

LZStats

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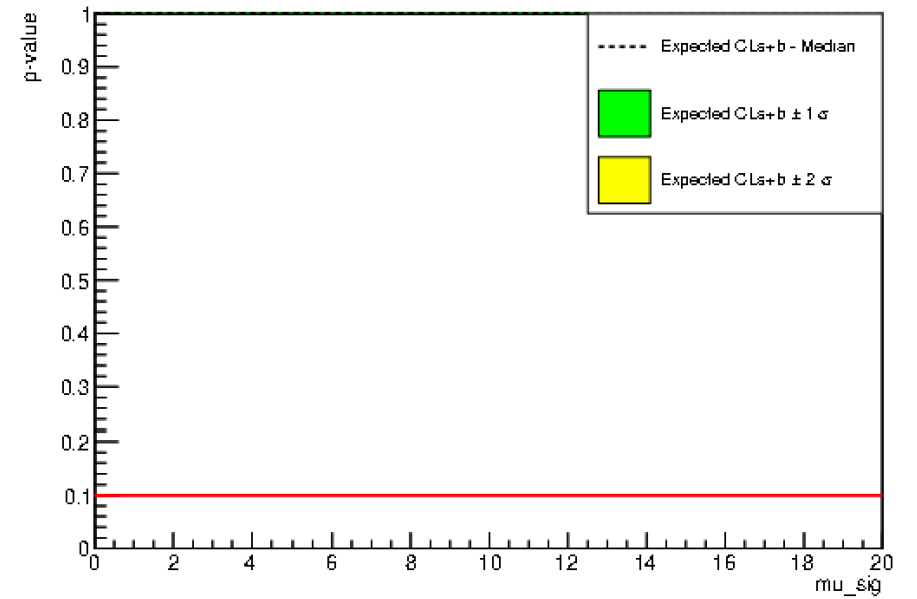
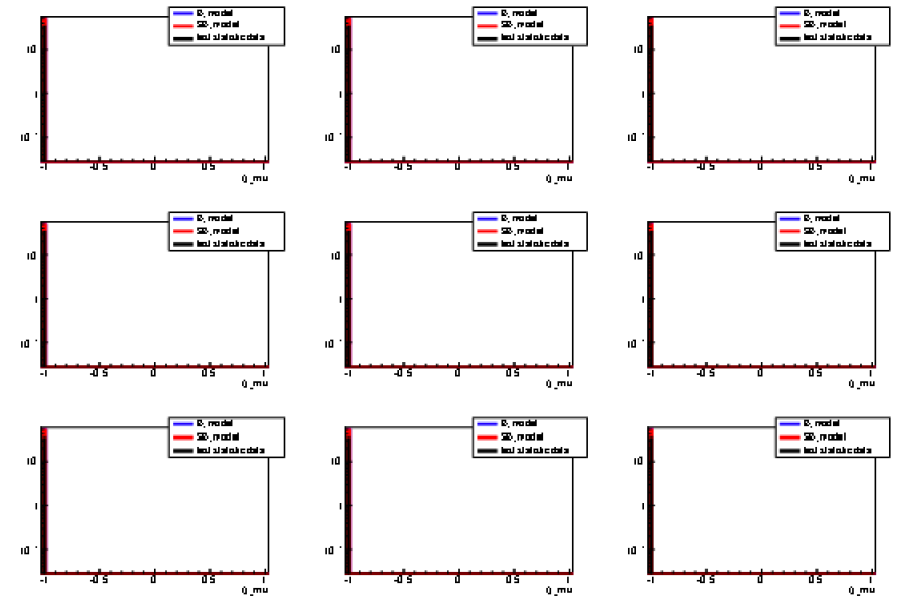
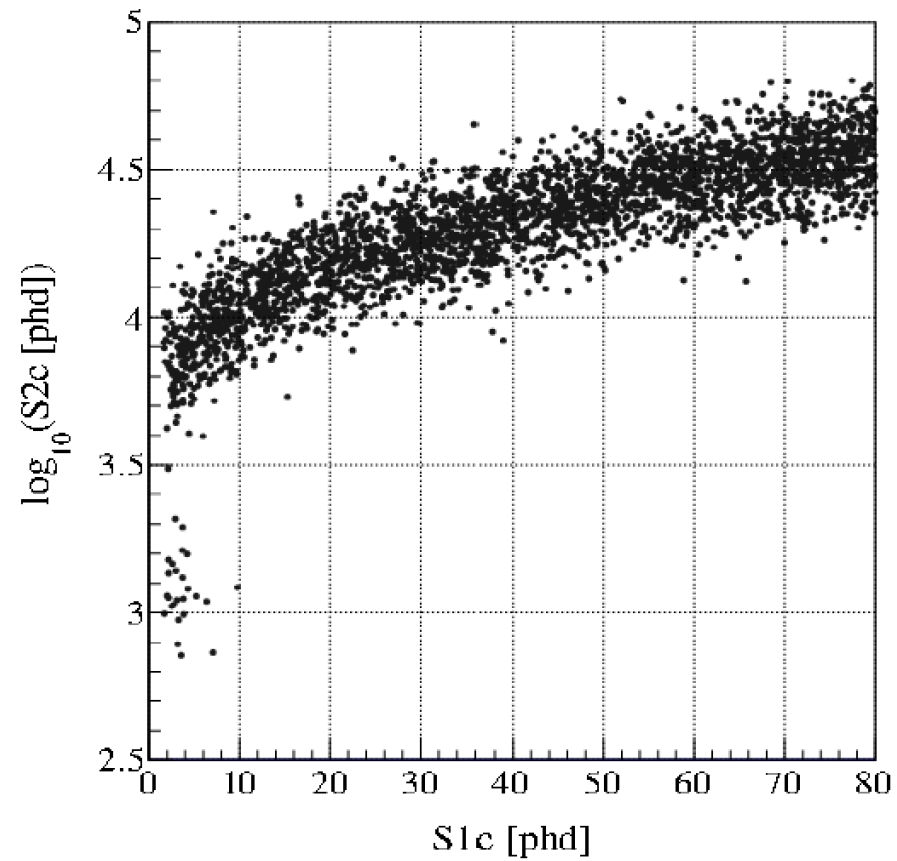
What's done

- LZNESTUtils: Change to a new branch
- PdfMakers: compile the background code successfully
- LowR_NR: passed 12 root files (1 signal +11 backgrounds) to make a workspace (1 root file)
- LZStats: run the code locally with the workspace generated from the LowR_NR

Running LZStats

- Frequentist Analysis (limit setting)
 - Confidence level: 90%
 - Fiducial mass (kg): 5600
 - Livetime(days) : 1000
 - Paritcle mass (GeV): 40
 - MC toys per point : 100
 - Number of Points: 9
 - Min POI: 0
 - Max POI: 20

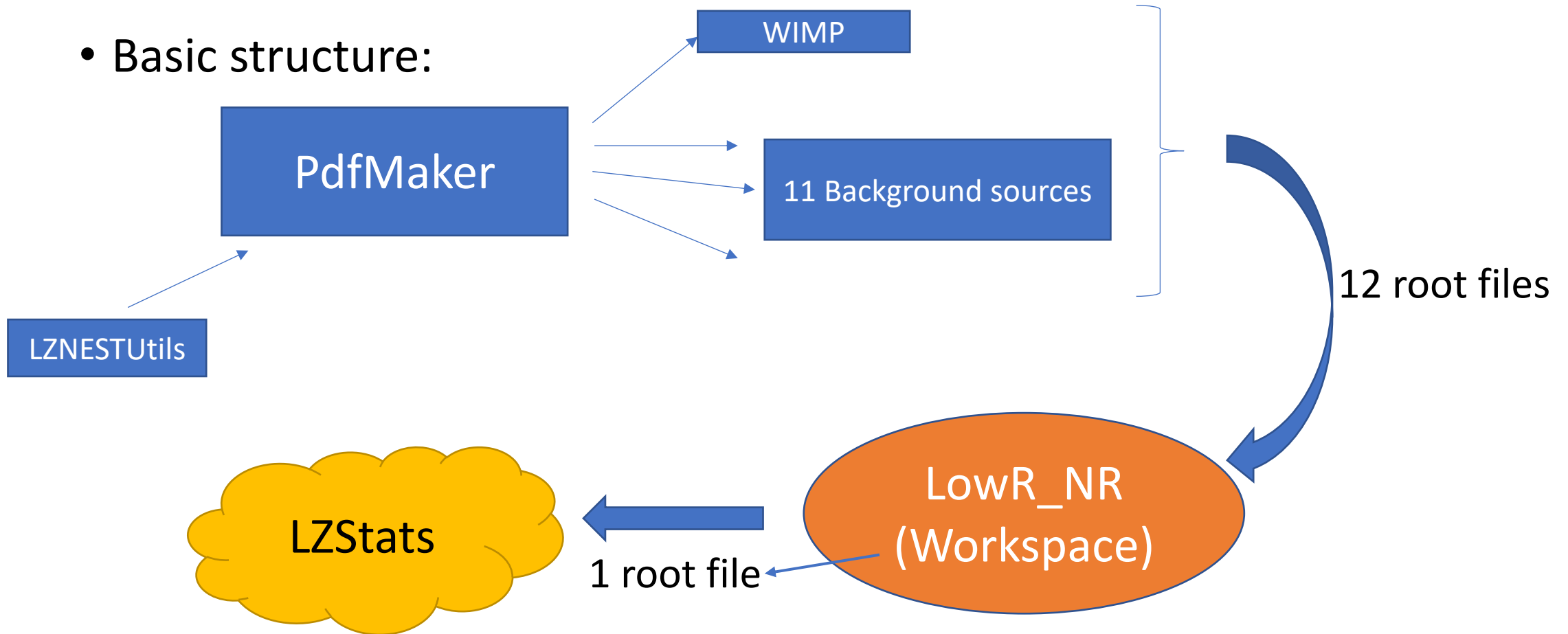
Problem



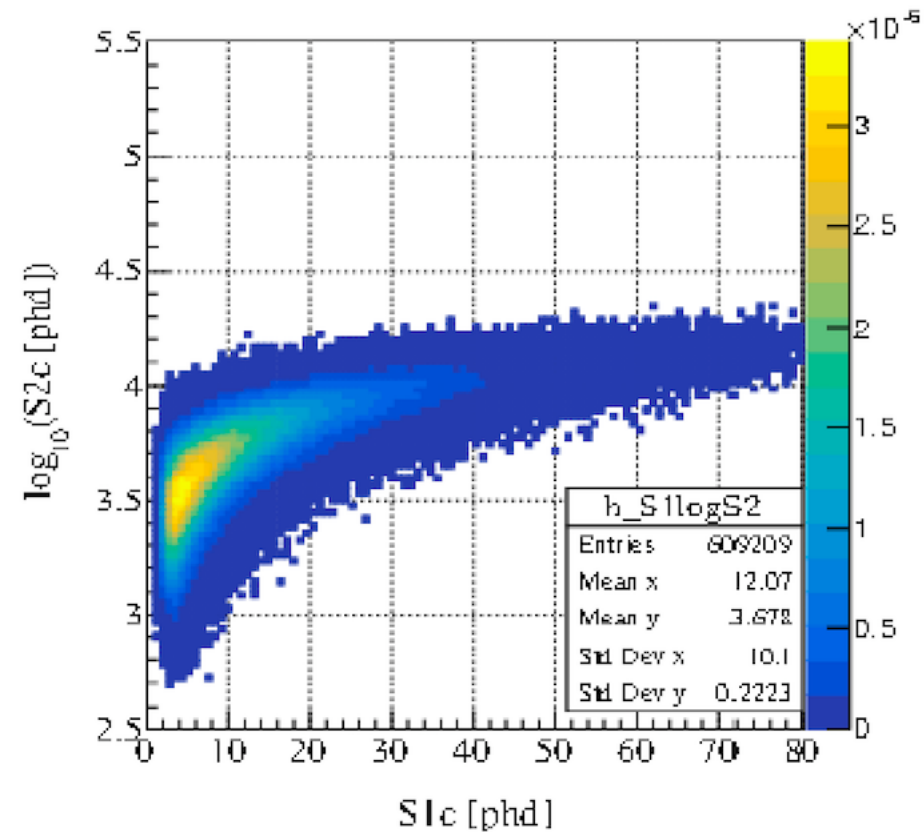
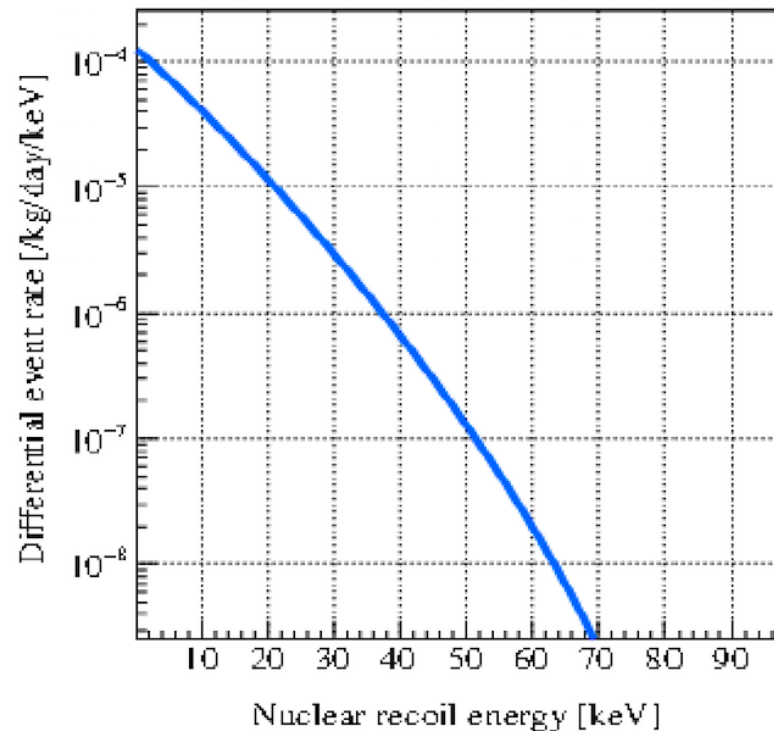
```
Error in <ROOT::Math::FitResult>: FitConfiguration and Minimizer result are not  
consistent  
Number of free parameters from FitConfig = 12  
Number of free parameters from Minimizer = 11
```

Changed LZStats

- Basic structure:



Output of signal (40GeV WIMP) from PdfMaker



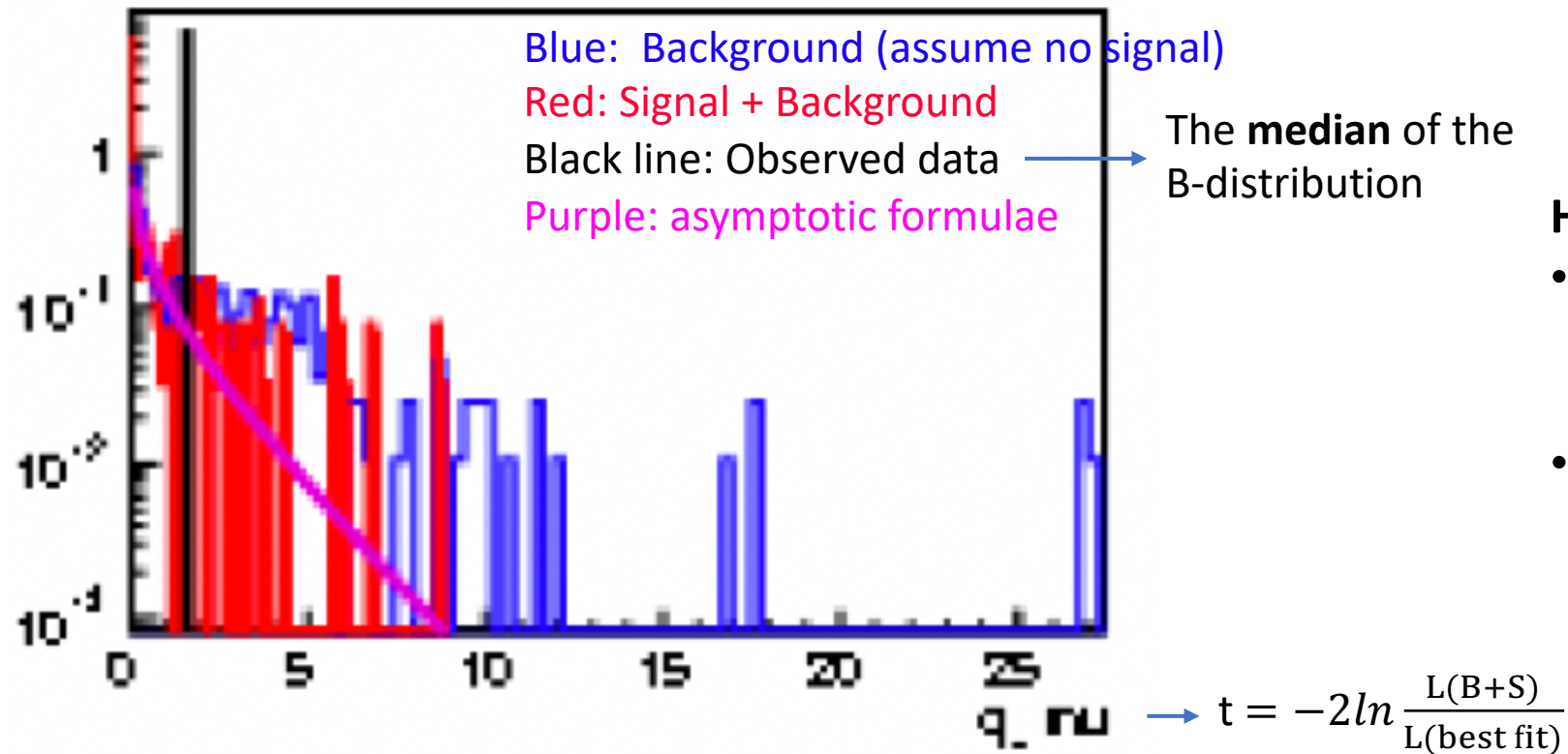
Workspace → RooWorkspace

- Settings
 - WIMP_mass = 40
 - Interaction type = Spin Independent
 - Livedays = 1000
 - Fiducial (kg) = 5600

Problem/To do

- Have trouble compiling the background code, one function in the background code is not defined in the LZNESTUtils → possible solution: change branches in the LZNESTUtils.

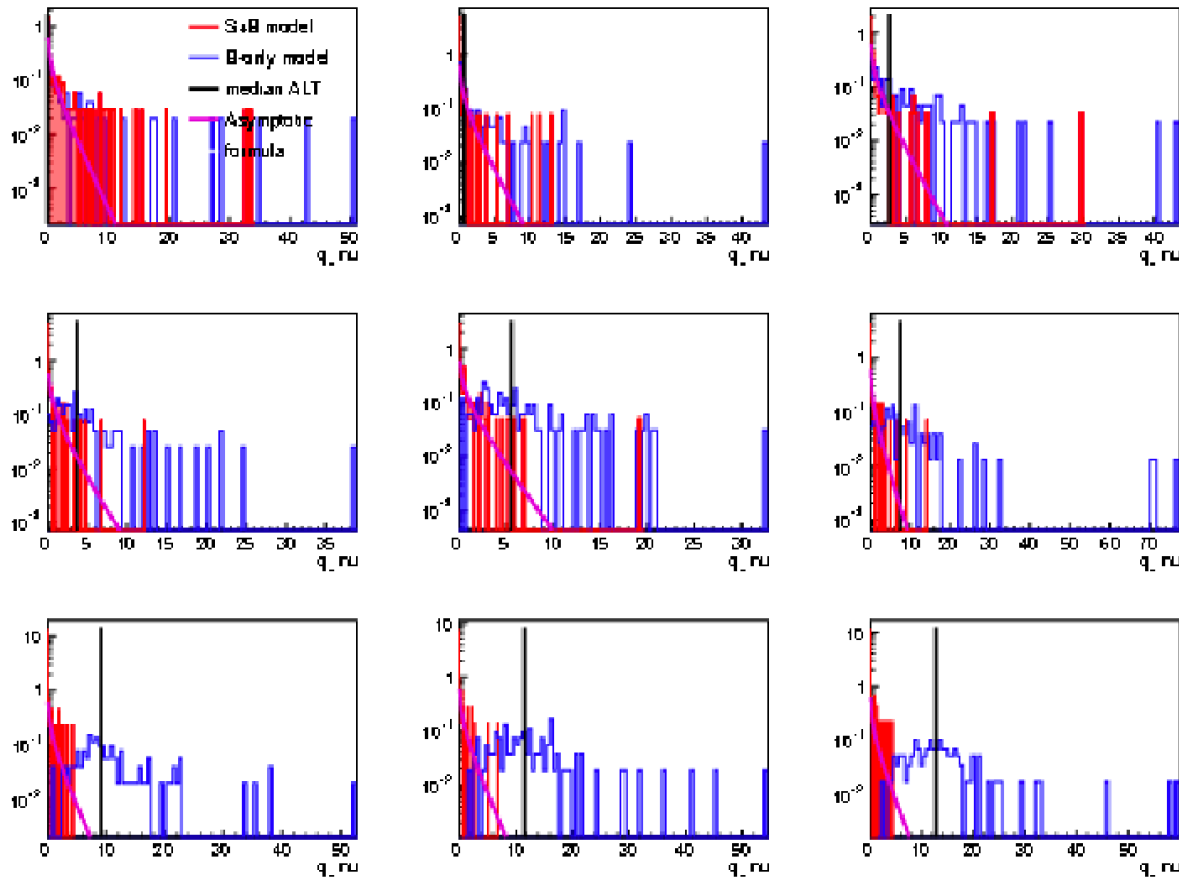
Analysis of a single graph



Hypothesis:

- **H0:** The data has both background and signal events fixed signal
- **H1:** The data only has background events floating

Increasing POI (0~15)



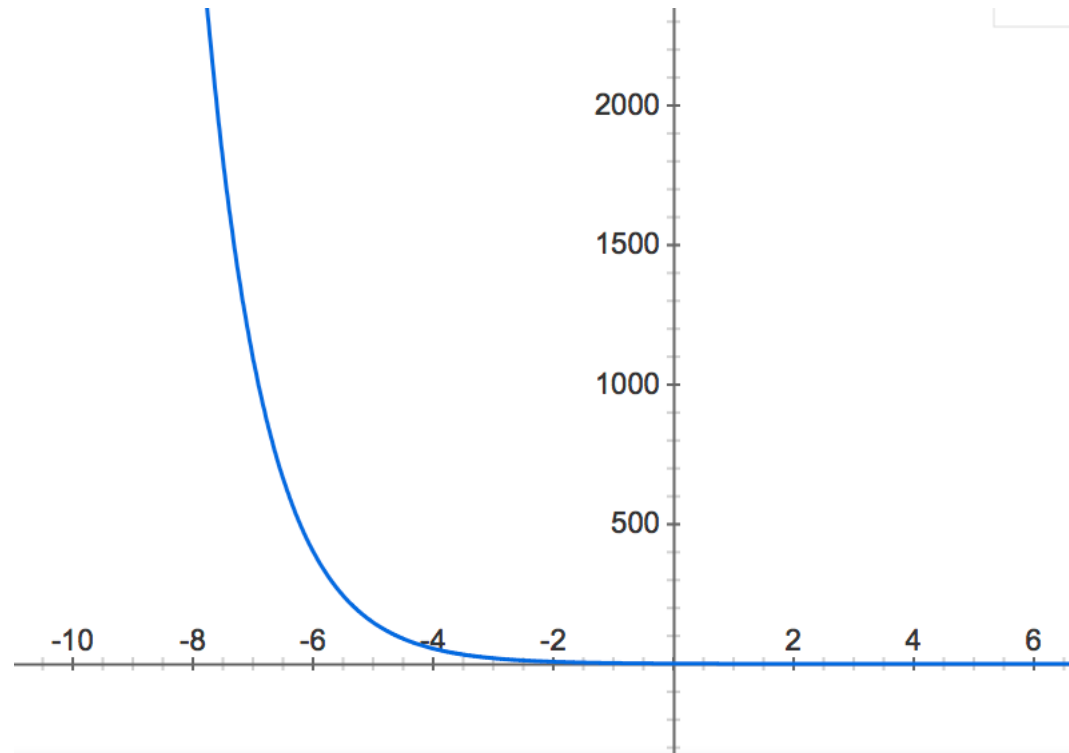
Method

- Background is fixed for different WIMP masses
- For one WIMP mass, increasing values of the parameter of interest (POI) $\rightarrow$ the cross section of the WIMP's interaction with Xenon
- Find the upper limit on the POI

$$L(\mu, \boldsymbol{\theta}) = \prod_{j=1}^N \frac{(\mu s_j + b_j)^{n_j}}{n_j!} e^{-(\mu s_j + b_j)} \prod_{k=1}^M \frac{u_k^{m_k}}{m_k!} e^{-u_k}$$



For high POI $\rightarrow$ high μs_j



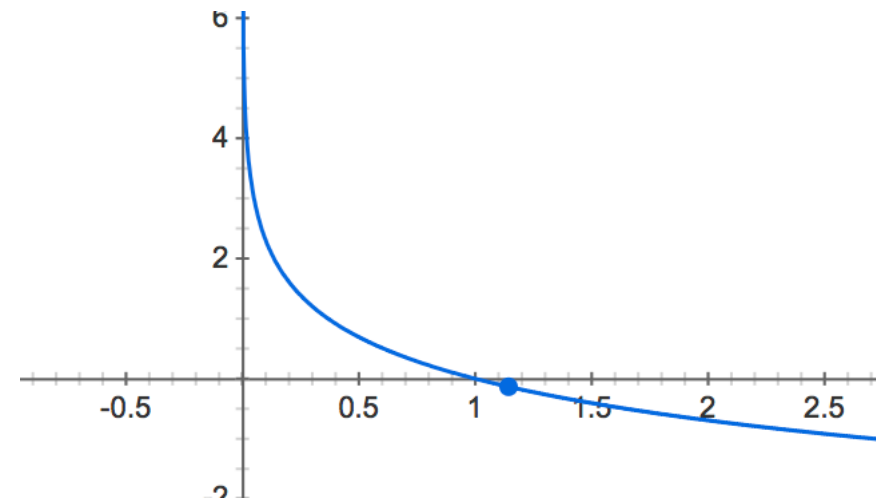
Equations & Graphs

$$\lambda(\mu) = \frac{L(\mu, \hat{\theta})}{L(\hat{\mu}, \hat{\theta})}$$

μ : fixed
 $\hat{\mu}$: floating

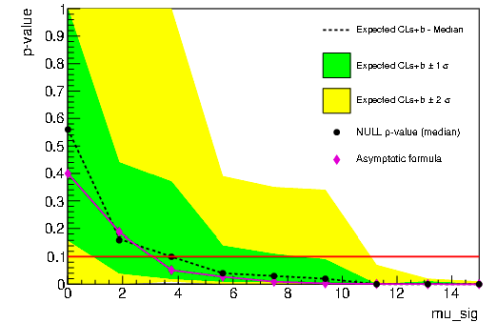
$$t_{\mu} = -2 \ln \lambda(\mu)$$

$\ln x$ vs x



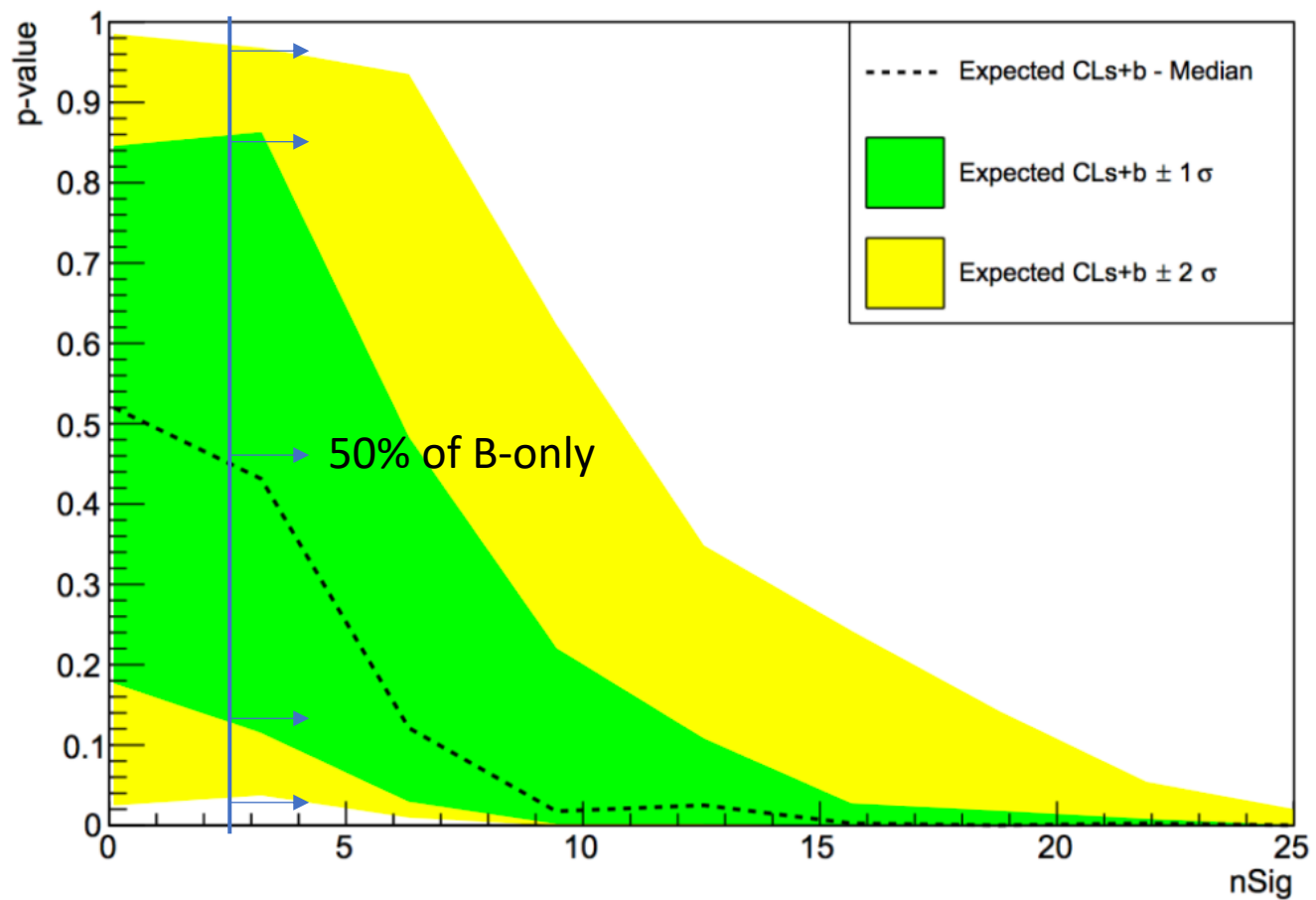
To do

- How to get the upper limit, basically how to get this graph from the nine graphs.
- Analyze the graph

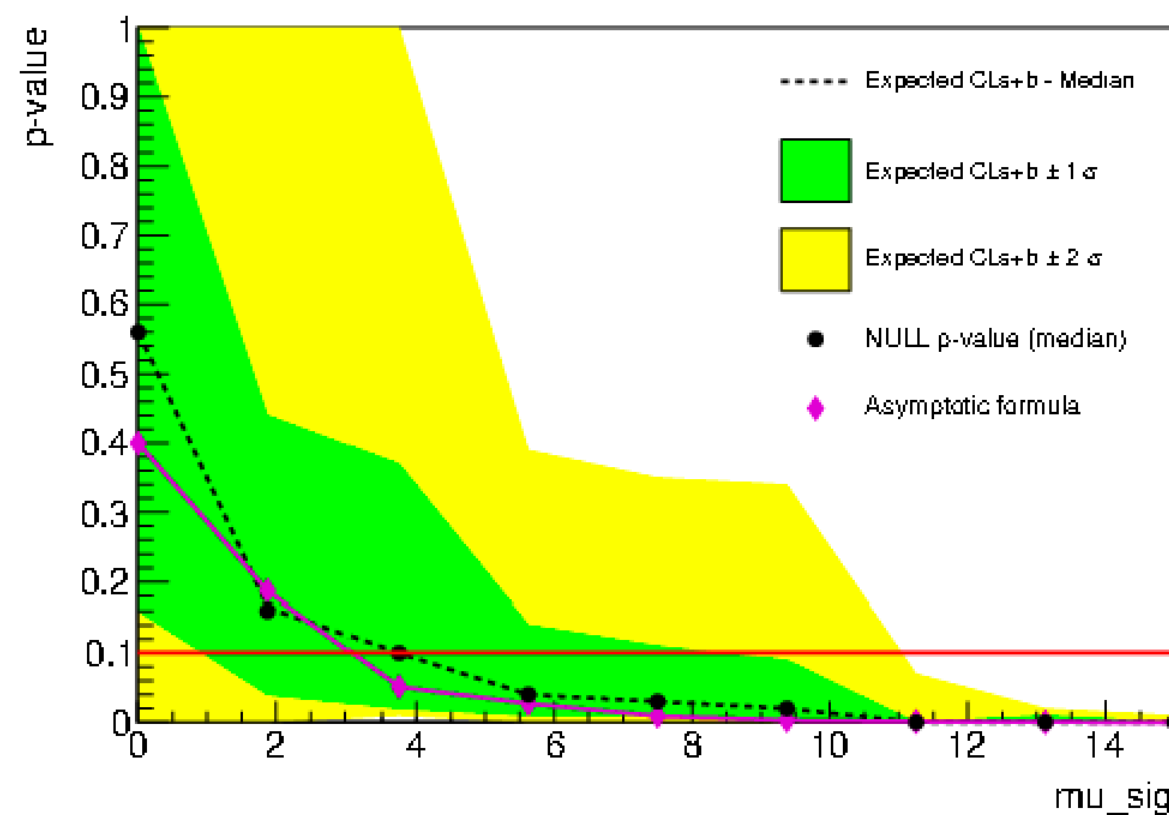
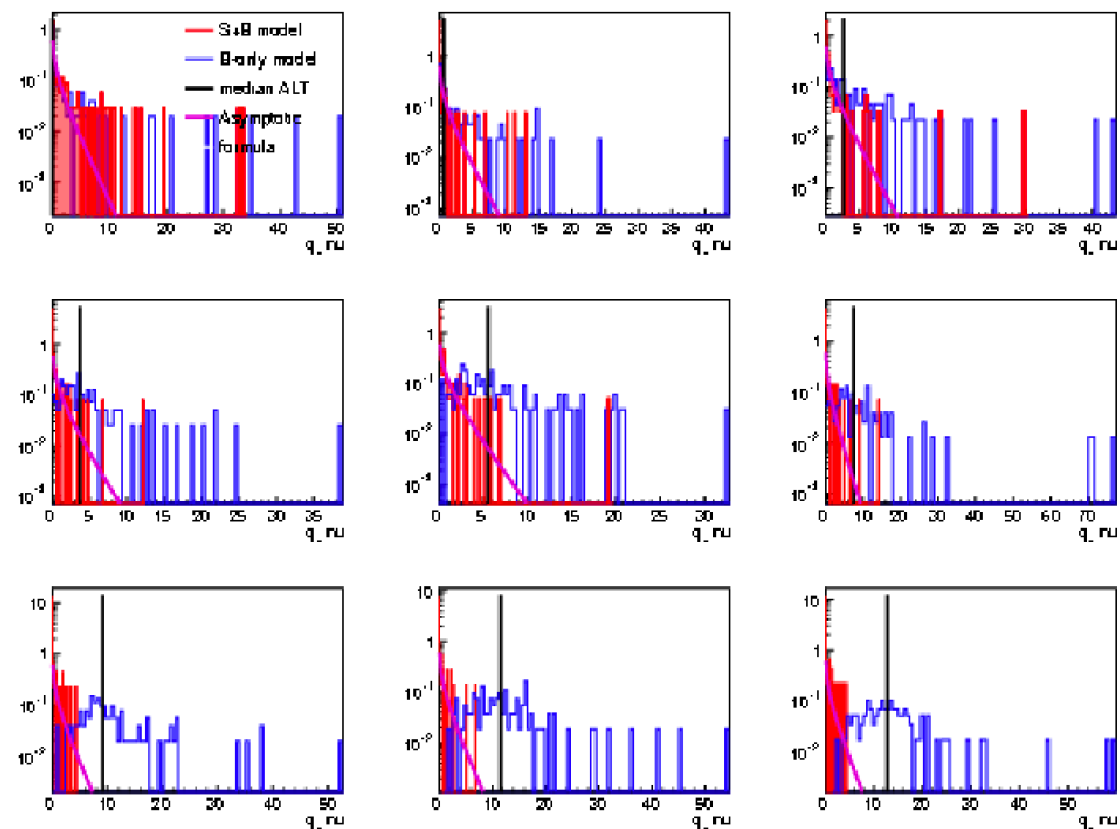


Done:

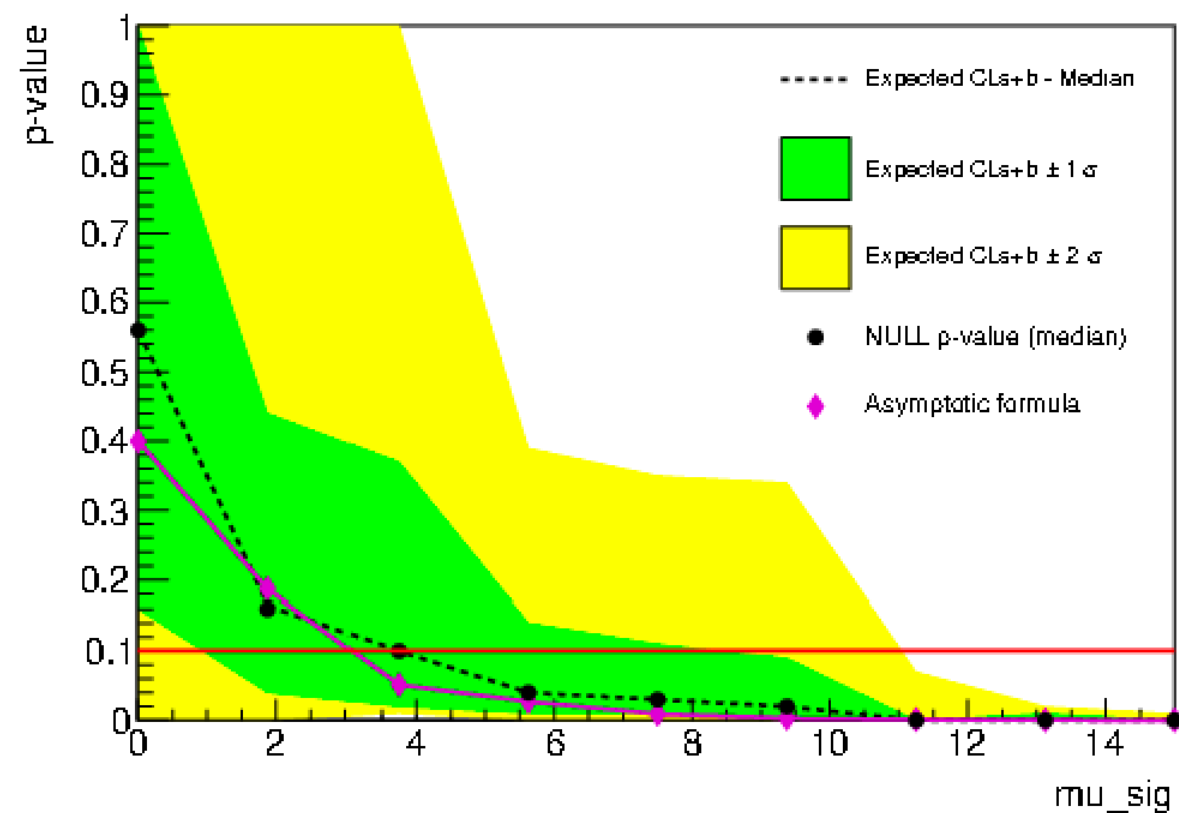
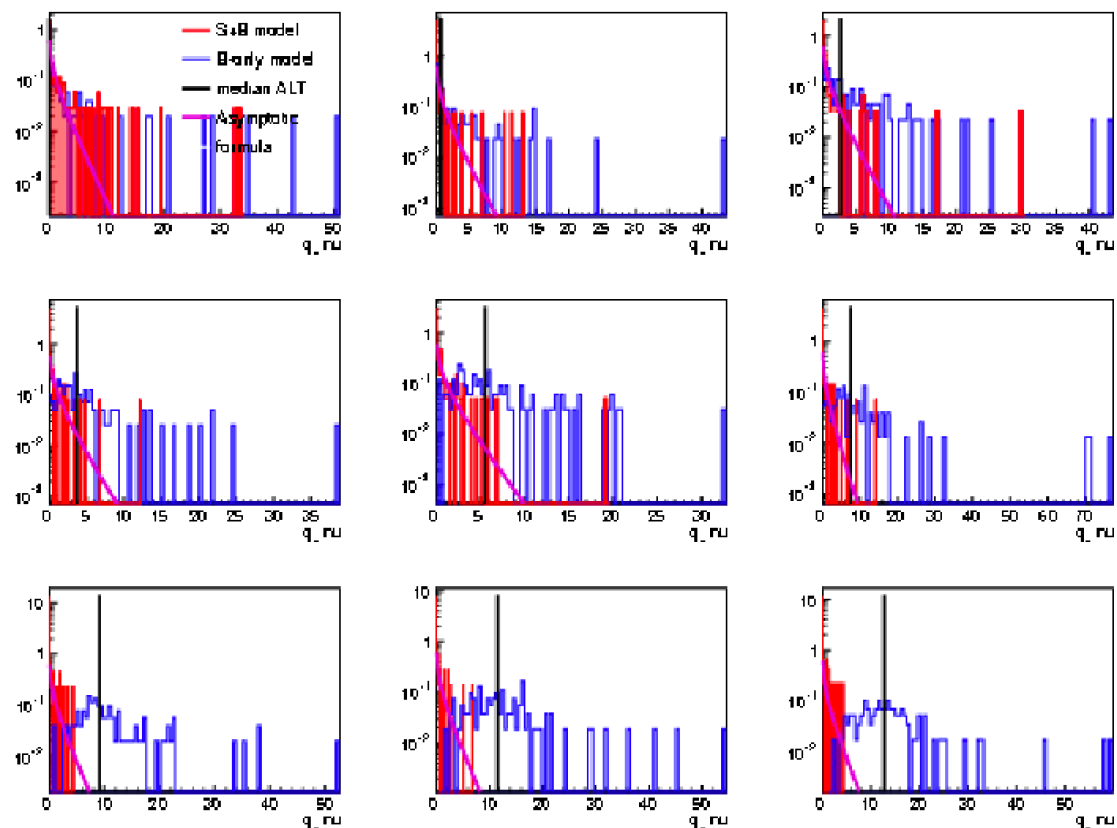
- For mass = 2.0000 GeV
 - ERROR: WIMP histogram is empty for mass 2.0 → Mass 2.0 is too small
- Mass: 10, 16.2222, 27.8256, 46.4159, 66.6667, 100, 200, 1000
- Moved the output from scratch to hdfs.
- Settings: 100 Ntoys, 1e7 samples, take 9 POI, 1000 livedays



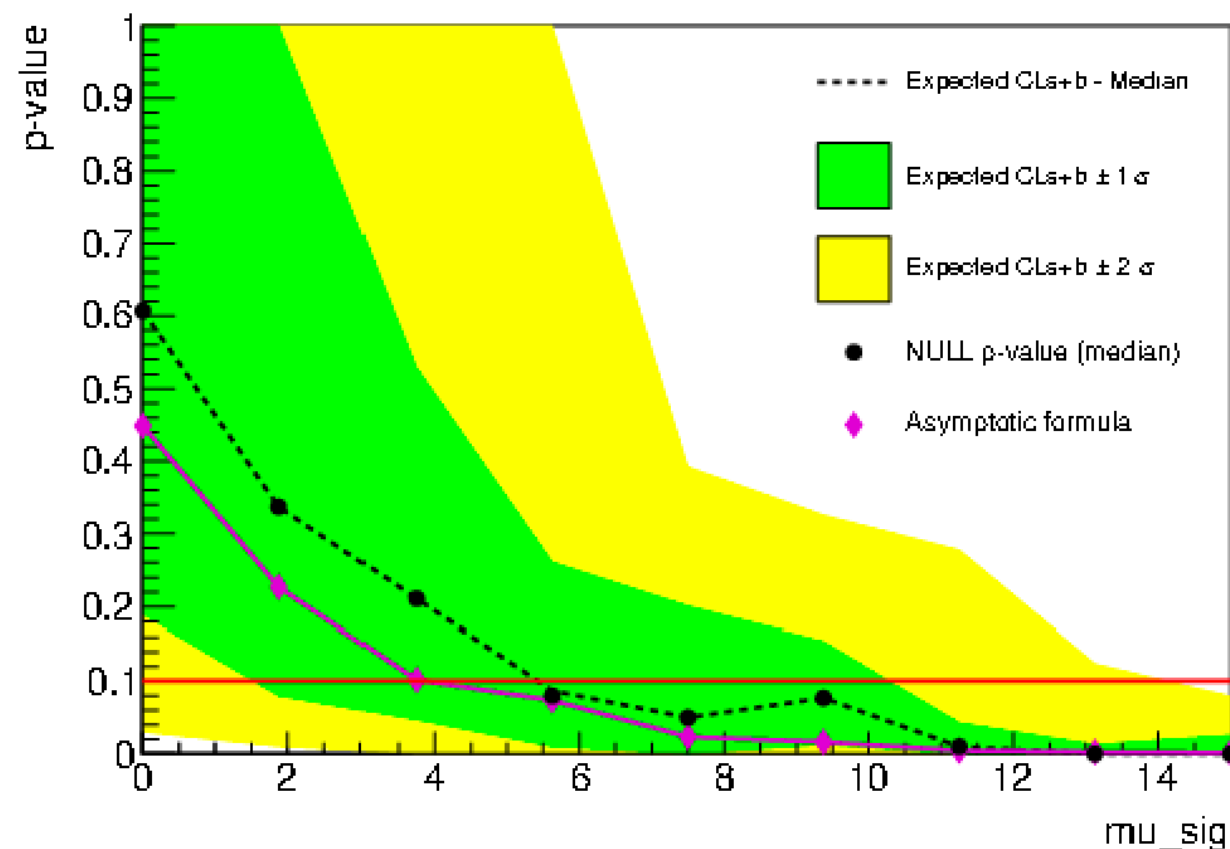
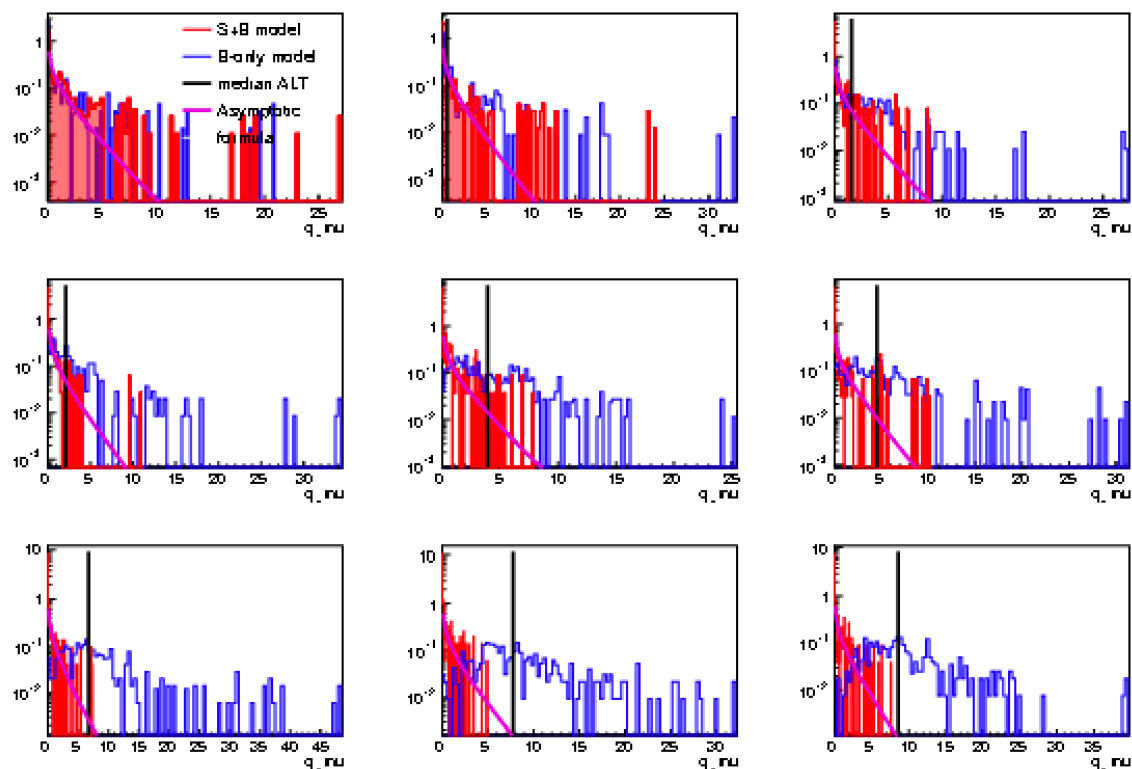
Mass = 16.2222

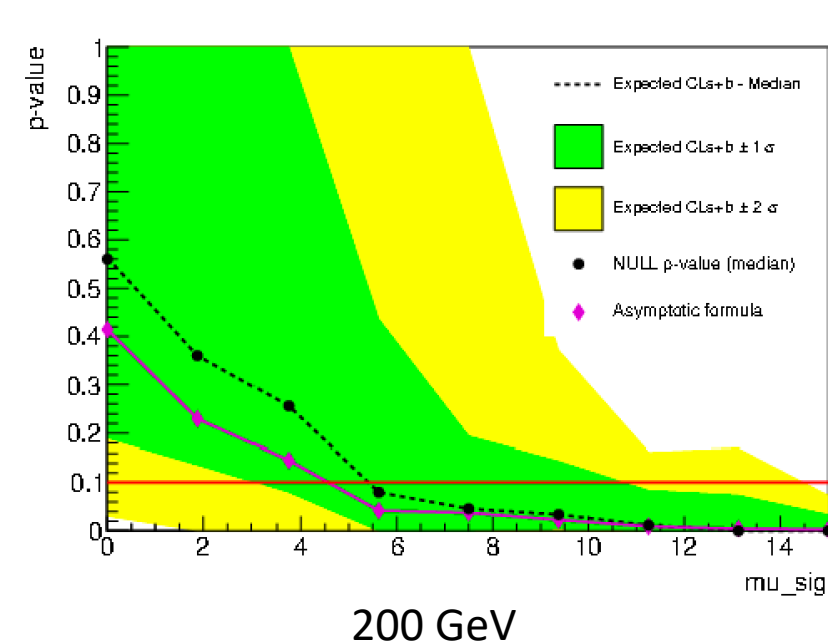
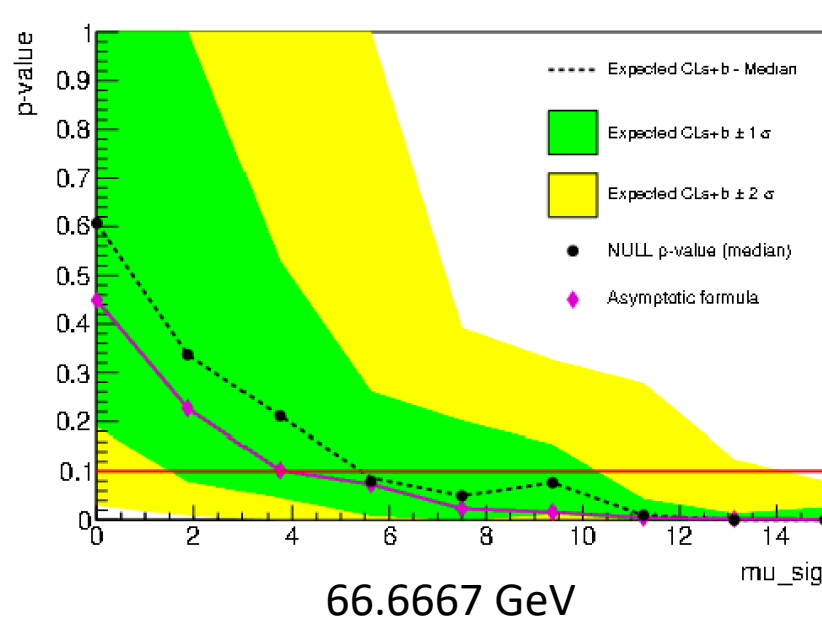
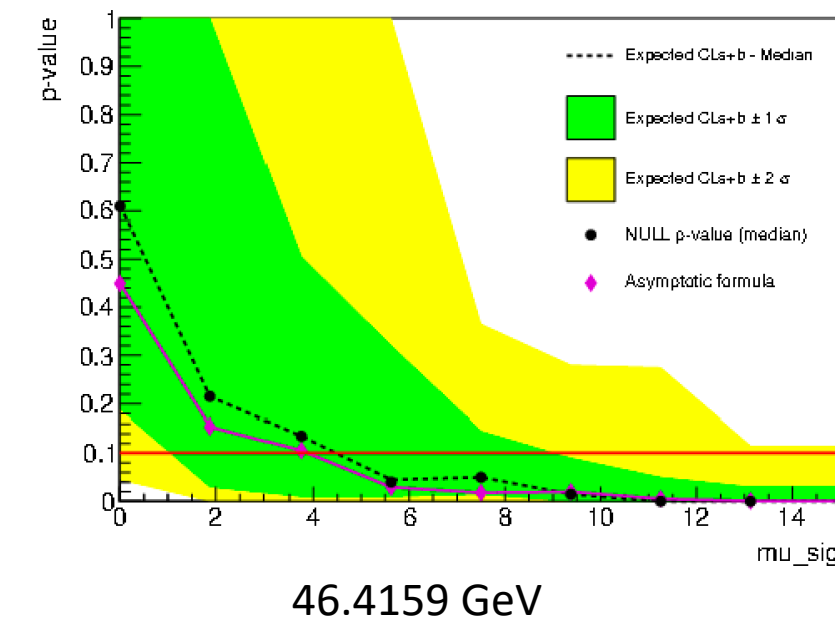
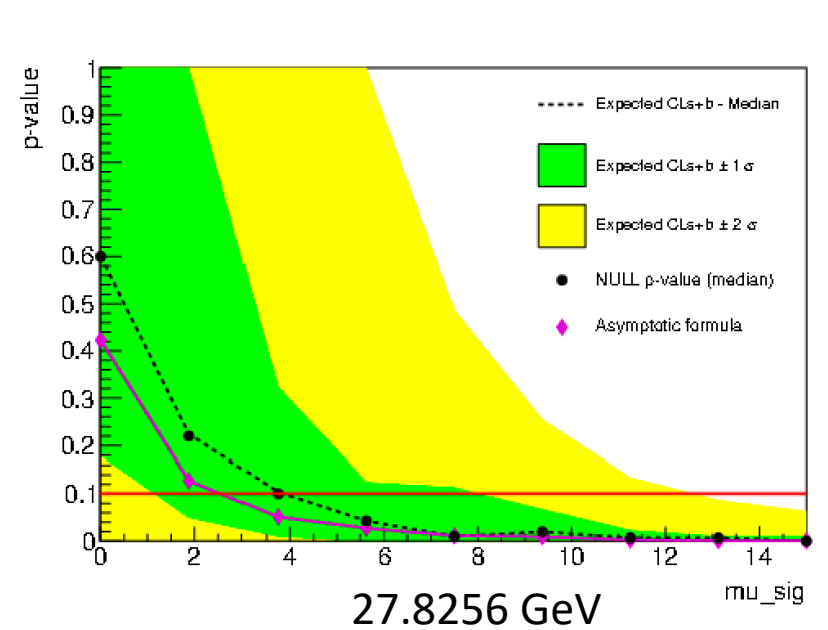
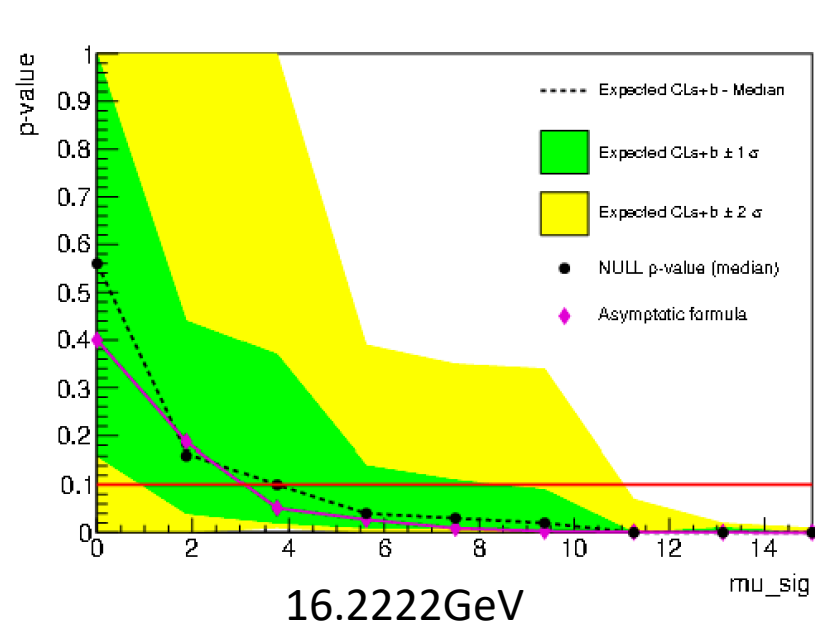
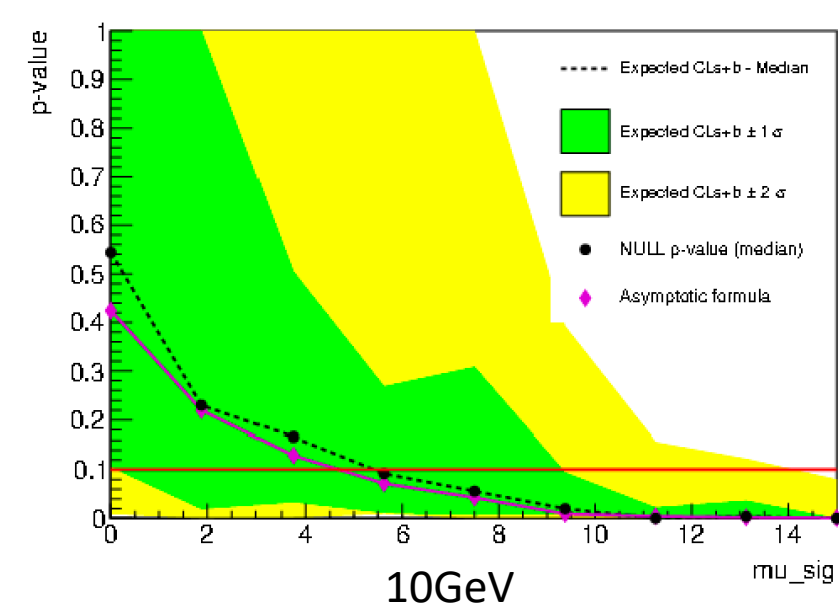


Mass = 16.2222

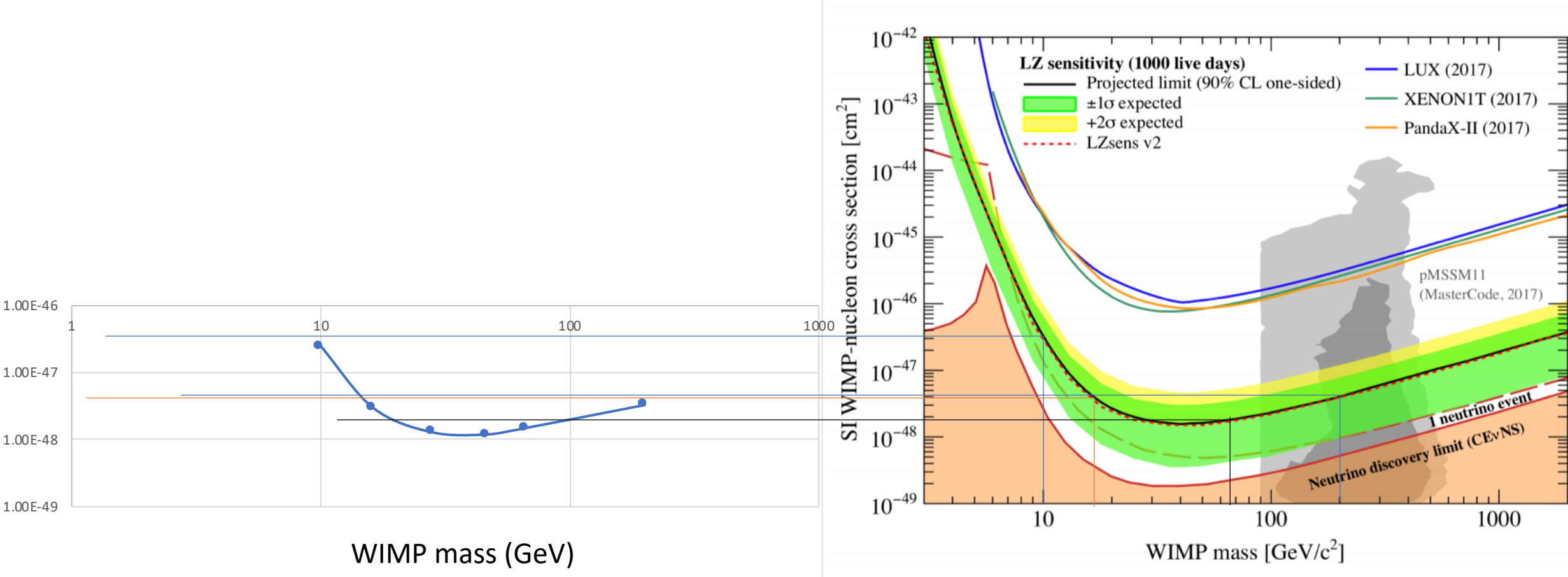


Mass = 66.6667





log scale lz sensitivity :



Understanding the structure of LZStats

- **Submit_MassJobs.sh:**
 - calls for the other two scripts, the one that submits jobs to the cluster
 - Kr mass = 2.0000 & 66.6667
 - #jobs for each mass = 10
- **runWiscJobs.py:**
 - Defines variables and parameters for a job running
- **Submit_lzstats.sh:**
 - When run Submit_MassJobs.sh, each job runs this script on the cluster
- **Setup.sh:**
 - set up the environment

Problem

- For one mass, when extracting 10 tar.gz files, only get one result “...run1”
- Check the error text, ImportError

```
ImportError: /cvmfs/lz.opensciencegrid.org/external/Python/2.7.15/x86_64-centos7-gcc7-opt/lib/python2.7/lib-dynload/array.so: undefined symbol: _PySlice_Unpack  
Info in <RooWorkspace::SaveAs>: ROOT file ./output/lzstats-LZ projected 1e7-WIMP
```

- Ask Jonathan:
 - For the Jobs submitted to the cluster, the python cannot load the yaml package → unable to change the run number → all the runs have the same run number, run1
- The yaml package is exported in setup.sh