LZStats

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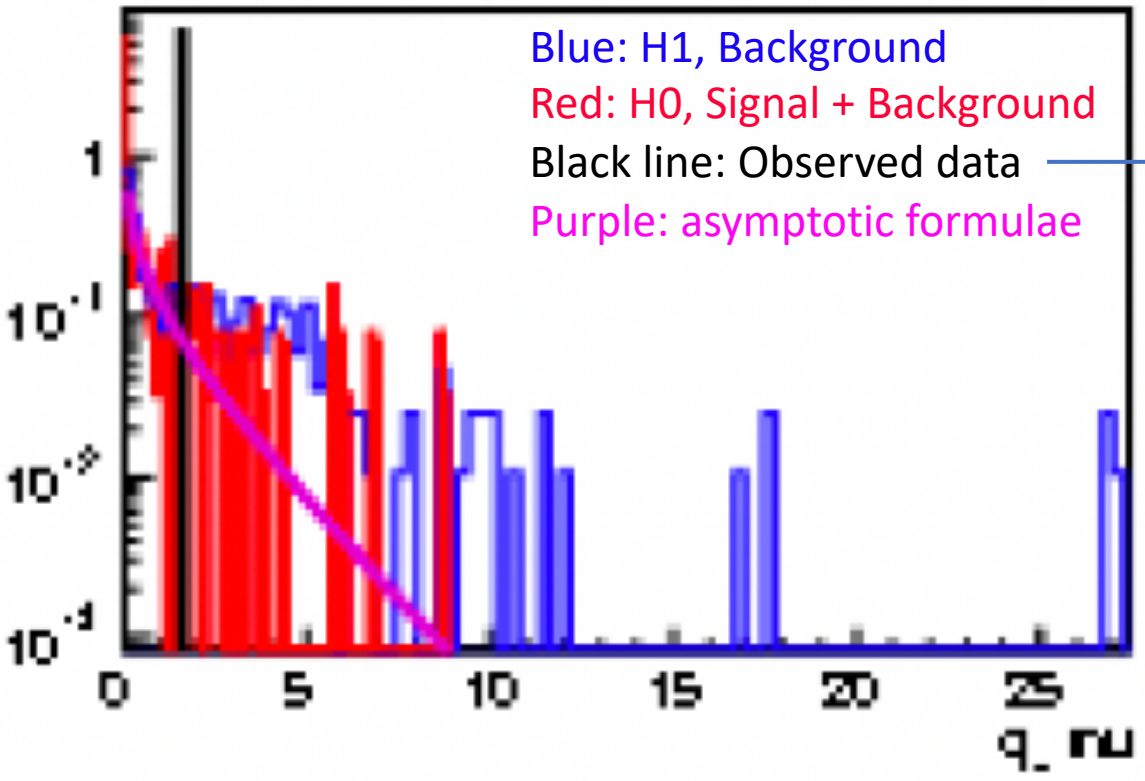
Analysis of a single graph



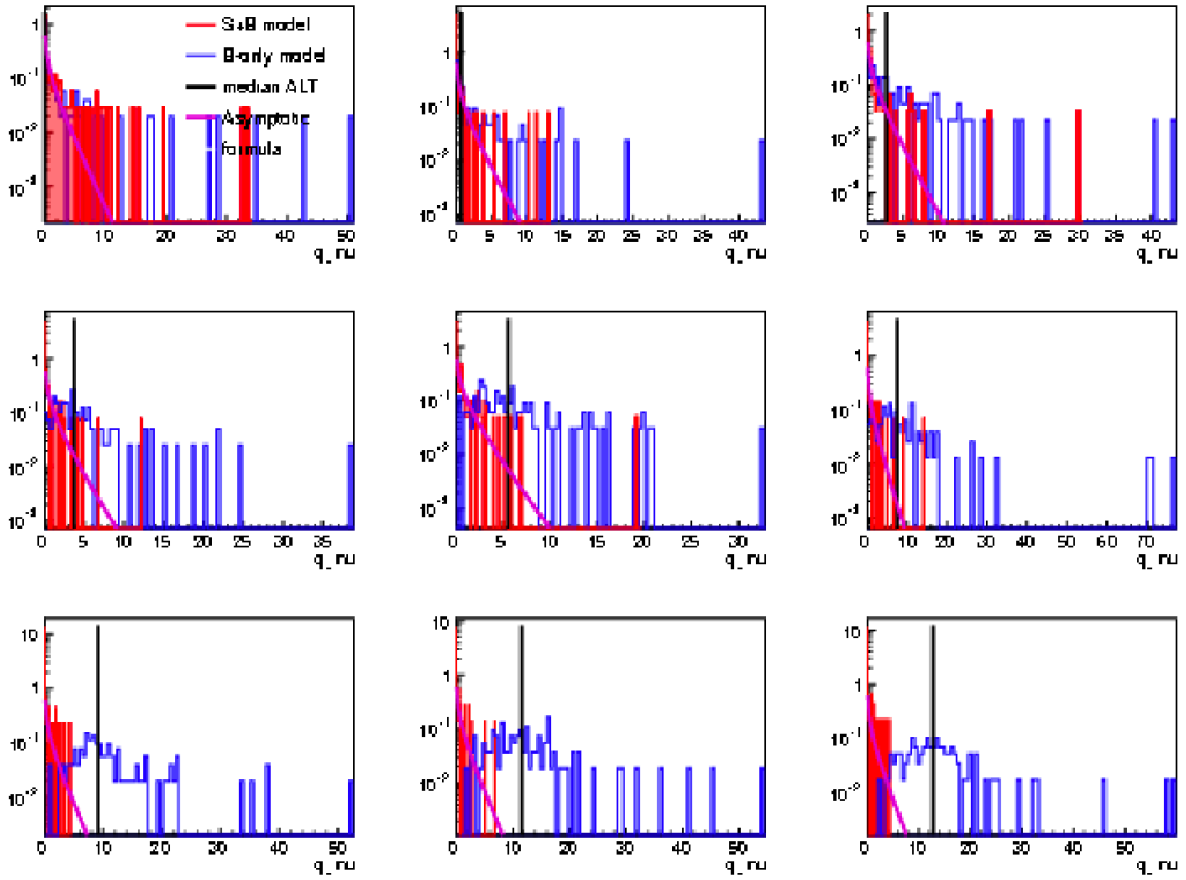
The **median** of the B-distribution

$$t = -2ln\frac{L(B+S)}{L(\text{best fit})}$$

Hypothesis:

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

Increasing POI (0~15)

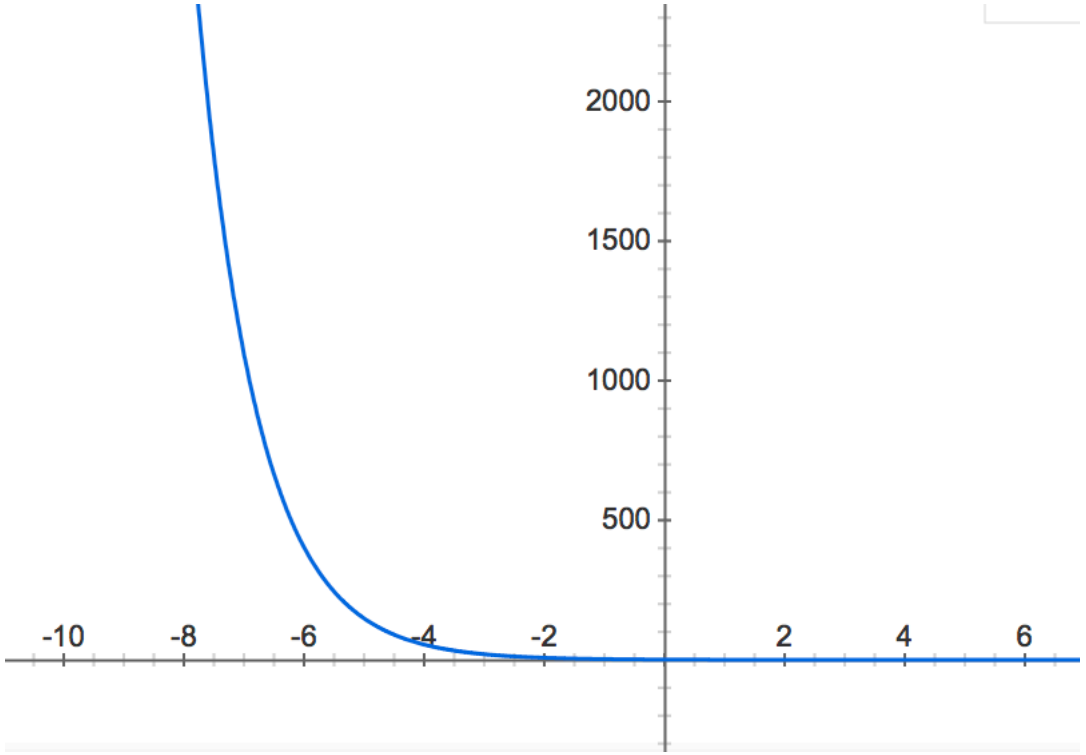


Method

- Background is fixed for different WIMP masses
- For one WIMP mass, increasing values of the parameter of interest (POI)→ 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 → high μsj



Equations & Graphs

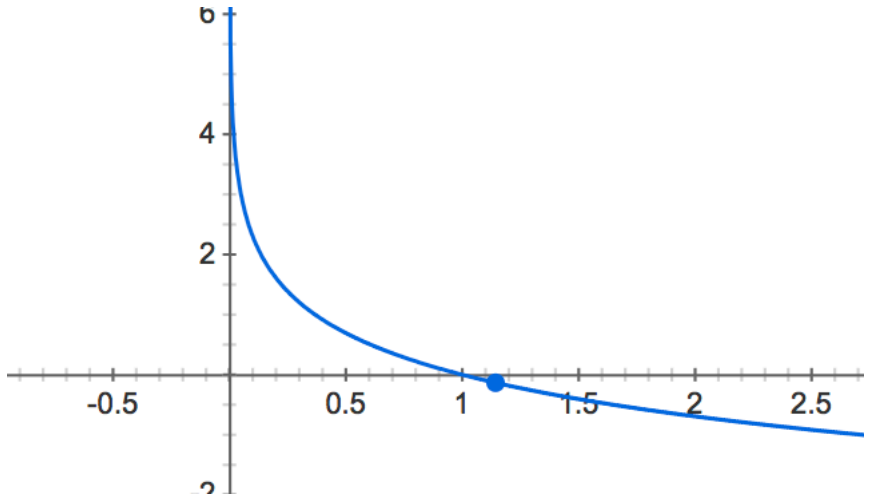
$$\lambda(\mu) = \frac{L(\mu, \hat{\hat{\boldsymbol{\theta}}})}{L(\hat{\mu}, \hat{\boldsymbol{\theta}})}$$

μ : fixed

$\hat{\mu}$: floating

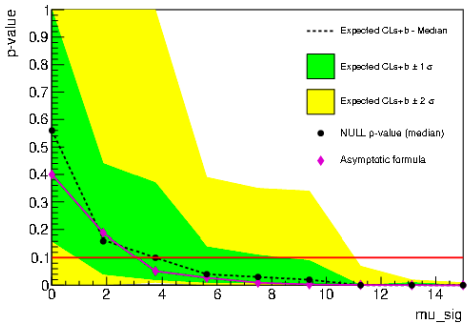
$$t_\mu = -2 \ln \lambda(\mu)$$

$\ln x$ vs x



To do

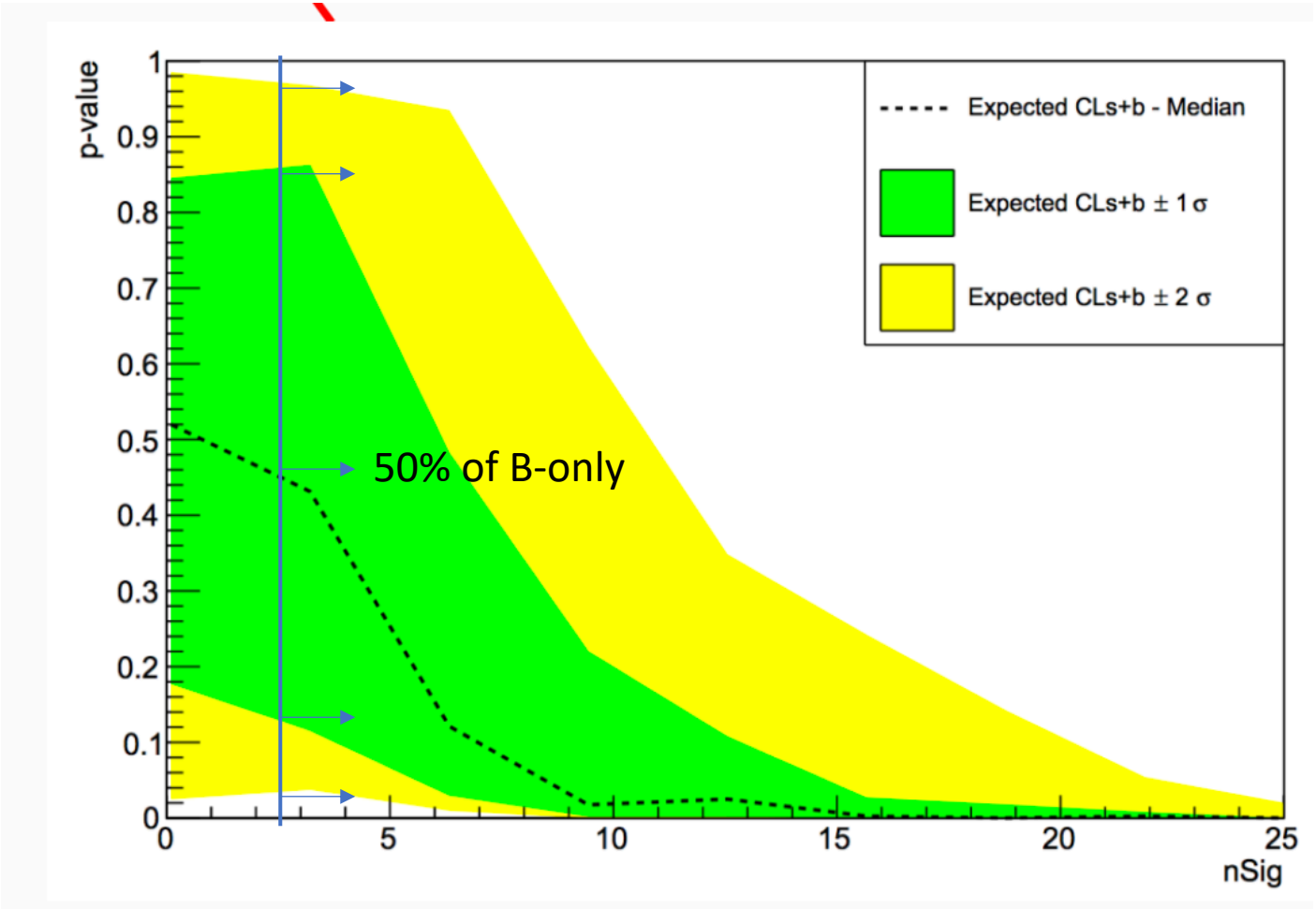
- How to get the upper limit, basically how to get this graph from the nine graphs.
- Analyze the graph



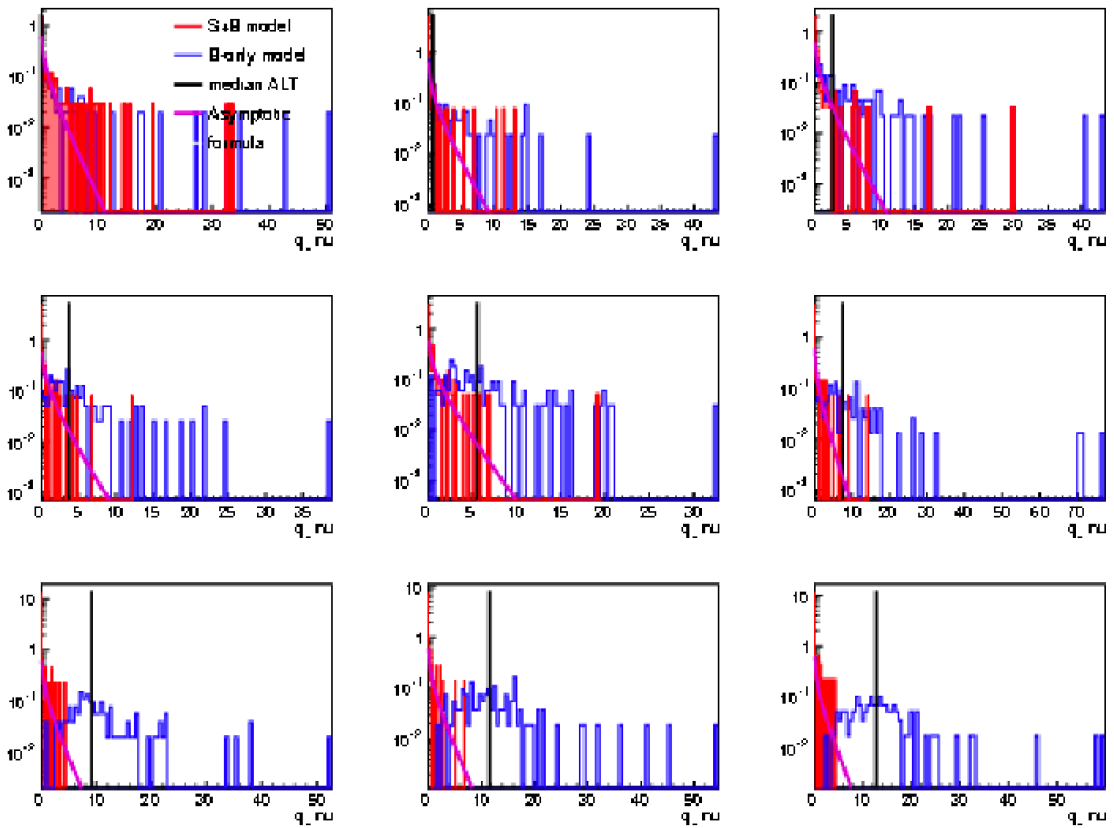
Done:

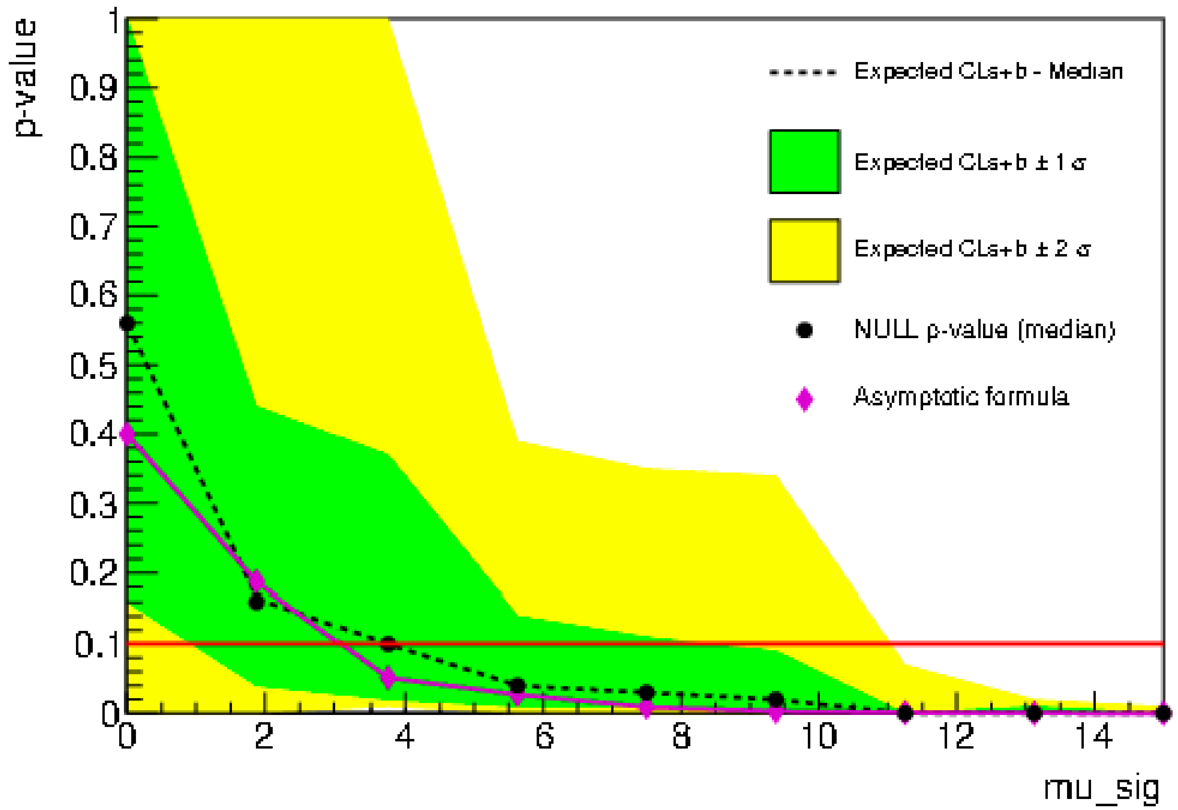
- For mass = 2.0000 GeV
  - ERROR: WIMP histogram is empty for mass 2.0 → Mass 2.0 is too small
- Mass: 10, 16.2222, 27.8256, 46.4159, 66.6667, 100, 200, 1000
- Moved the output from scratch to hdfs.

- Settings: 100 Ntoys, 1e7 samples, take 9 POI, 1000 livedays

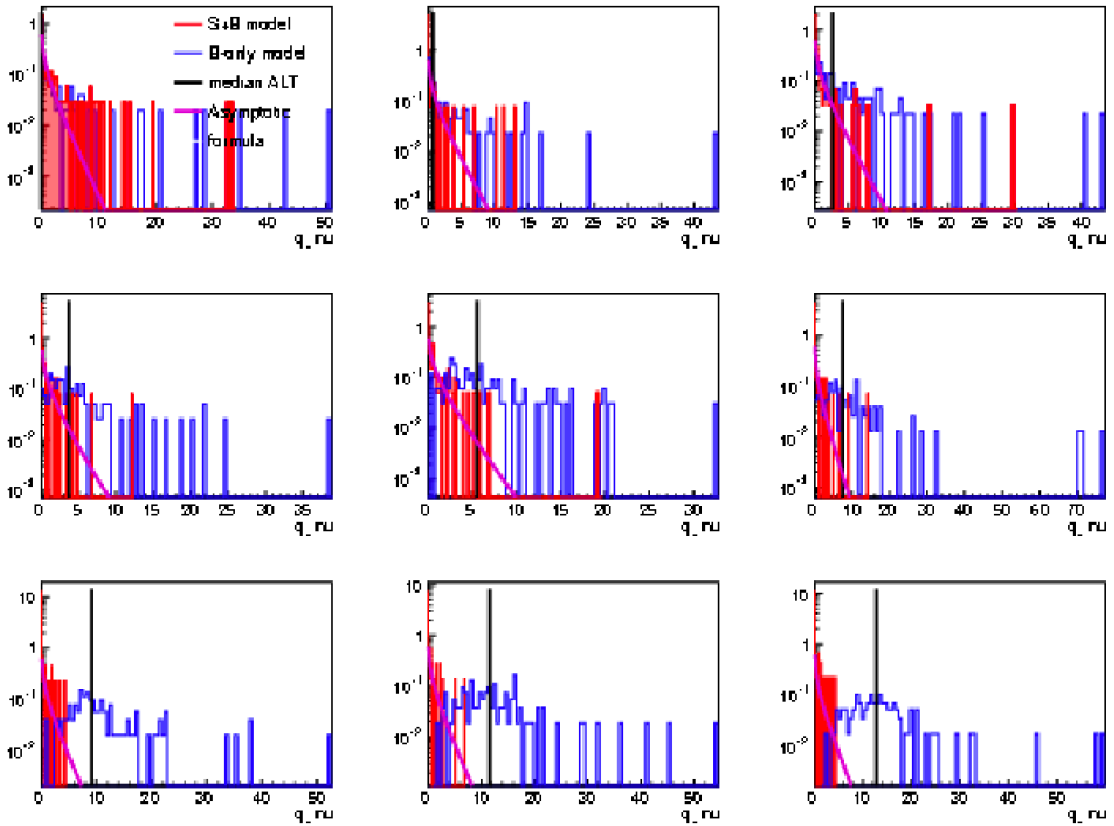

p-value
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
5
10
15
20
25
nSig
Expected CLs+b - Median
Expected CLs+b ± 1 σ
Expected CLs+b ± 2 σ
50% of B-only

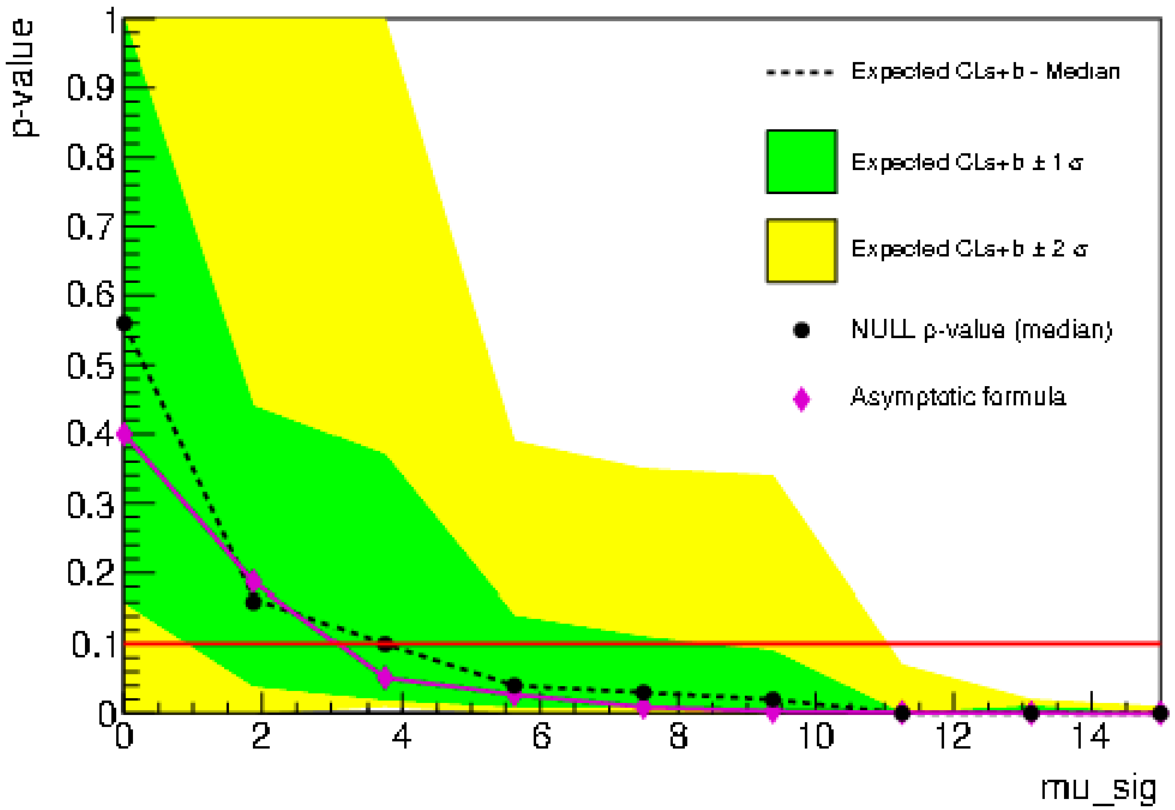
Mass = 16.2222


S+B model
B-only model
median ALT
Asymptotic formula
q_mu

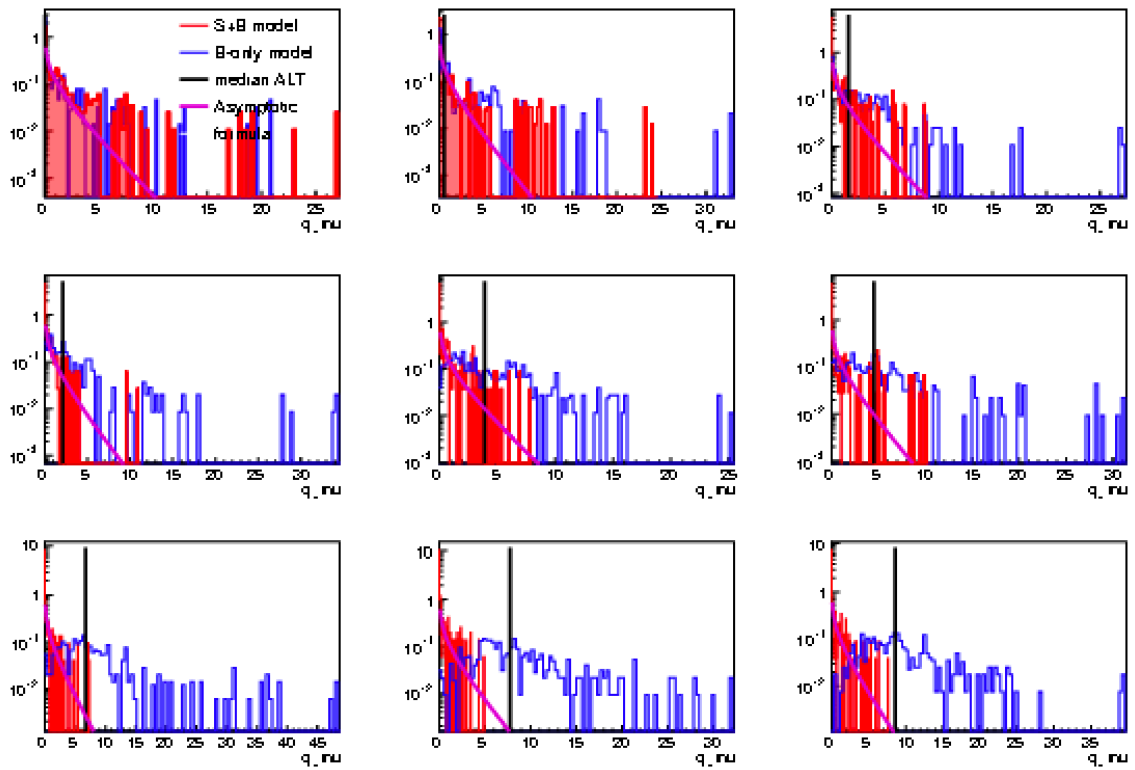

p-value
mu_sig
Expected CLs+b - Median
Expected CLs+b ± 1 σ
Expected CLs+b ± 2 σ
NULL p-value (median)
Asymptotic formula

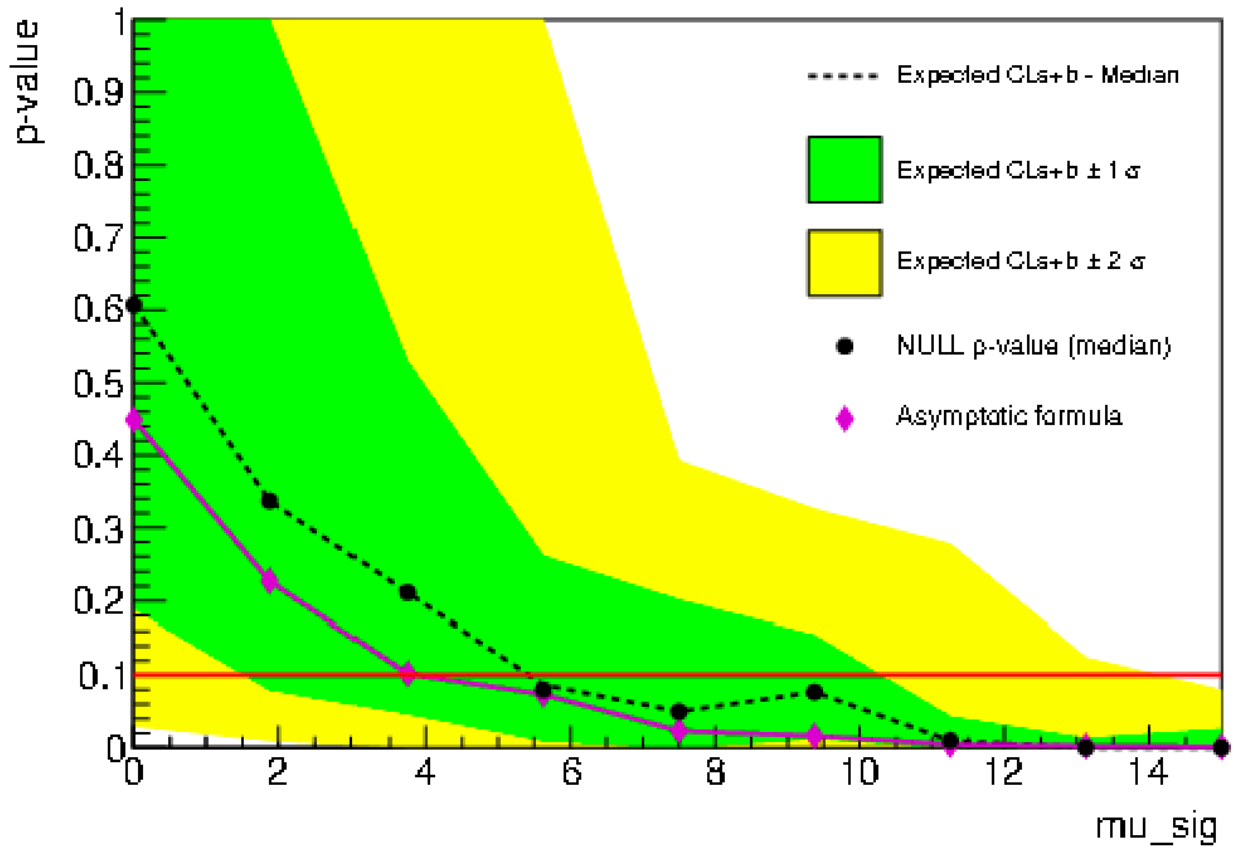
Mass = 16.2222

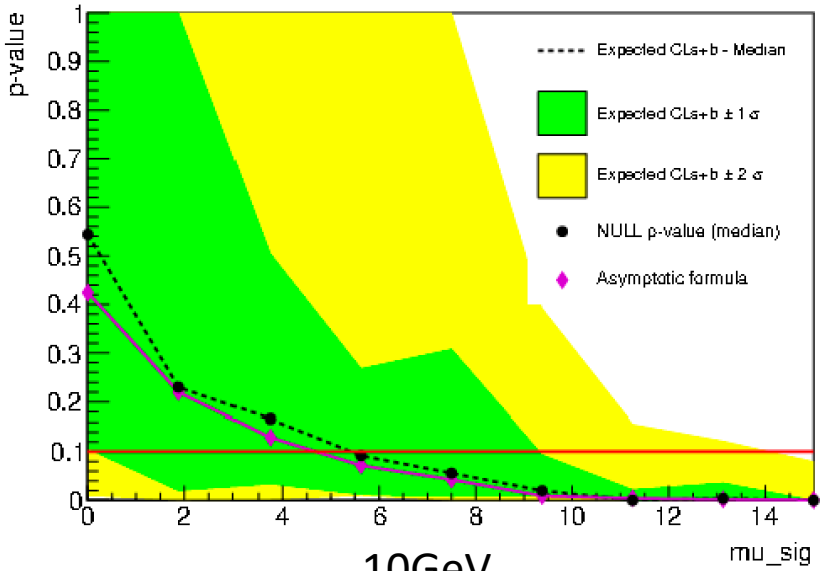

S+B model
B-only model
median ALT
Asymptotic formula
q_mu


p-value
mu_sig
Expected CLs+b - Median
Expected CLs+b ± 1 σ
Expected CLs+b ± 2 σ
NULL p-value (median)
Asymptotic formula

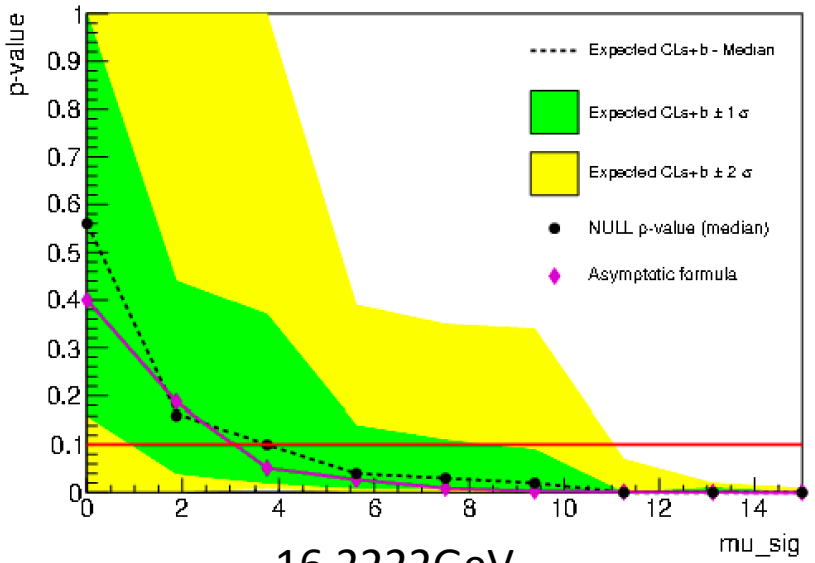
Mass = 66.6667


S+B model
B-only model
median ALT
Asymptotic formula
q_mu

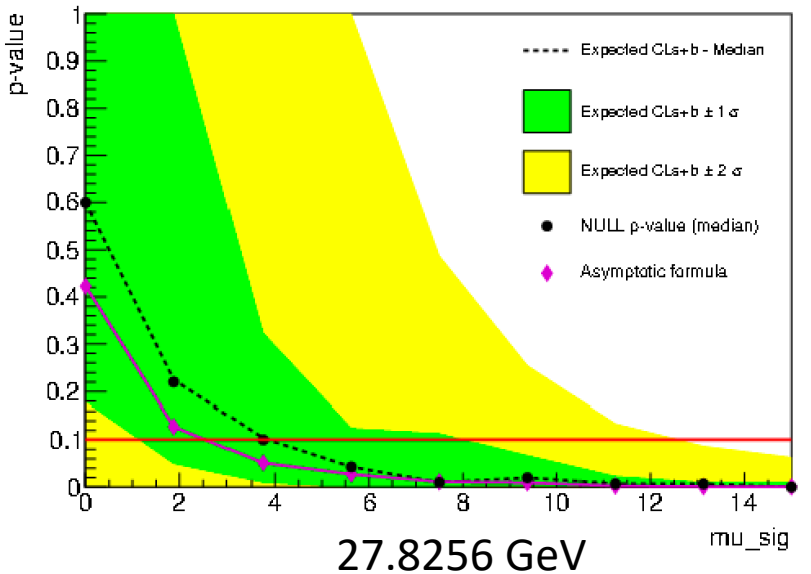

p-value
mu_sig
Expected CLs+b - Median
Expected CLs+b ± 1 σ
Expected CLs+b ± 2 σ
NULL p-value (median)
Asymptotic formula



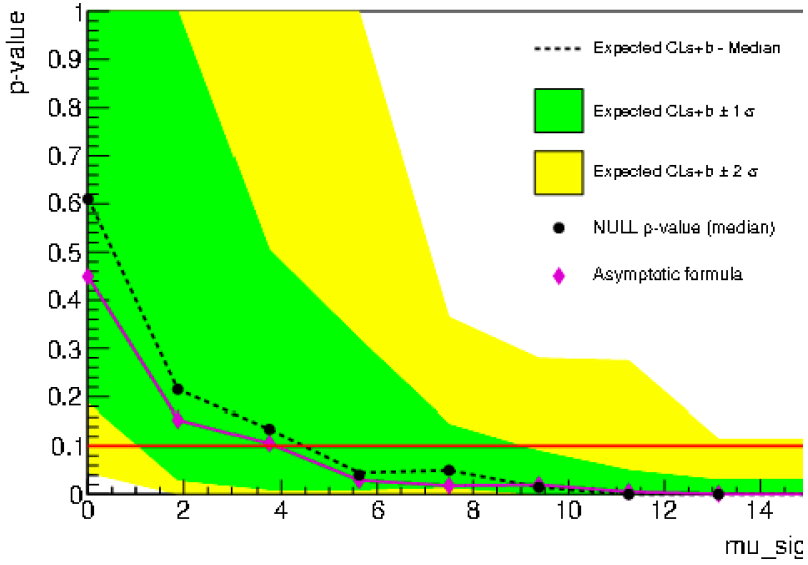
10GeV



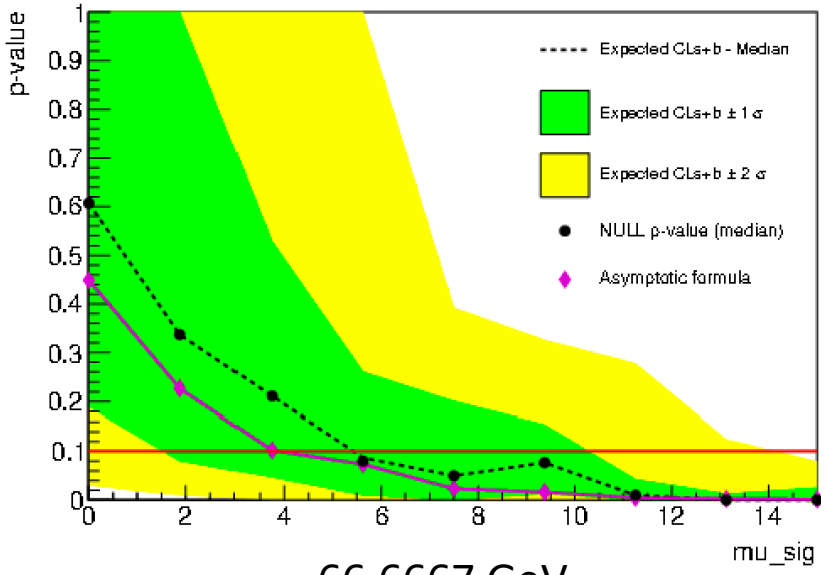
16.2222GeV



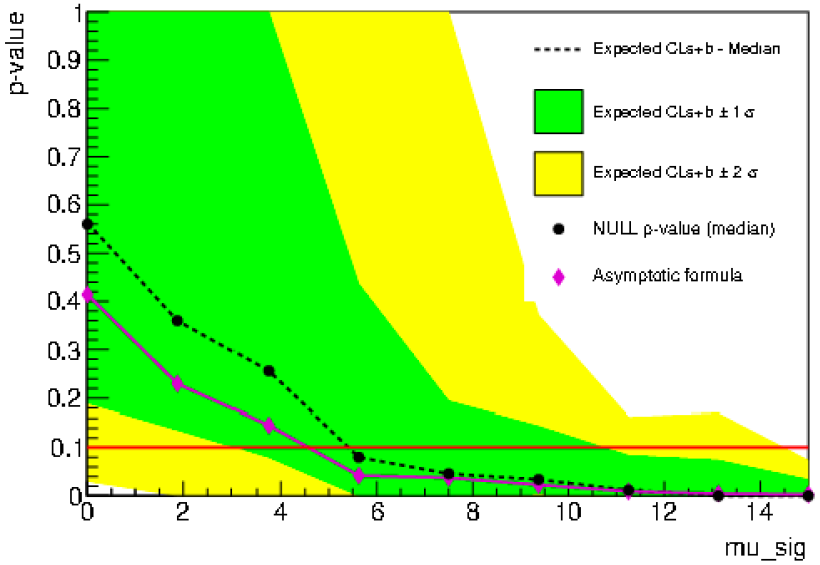
27.8256 GeV



46.4159 GeV

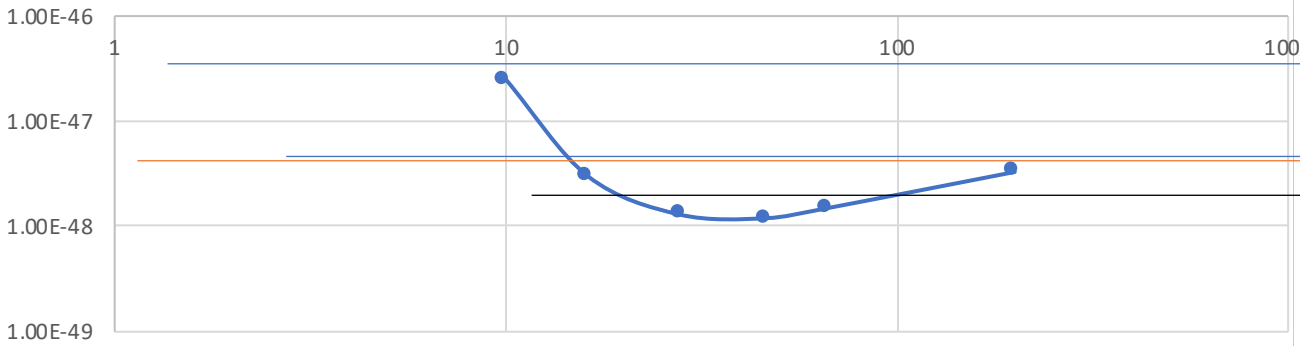


66.6667 GeV

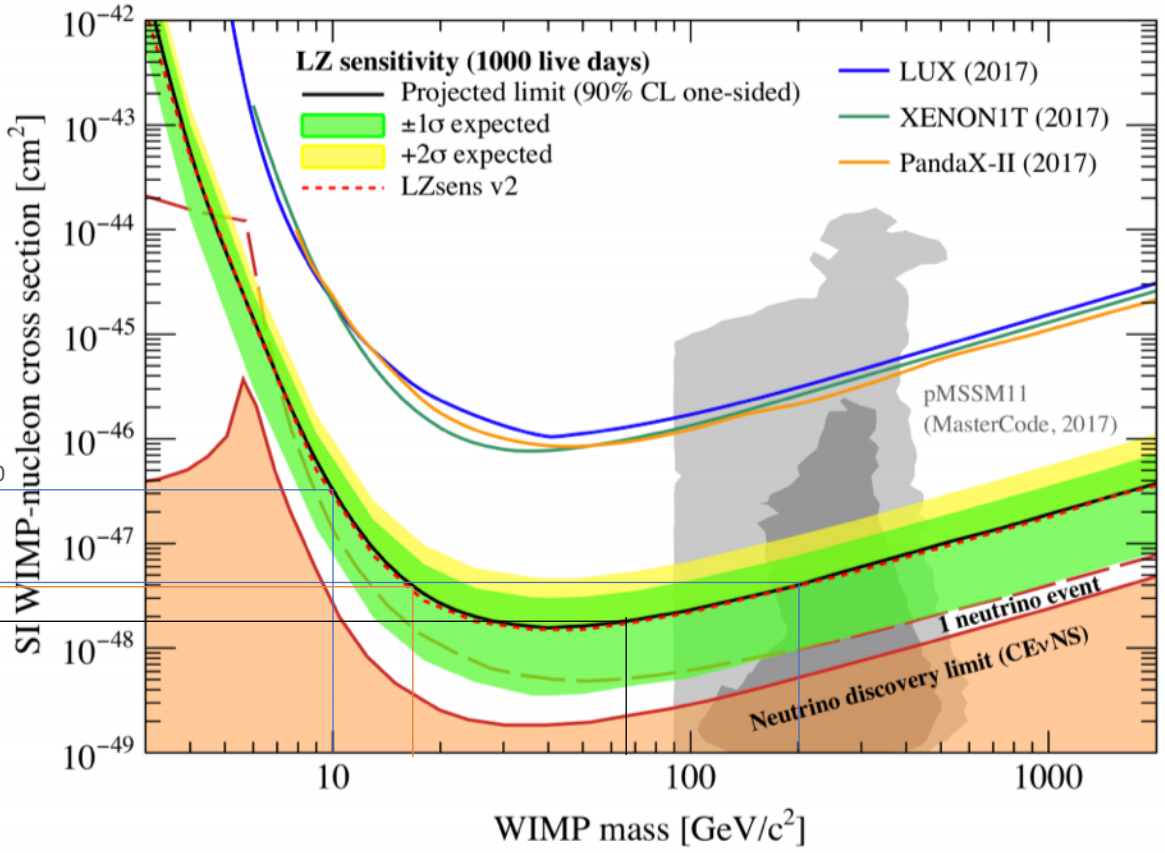


200 GeV

log scale lz sensitivity :



WIMP mass (GeV)



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