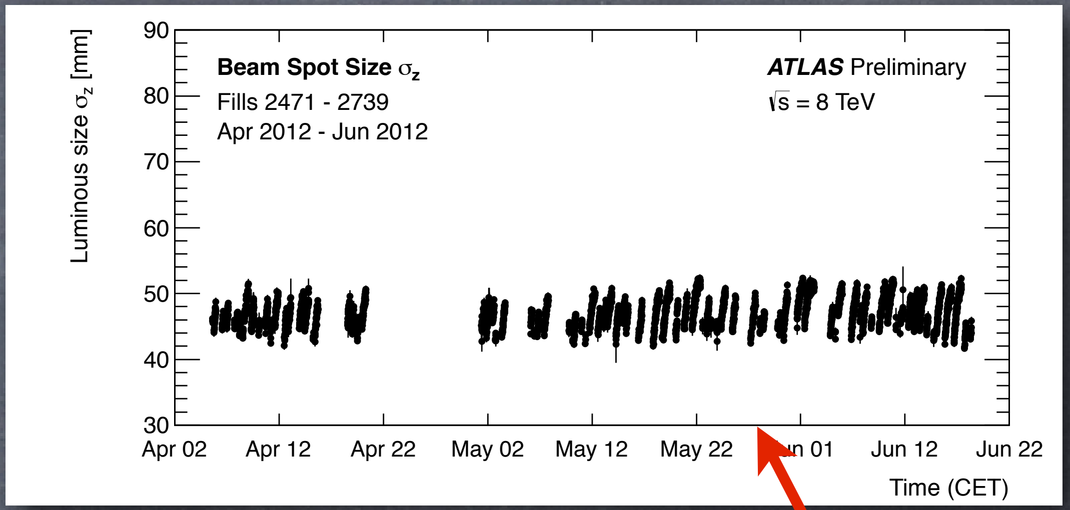
Running until Xmas: Will have about 5 + 25 = 30fb^{-1}. Then shutdown until 2015

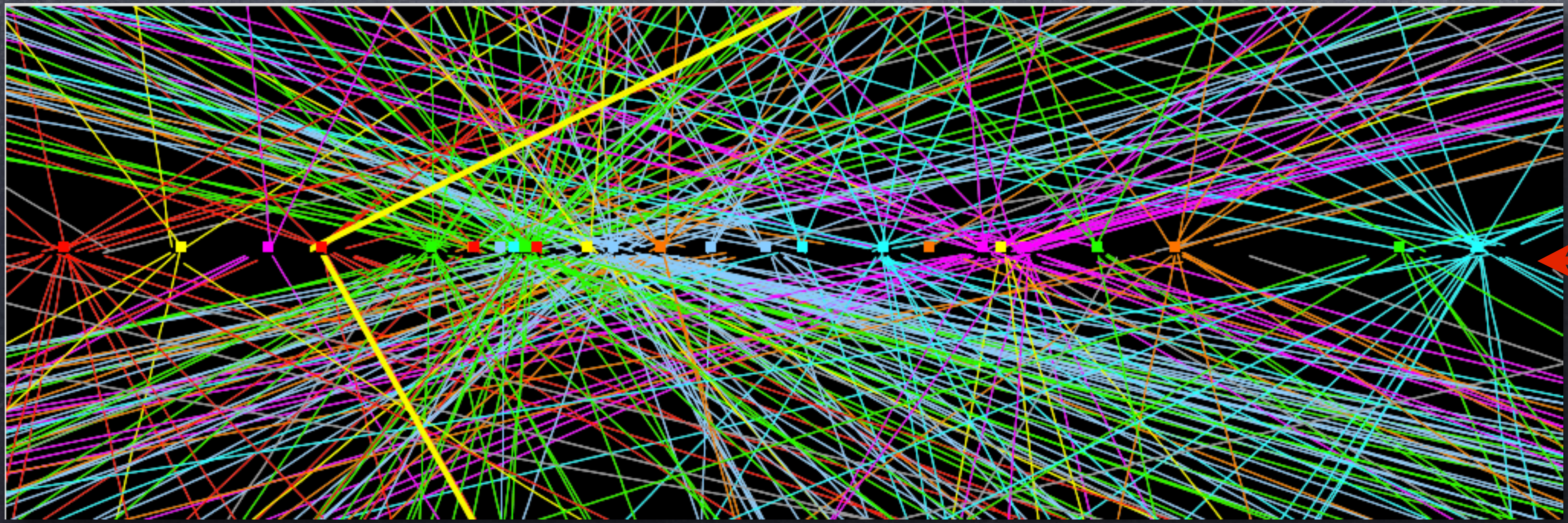


Multiple pp interactions per X'ing



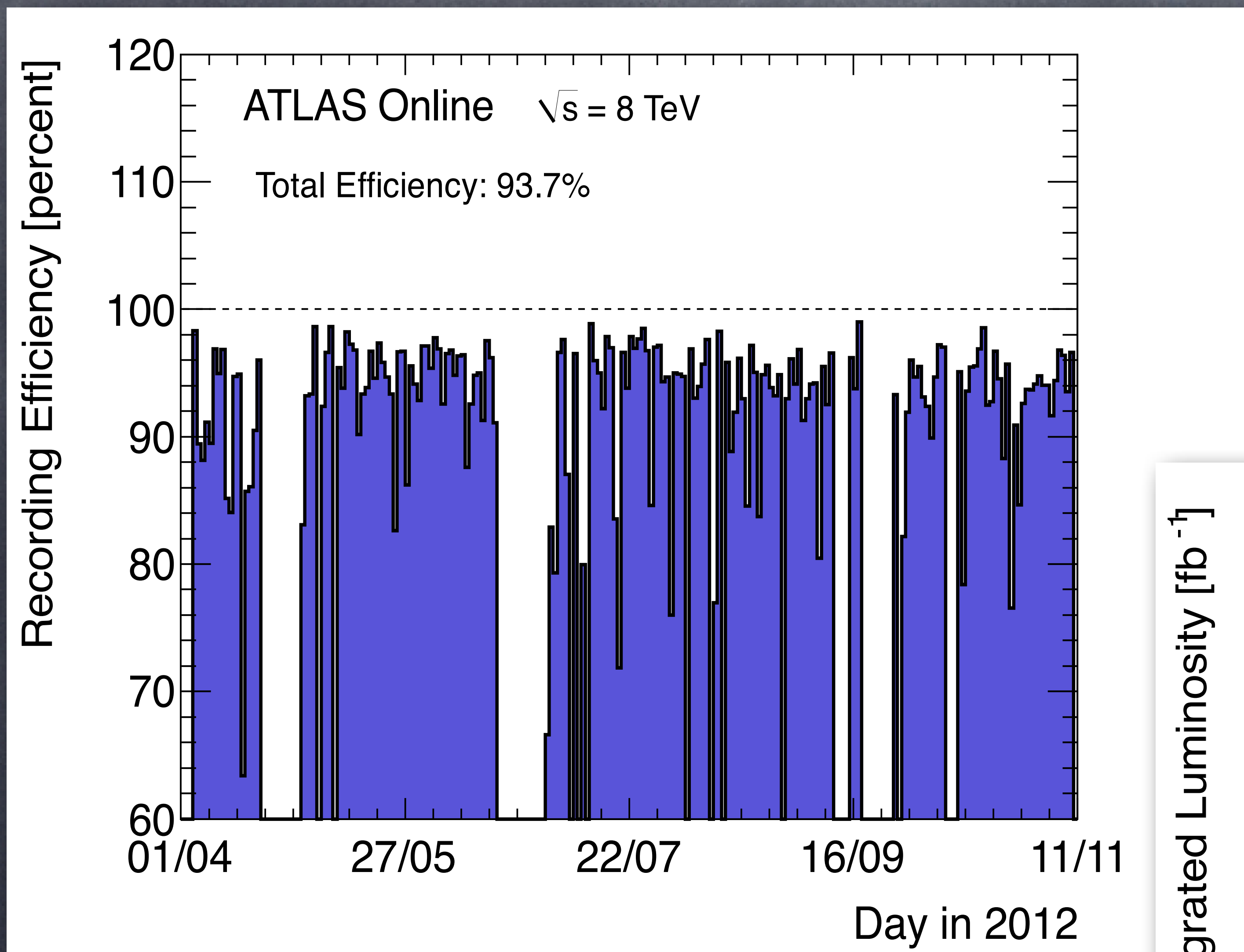
Running at 50 ns instead of 25 ns => Two times more interactions per BX

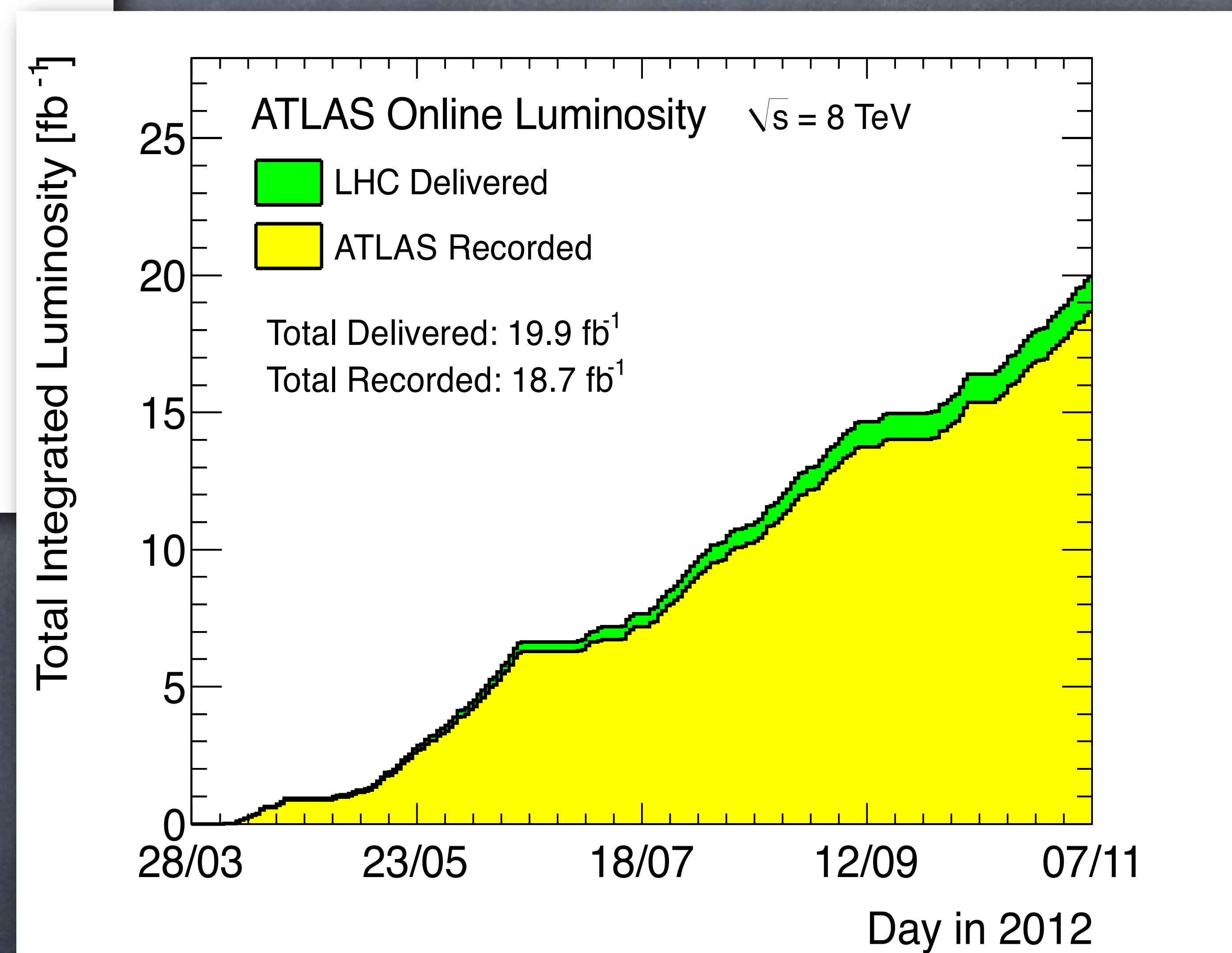




20-30 vertices over 45 mm

ATLAS recording efficiency high

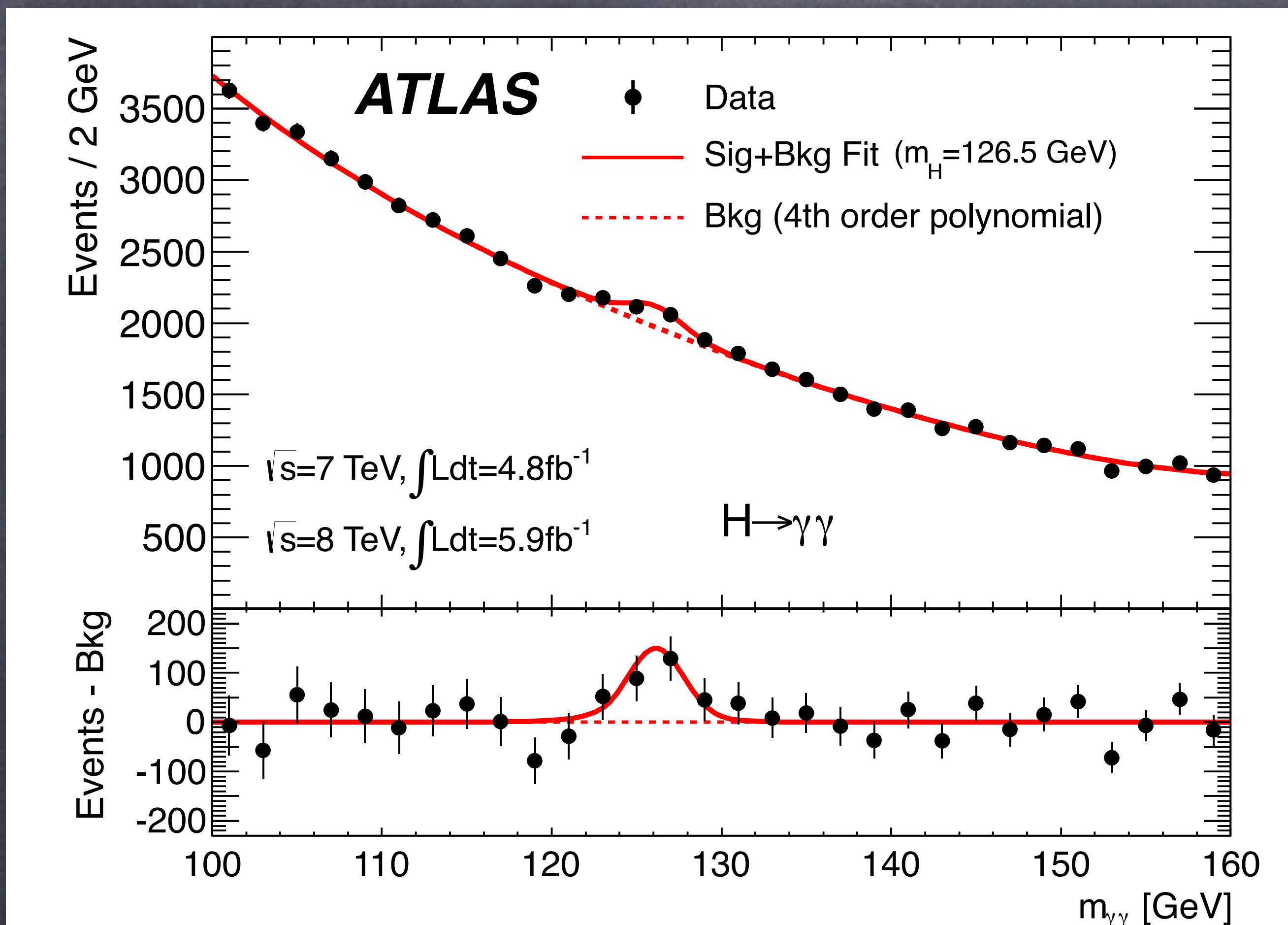


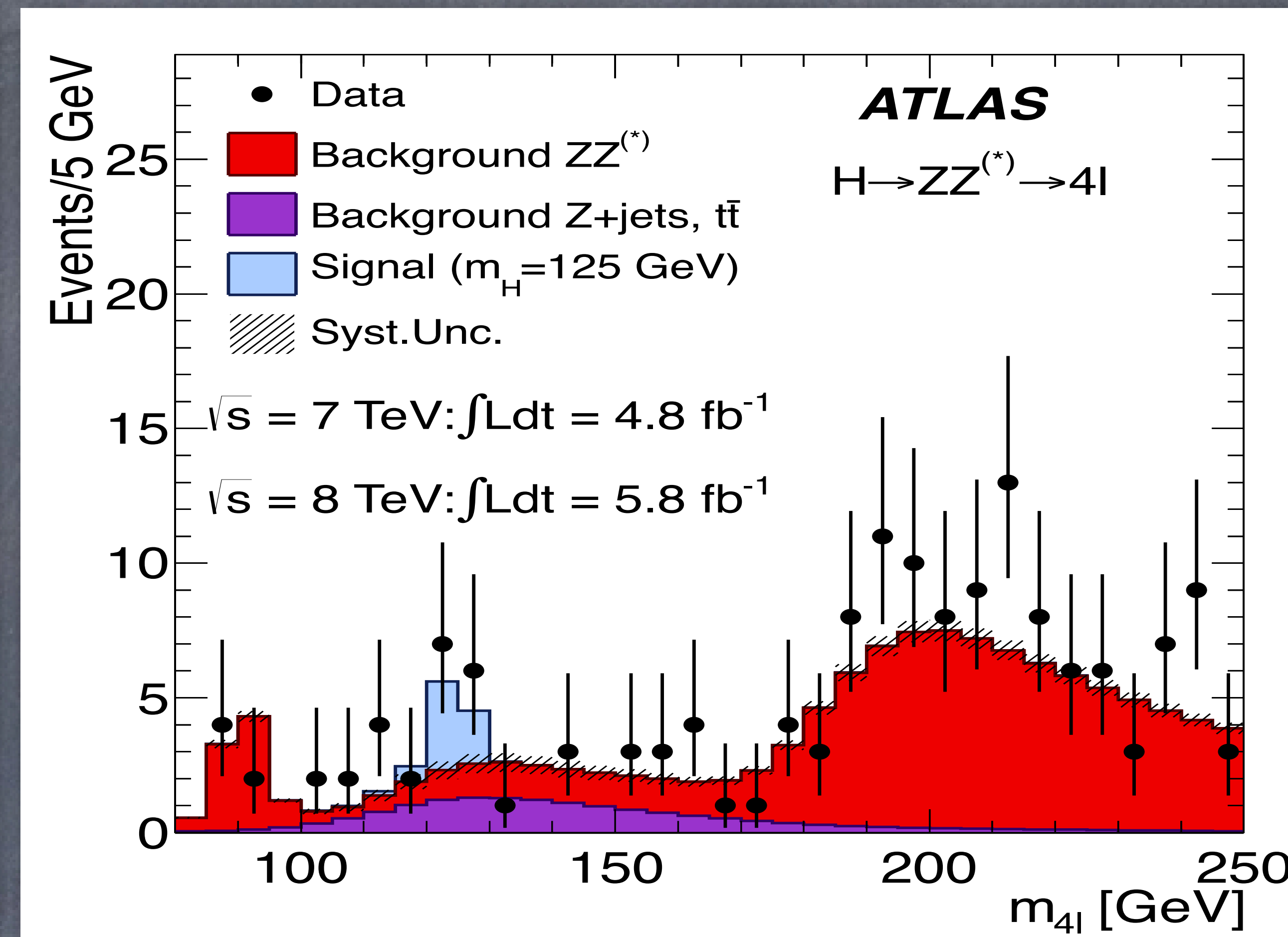


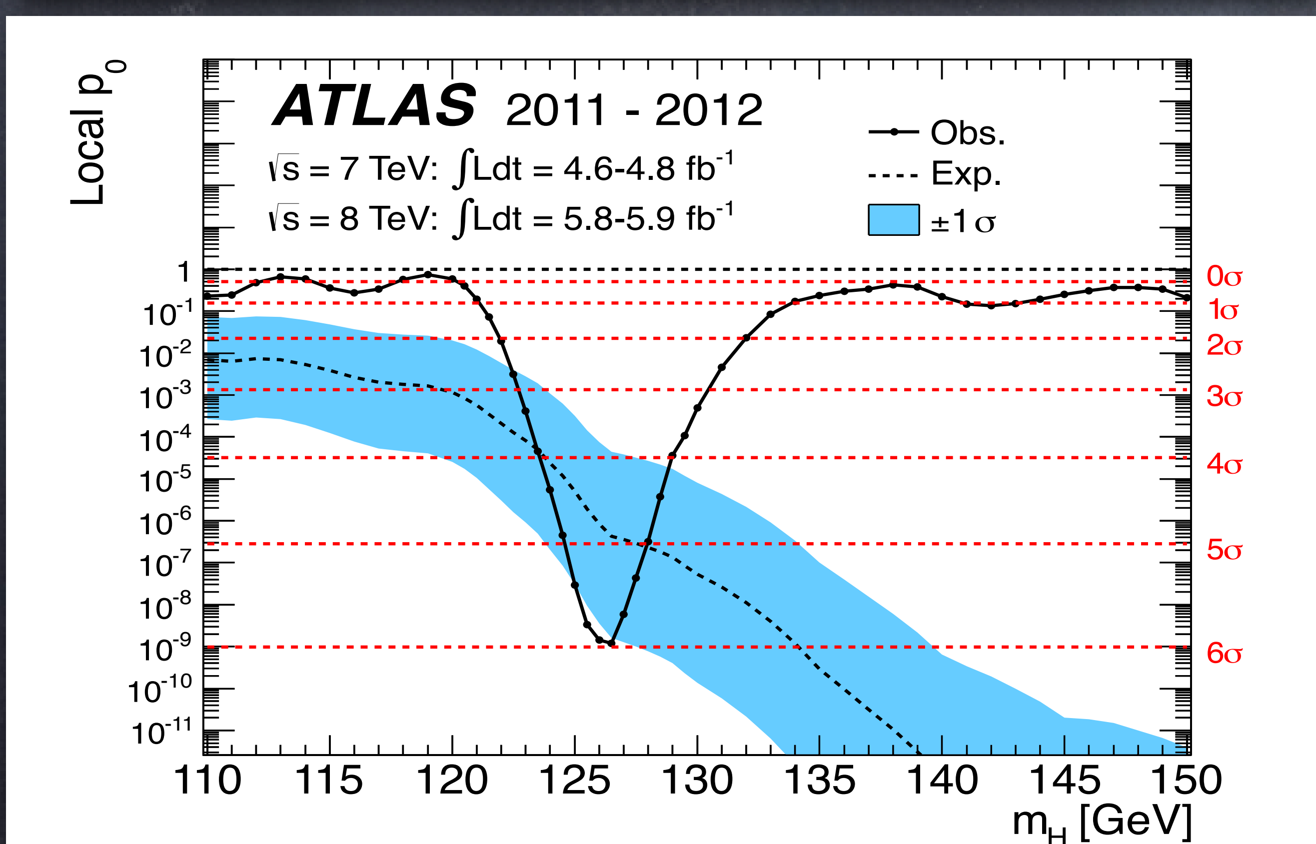
ATLAS operation etc.:
- Essential part of ATLAS programme!
- 670 man year per year.
- About 25% of every ATLAS members time.

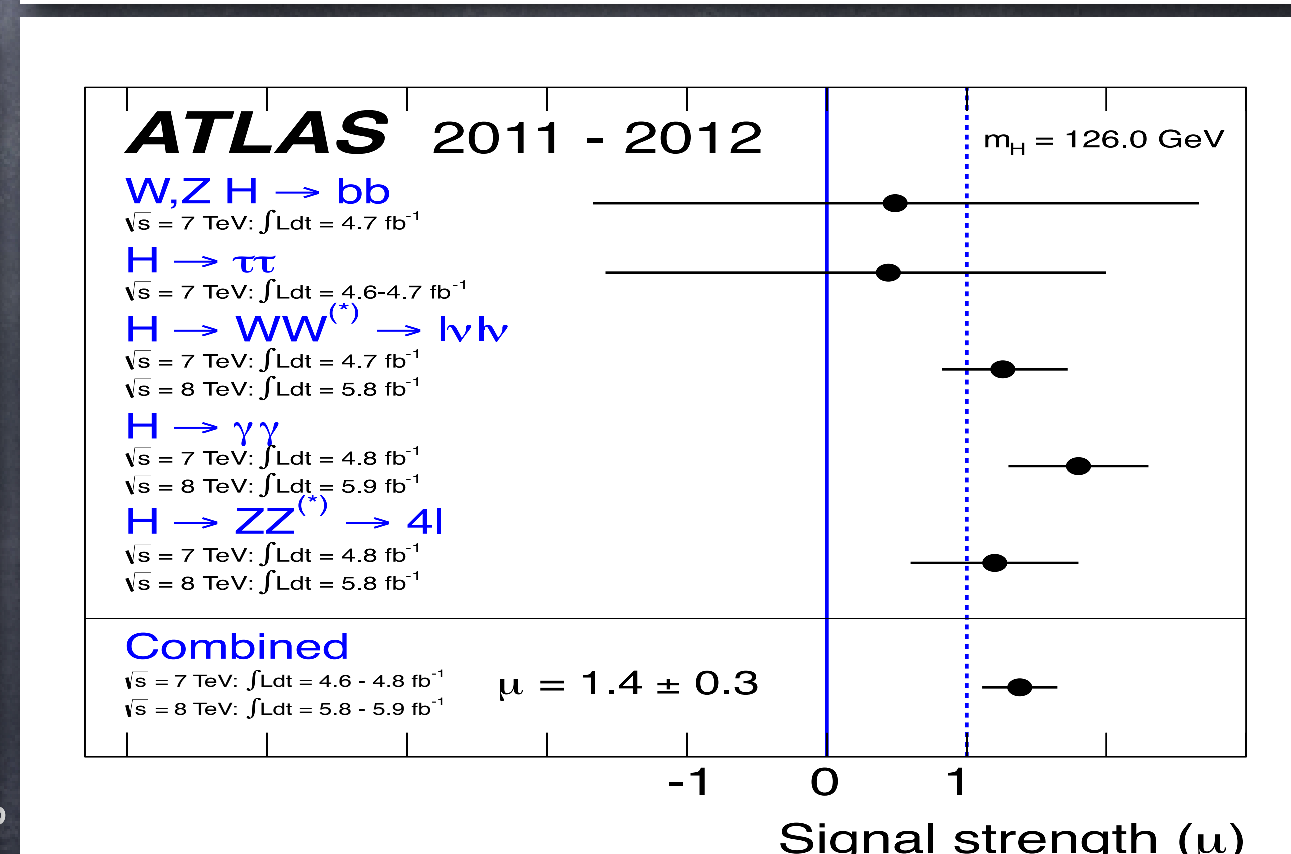
SM Higgs @ 125 GeV (?)

Higgs Discovery



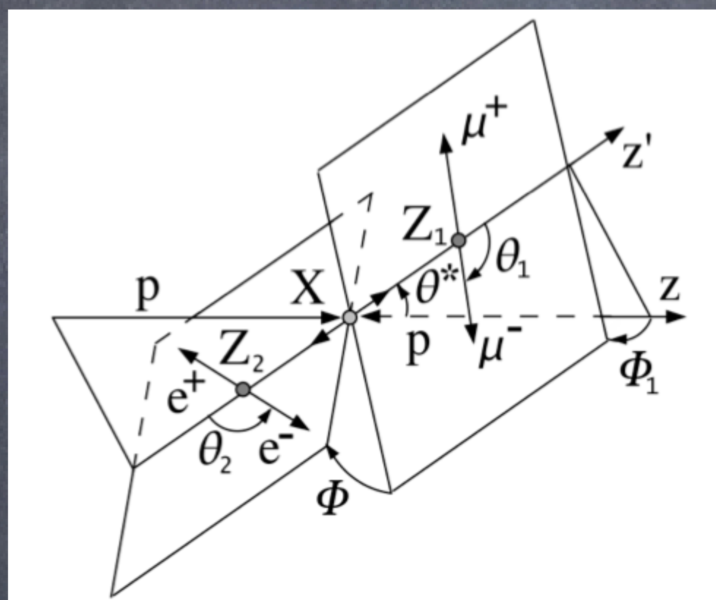


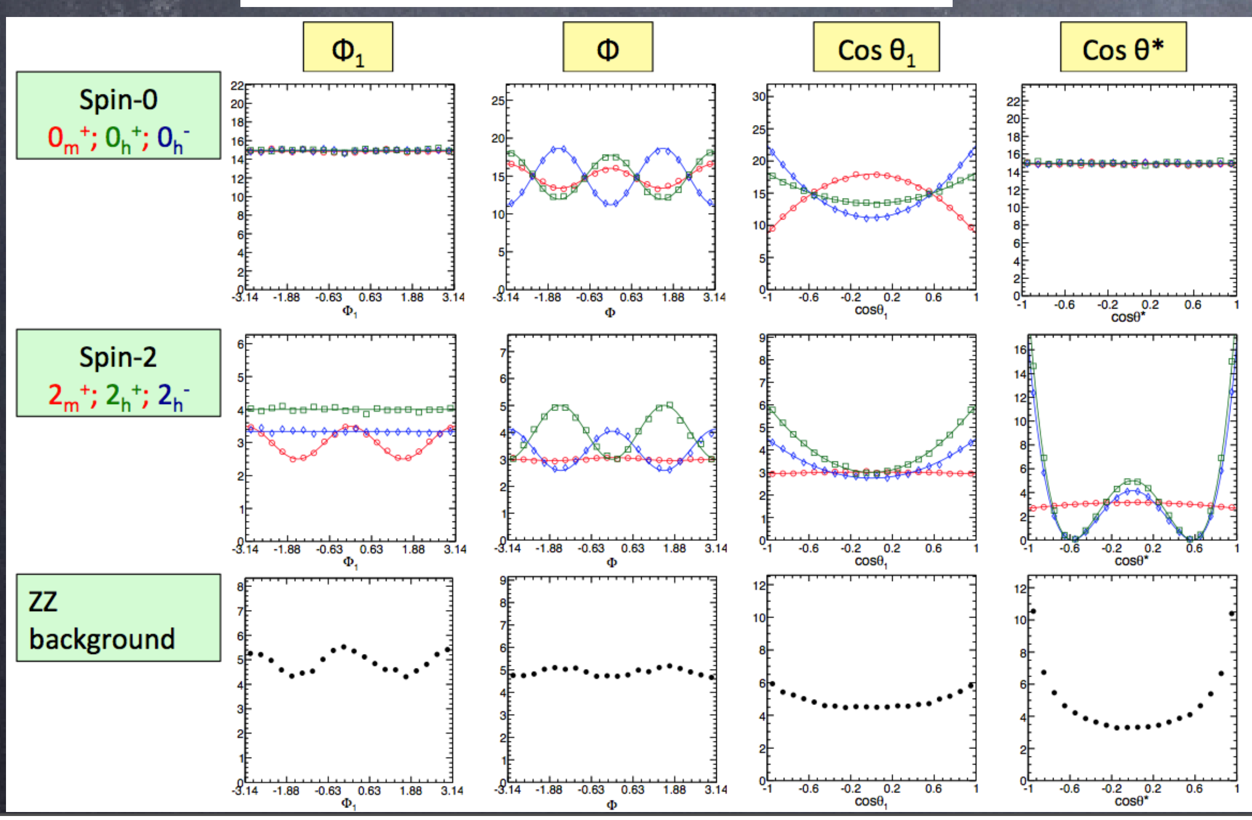




Spin/CP Analysis

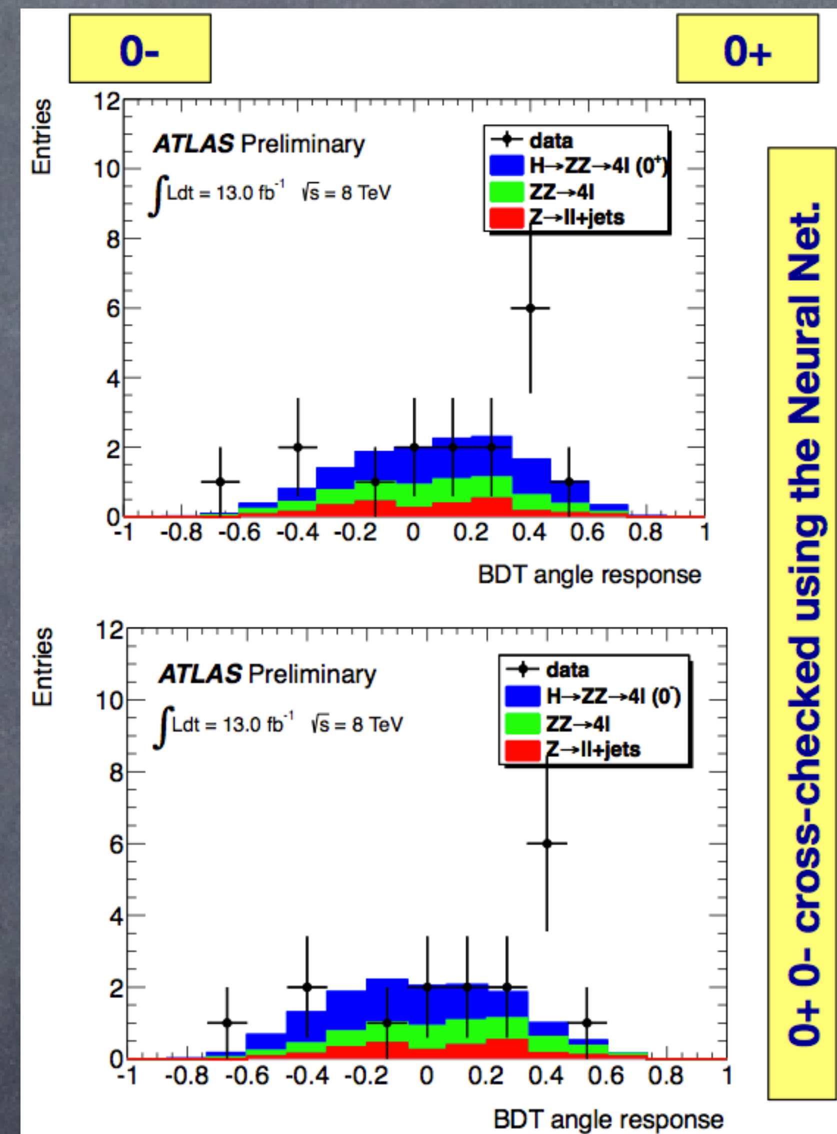
In H->ZZ*->4l, sensitivity to spin/CP through 5 production/decay angles and 2 inv. masses.





Ongoing

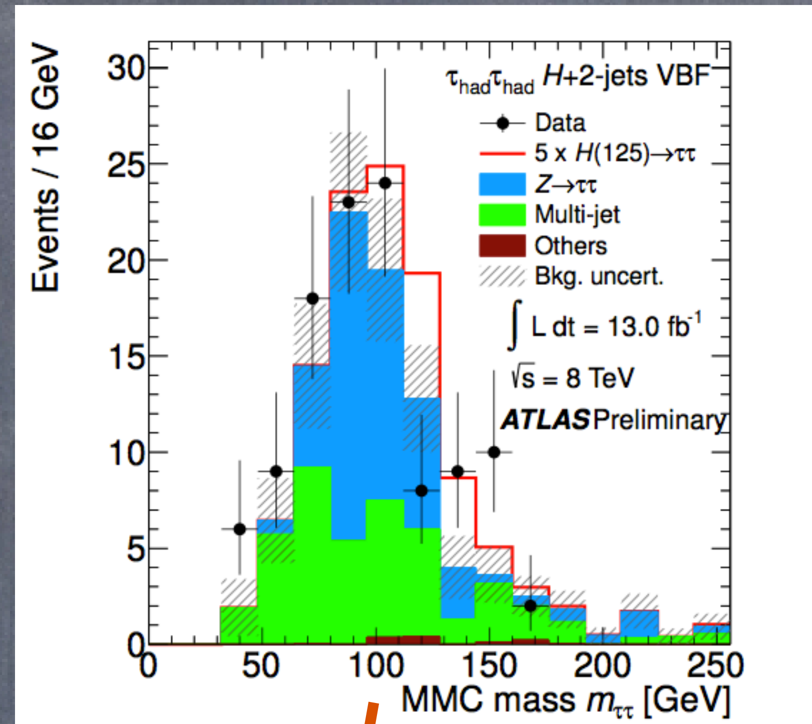
Example on BDT based analysis to separate 0^- from 0^+

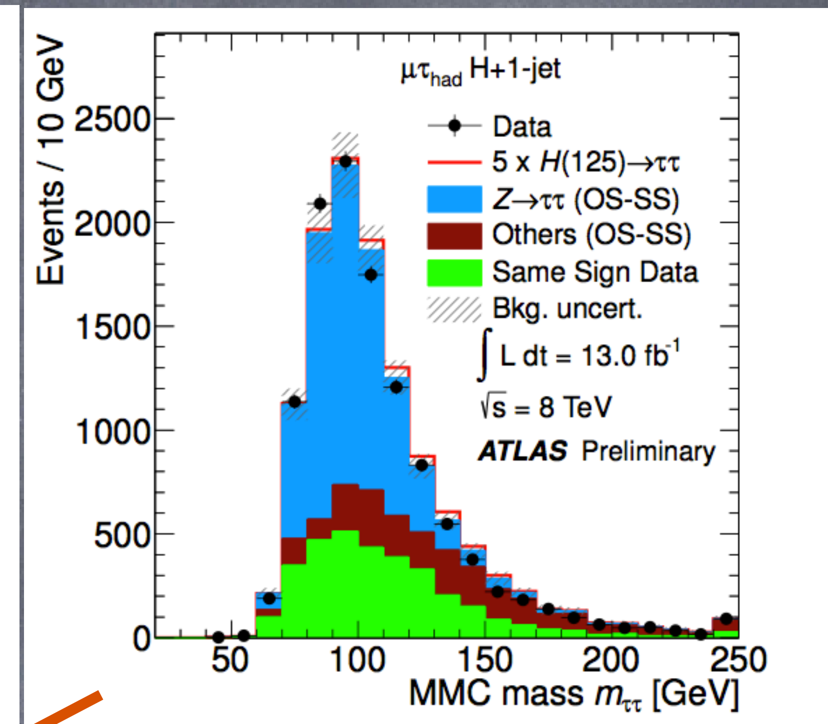


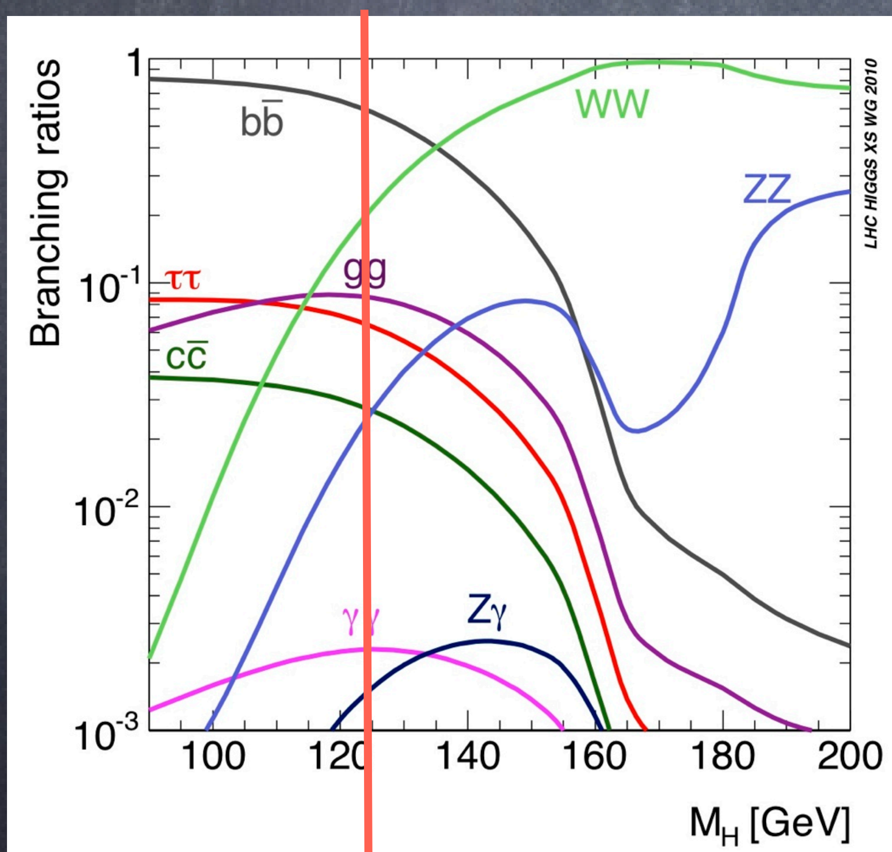
Also MatrixElement-based analysis

Higgs -> tautau

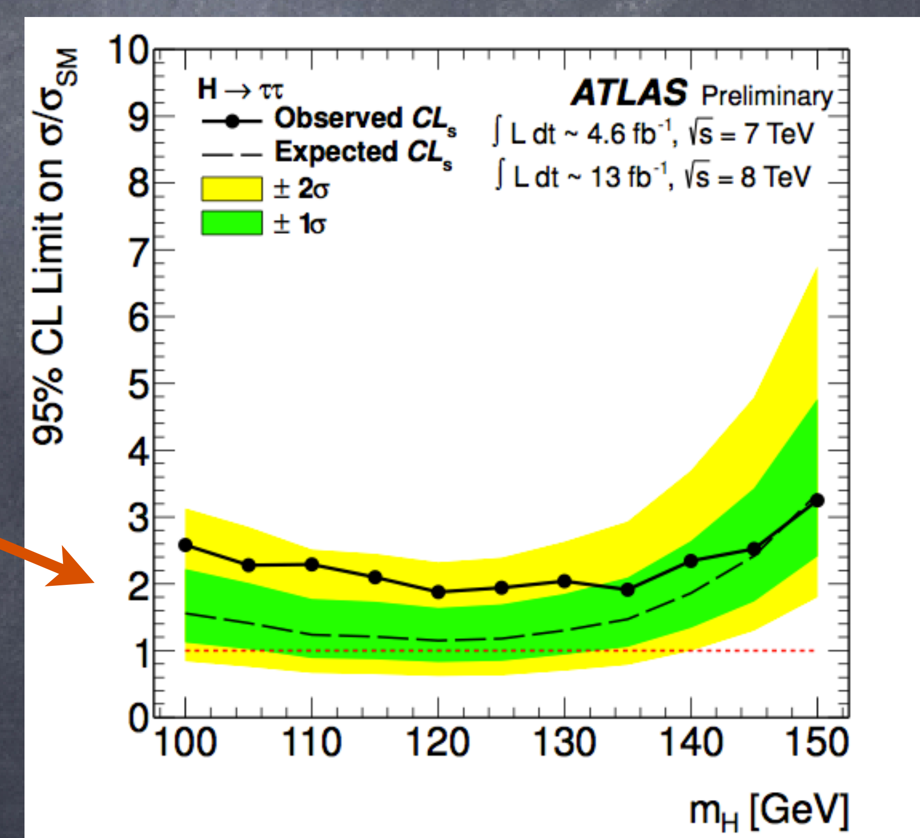
Measurement of Higgs leptonic BRs: Only bbbar and tautau have sizable xsects. Both channels obscured by large QCD background.



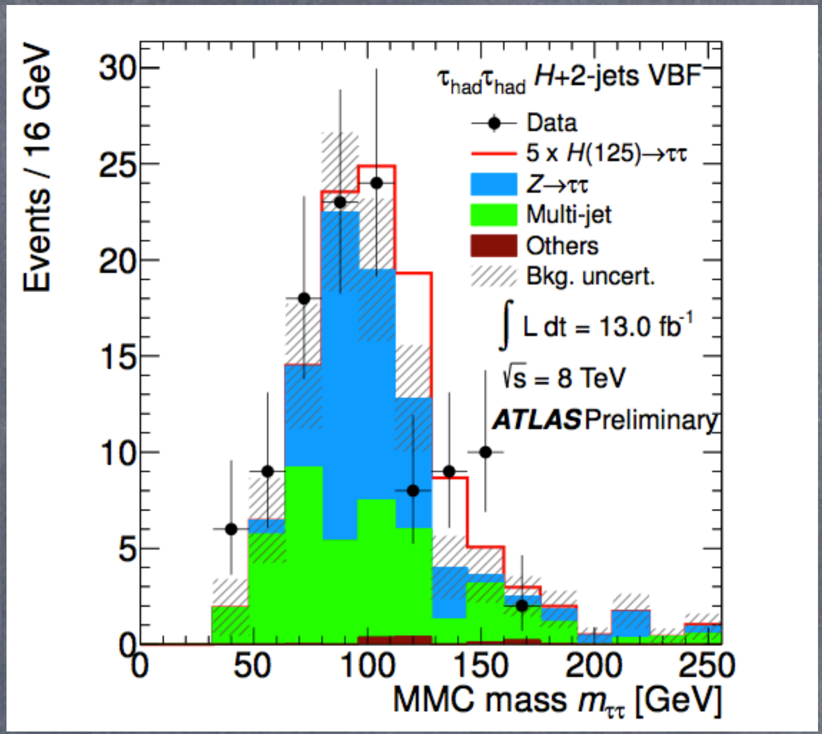


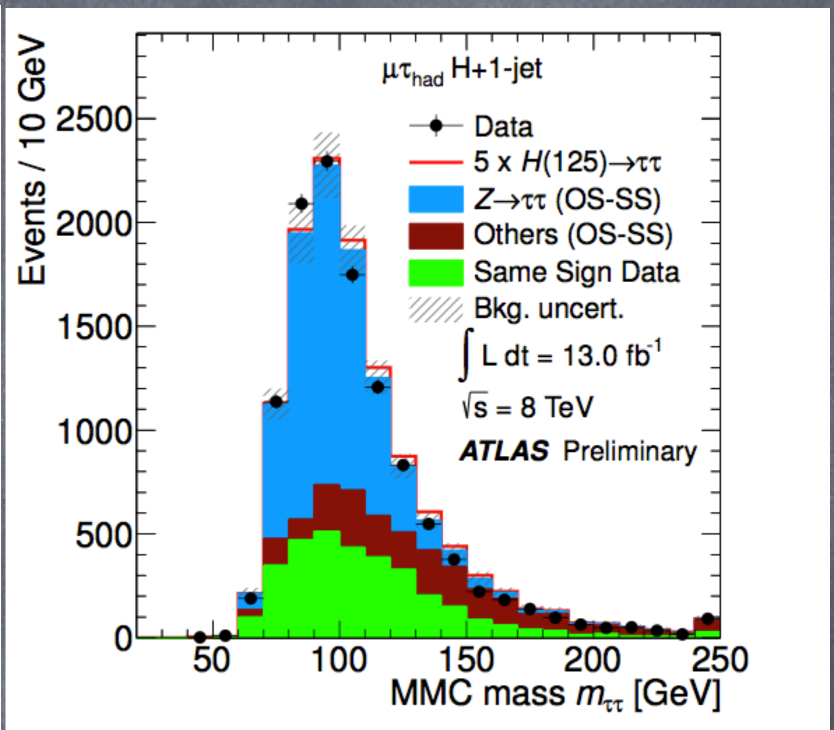


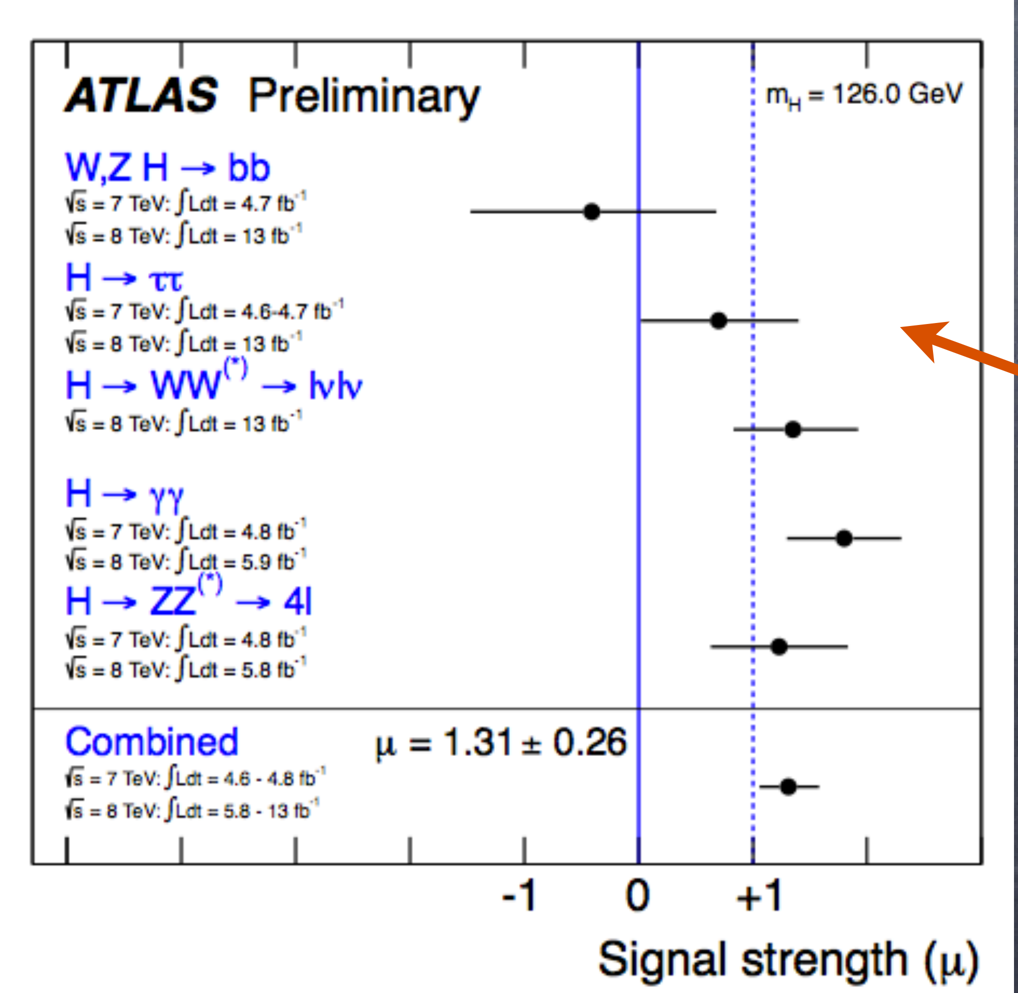
Total of 11 different categories

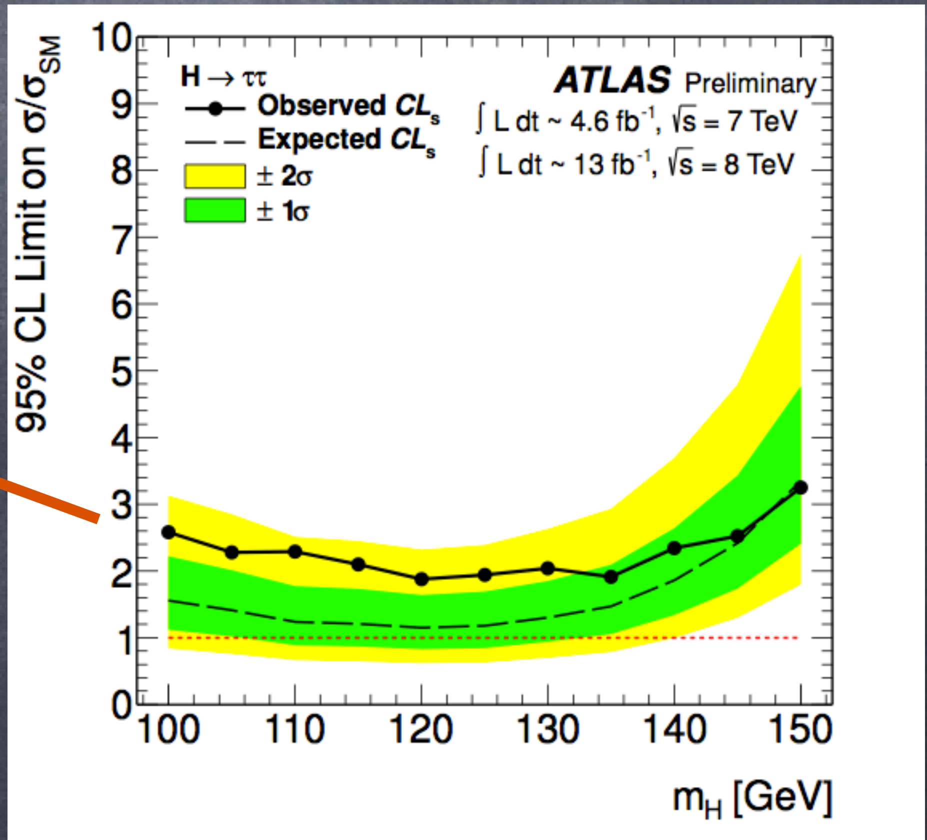


Higgs -> tautau

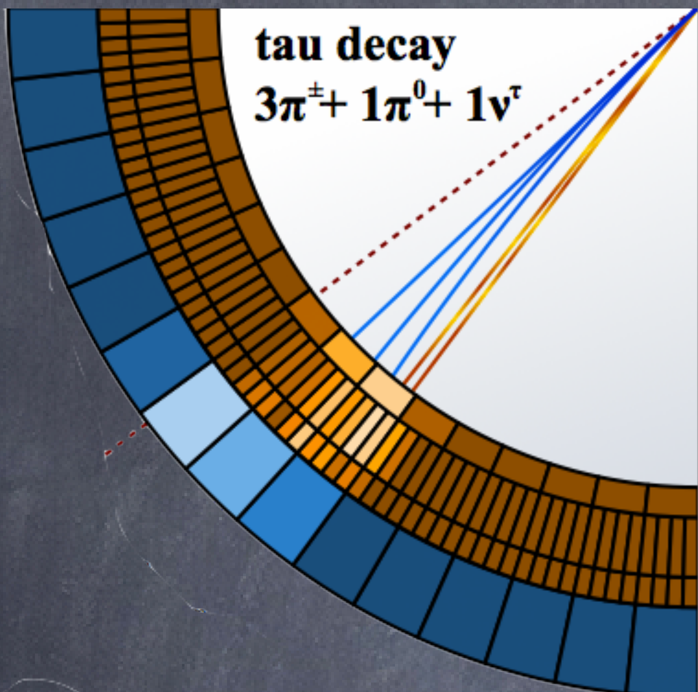




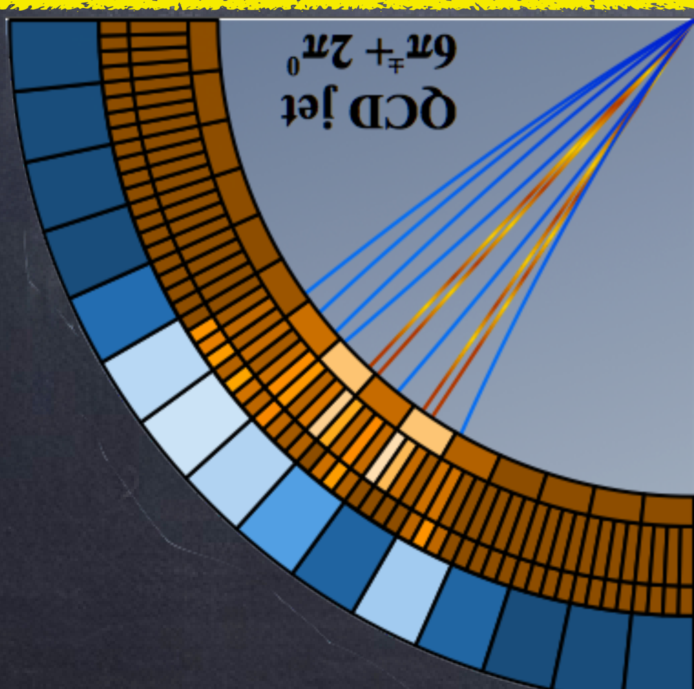




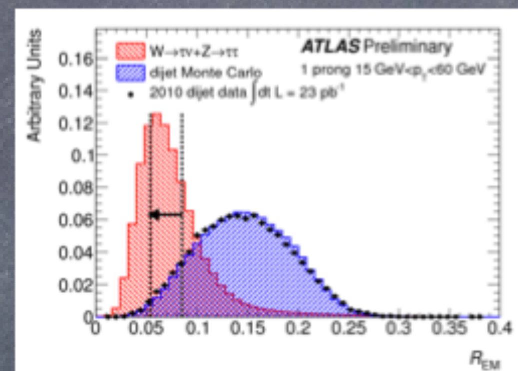
Tau Identification & Performance

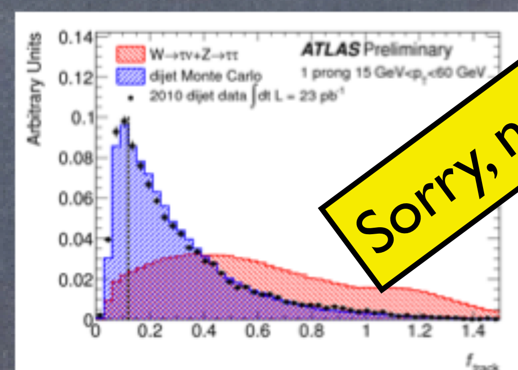


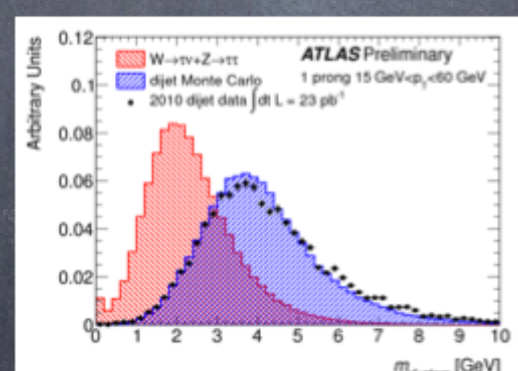
Separation of narrow "tau jets" from wider "QCD jets"

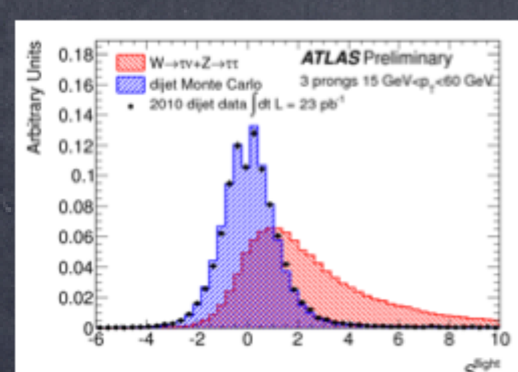


ID variables

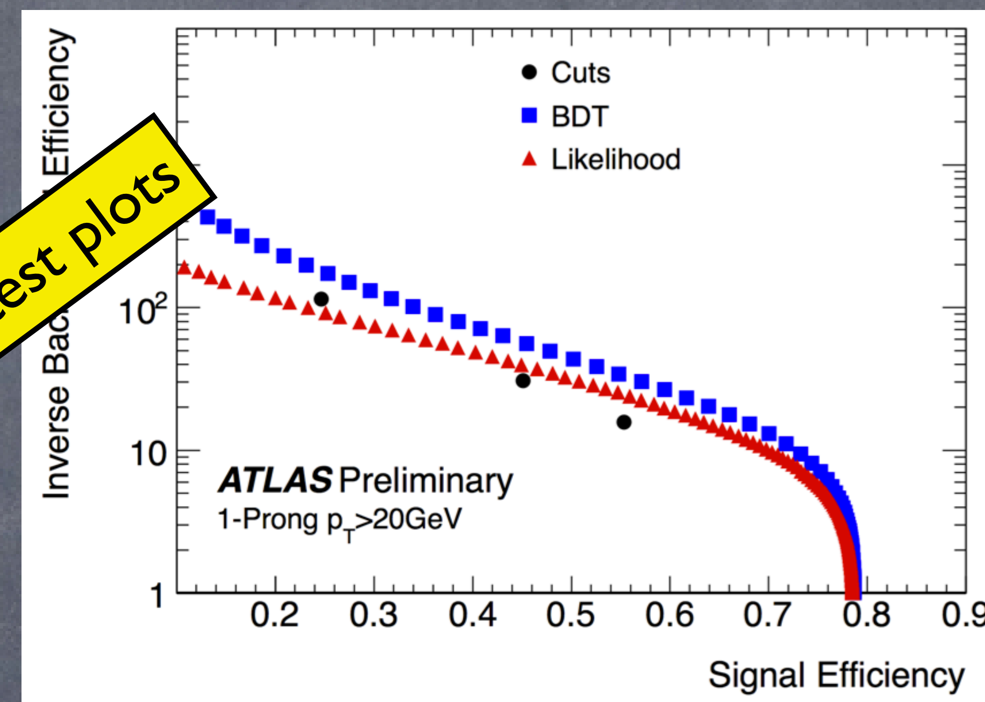








Performance

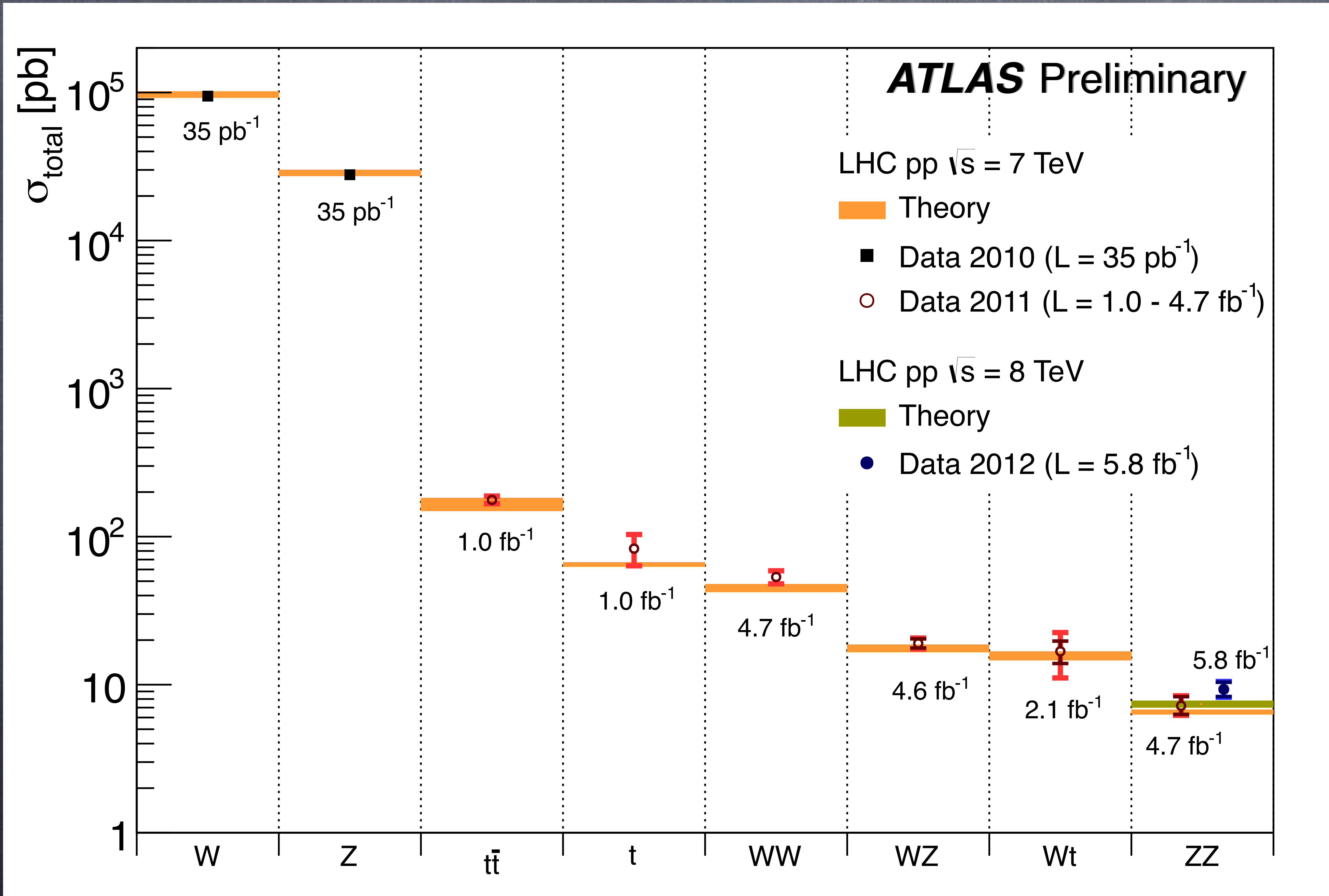


Sorry, not the latest plots

Also contributions to tau energy scale

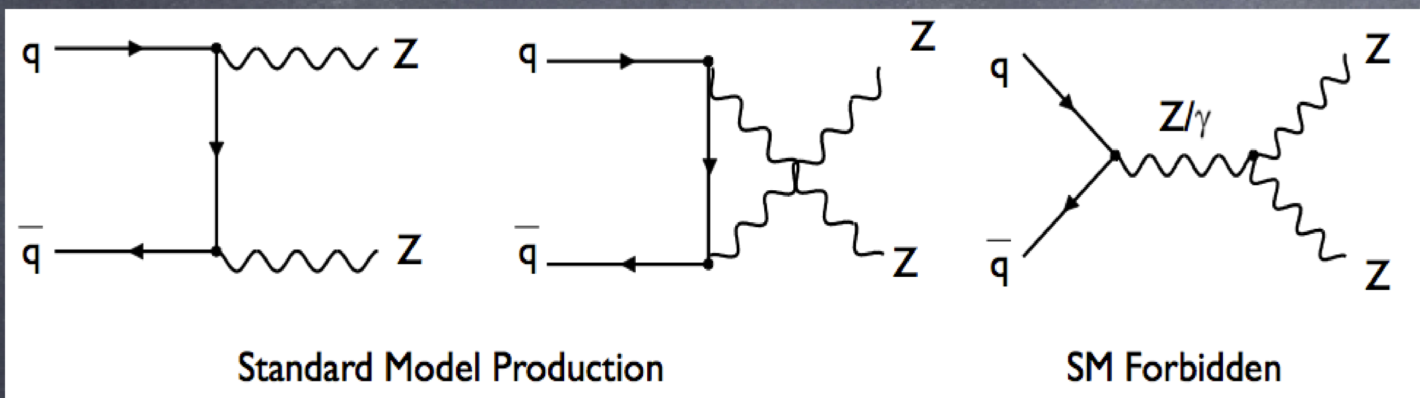
Standard Model

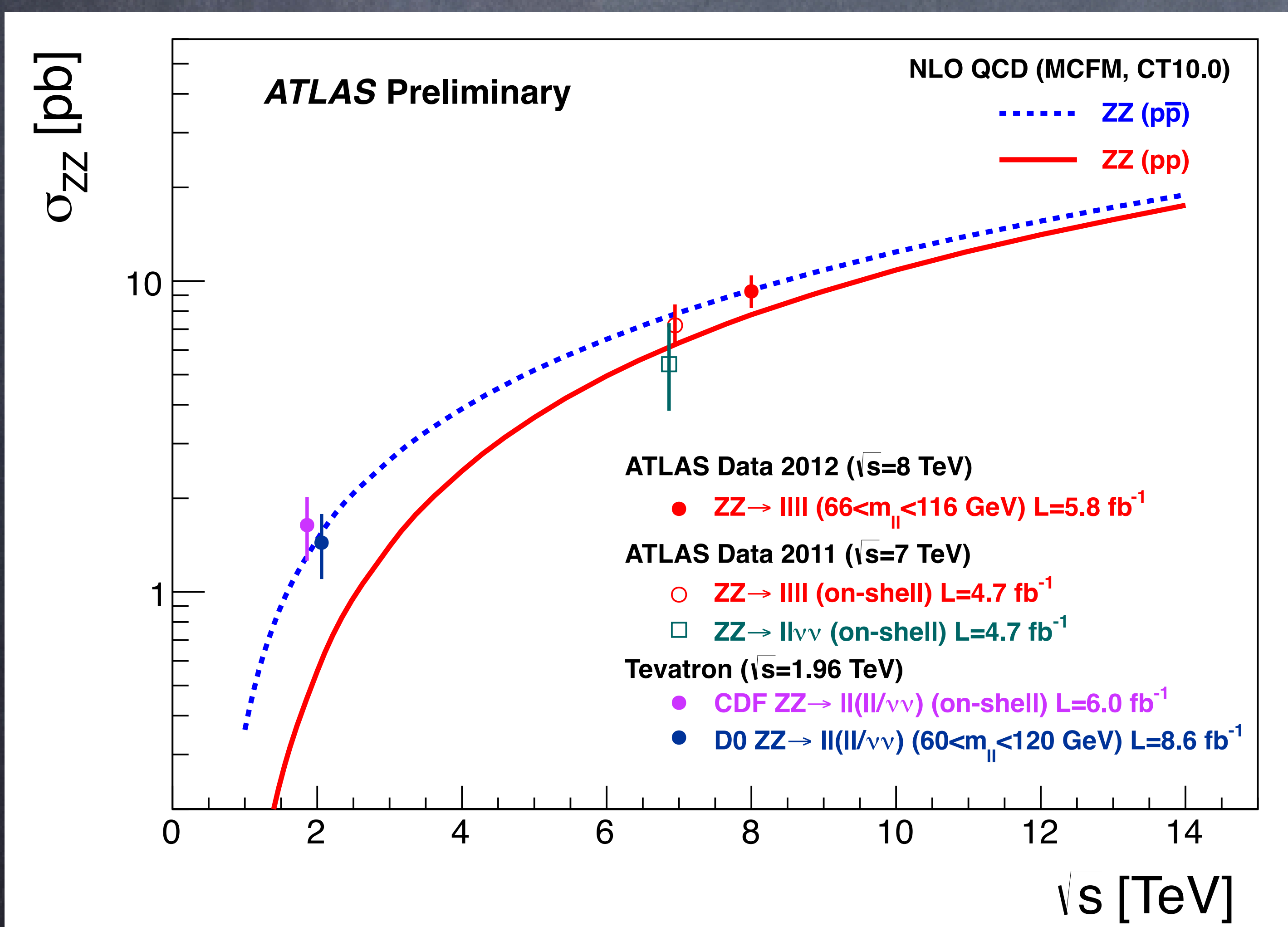
Rediscovering Standard Model

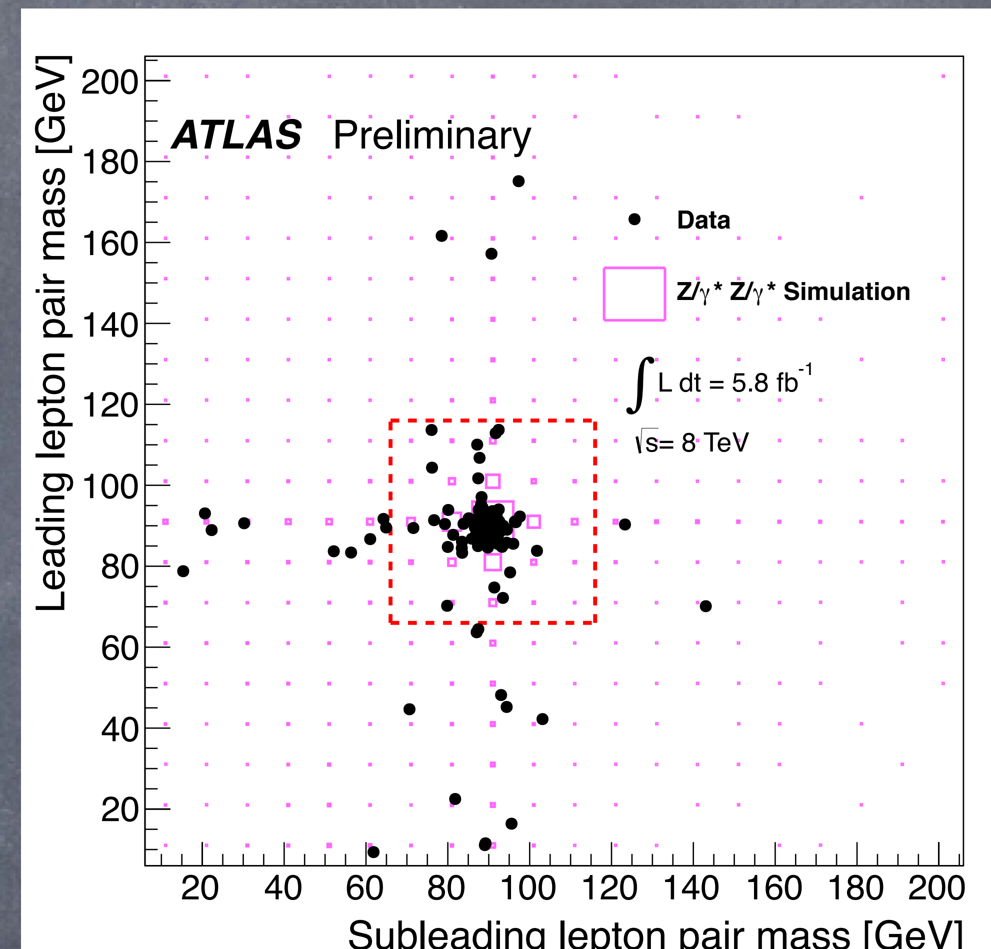


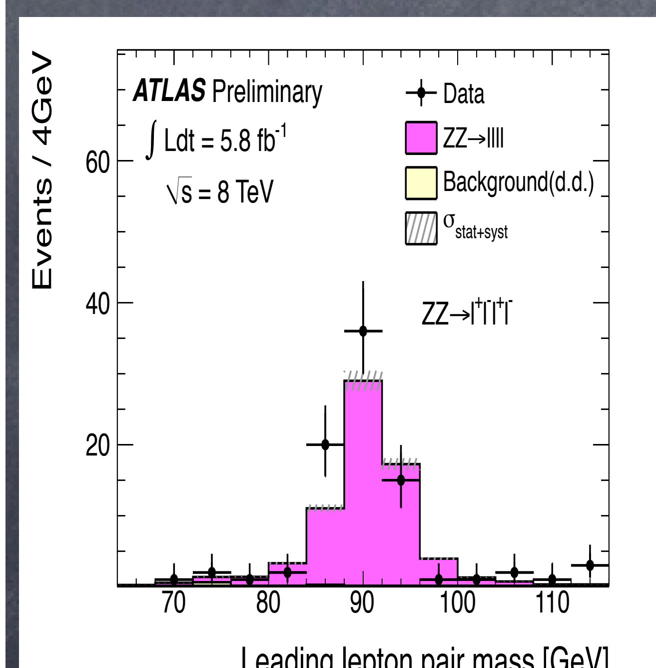
Dibosons: ZZ -> llll

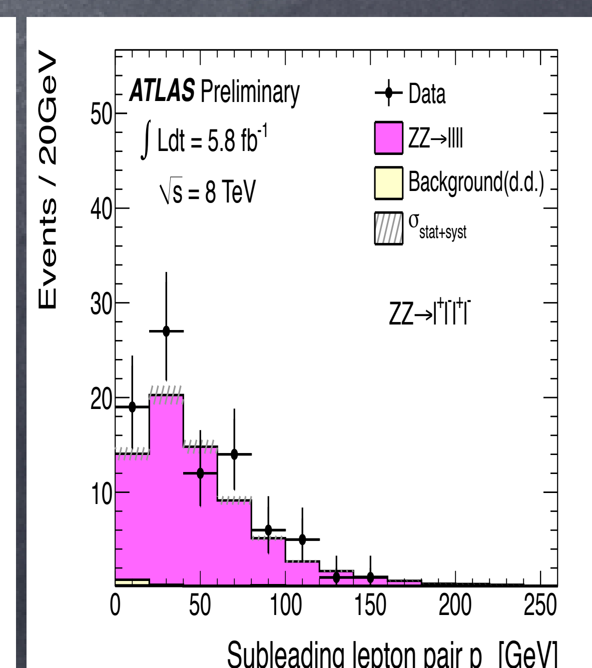
Gauge boson self-coupling
Bckg. to Higgs and other searches











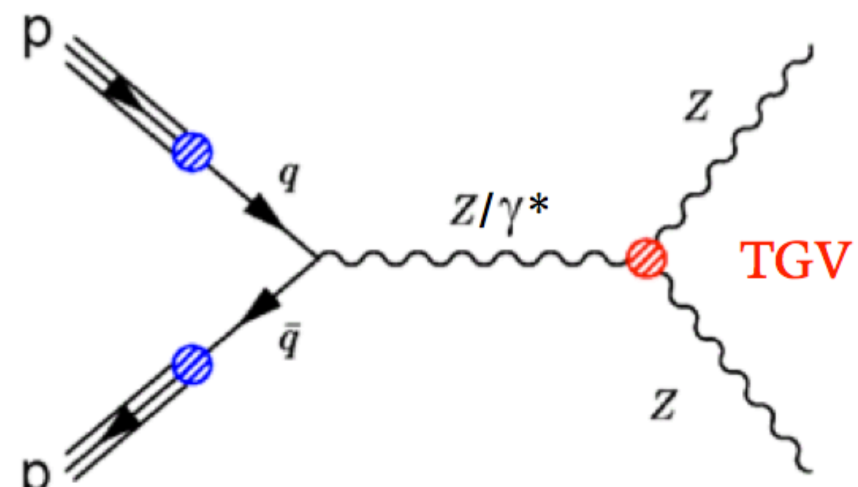
Diboson production: Trilinear Gauge Couplings

Model independent parametrisation of new physics operating at a much higher scale is introduced via generic operator expansion.

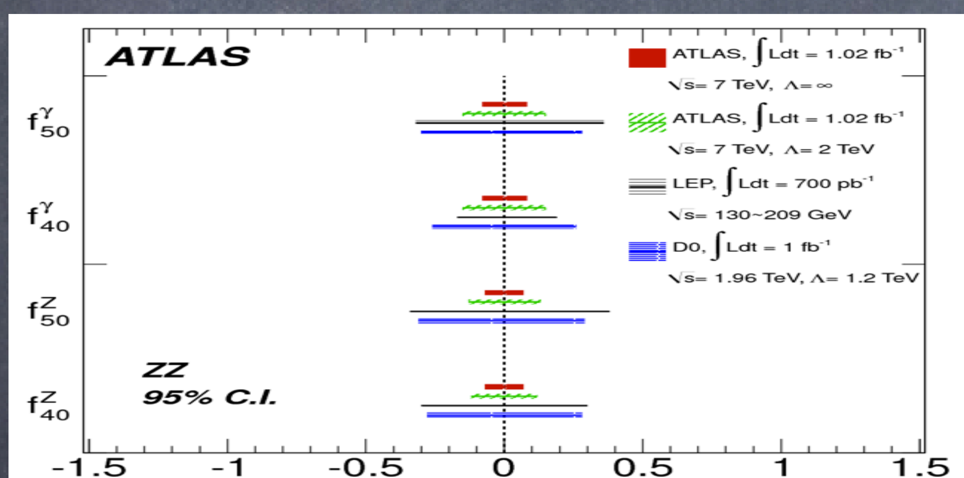
As example ZZ production:

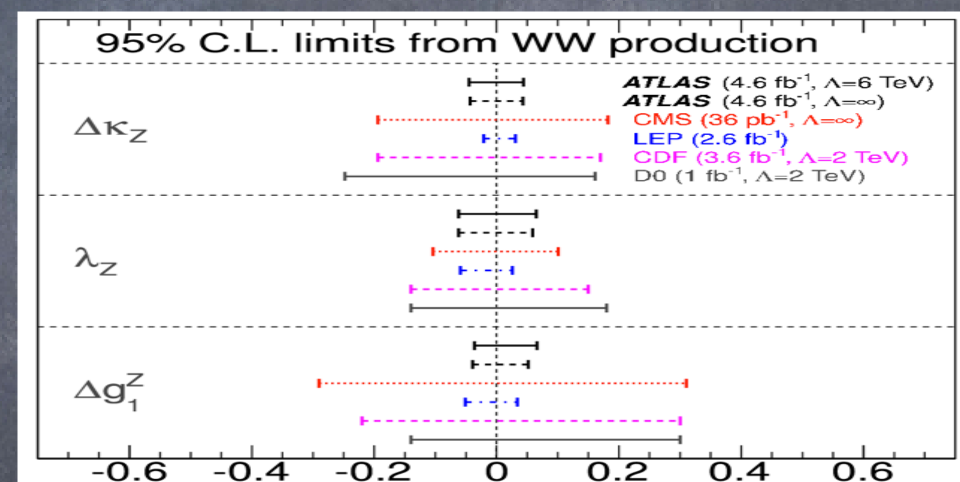
$$\mathcal{L}_{TGC} = \frac{e}{m_Z^2}\left[f_4^V(\partial_\mu V^{\mu\beta})Z_\alpha(\partial^\alpha Z_\beta) + f_5^V(\partial^\sigma V_{\sigma\mu}\tilde{Z}^{\mu\beta}Z_\beta)\right]$$

f_i^V where $V = \{Z, \gamma\}$ and $i = \{4, 5\}$

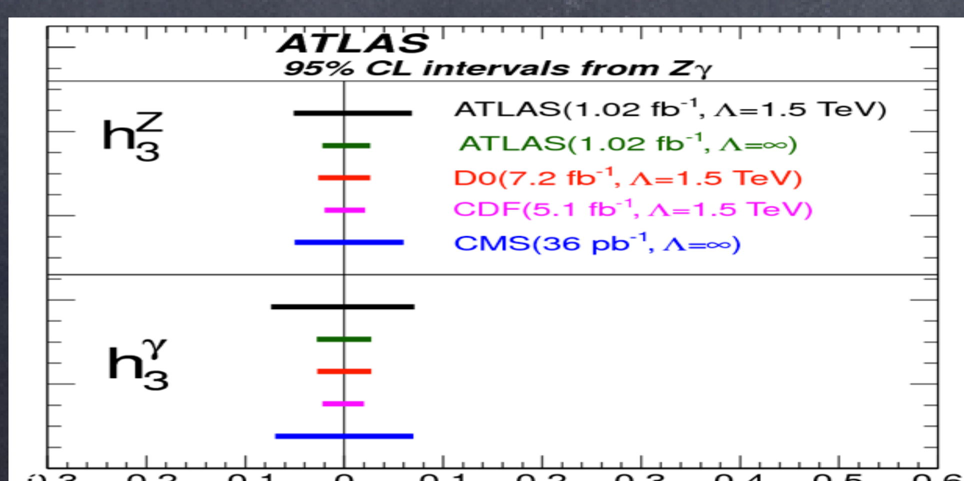


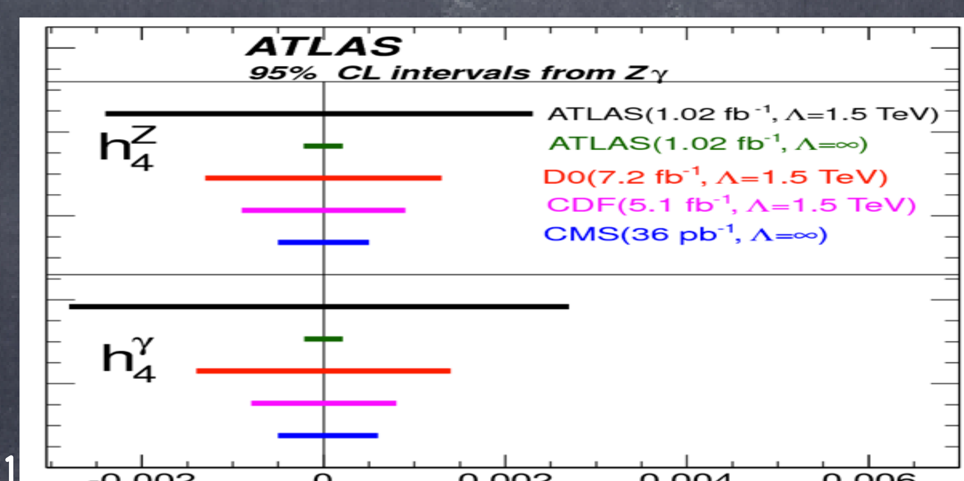
Measurements of Trilinear Gauge Couplings provide sensitive tests of the symmetries in the SM.



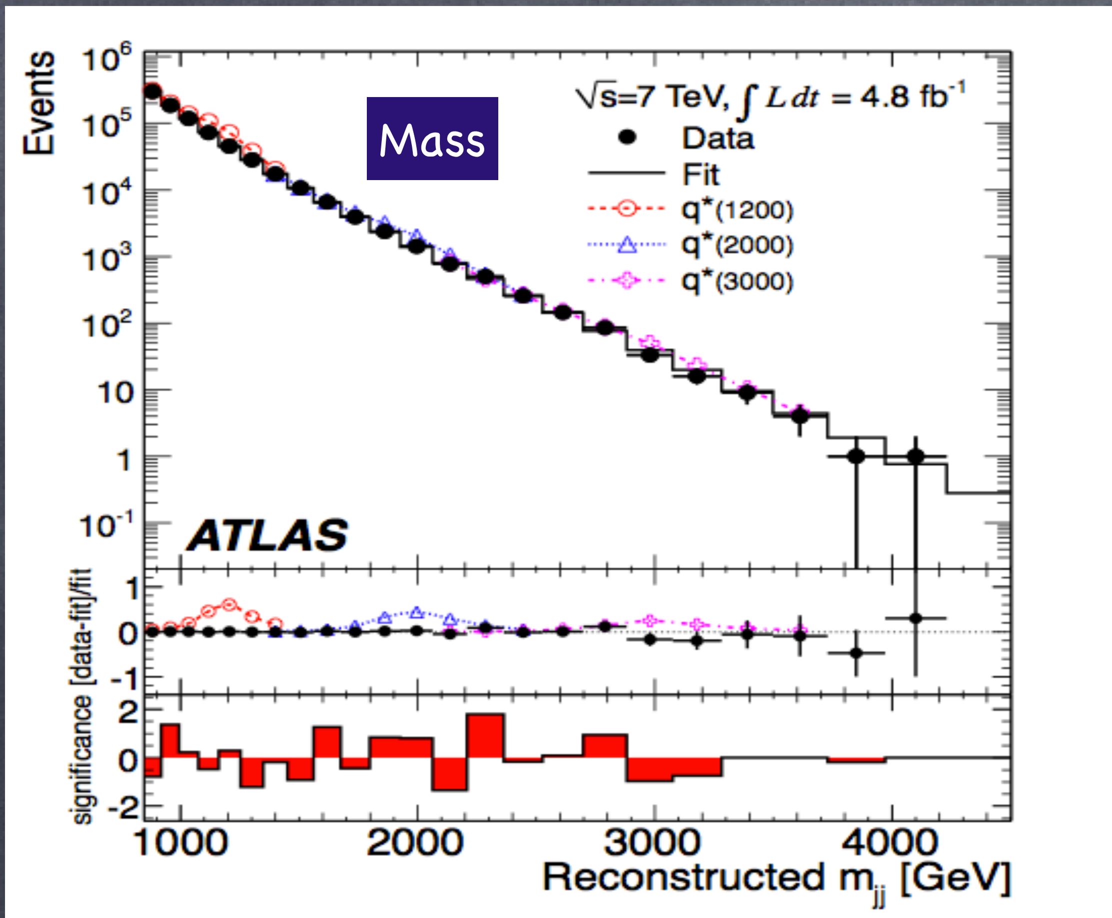


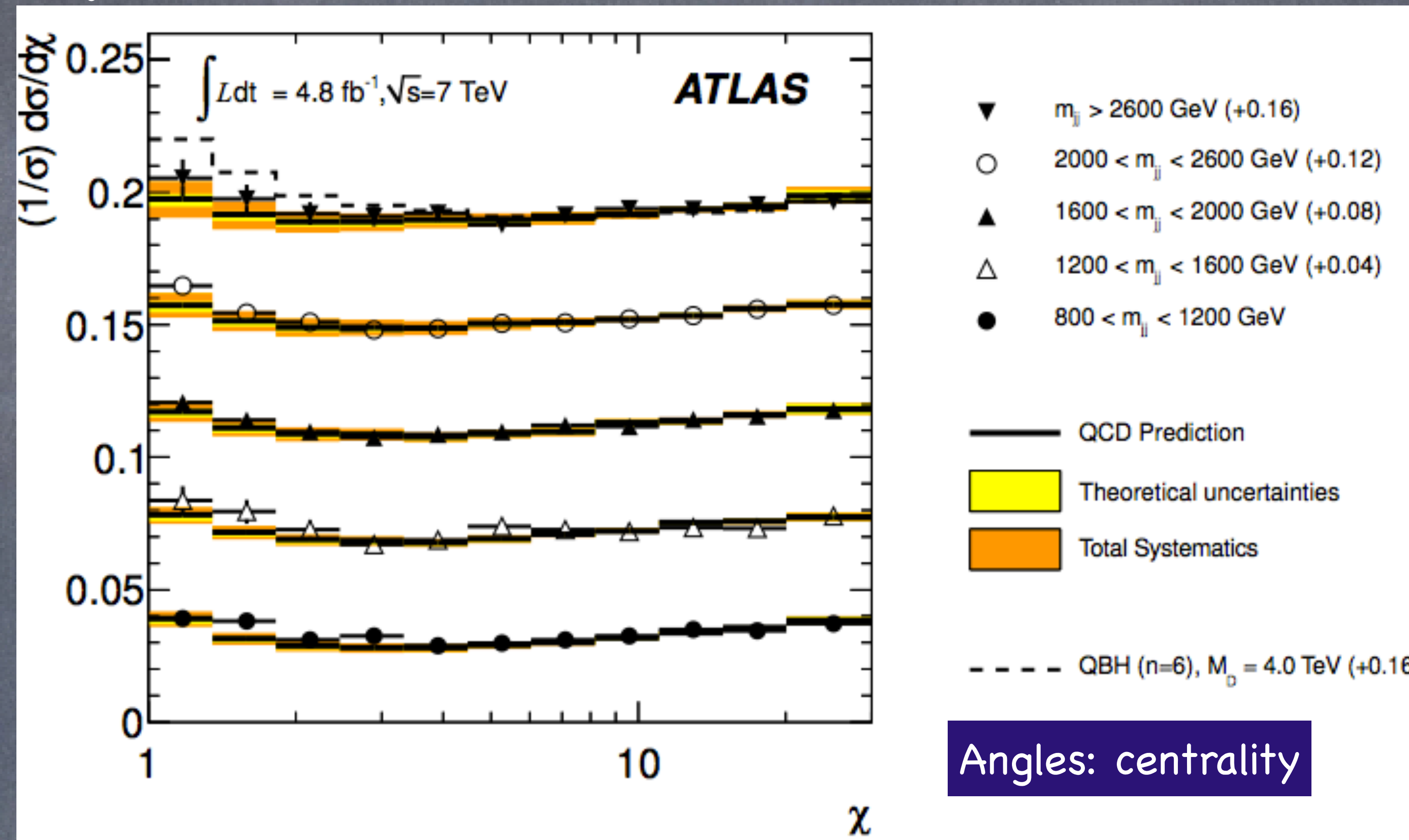
So far, everything consistent with Standard Model

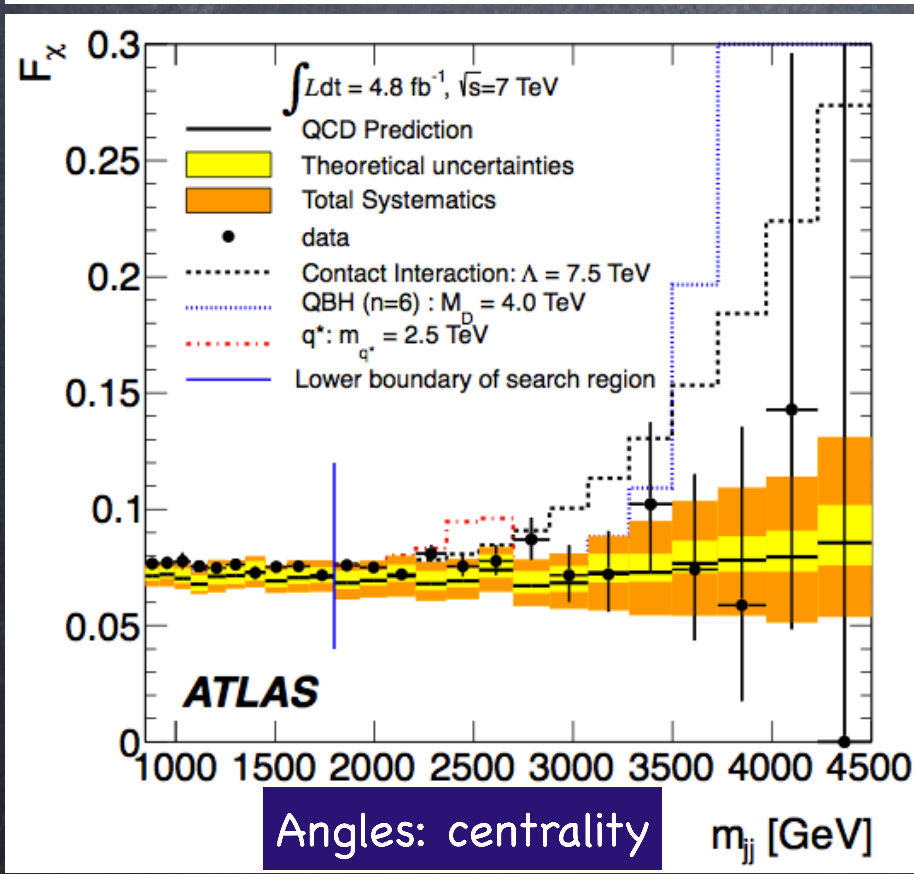




Search for new phenomena in Dijets





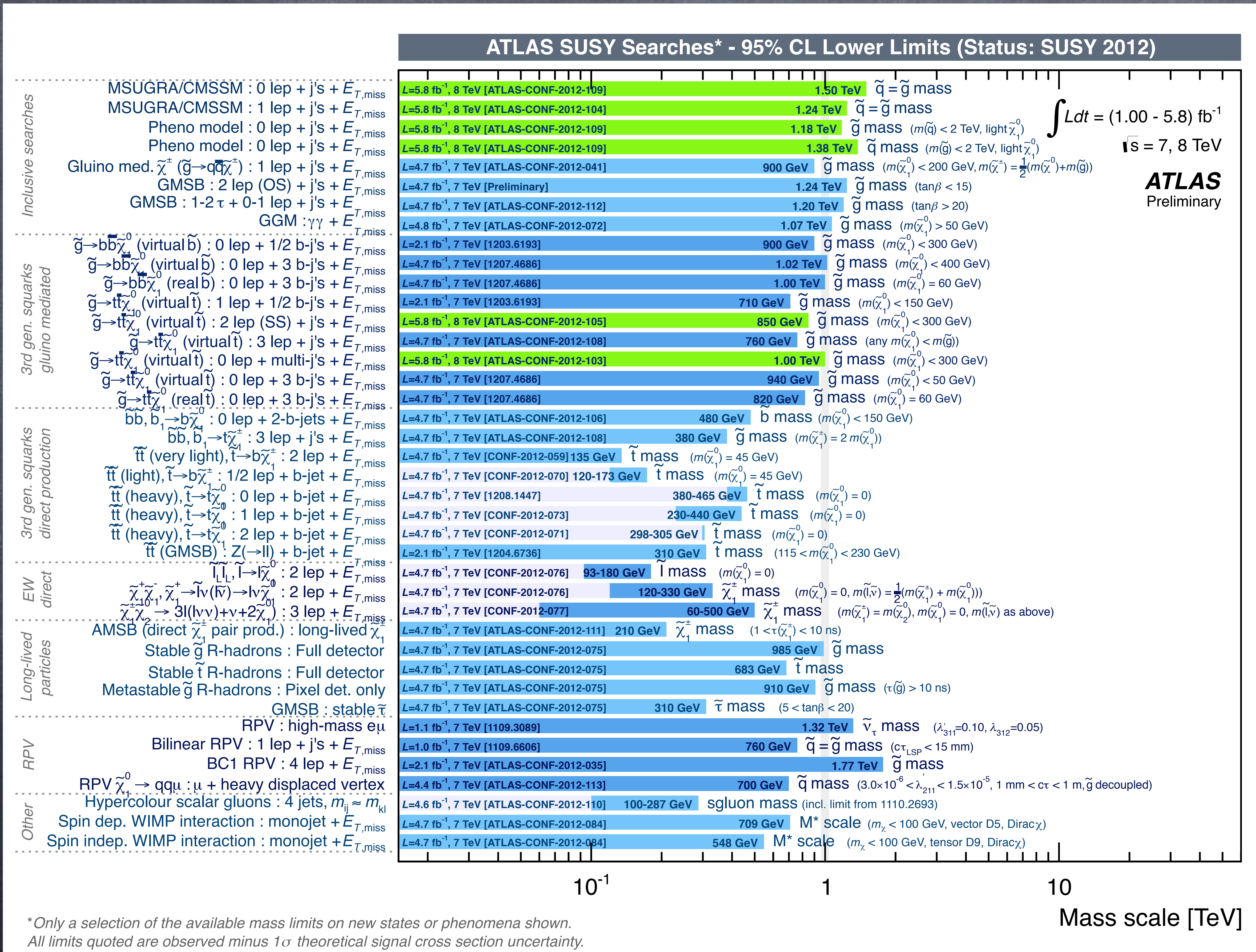


Very powerful analysis. Ruling out:

- excited quarks below 2.83 TeV
- colour octet scalars below 1.86 TeV
- heavy W bosons below 1.68 TeV
- string resonances below 3.61 TeV
- quantum black holes with ... below 4.11 TeV
- quark contact interactions compositness scale 7.6 TeV
- ...

SUSY Searches

SUSY Summary

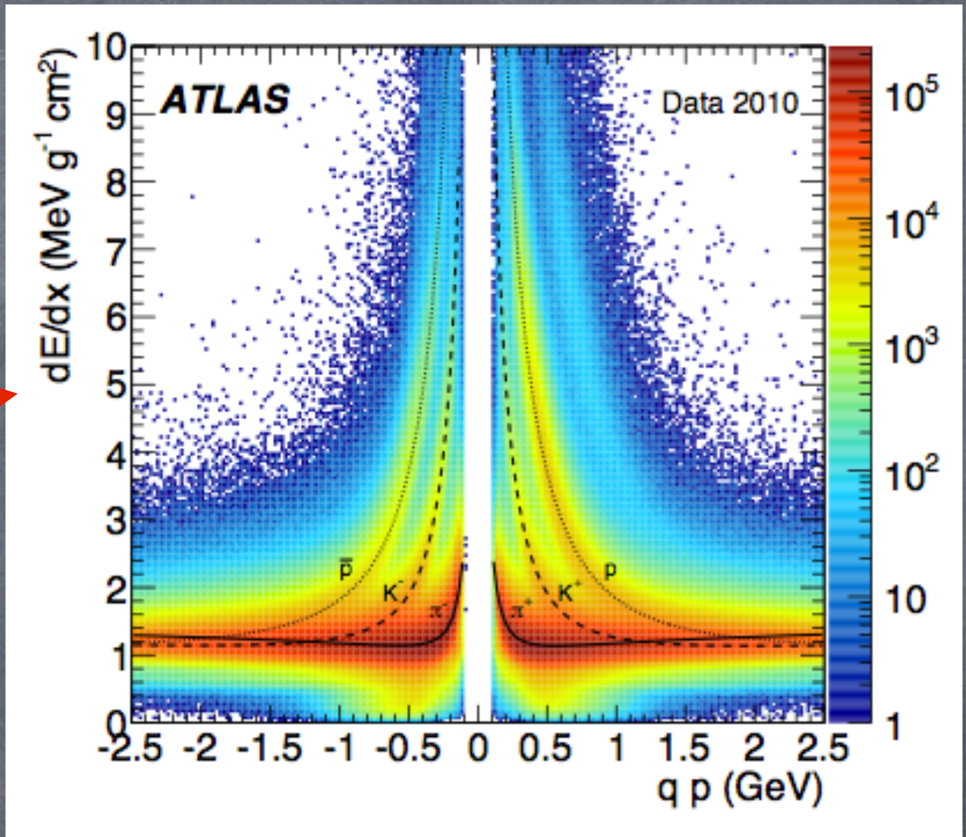


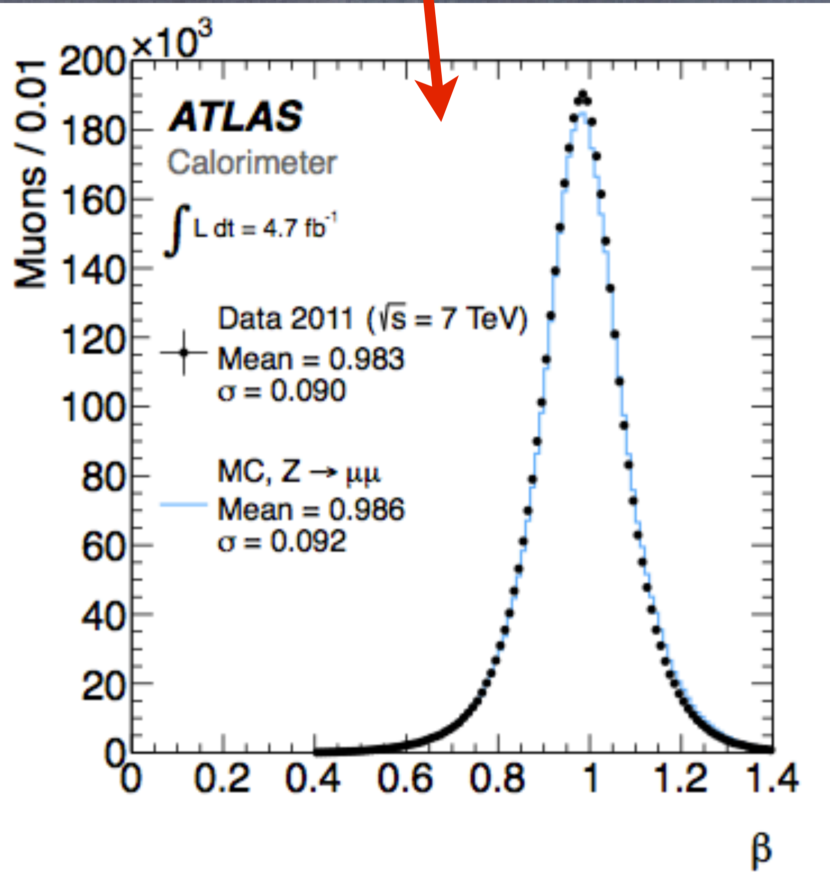
Monday, November 12, 12

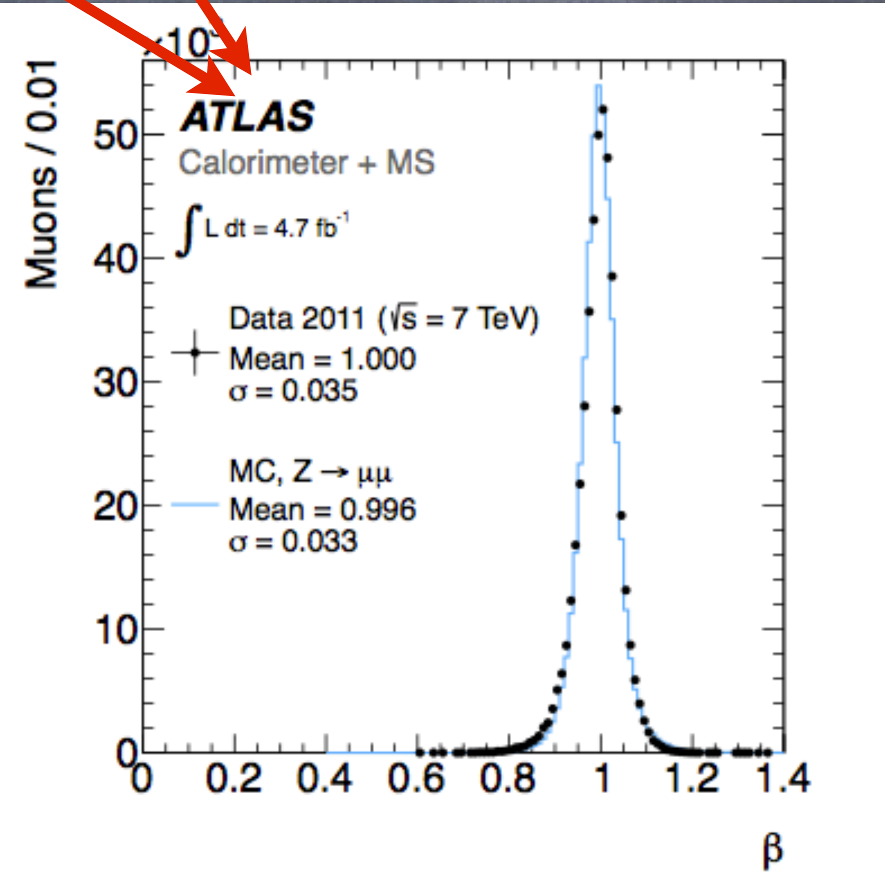
Search for Heavy Long-lived Particles

sleptons, R-hadrons, ...

Aggressive exploitation of ATLAS particle identification capabilities:
- Specific ionisation in the Pixel silicon
- Time-of-flight in **calorimeters** and **Muon System**







Heavy Long-lived Particles

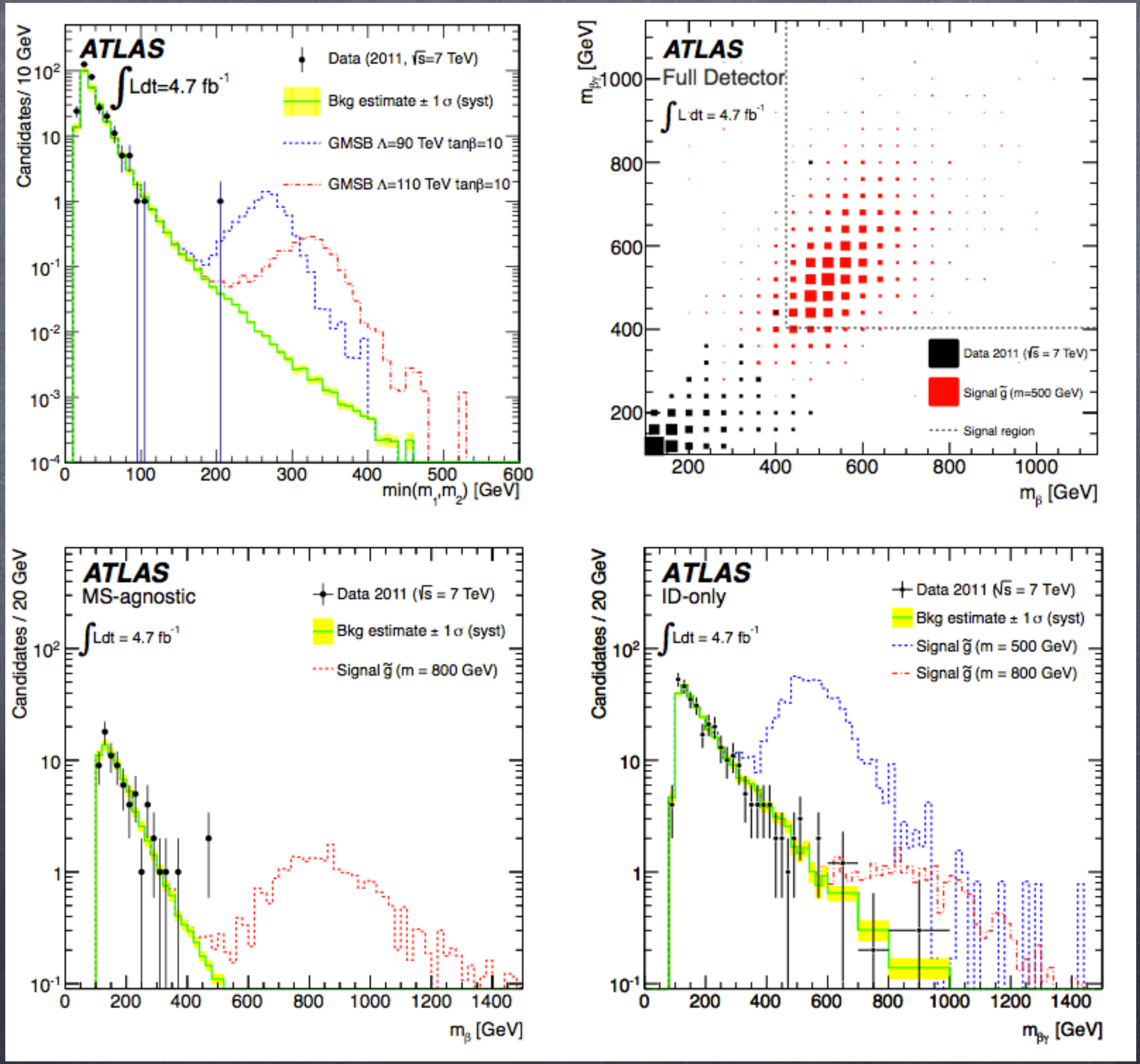
Mass of candidates established through measurement of

i) momentum, p

ii) velocity, β or βγ

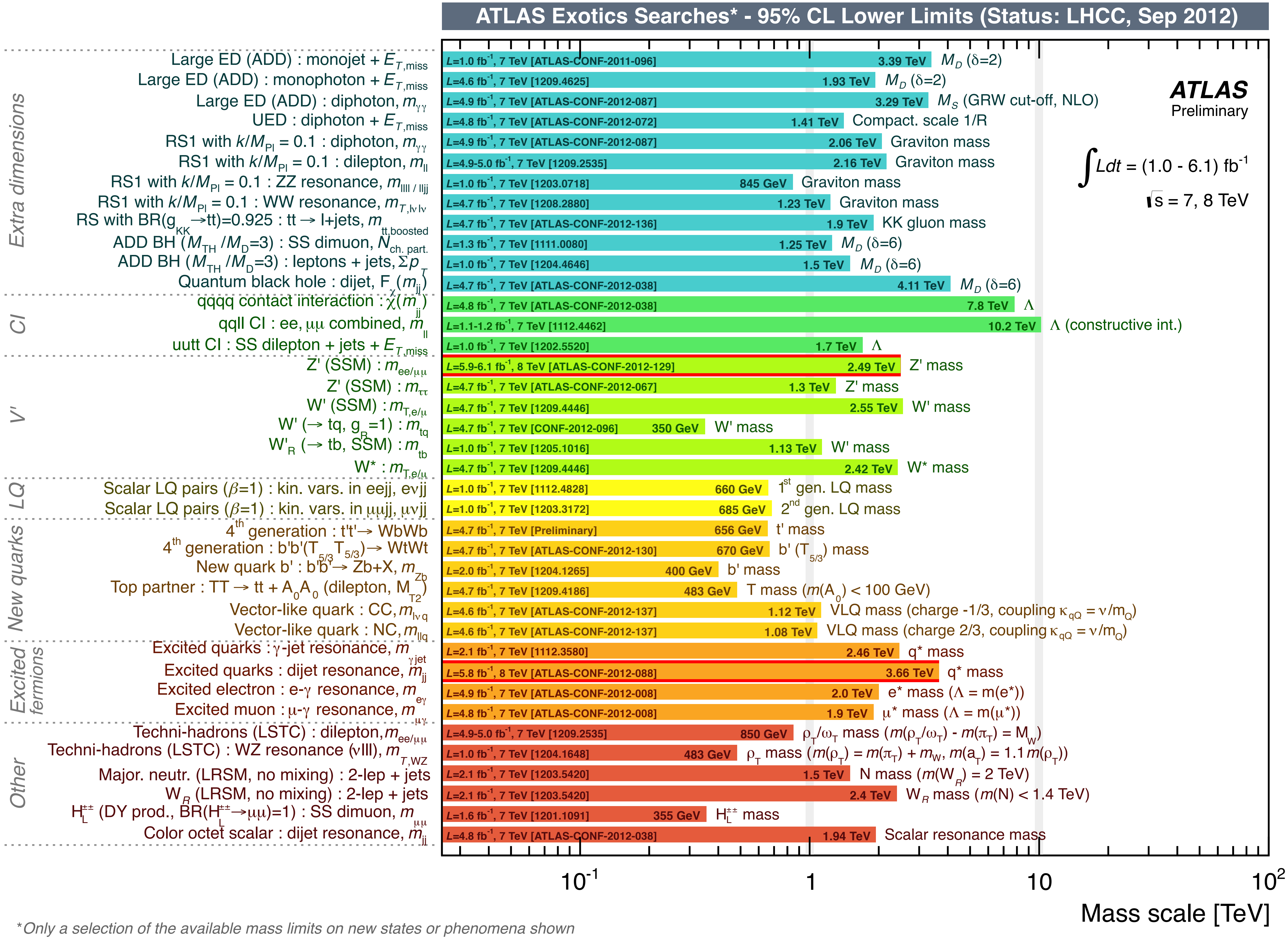
Analysis setting limits on many possible LLPs:

- stau in GMSB
- directly produced sleptons
- R-hadrons (gluino, stop, sbottom)

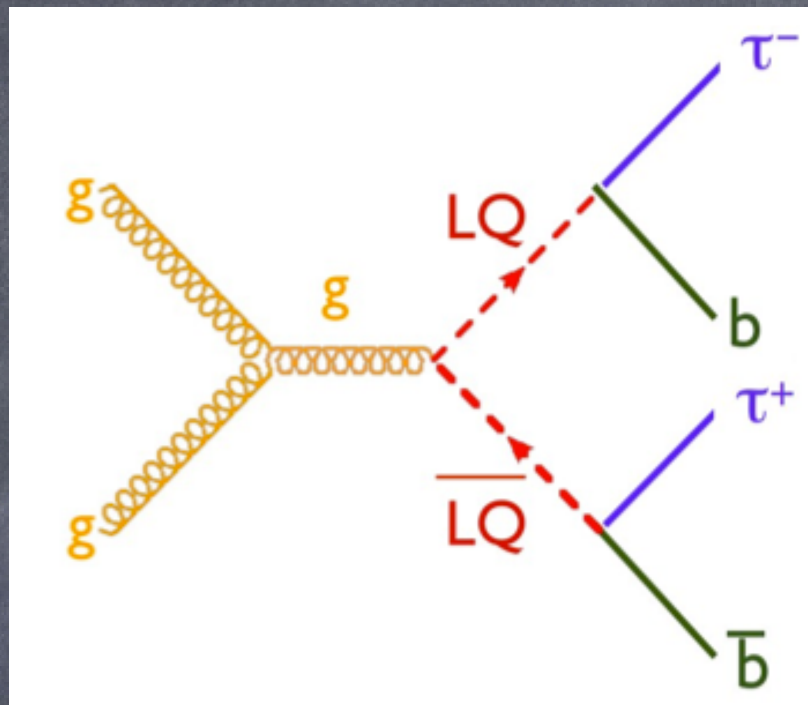


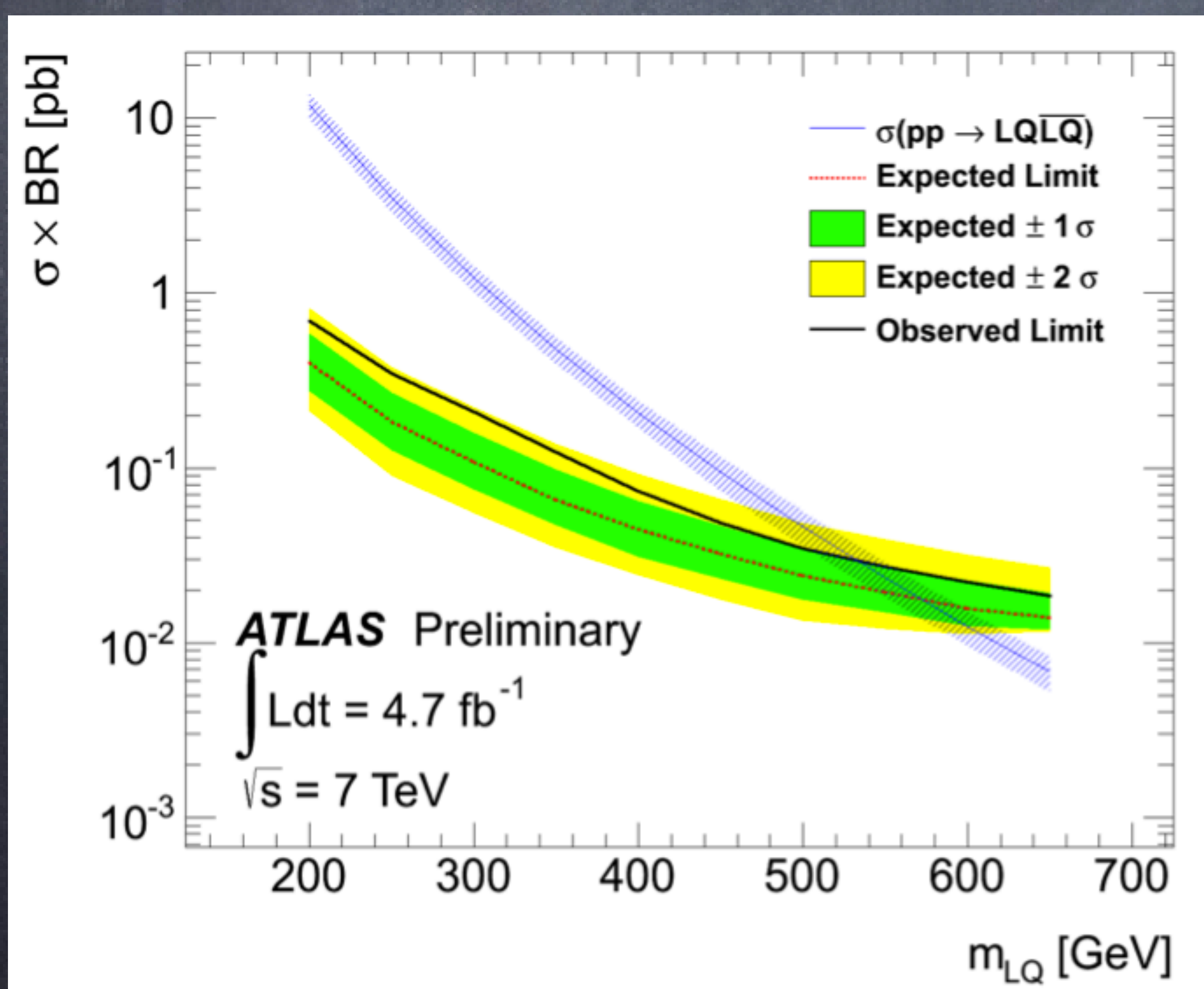
Other Searches

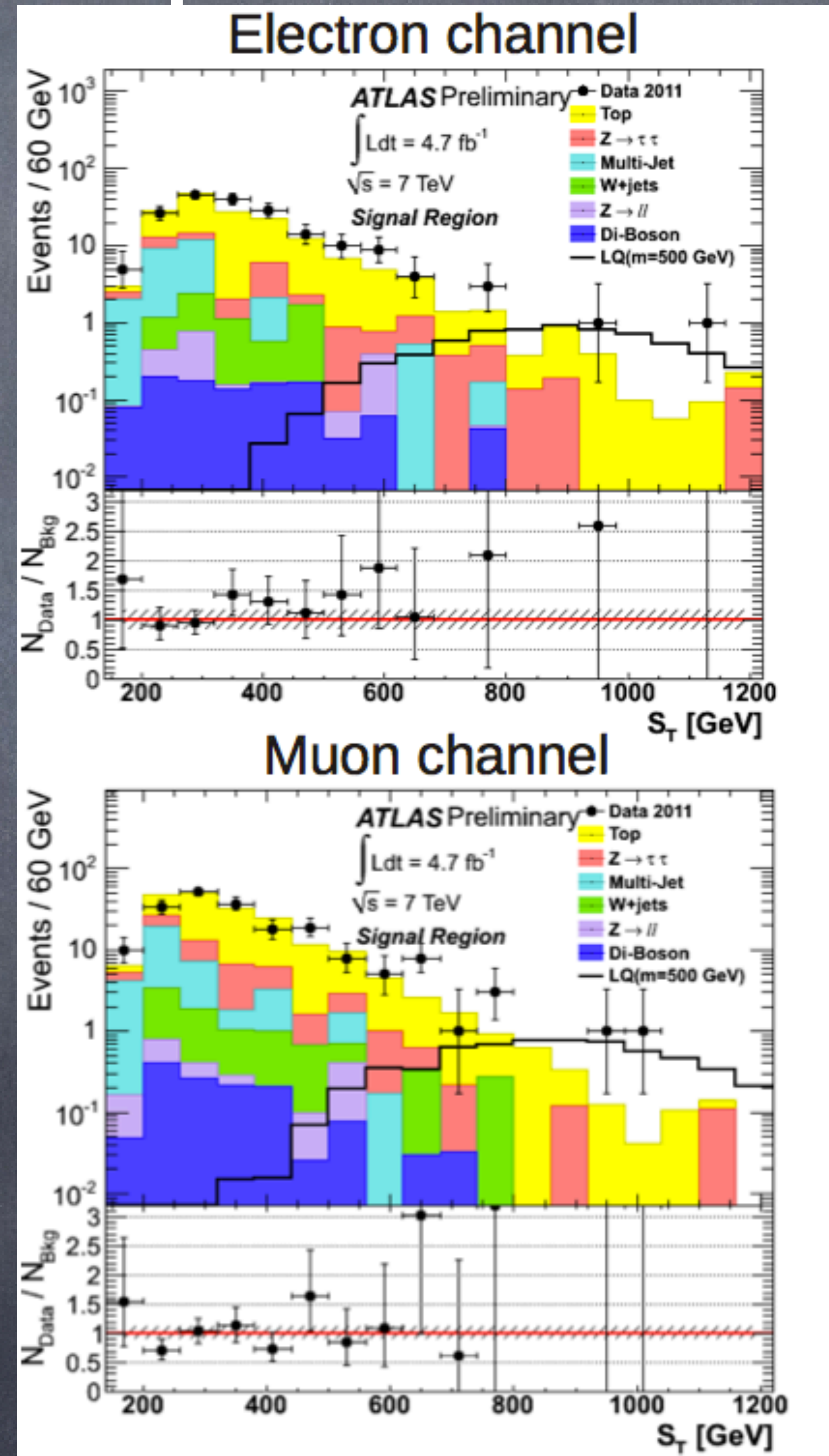
“Exotics” Summary



3rd Generation Leptoquark search





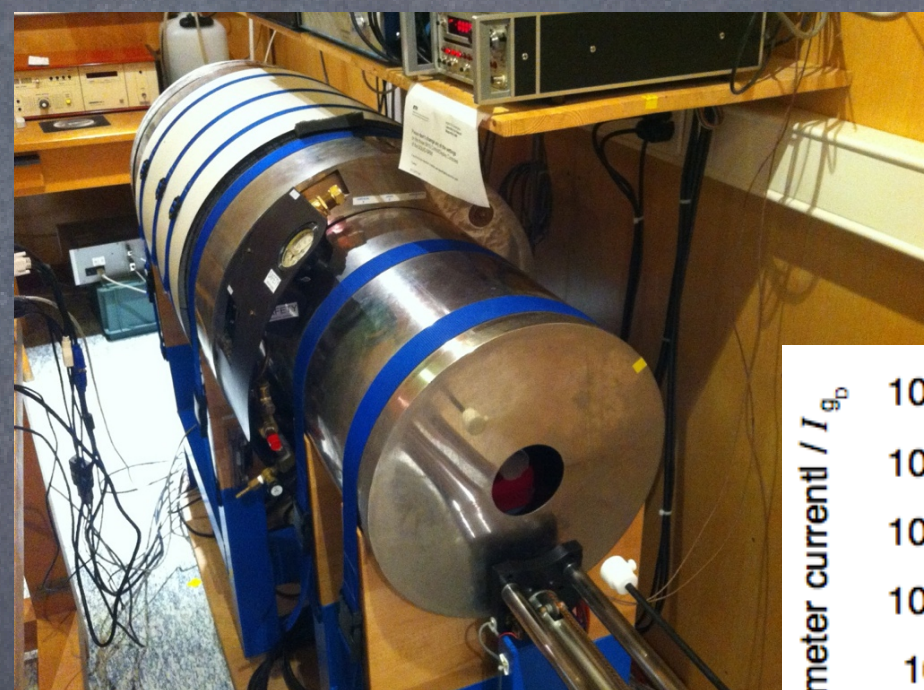


Monopole Search

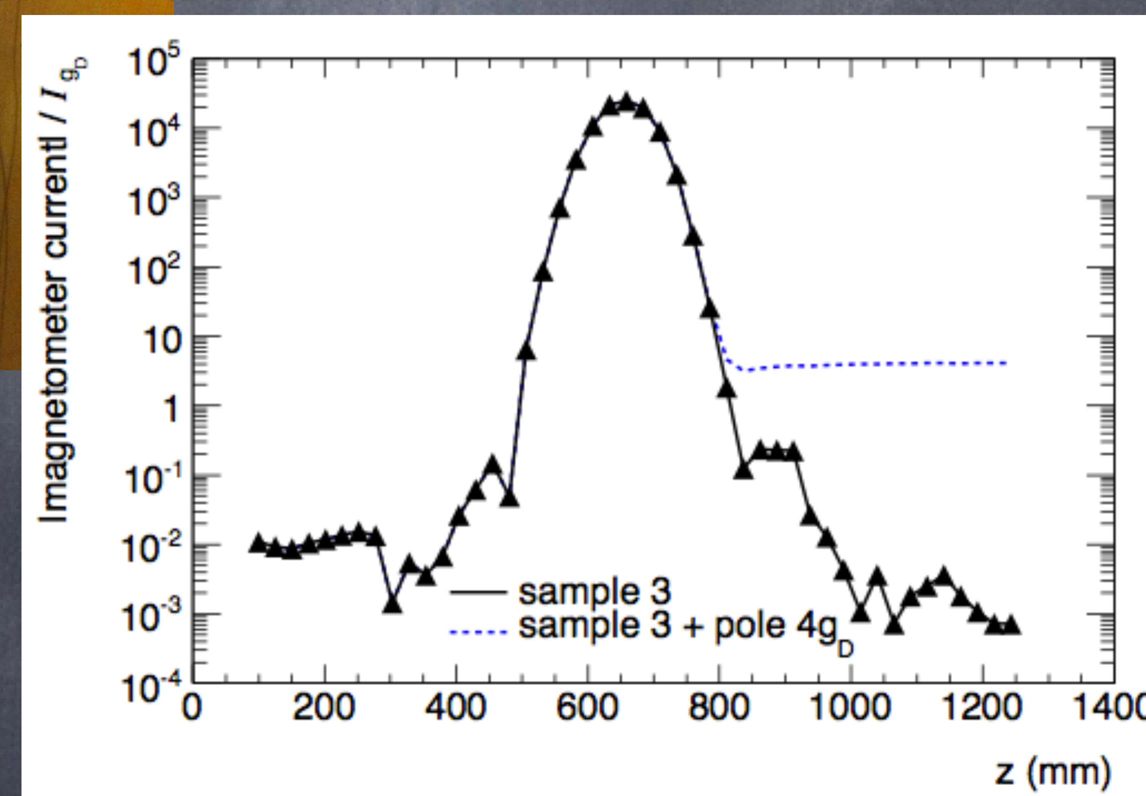
Searching for magnetic monopoles trapped in accelerator material at the Large Hadron Collider

M. Dam Joergensen, A. De Roeck, H.-P. Hächler, A. Hirt, A. Katre, P. Mermod, D. Milstead, T. Sloan

Pass interaction region accelerator material through SQUID.



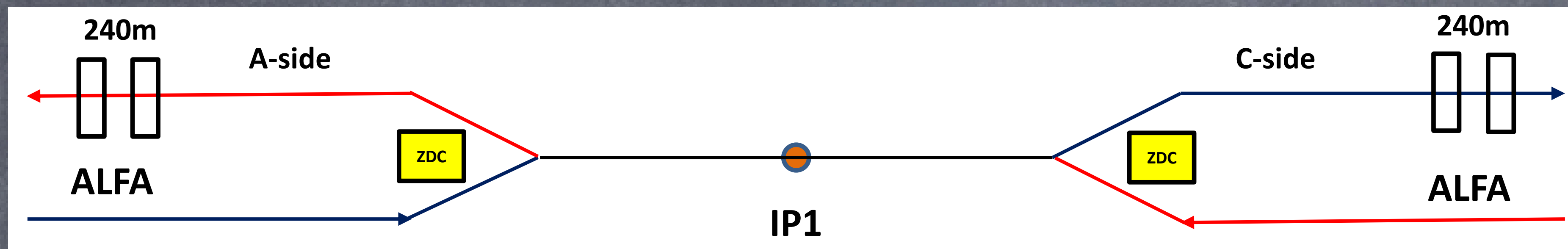
Observed current and would be signal from monopole



Planning to build facility to analyse complete CMS and ATLAS beam pipes when replaced about 2018

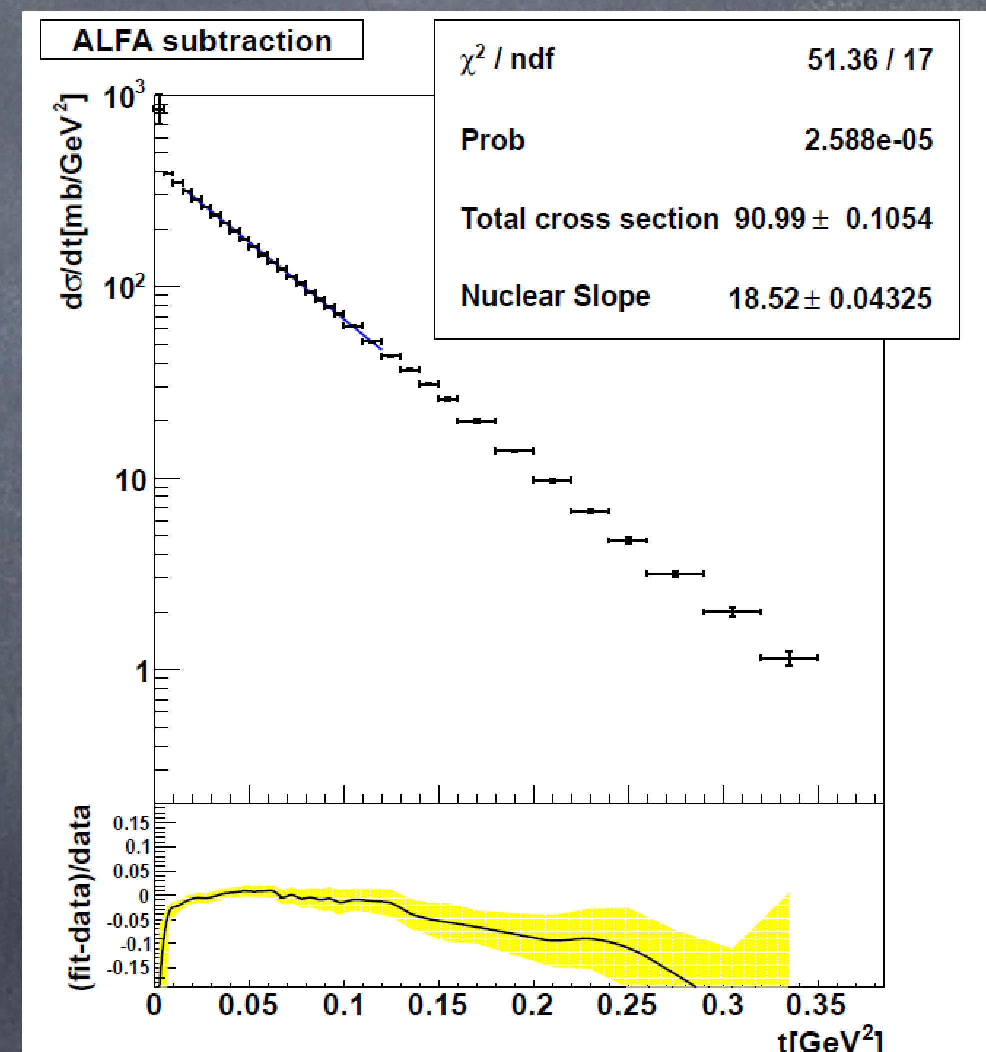
Soft QCD and such

ALFA Forward Spectrometer



Continue long tradition
for total, elastic, diffractive
etc pp cross-sections.
Applications in luminosity,
forward physics and astro-p.

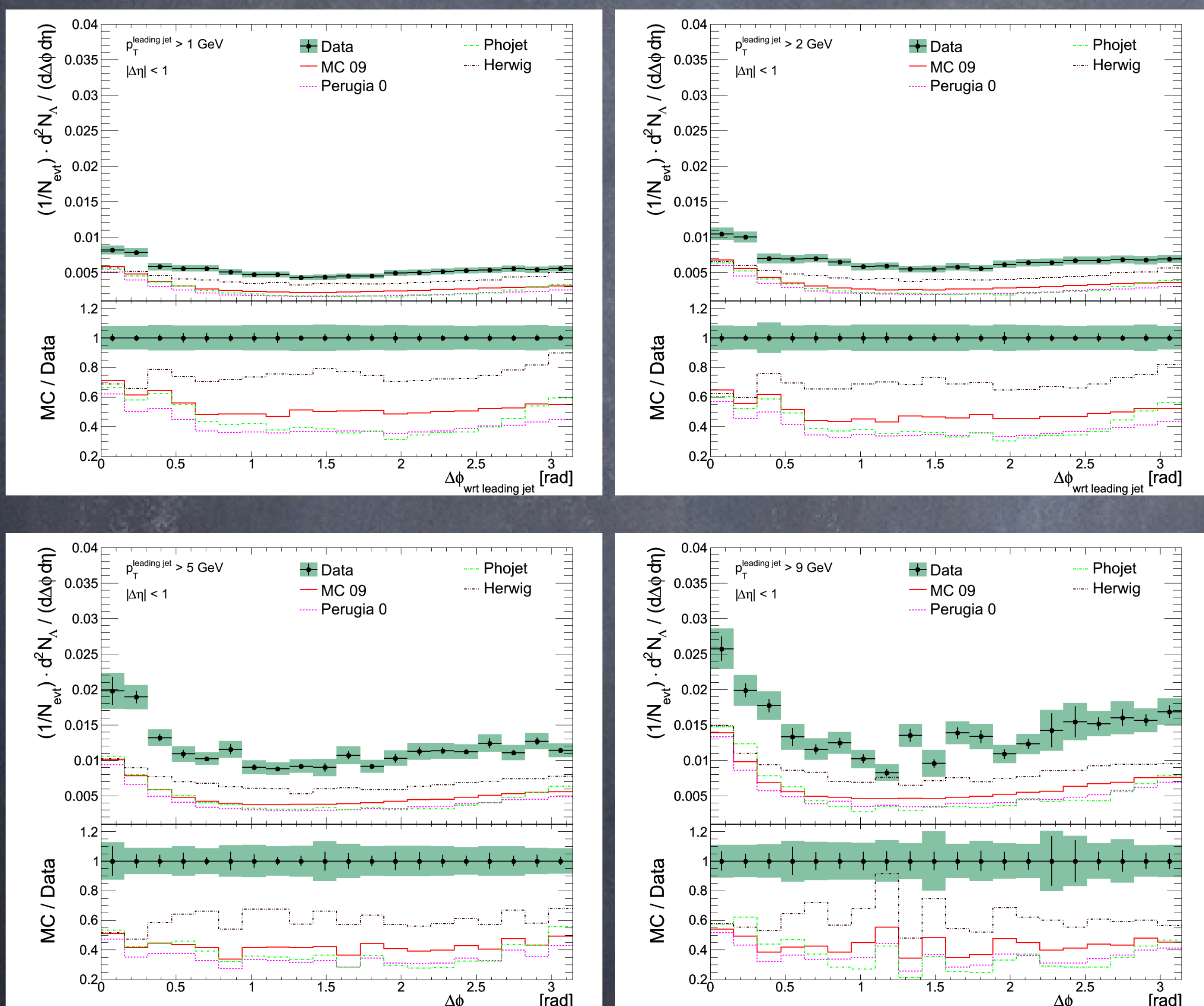
Results from beta* = 90m
run in Oct 2011 ---------------->

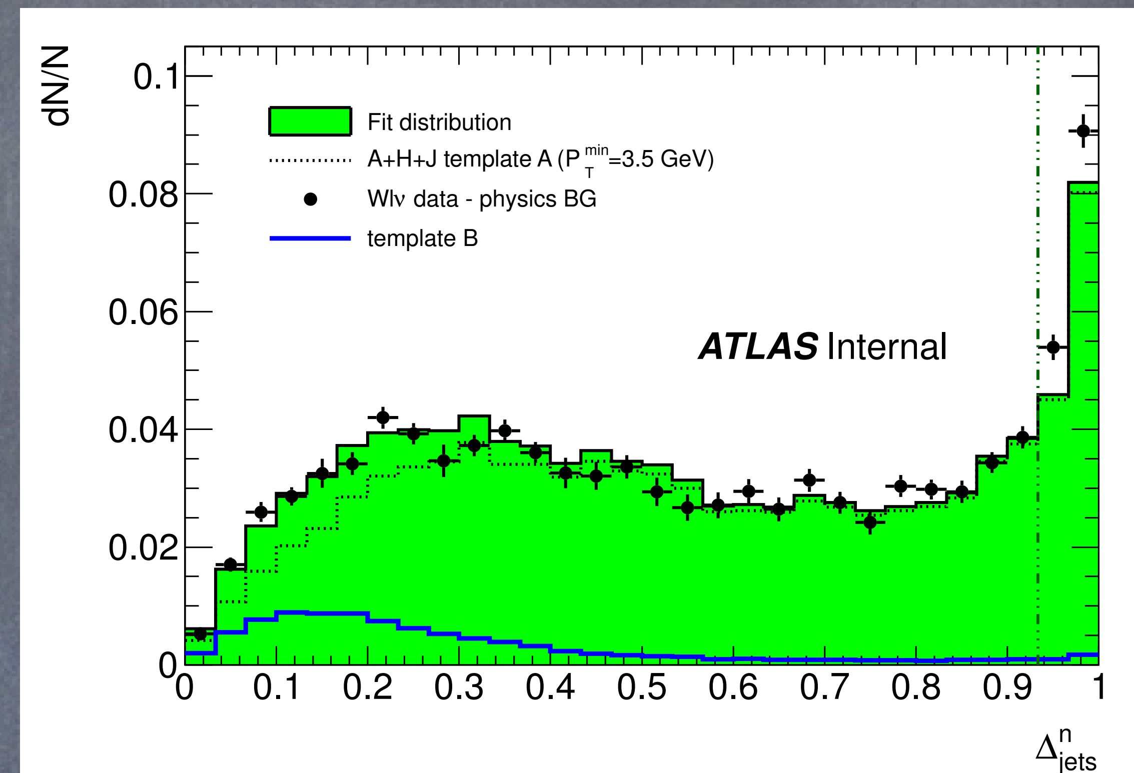


Much more accuracy from
1km run Oct 2012
reaching Coulomb interference

Underlying Event

o More Lambda and K0 in UE than predicted





o DPI from fit to W+2jets
Next: Repeat for Z+2jets

Also pA/pp: l^+l^- + X
Nuclear pdf's – in progress

Short Outlook

Finishing off the <10 TeV Analyses

- **Higgs Discovery:** Higgs or not? Standard Model or not? Or perhaps MSSM?
  - Measure its properties the best we can (need statistics)
    - Braching fractions: In particular, need to understand better the fermionic BRs (tautau + bbbar)
    - Spin-parity: ZZ channel is main handle
- **Precision Standard Model measurements:**
  - A prominent method to look for new physics
    - Di-bosons and TGC
    - Dijets
    - W mass
- **SUSY Searches:**
  - SUSY partners "getting heavy", especially squarks and gluinos. Natural?
  - Still some room for lightish sleptons and third generation squarks
- **Other searches:**
  - Rapidly closing the door for many "speculations"