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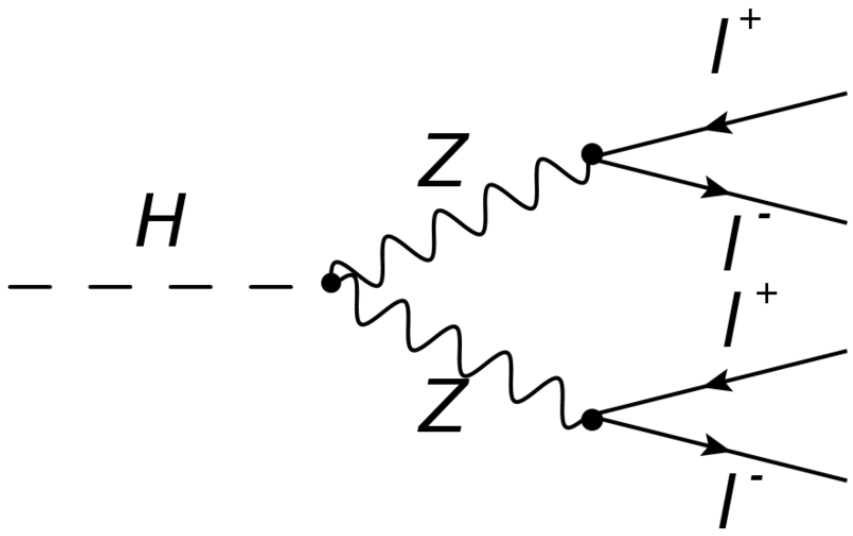
Outline

- Project not fully decided at this point
- Talk about what I have been doing so far
- Two likely subjects for my project

Initial Exercise

- Small amount of coding experience, none with ROOT
- Analyze the H -> ZZ(*) -> 4l chain and reproduce graphs of invariant mass and transverse momentum http://cds.cern.ch/record/1523699/files/ATLAS-CONF-2013-013.pdf
- Data taken from 2012 of 20 fb^{-1} and sqrt(s) = 8 TeV



Problems Arise

- Unaware that cuts had been applied in creating the nTuples which eliminated most low-pT leptons and with them the Higgs signal
- Data left produced only 3 lepton quadruplets with IM below 150 GeV, which makes it impossible to find a Higgs signal of 125 GeV

Initial Exercise Part 2

- Instead look at the SM ZZ -> 4l chain

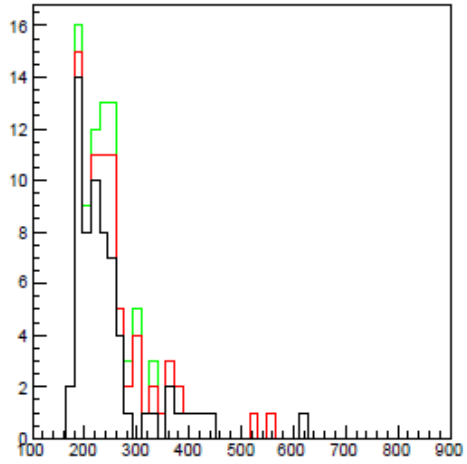
http://cds.cern.ch/record/1525555/files/ATLAS-CONF-2013-020.pdf

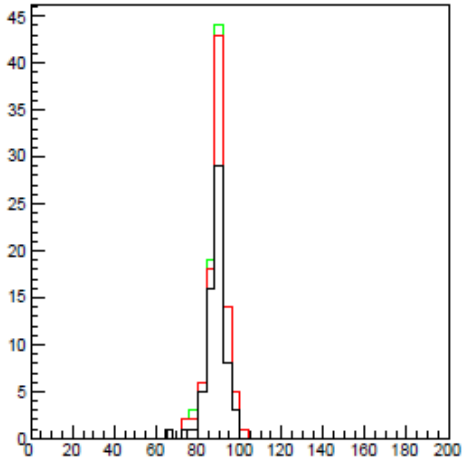
- Both Zs on-shell so this avoids the problem

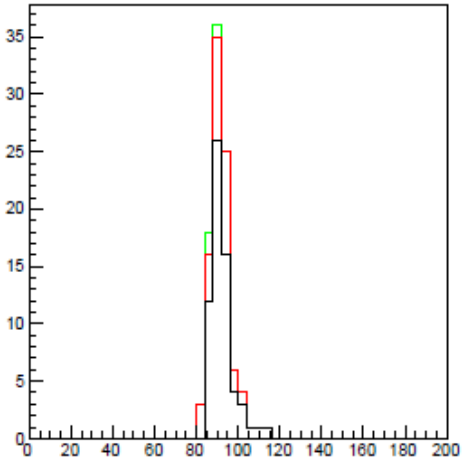
- Cuts applied
  - Require 4 leptons – only looking for eemm, eeee, mmmm
  - Require that leptons come in oppositely charged pairs
  - Ensure all leptons have P_t > 7 GeV
  - Check that both lepton pairs are 66 GeV < P_t < 116 GeV
  - Note: Leading pair is determined to be that with IM closest to a Z (91 GeV)

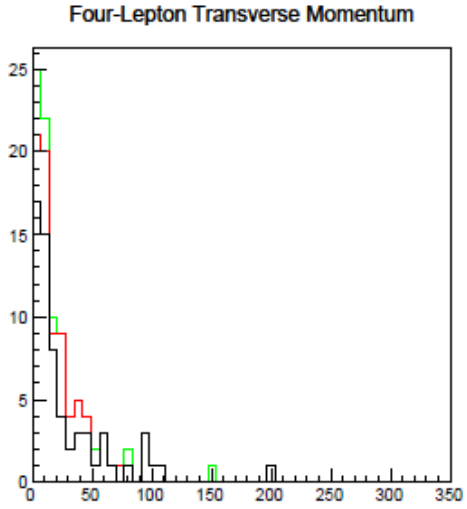
Results (Data)

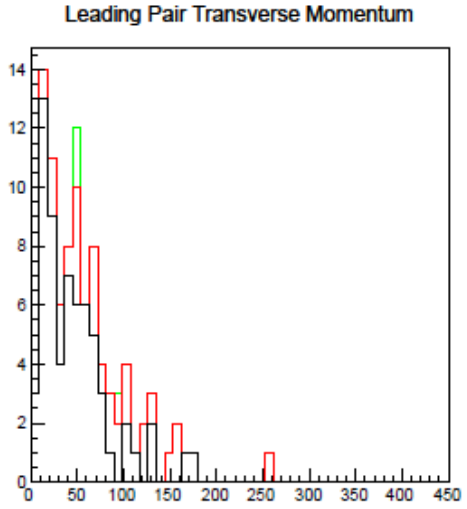
Legend:
Black: eemm
Red: mmmm
Green: eeee

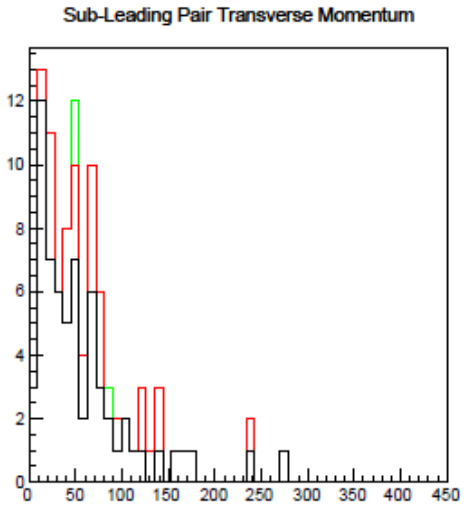








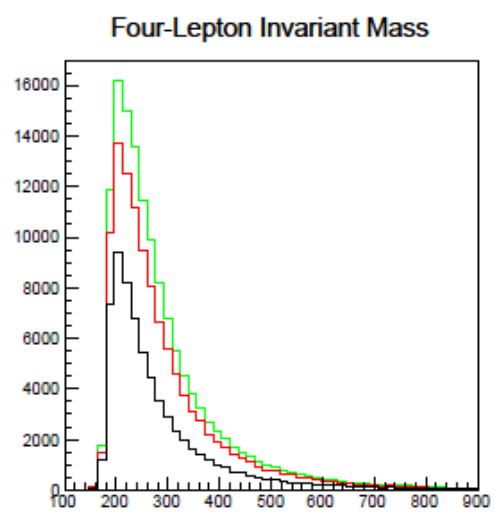


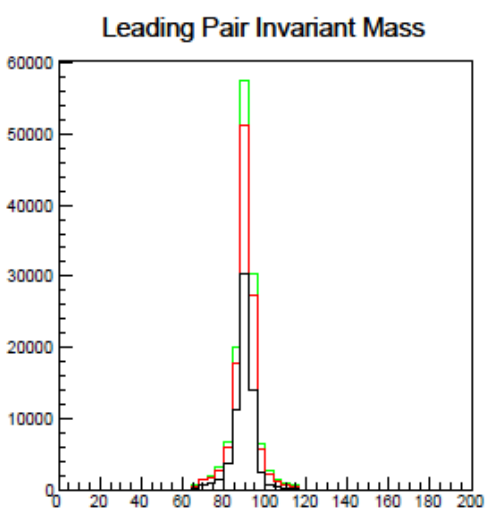


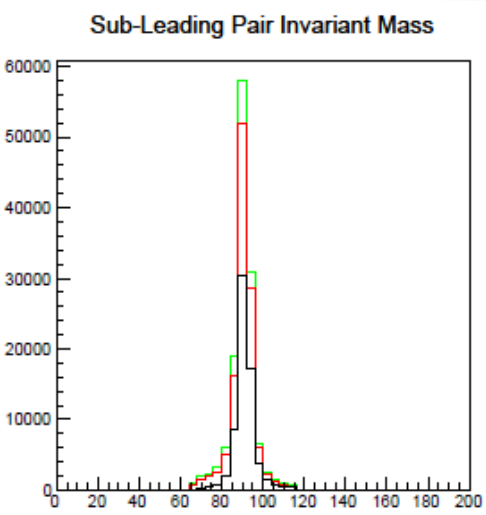
Results (MC)

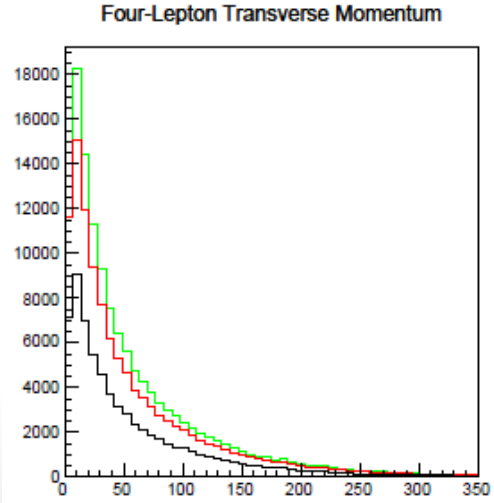
Processes included:

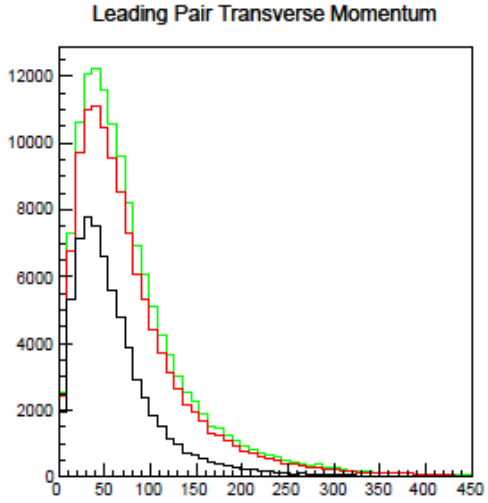
gg->ZZ->4e
gg->ZZ->4m
gg->ZZ->2e2m
ZZ->2m2t(mll>4GeV)
ZZ->4e(mll>4GeV)
ZZ->2e2m(mll>4GeV)
ZZ->2e2t(mll>4GeV)
ZZ->4m(mll>4GeV)
ZZ->4t(mll>4GeV)
ZZ->eenunu(mll>4GeV)
ZZ->mumununu(>4GeV)
ZZ->tautaununu(>4GeV)
ZZ->llnunu+jj (6EW)
ZZ->llll+jj (6EW)

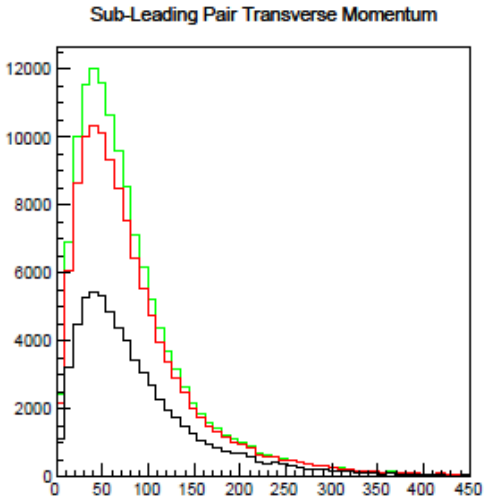












Further Improvements

- Improve graph formatting
- Normalize Monte Carlo plots

Potential Research Projects

- W-gamma background estimate in HWW analysis
  - Important because kinematically similar to Higgs signal
  - New method based on conversion electron properties

- Study slight discrepancies in W+W- cross-sections which may be signs of new physics
  - Cross sections measured by ATLAS and CMS, while within error limits, are consistently higher than predicted by theory which can be explained by charginos. http://arxiv.org/pdf/1206.6888v2.pdf
  - ATLAS: 53.4 +- 2.1(stat) +-4.5(syst) +- 2.1(lumi) pb
  - CMS: 52.4 +- 2.0(stat) +-4.5(syst) +- 1.2(lumi) pb
  - Theory: 47.0 +- 2.0 pb

  (These are the cross-sections for 7 TeV COM energy)

Thank You

Questions?

Top of Le Reculet

Cutflow

	eemm	mmmm	eeee
Total Events:	2.68884e+06		
Four Leptons:	200167		
Flavor Pairs:	79017	80452	39292
Opp Charges:	78579	80448	38876
Indiv. Energies:	78579	80448	38876
Pairs in IM Range:	66711	44958	22801