Short exercise - part 2

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Short exercise - part 1

Introduction / cross section measurement

- We are looking for a specific decay mode of top pair production:
  - semileptonic decay mode in muon-only channel
  - BR(tt→μνbqqb) ~ 2 × 11% × 67% ~ 15%
  - only a small fraction of decaying tt-bar events is under investigation
- Out of those a fraction is lost because of
  - trigger efficiency
  - (Acceptance) x (reconstruction efficiency)
- The number of observed events after selection includes background events surviving our selection
  - we can subtract this contribution based on MC prediction
  - now we are ready to compute the cross section:
    - $N = \sigma L$
  - but... we need to keep into account trigger efficiency and acceptance

- NNLO cross-section at $\sqrt{s}$ = 7 TeV (M. Czakon, A. Mitov, 2013)
  - $\sigma(pp \rightarrow tt) = 173.60\ ^{+11.24}\ _{-11.78}\ pb^{-1}$

Short exercise - part 1

Integral and errors

- IntegralAndError method from TH1F gives back integral value and associated error
- Useful to estimate number of events and its uncertainty

```
minBin = histo.GetXaxis().GetFirst()
maxBin = histo.GetXaxis().GetLast()
nDataErr = ROOT.Double()
nData = histo.IntegralAndError(minBin, maxBin, nDataErr)
### nDataErr will be overwritten with the correct value for the uncertainty
print "Integral %f +/- %f"%(nData,nDataErr)
```

- In Plotter.py you can find some useful functions:
  - getHisto(var, samp)
    - get TH1F histogram “var” for sample “samp”
  - getBkgHisto(var, samples)
    - get TH1F histogram “var” for the sum of background contributions
  - getSigHisto(var)
    - get TH1F histogram “var” for the signal (ttbar)
- Add it in your python file
  - please run processEvents() only if you actually need to redraw the plots!

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Introduction / cross section measurement

1. Background subtraction:
   - after applying selection to data and MC, count the number of expected background events in simulation and subtract it to the number of observations
2. Evaluate acceptance
   - the acceptance includes all the selection cuts that have been applied, and it accounts also for the fact that we are selecting only semileptonic decay of top quark pair, in the muon channel
   - to compute it, compare the integral of the tt-bar histogram applying and without applying your selection (excluding trigger selection)
   - the latter number is 7928.61
3. Evaluate the trigger efficiency
   - trigger selection is not applied a-priori on simulated tt-bar events, so you can use it to estimate trigger efficiency after the selection
4. Cross section computation:
   - calculate the top pair production cross section at 7 TeV
   - remember to correct by trigger efficiency, ε_{trig}, and acceptance, A
5. Quote statistical uncertainty
   - compute the statistical uncertainty due to limited availability in terms of statistics

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Introduction / cross section measurement

6. Evaluate the impact of systematic uncertainties as well and quote them in the result
   - 10% on luminosity
   - MC statistical uncertainty on background, acceptance and trigger efficiency
   - (This is just an exercise we are neglecting many other systematic uncertainties...! :-))

7. Compare your result with theory expectation

- To be shown in the paper:
  - The selection that you applied with brief motivations and plots
  - Cross-section with statistical, systematic, and total uncertainties
    - report also the number of data and background events expected
  - Trigger efficiency (with MC stat error)
    - report also the raw number used to calculate it
  - Acceptance (with MC stat error)
    - report also the raw number used to calculate it

backup