Wall Model

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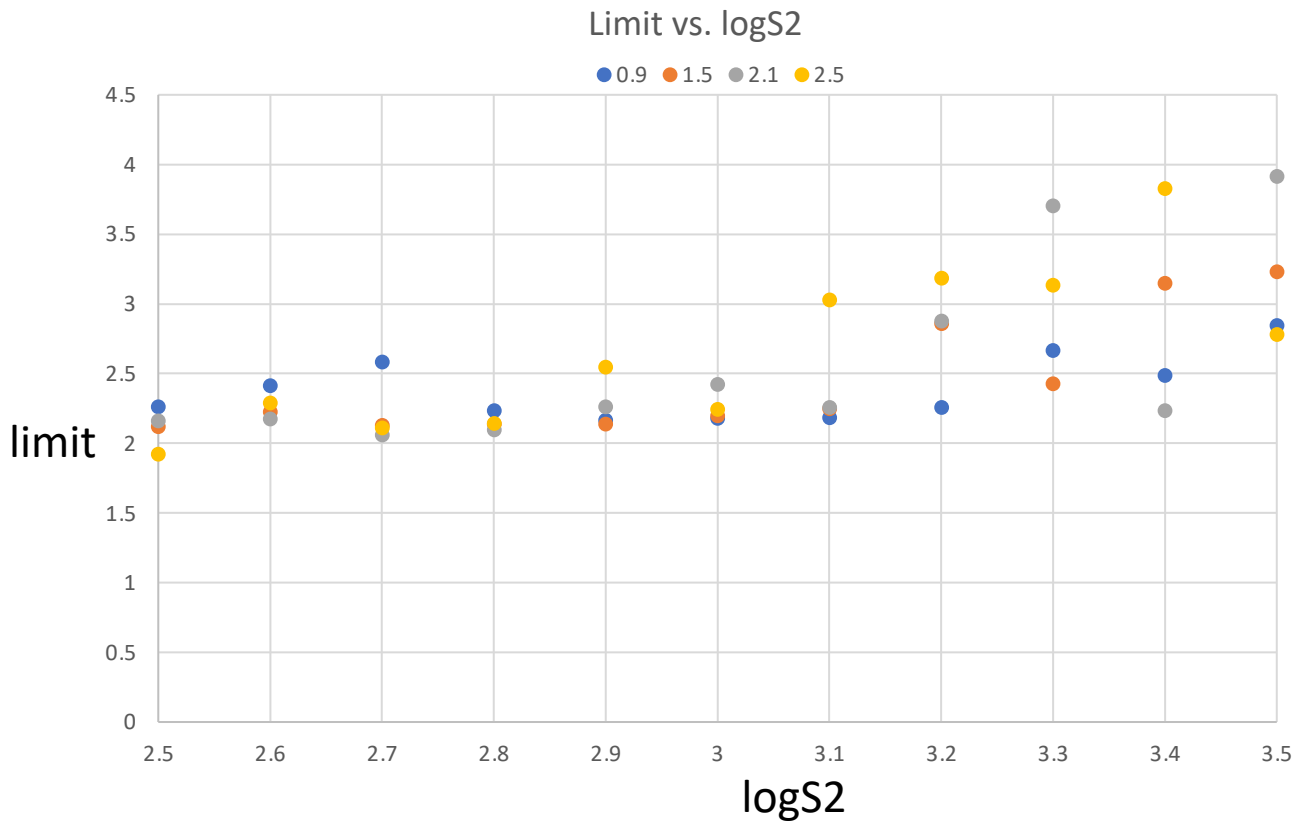
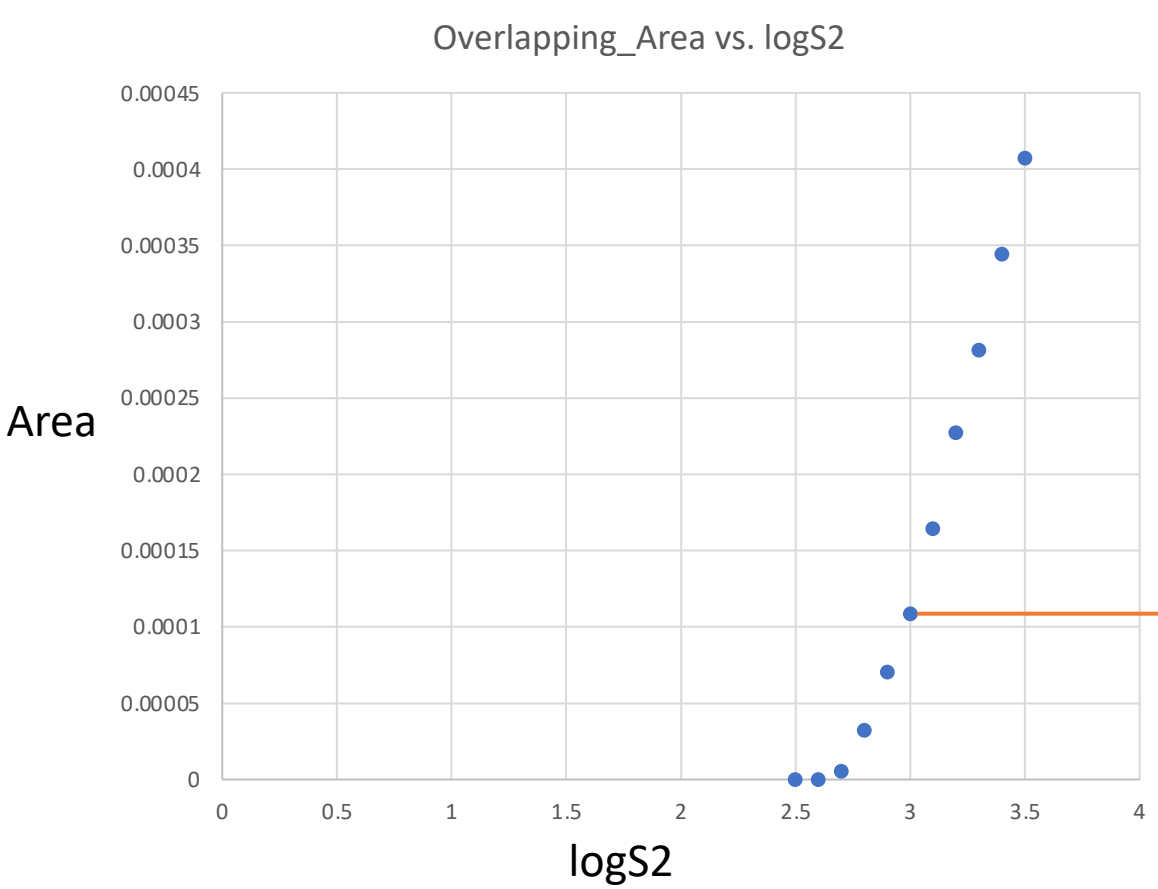
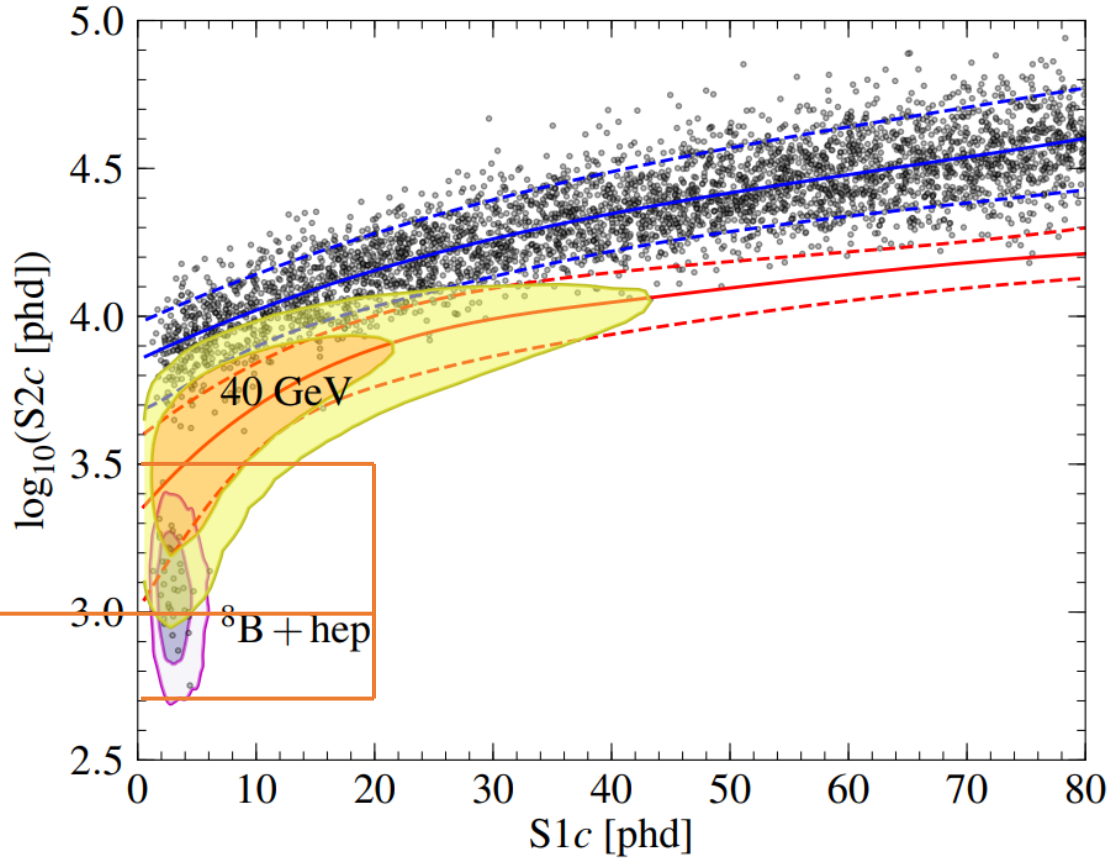
2020

Update

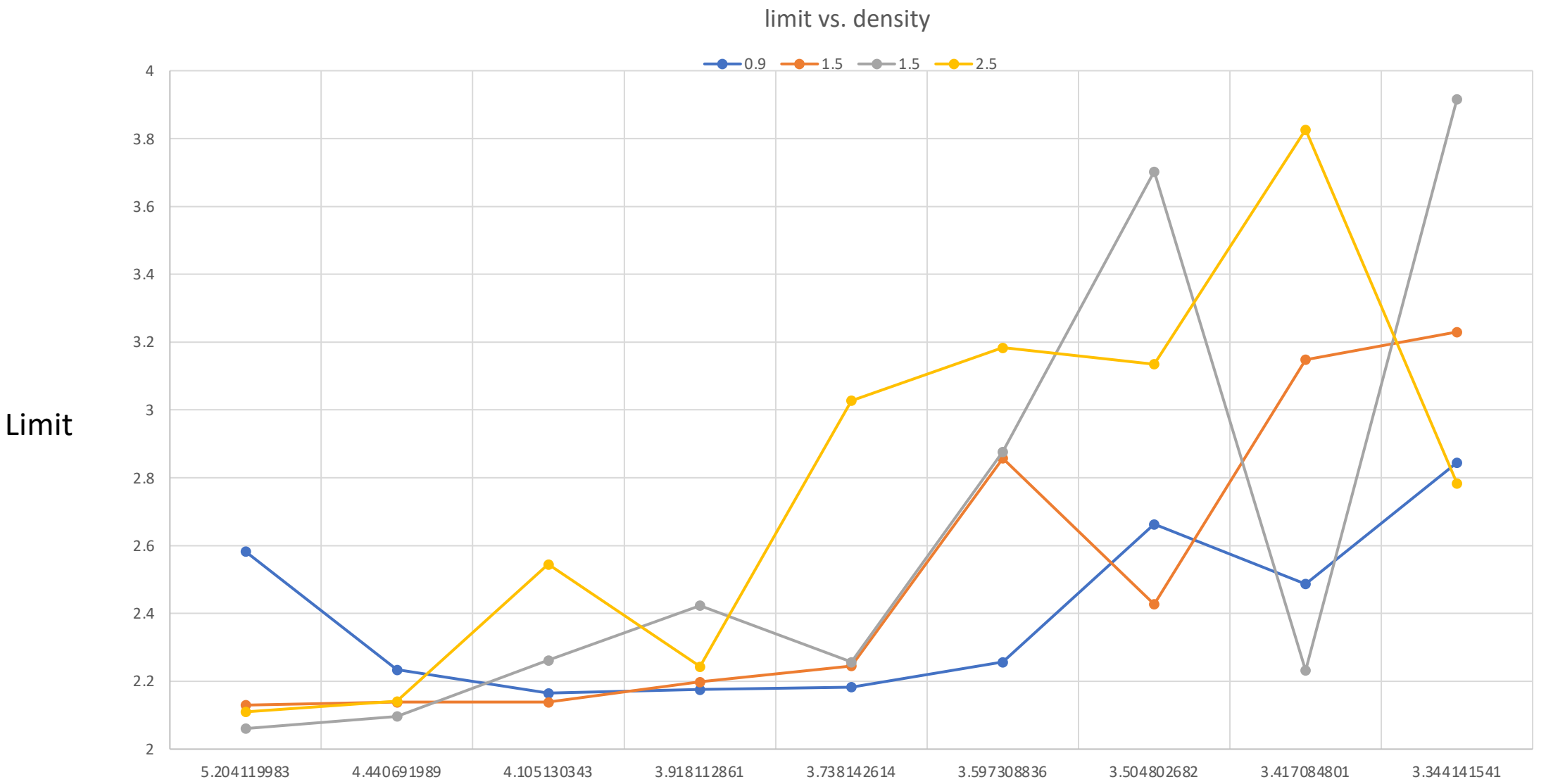
- Problem: with fixed #wall, increasing logS2, the density of #wall/bin varies
- Solution:
  - 1. change the x-axis to ratio (#wall/overlapping_area)
  - 2. redo the tests with changing density



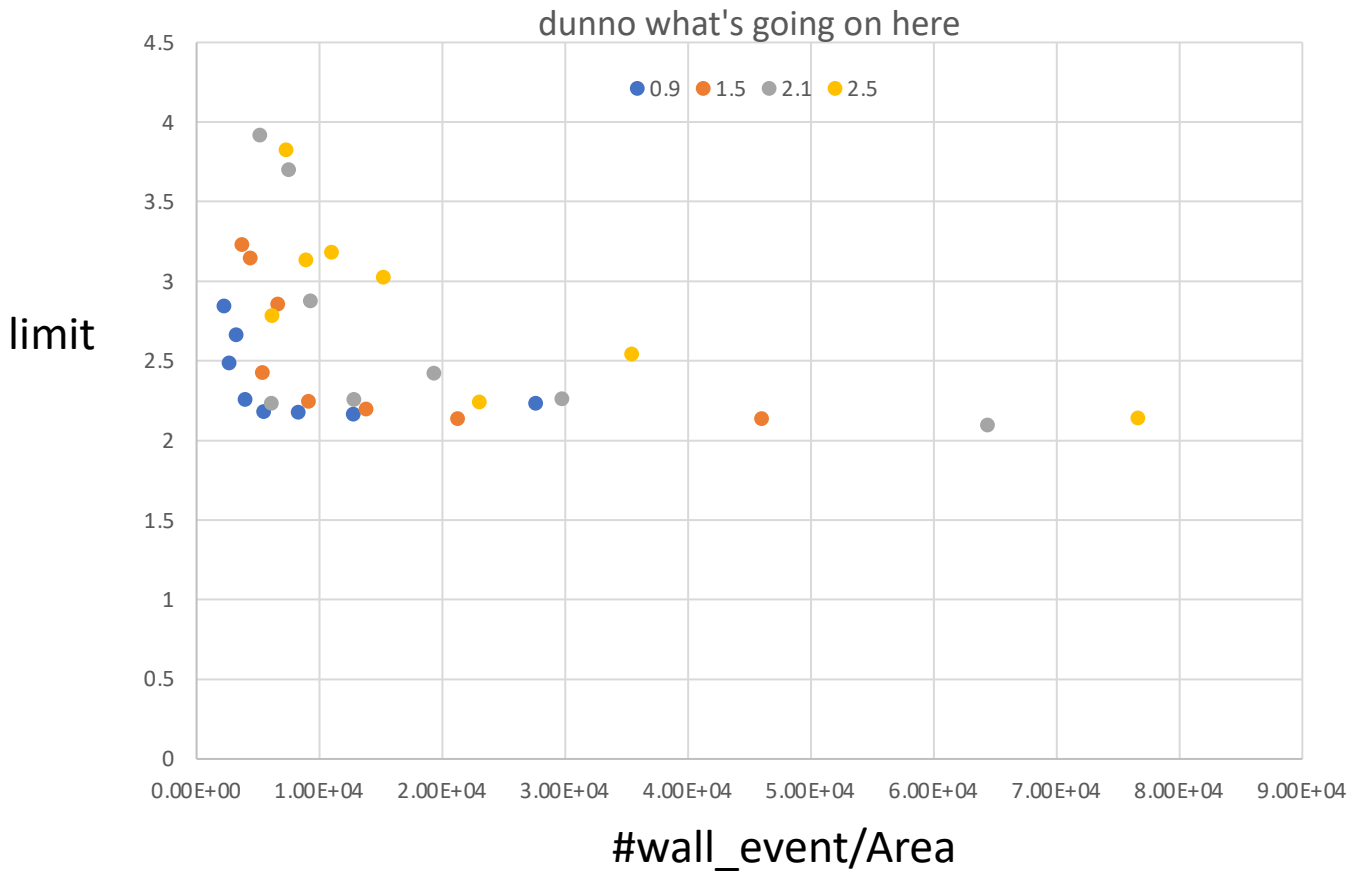




A dramatic change in area, after logS2 = 3

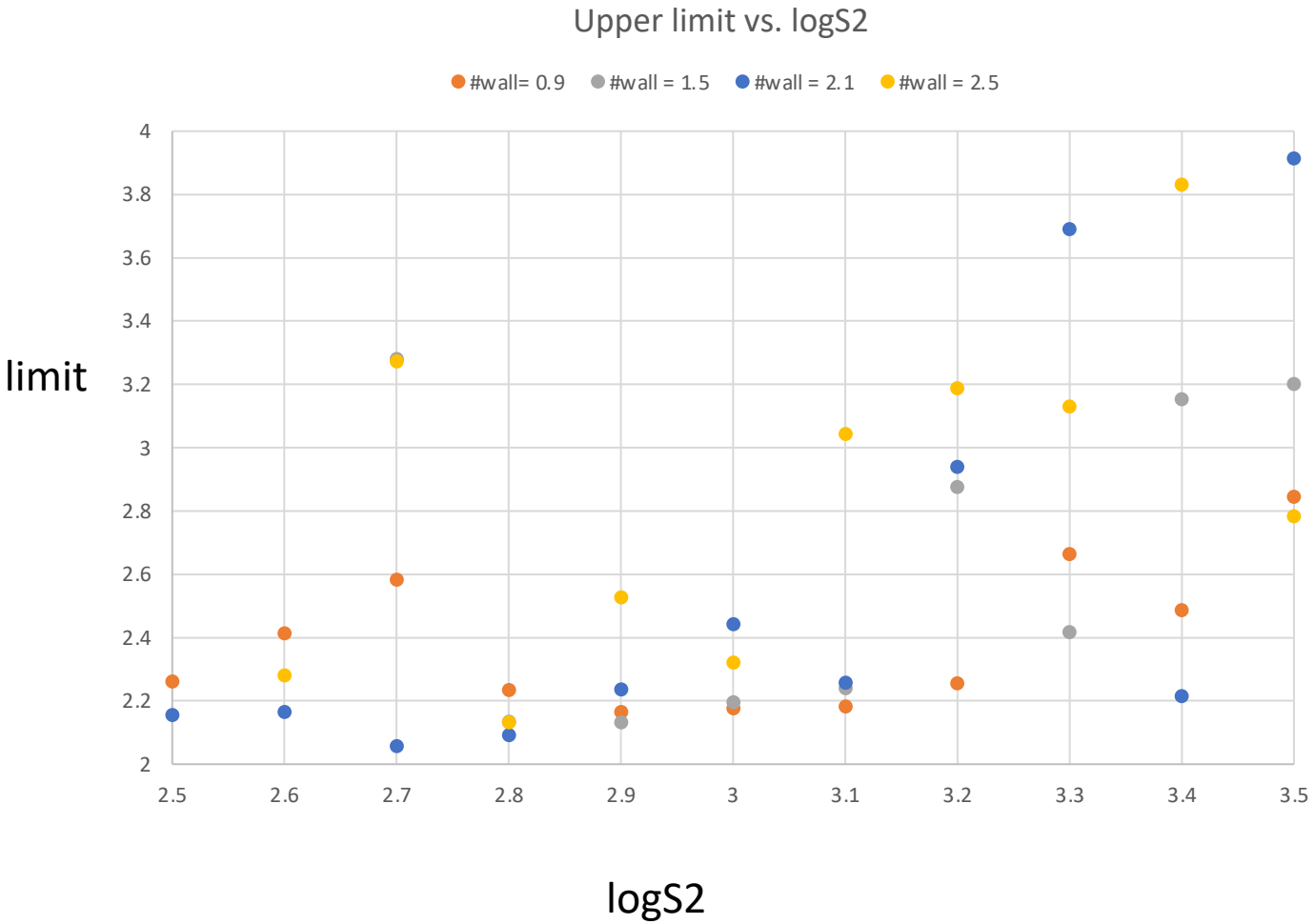

limit vs. density
0.9
1.5
1.5
2.5
4
3.8
3.6
3.4
3.2
3
2.8
2.6
2.4
2.2
2
5.204119983
4.440691989
4.105130343
3.918112861
3.738142614
3.597308836
3.504802682
3.417084801
3.344141541
Limit
Higher density
Lower logS2
#WE/Area
Lower density
Higher logS2

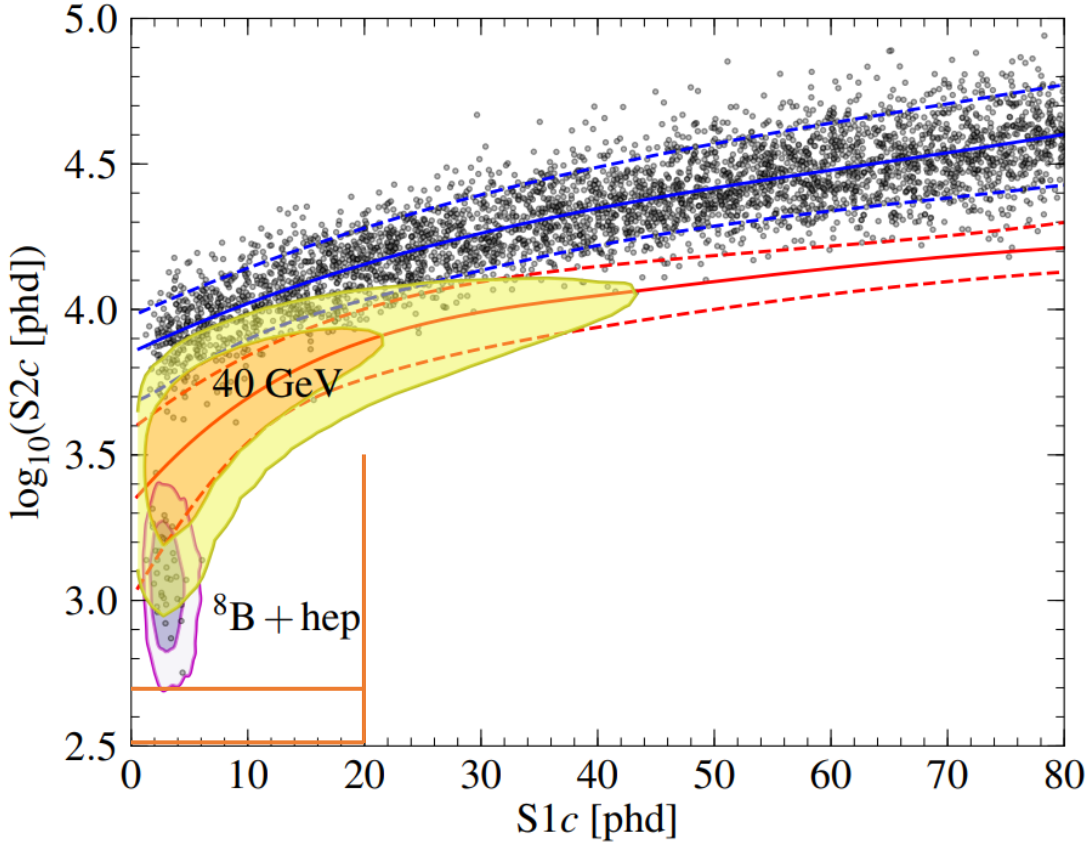
Previous Slide


dunno what's going on here
0.9
1.5
2.1
2.5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
0.00E+00
1.00E+04
2.00E+04
3.00E+04
4.00E+04
5.00E+04
6.00E+04
7.00E+04
8.00E+04
9.00E+04
limit
#wall_event/Area

Update

- 2D plot: upper limit vs. logS2 vs. #wall_events
  - 1000 toys, 60d, 40 GeV
  - Keep S1 constant at 20, varying logS2 from 2.5~3.5
  - Wall model: overlapping part with the existing model
  - 4 difference #wall_events: 0.9, 1.5, 2.1, 2.5

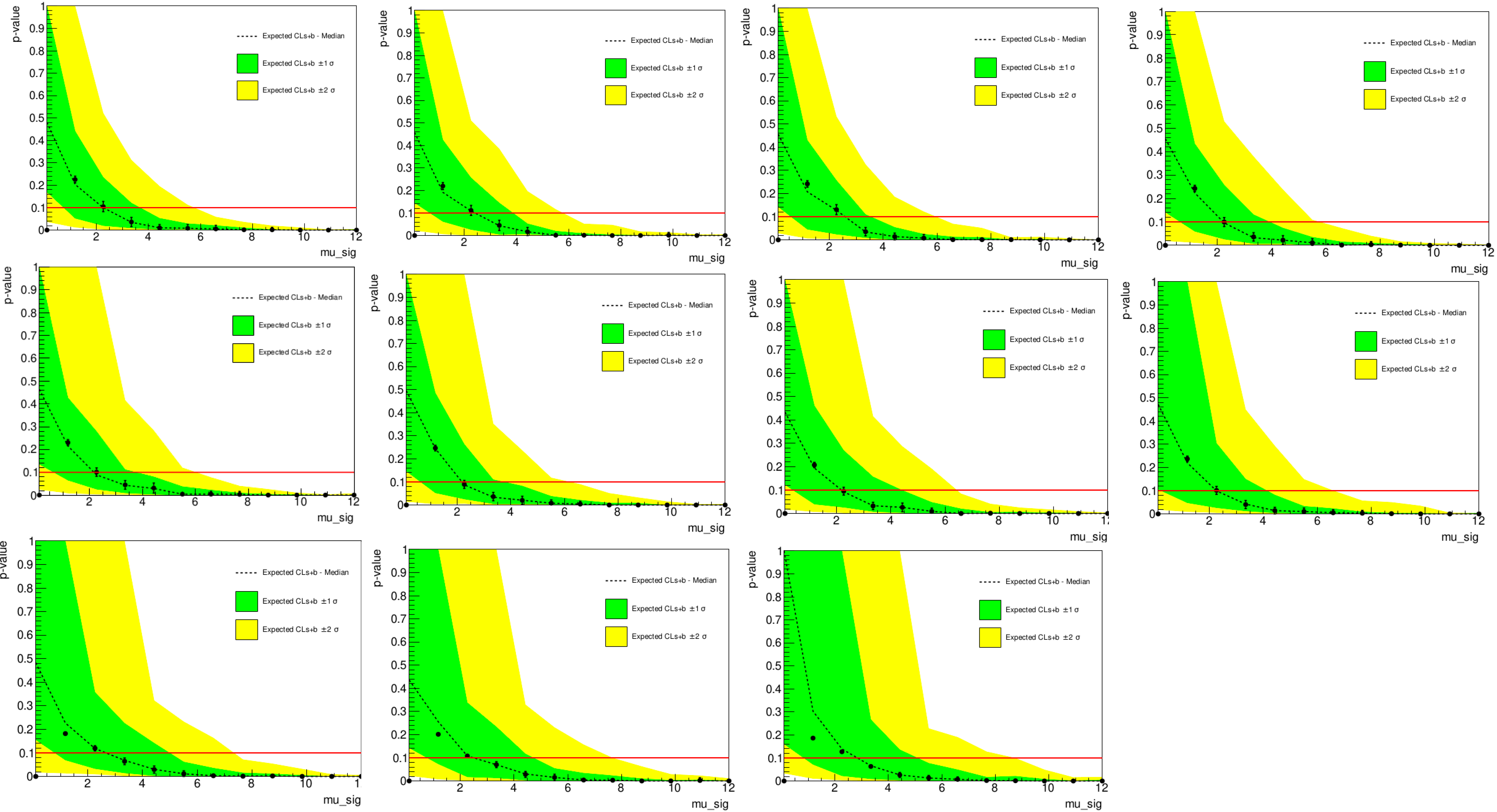

Upper limit vs. logS2
#wall= 0.9
#wall = 1.5
#wall = 2.1
#wall = 2.5
limit
logS2
4
3.8
3.6
3.4
3.2
3
2.8
2.6
2.4
2.2
2
2.5
2.6
2.7
2.8
2.9
3
3.1
3.2
3.3
3.4
3.5

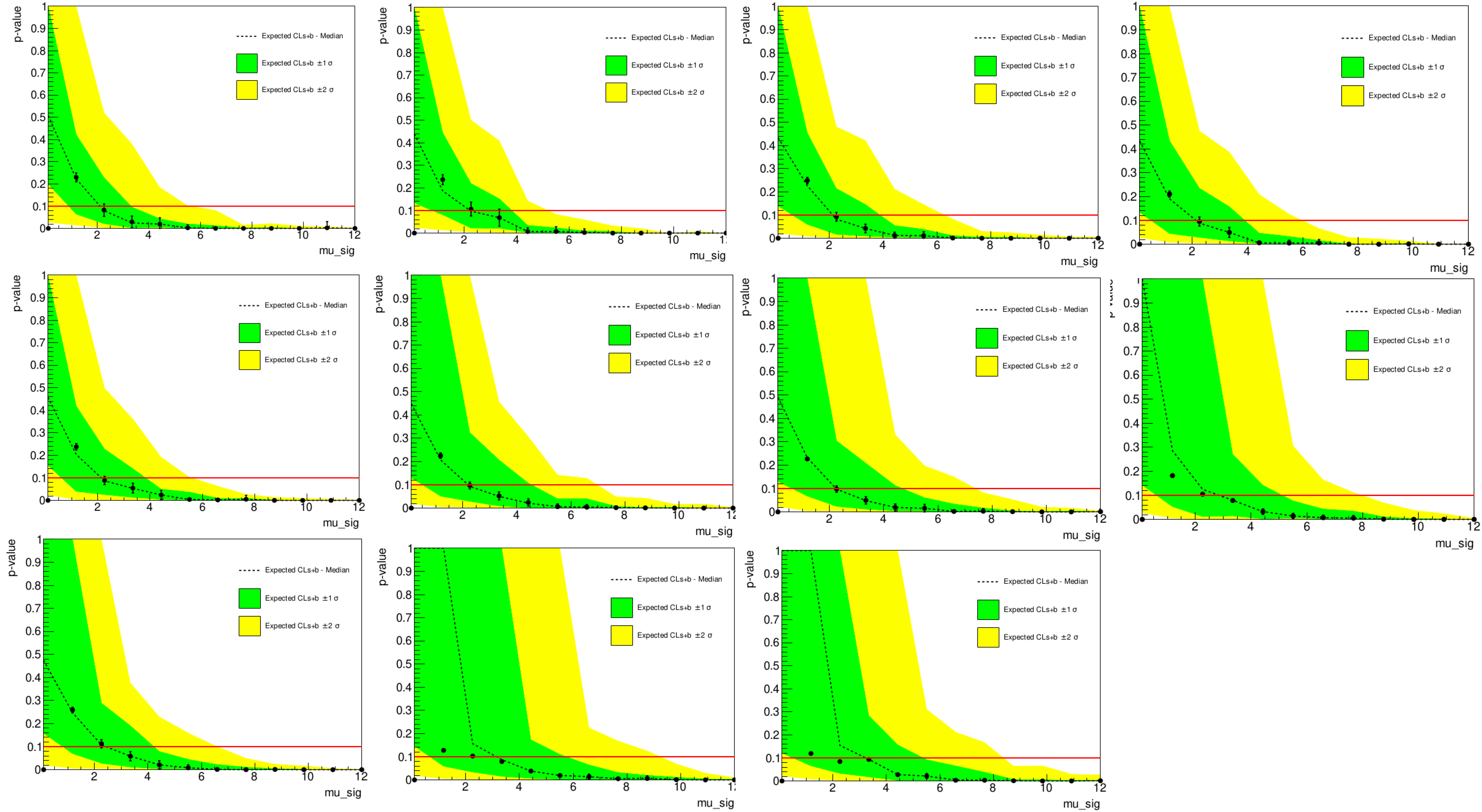

5.0
4.5
4.0
3.5
3.0
2.5
$\log_{10}(S2c\ [phd])$
40 GeV
$^8B + hep$
0
10
20
30
40
50
60
70
80
S1c [phd]

Problem

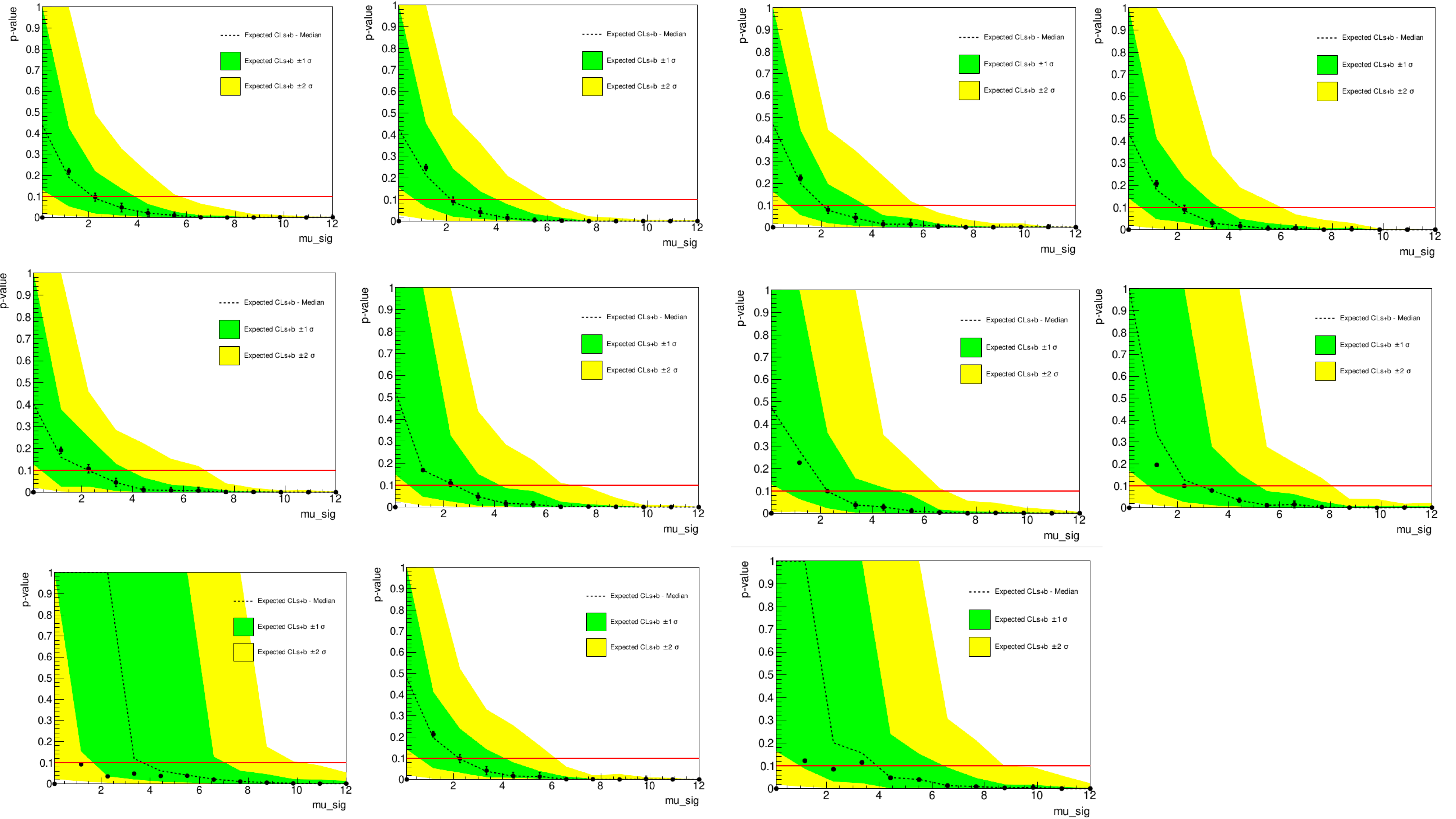
- For three cases (lower logS2 values), problem getting the upper limit
  - # wall = 1.5, logS2 = 2.5 (34.8%)
  - # wall = 1.5, logS2 = 2.6 (34.8%)
  - # wall = 2.5, logS2 = 2.5 (44.9%)

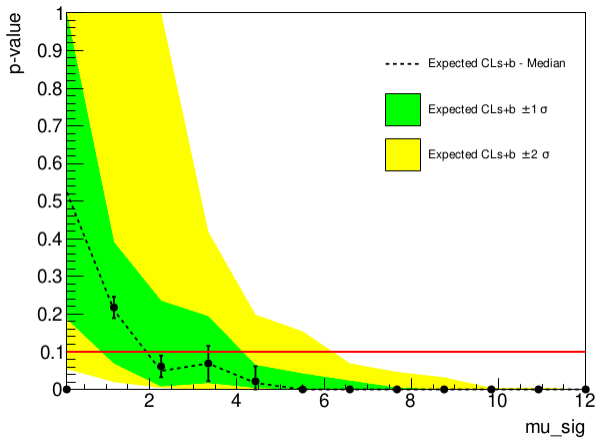
```
[#0] WARNING:Eval -- HypoTestInverterResult::CalculateEstimatedError - no valid points
 - cannot estimate  the upper limit error
```

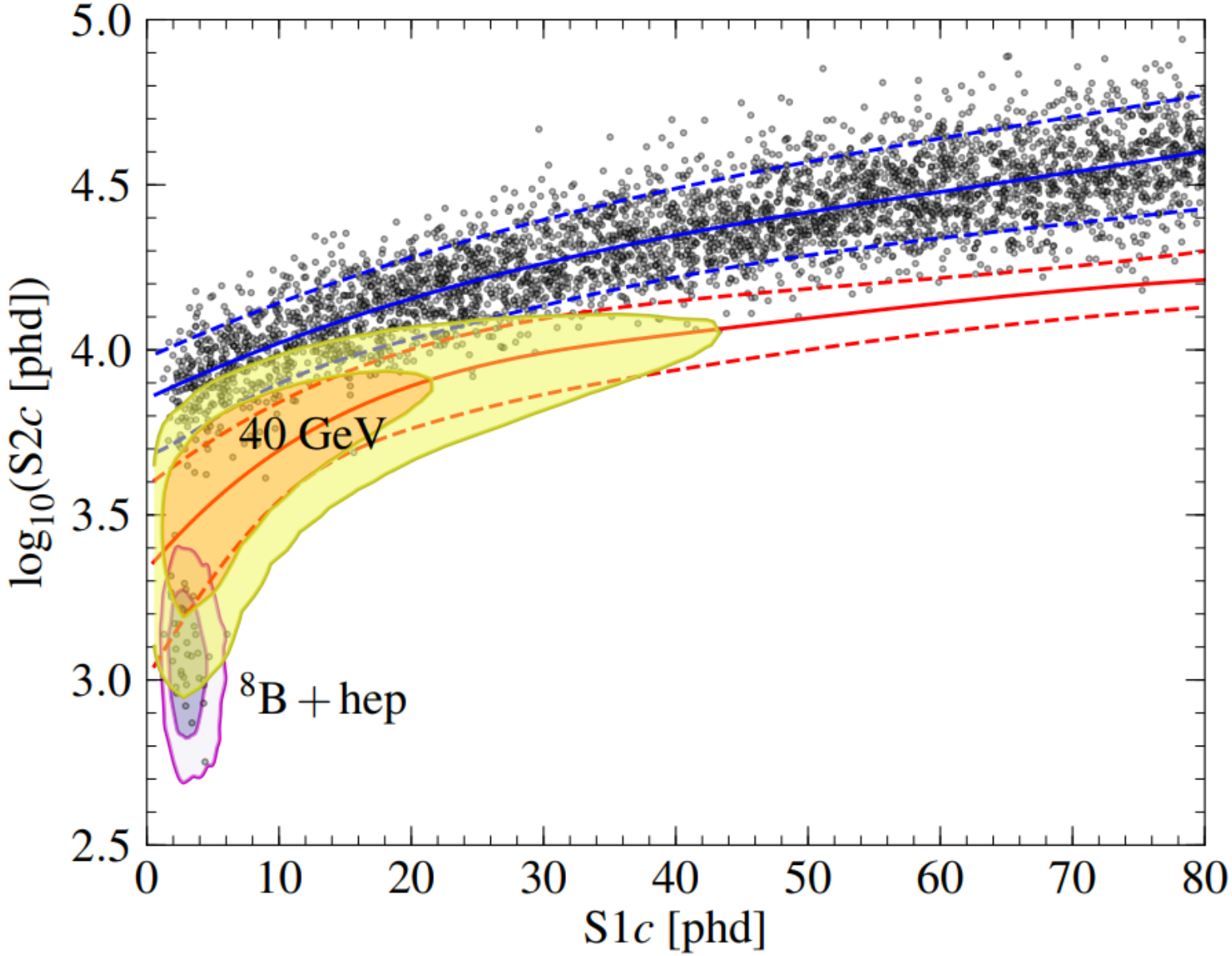

p-value
mu_sig
Expected CLs+b - Median
Expected CLs+b ±1 σ
Expected CLs+b ±2 σ



p-value
mu_sig
Expected CLs+b - Median
Expected CLs+b ±1 σ
Expected CLs+b ±2 σ


p-value
mu_sig
Expected CLs+b - Median
Expected CLs+b ±1 σ
Expected CLs+b ±2 σ

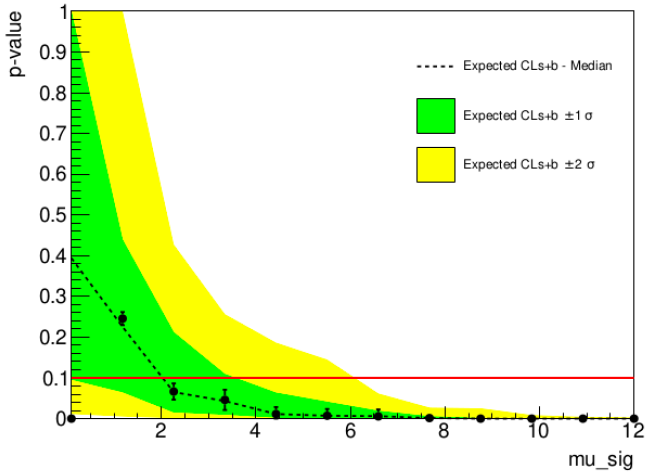

p-value
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
2
4
6
8
10
12
mu_sig
Expected CLs+b - Median
Expected CLs+b ±1 σ
Expected CLs+b ±2 σ


5.0
4.5
4.0
3.5
3.0
2.5
0
10
20
30
40
50
60
70
80
log10(S2c [phd])
S1c [phd]
40 GeV
8B + hep

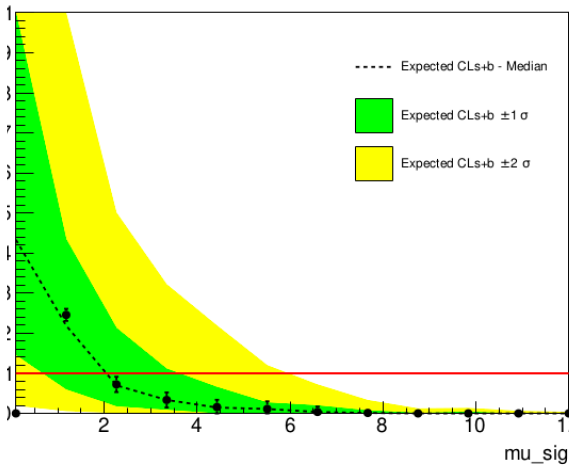
Update

- WDNM test on S1, logS2, # expected_wall
  - 1000 toys, 40 GeV, 60d, Max_POI = 12
- Compared # of failed toys for different cases

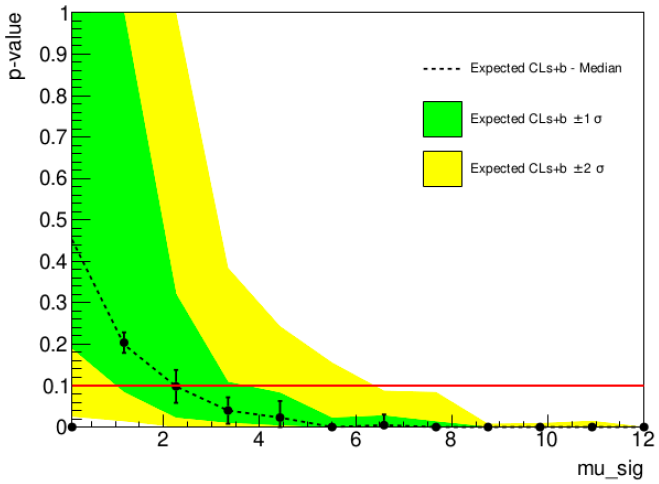
WDNM



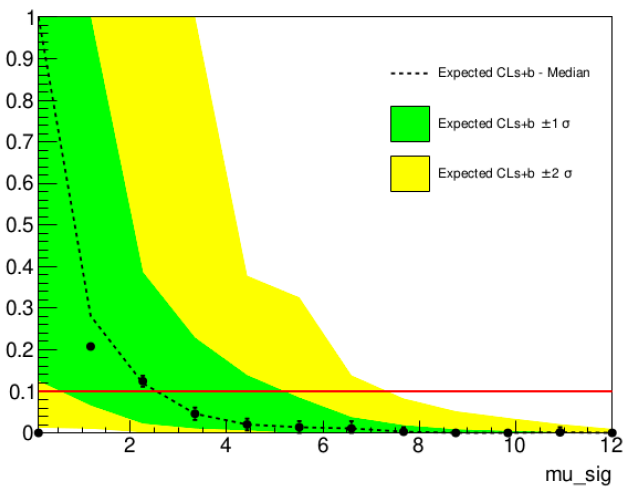
#wall = **0.9**, logS2 = **3**, S1 = **80**



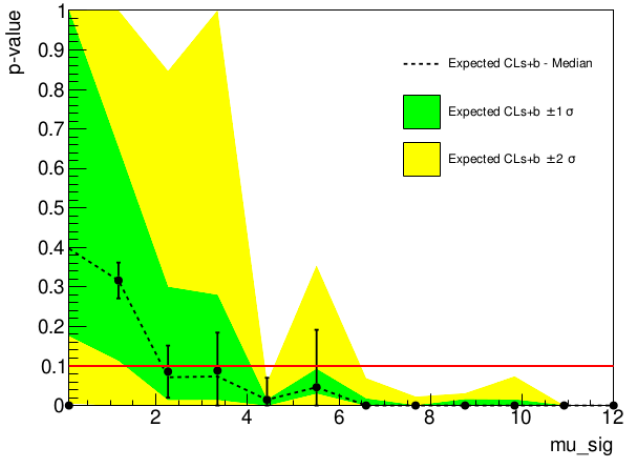
#wall = **0.9**, HlogS2 = **3**, S1 = **16**



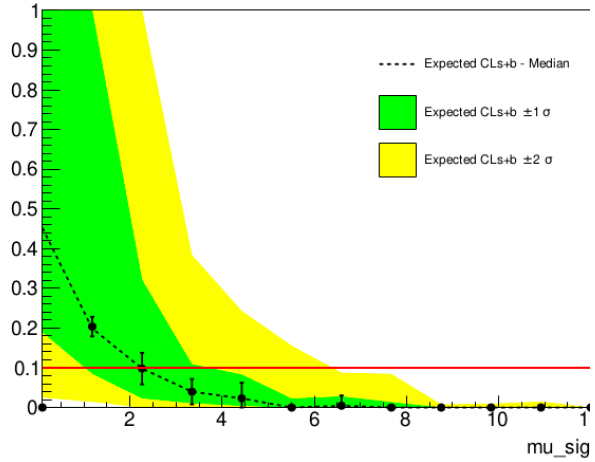
#wall = **0.9**, HlogS2 = **3.5**, S1 = **80**



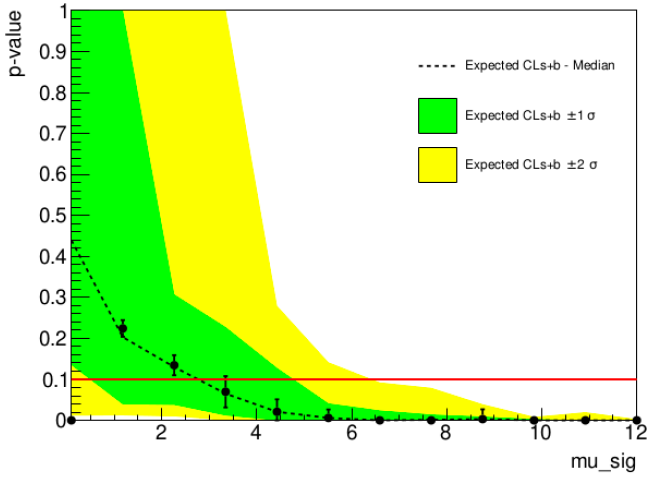
#wall = **0.9**, HlogS2 = **3.5**, S1 = **16**



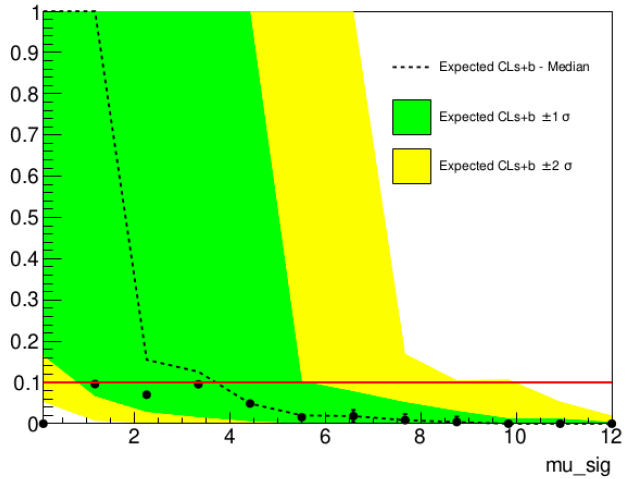
#wall = **3**, logS2 = **3**, S1 = **80**



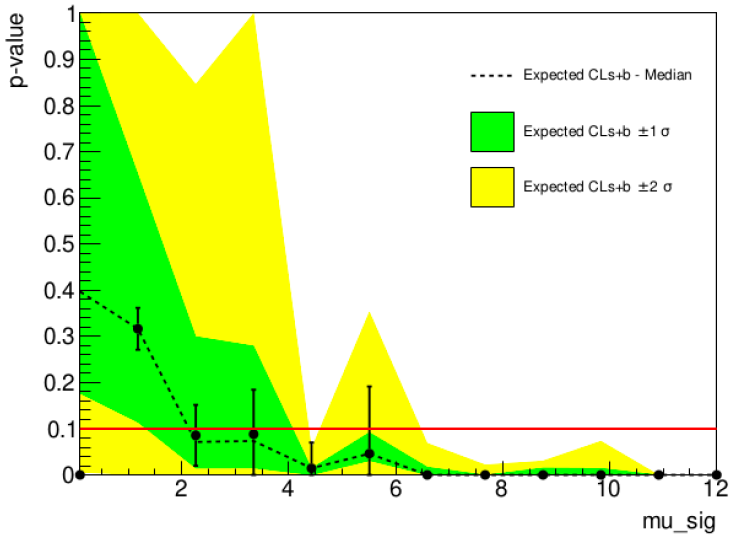
#wall = **3**, HlogS2 = **3**, S1 = **16**

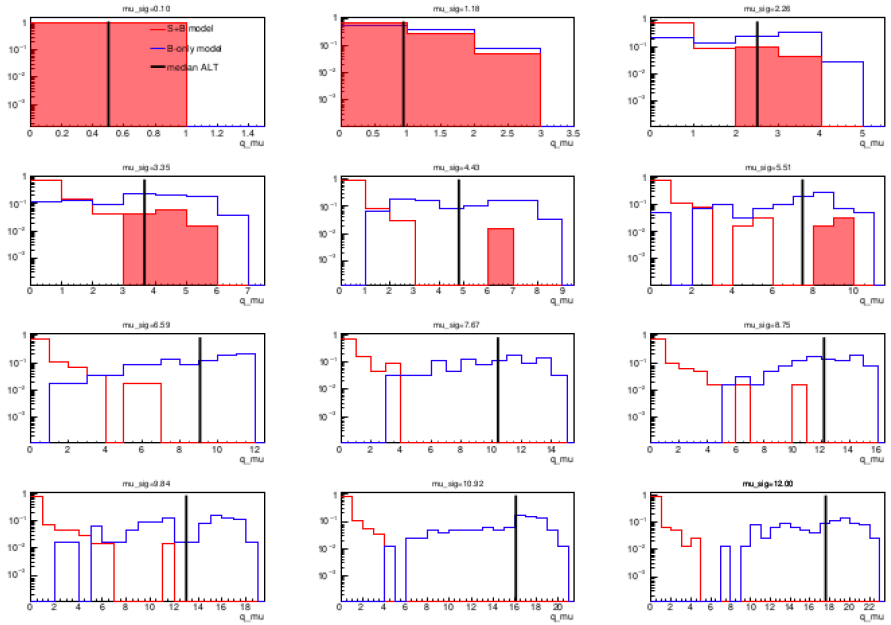


#wall = **3**, HlogS2 = **3.5**, S1 = **80**

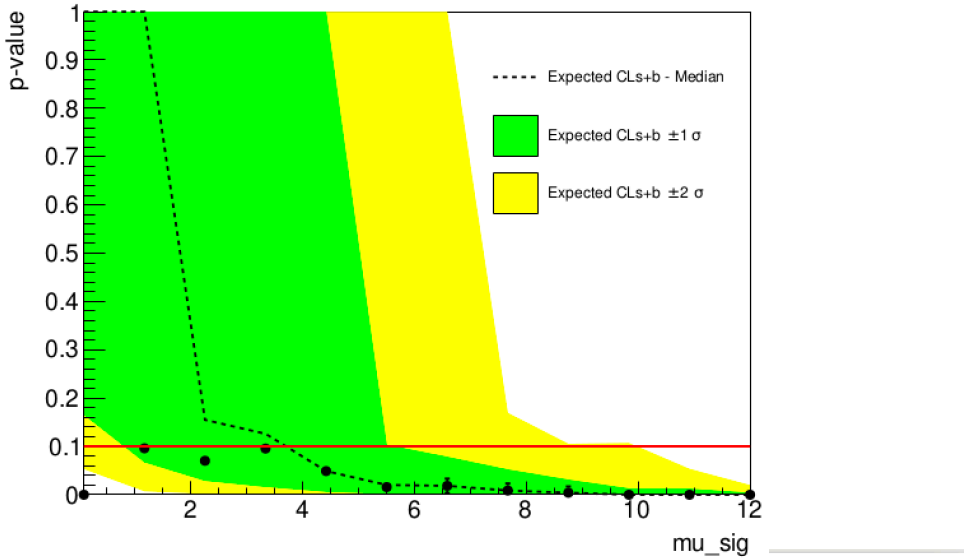


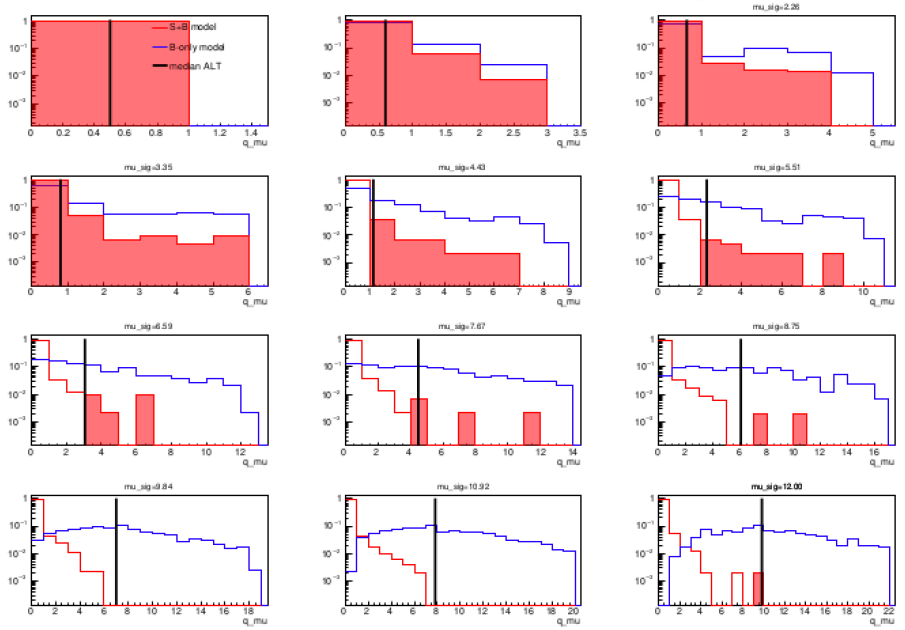
#wall = **3**, HlogS2 = **3.5**, S1 = **16**





#wall = 3, logS2 = 3, S1 = 80





#wall = 3, HlogS2 = 3.5, S1 = 16

failed events

Total toy run: 24011

(#expected_wall, logS2, S1)

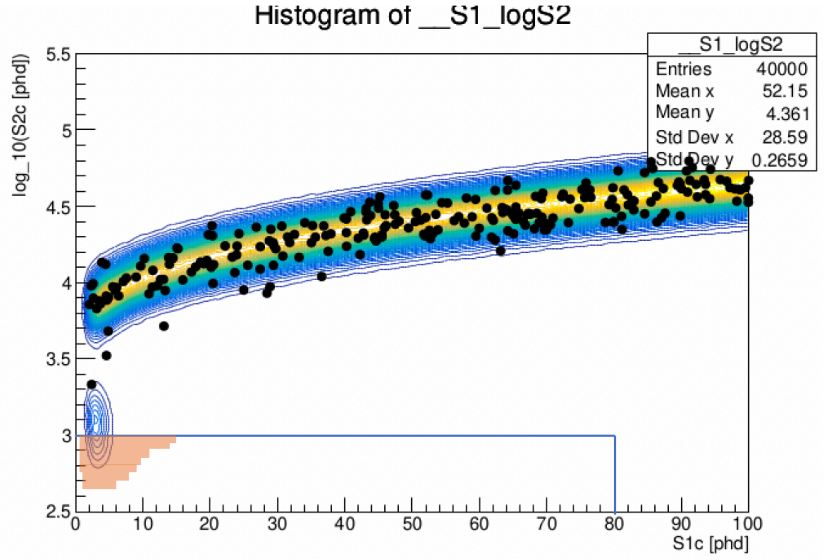
	(0.9, 3, 80)	(0.9, 3, 16)	(0.9, 3.5, 80)	(0.9, 3.5, 16)	(3, 3, 80)	(3, 3, 16)	(3, 3.5, 80)	(3, 3.5, 16)
#Failed	4029	2440	3494	3748	13065	10839	9051	7771
%	17%	10%	15%	16%	54%	45%	38%	32%

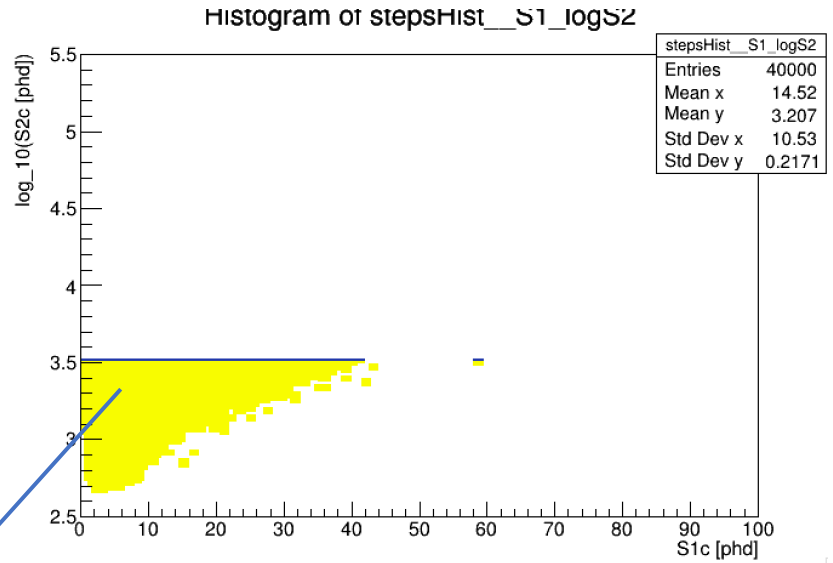
For expected_wall = 0.9, varing logS2 & S1 values do not affect the % of failed toys much

For expected_wall = 3, a clear decrease in % of failed toys with higher logS2, lower S1 (around B8 region)

Improvement

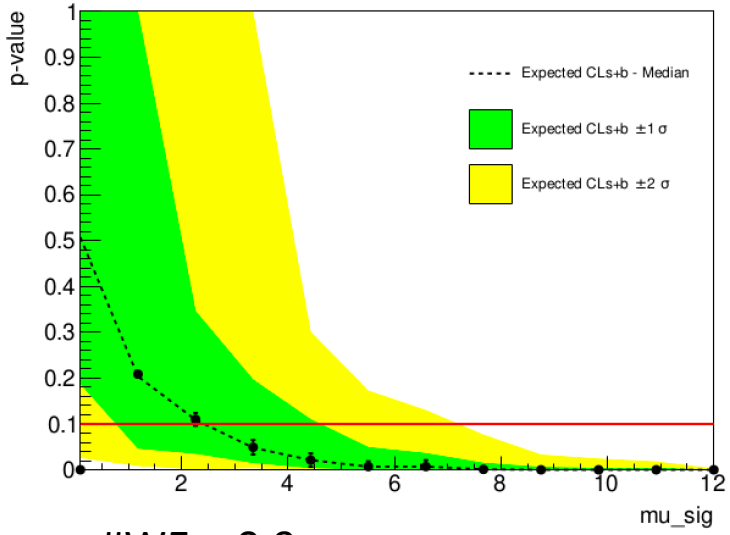
- To decrease the #failed toys
  - For WDNM case, since the failed toys will not be used to determine the limit, create the wall model to be the region that overlaps with the current existing model → adding a wall model with uniform likelihood distribution to the current existing model





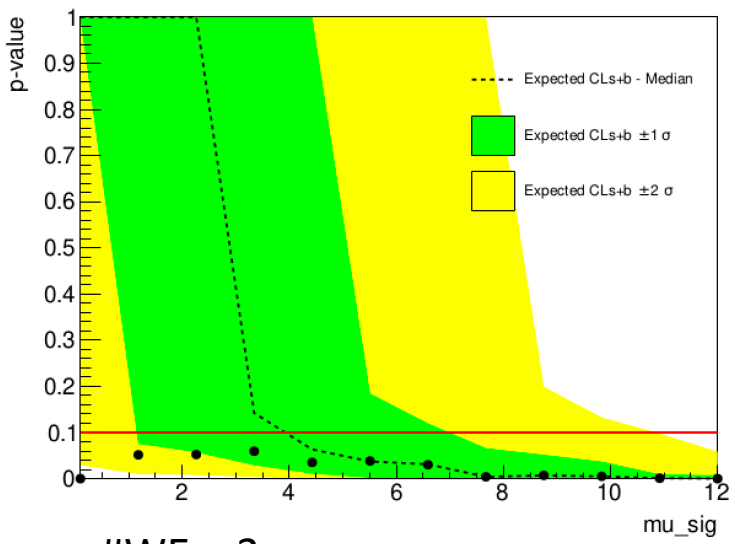
New wall model

B8



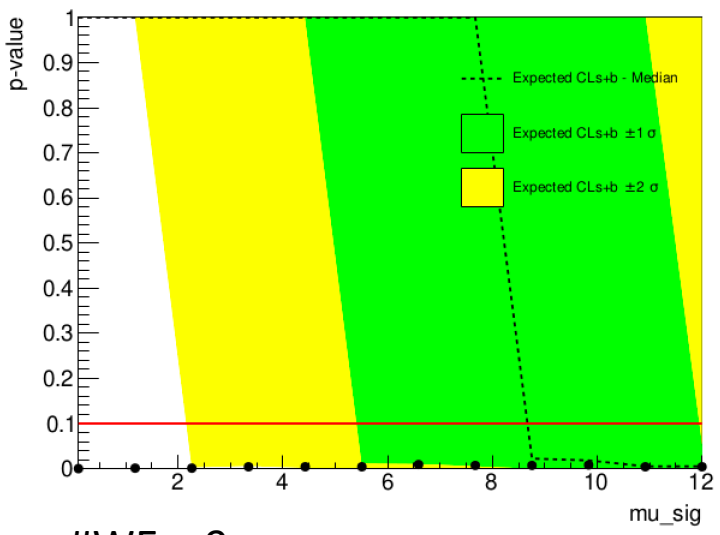
#WE = 0.9

Failed toys: 50/ 24011 ~ 0.021%



#WE = 3

Failed toys: 50/ 24011 ~ 0.021%

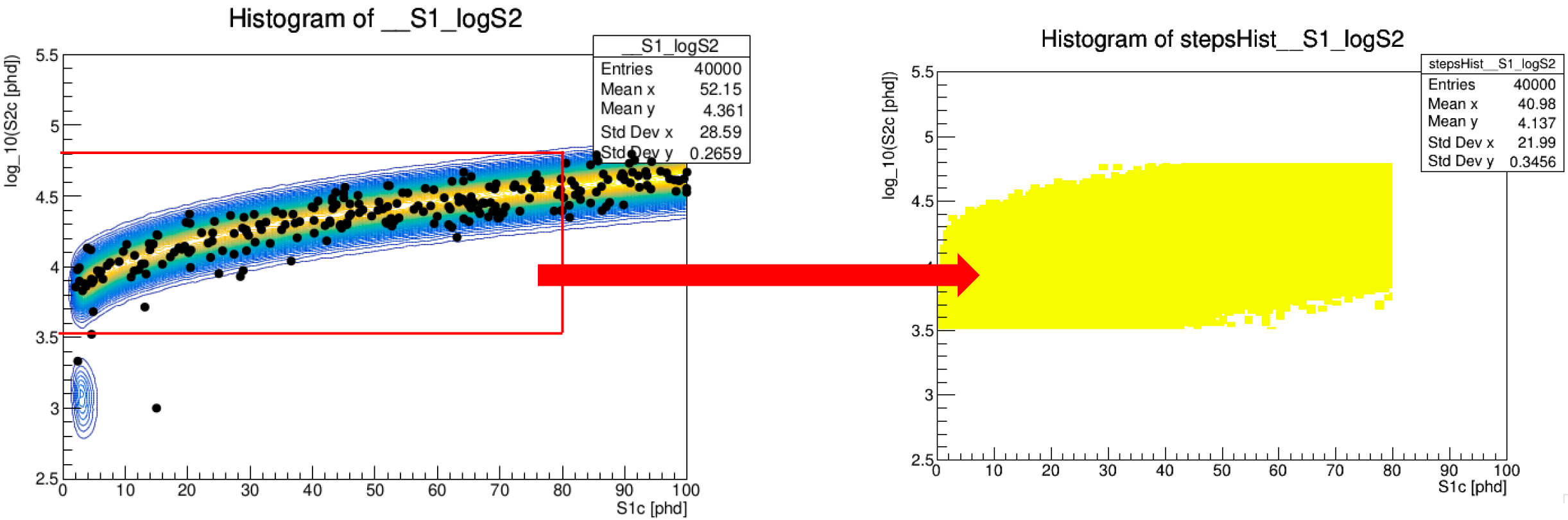


#WE = 9

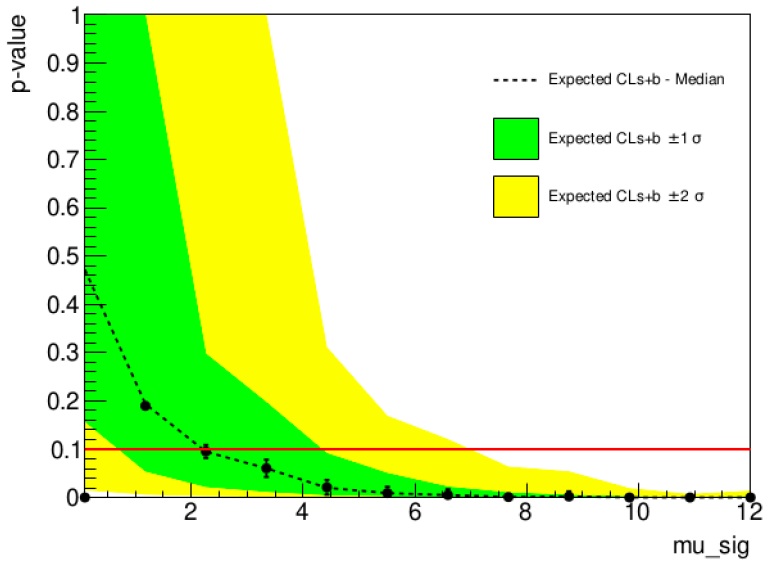
Failed toys: 187/ 24011 ~ 0.078%

Worse limit creation

- How to create a worse limit?
  - Mess with the mu_sig region

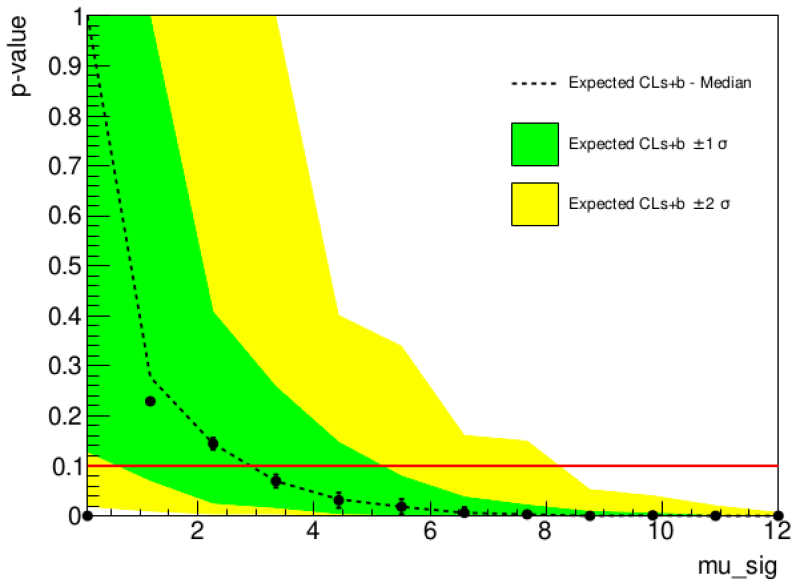


Mu_sig



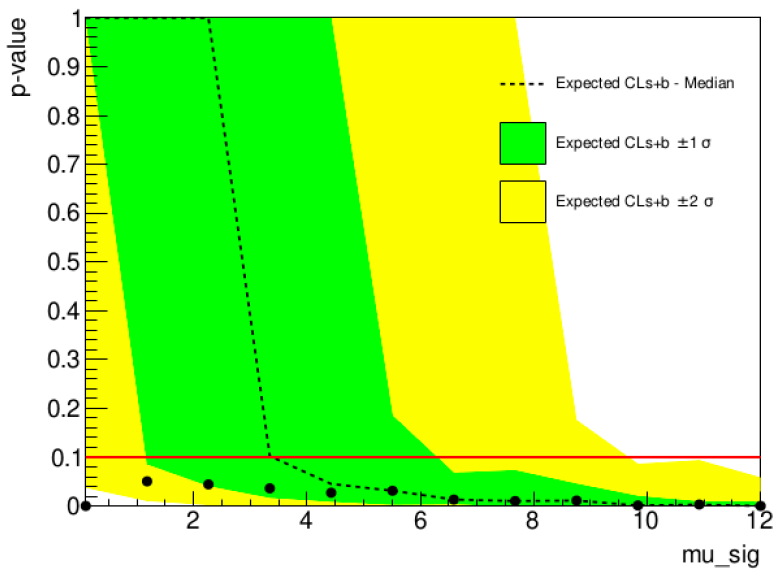
#WE = 0.9

Failed toys: 13/ 24011 ~ 0.005%



#WE = 3

Failed toys: 19/ 24011 ~ 0.008%



#WE = 9

Failed toys: 55/ 24011 ~ 0.023%

The wall model for mu_sig region is much larger than for the B8 region, maybe create a similar area of wall model in mu_sig region?