



$X \rightarrow hh \rightarrow 4b$

motivation, preliminary jet efficiency &
preparations for run 2

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REU work at CERN winter 2015

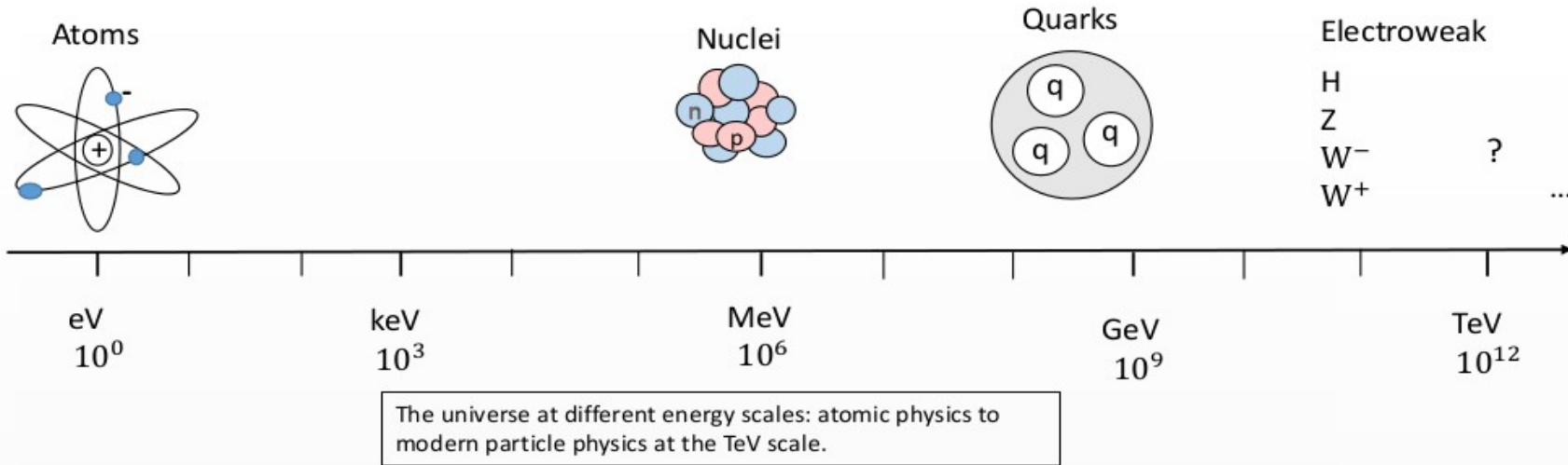
mentors: Stephane Willocq & Massimiliano Bellomo

April 9, 2015

Outline

- The Exotics group
- My project
- Learning & Enrichment
- Future





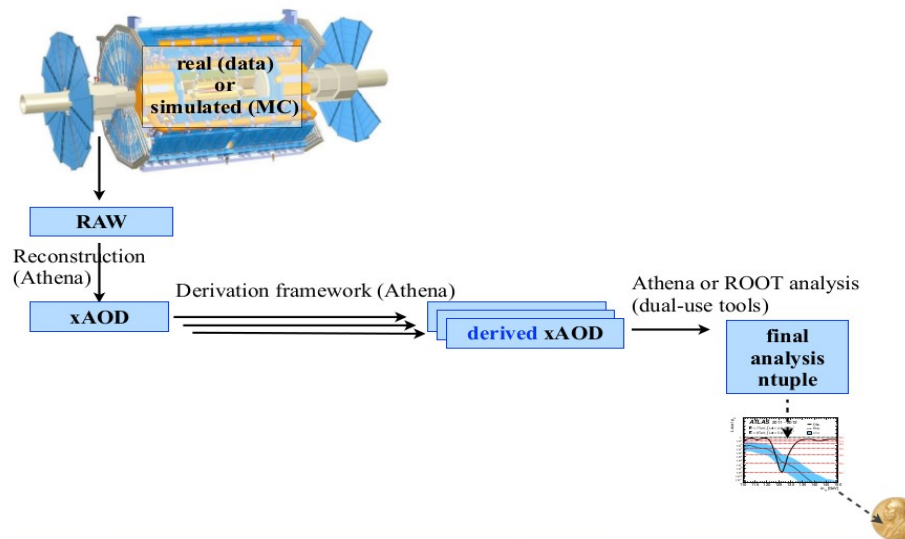
Discovery of the Higgs boson opens new possibilities of probing the Electroweak scale and the production of heavy particles at the LHC

- Use the Higgs boson as a tool for further discovery
- Many new physics models predict significant rates of Higgs pair production
 - New resonances : Kaluza-Klein Graviton
 - Extended Higgs sector : 2 Higgs doublet model
 - Non-resonant production : new coloured scalars

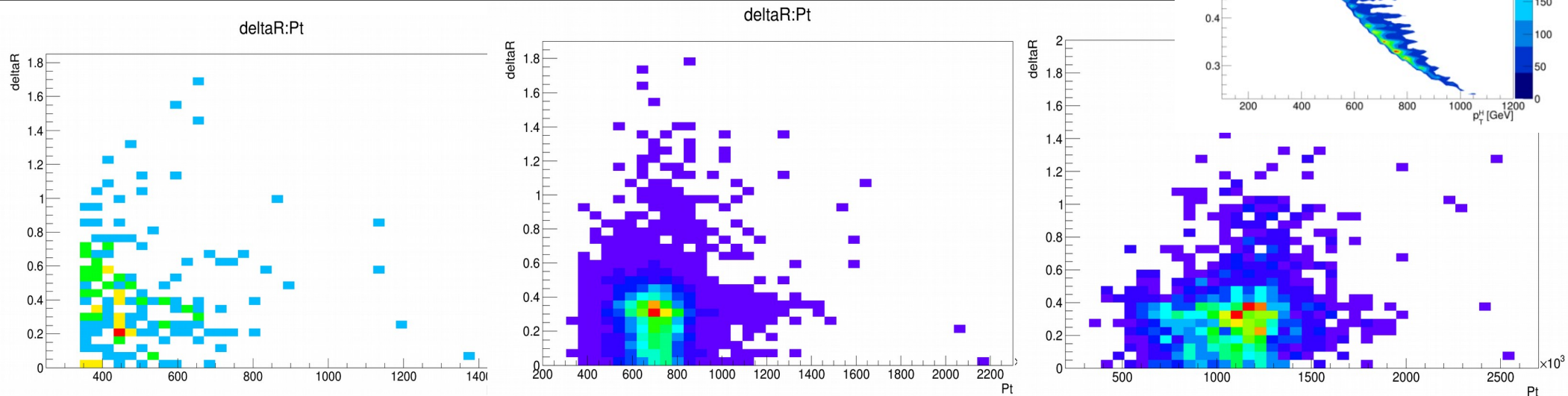
XhhBoosted package

- <https://svnweb.cern.ch/trac/atlasphys-exo/browser/Physics/Exotic/JDM/hh4b/Run2/Code/XhhBoosted>
- The algorithm:
- *Large-R jet selection* → *Ghost association of track jets* → *optimize delta eta* → *b-tagging*
- Event Loop package that builds on xAODAnaHelpers
 - A set of common algorithms performing basic object calibration, selection, and plotting
- To test out package:
- <https://twiki.cern.ch/twiki/bin/view/AtlasProtected/XhhExample>

The ATLAS Analysis Model

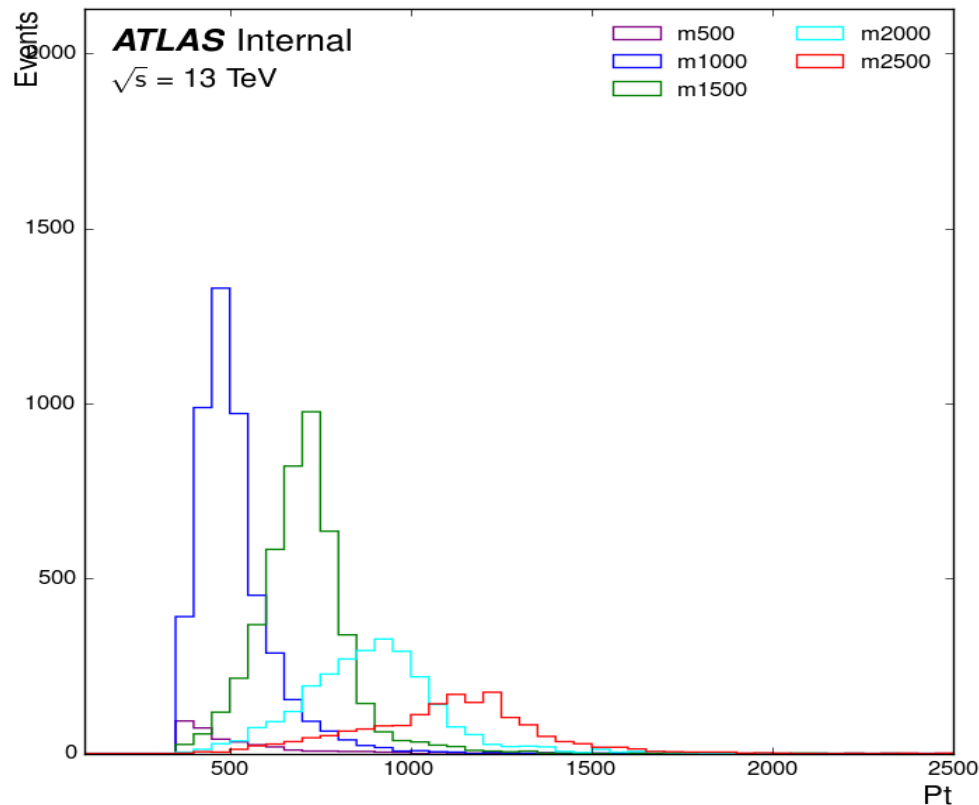
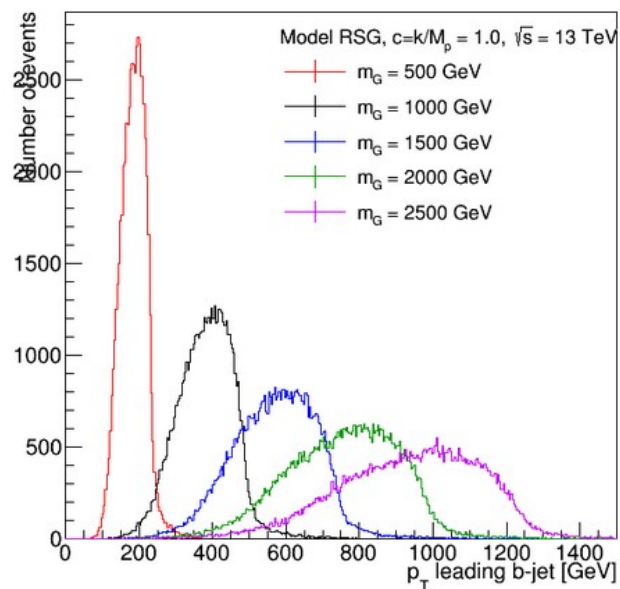


DeltaR vs Pt of leadingJet



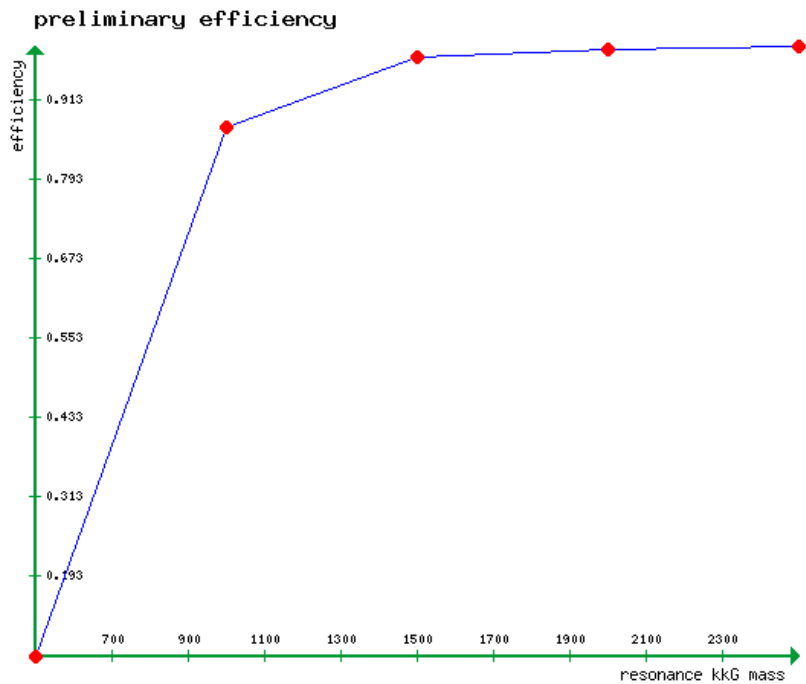
- Angular separation for 2-body decay products of a heavy particle is approximately : $\Delta R \sim 2m/P_t$
- For a Higgs with P_t greater than 625 GeV, the threshold where jets begin to merge is $R=0.4$
- This is the motivation for the boosted analysis strategy
- Allows for Higgs bosons with higher P_t to be reconstructed
- Plots ΔR as a function of leading jet P_t at 13 TeV : from left to right mass resonance signal 500,1500,2500 GeV
- Upper right corner plot is from 8TeV study with ΔR as a function of Higgs P_t

Leading jet Pt cut > 350 GeV

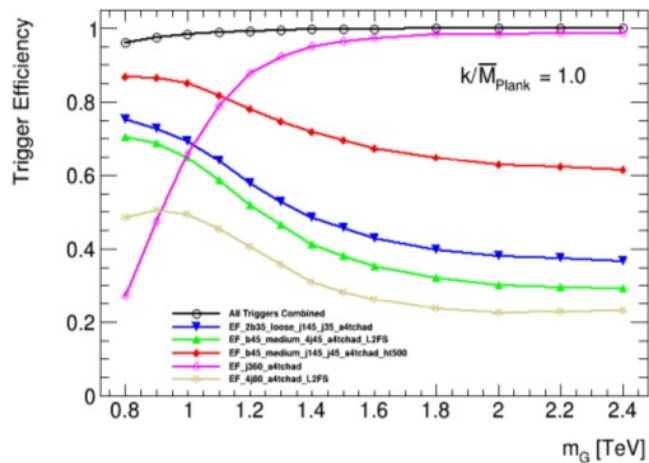


- Right plot : distribution of leading Jet Pt with different signal resonances of kkGraviton.
- LeadingJet cut > 350 GeV
- At higher Pt it is still unknown the best way to optimize for a signal

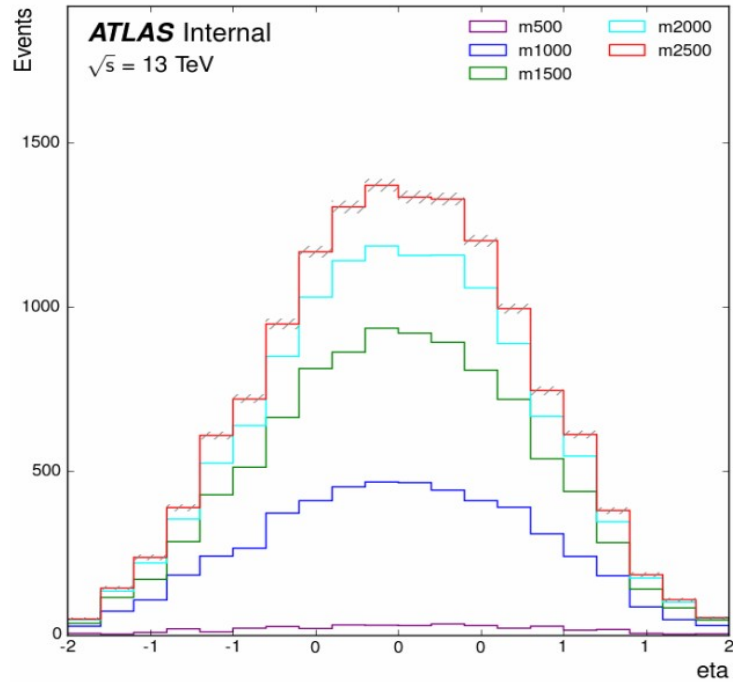
Preliminary efficiency based on leading jet pt cut



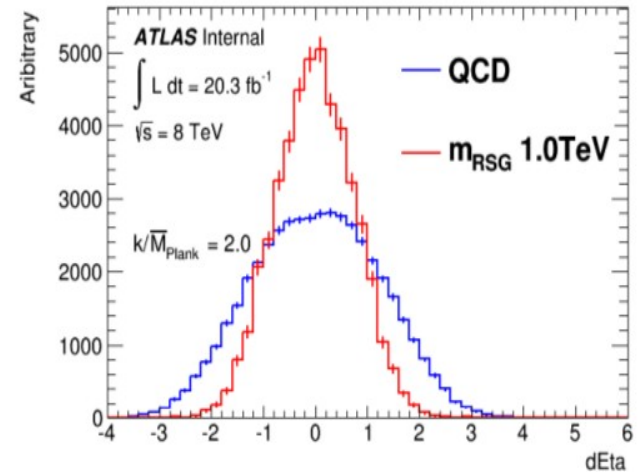
- Plot on left : 13 TeV
- After cut of leading Jet > 350 GeV
- Plot on bottom : 8 TeV
- After event and jet cleaning
- (both simulation)



Overall, correlation with expectations are reasonable

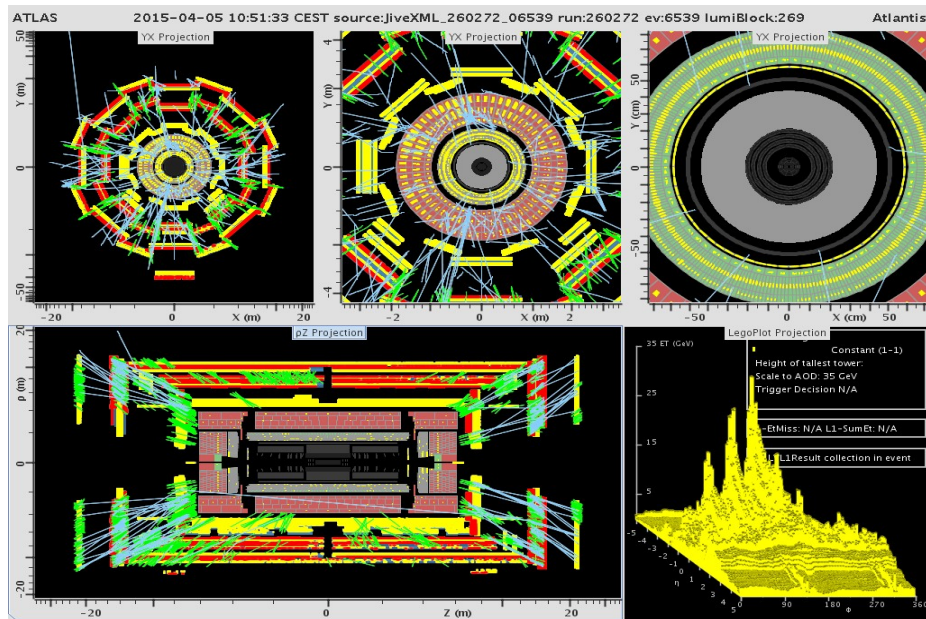


- Normalized distributions of eta and delta eta will be used in comparing QCD and ttbar backgrounds



But this does not mean that we know what to expect in run2

- We do know that combined jet reconstruction and flavour tagging will increase sensitivity
- Next steps : b-tagging optimization framework & QCD , ttbar studies
- What does run 2 have in store ?
- Indeed an exciting time to be here !



Acknowledgements

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