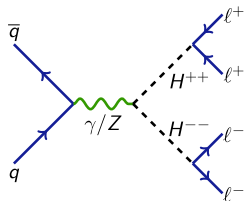
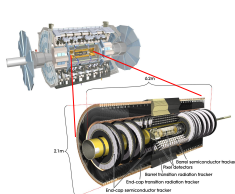


Searching for doubly-charged Higgs boson in multi-lepton final states with ATLAS

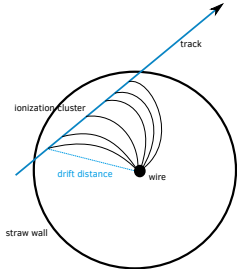
I tried so hard and got so far but in the end no significant excess is observed

Katja Mankinen

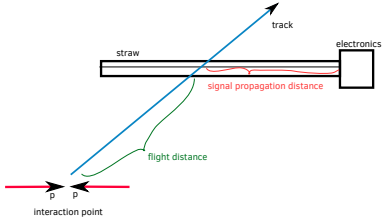


September 18, 2017

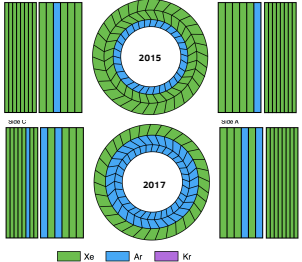
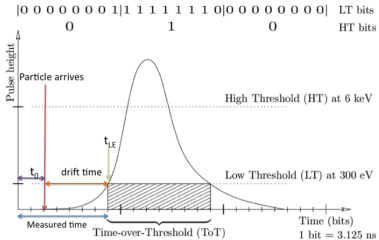
TRT - transition radiation tracker: t0 and r-t calibration

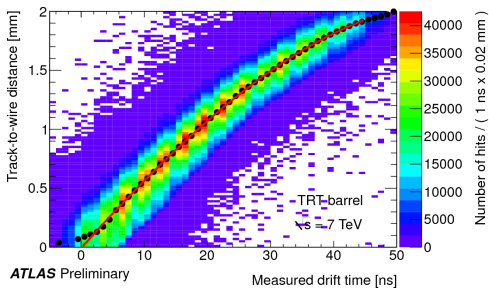
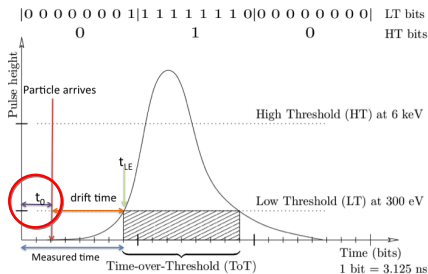


end view
diameter 4 mm



side view

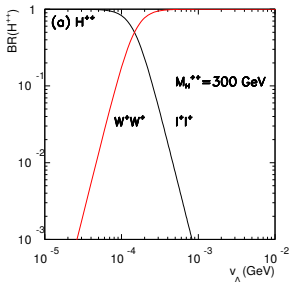
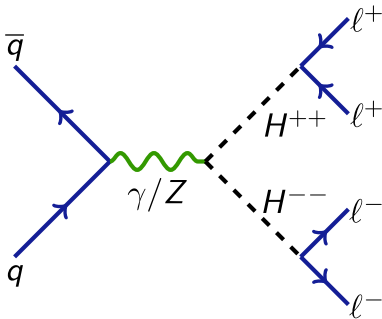




- ▶ $t_{\text{drift}} = t_{LE} - (t_{\text{collision}} + t_{\text{ToF}} + t_{\text{SP}}) = t_{LE} - t_0$
- ▶ once we have t_{drift} , we can calculate the track-to-wire distance as long as we know the $r - t$ relationship
- ▶ aim of the TRT calibration is to provide the best estimate for the track-to-wire distance based on measuring the t_{LE}
- ▶ → precise measurements of the trajectories of charged particles and the best momentum reconstruction in the TRT.

Main analysis goal: discover $H^{\pm\pm}$ through multi-lepton final states

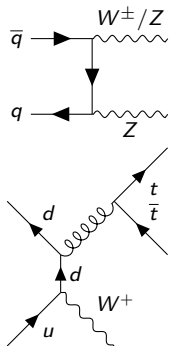
$$BR(H^{\pm\pm} \rightarrow \mu^{\pm}\mu^{\pm}) + BR(H^{\pm\pm} \rightarrow e^{\pm}e^{\pm}) + BR(H^{\pm\pm} \rightarrow e^{\pm}\mu^{\pm}) + BR(H^{\pm\pm} \rightarrow X) = 100\%$$



Backgrounds

Prompt

Real prompt leptons:
 $Z(W/Z), tt(W/Z)$

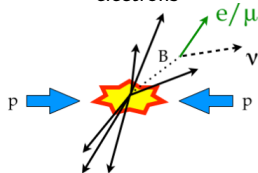


Estimated with simulation

Non-prompt

Real e or μ from non-prompt
decays, e.g. from heavy
flavored mesons

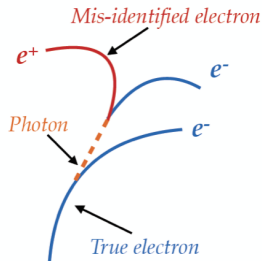
Jets mis-reconstructed
as electrons



Data-driven estimation with
the fake factor method

Charge-flip

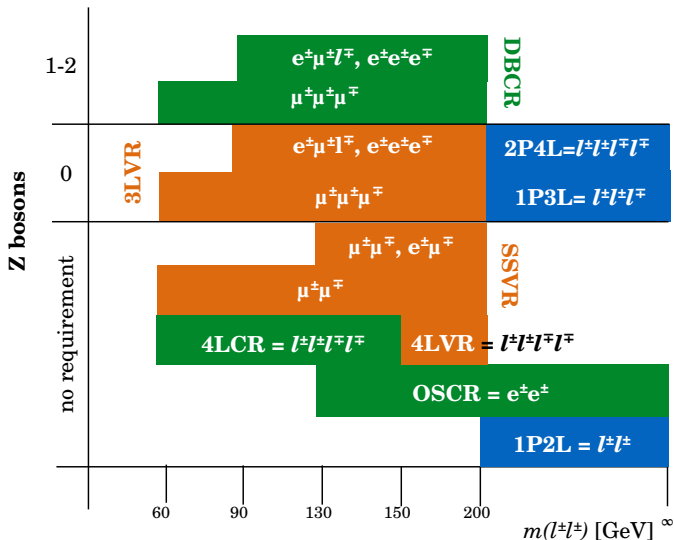
Oppositely charged leptons
with charge mis-ID:
 $Z/\gamma^*, tt, tW, W^\pm W^\mp$

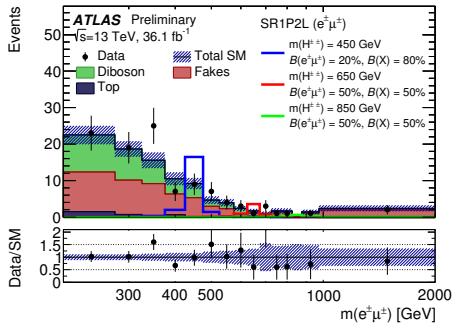
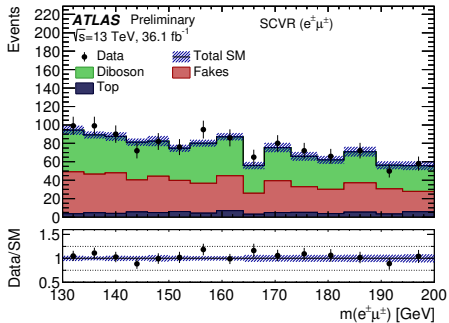


Charge-flip probability
measured in a $Z \rightarrow ee$ sample
with a likelihood fit

Analysis regions

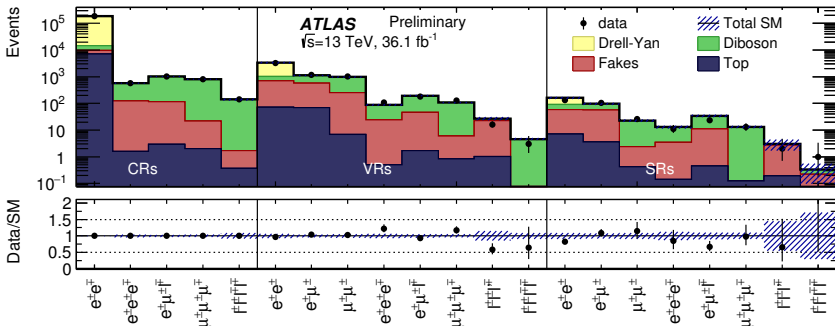
- (a) **Control regions (CR)**: to fit VV (ZW, ZZ) and DY normalization
- (b) **Validation regions (VR)**: to validate fakes and charge-flips
- (c) **Signal regions (SR)**: used to extract signal rate



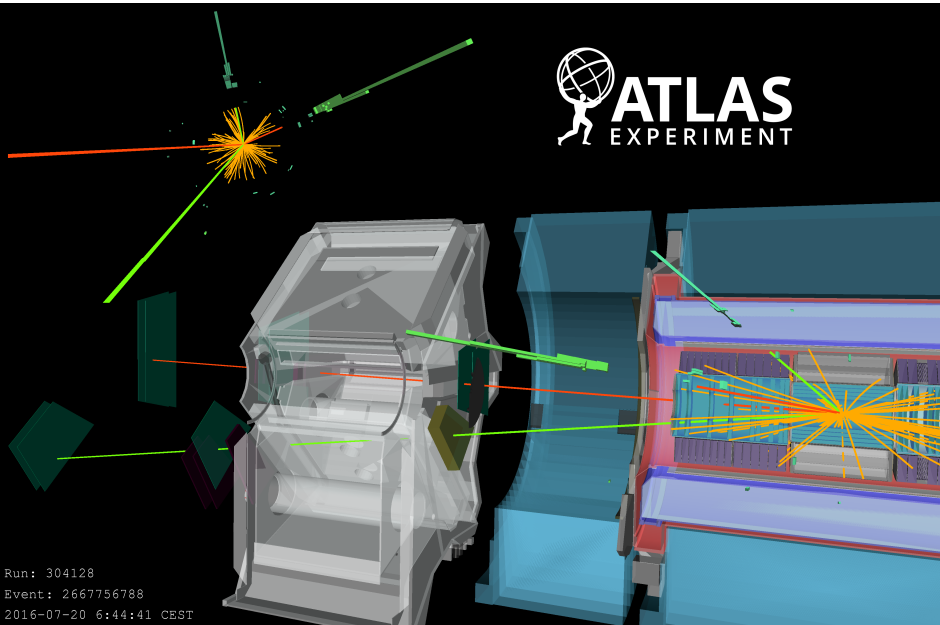


Fit & results

a maximum-likelihood fit of the invariant mass distribution



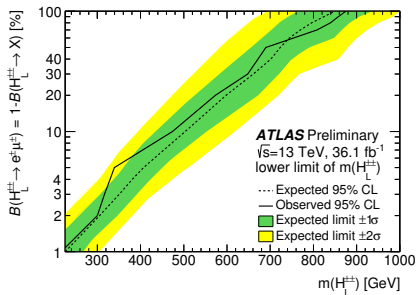
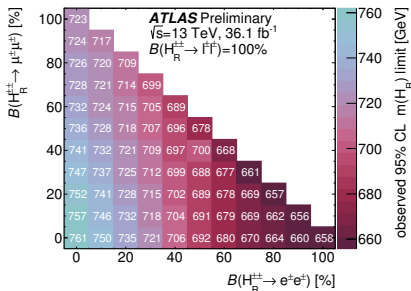
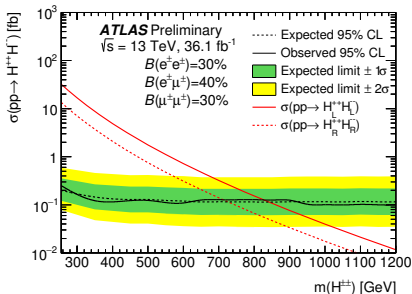
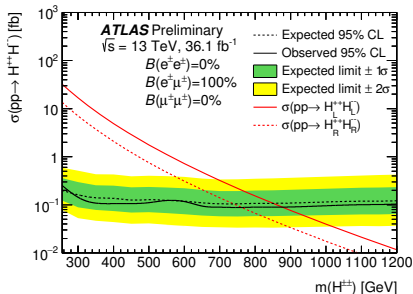
No significant excess is observed in any of the signal regions. :(



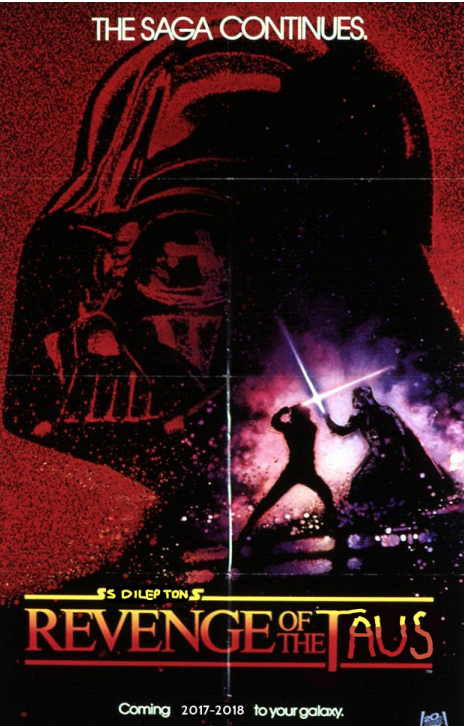
Run: 304128

Event: 2667756788

2016-07-20 6:44:41 CEST



THE SAGA CONTINUES.



STAR WARS THE FORCE AWAKENS

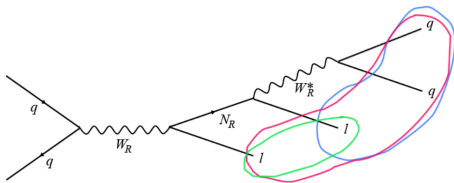
REVENGE OF THE TAUS

Coming 2017-2018 to your galaxy.

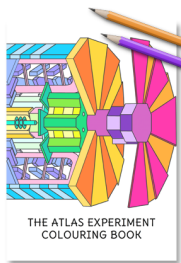


Coming next

- ▶ "Search for doubly-charged Higgs boson production in multi-lepton final states with the ATLAS detector using proton-proton collisions at $\sqrt{s} = 13 \text{ TeV}$ " is coming soon!
- ▶ Add taus to have all lepton combinations ($ee, e\mu, \mu\mu, e\tau, \mu\tau, \tau\tau$) and look at other $H^{\pm\pm}$ production mechanisms for the end of Run2 results; **model dependent** vs **model independent**
- ▶ Heavy neutrino SS channel:



- ▶ teaching Introduction to programming and computing for scientists
- ▶ studying Statistical Tools in Astrophysics



Wise final words

Go to CERN School of Computing!

Document your code and work and share with others!

