PCL
Poisson discreteness

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- 1 bin counting experiment
- Example is use

Stat Forum
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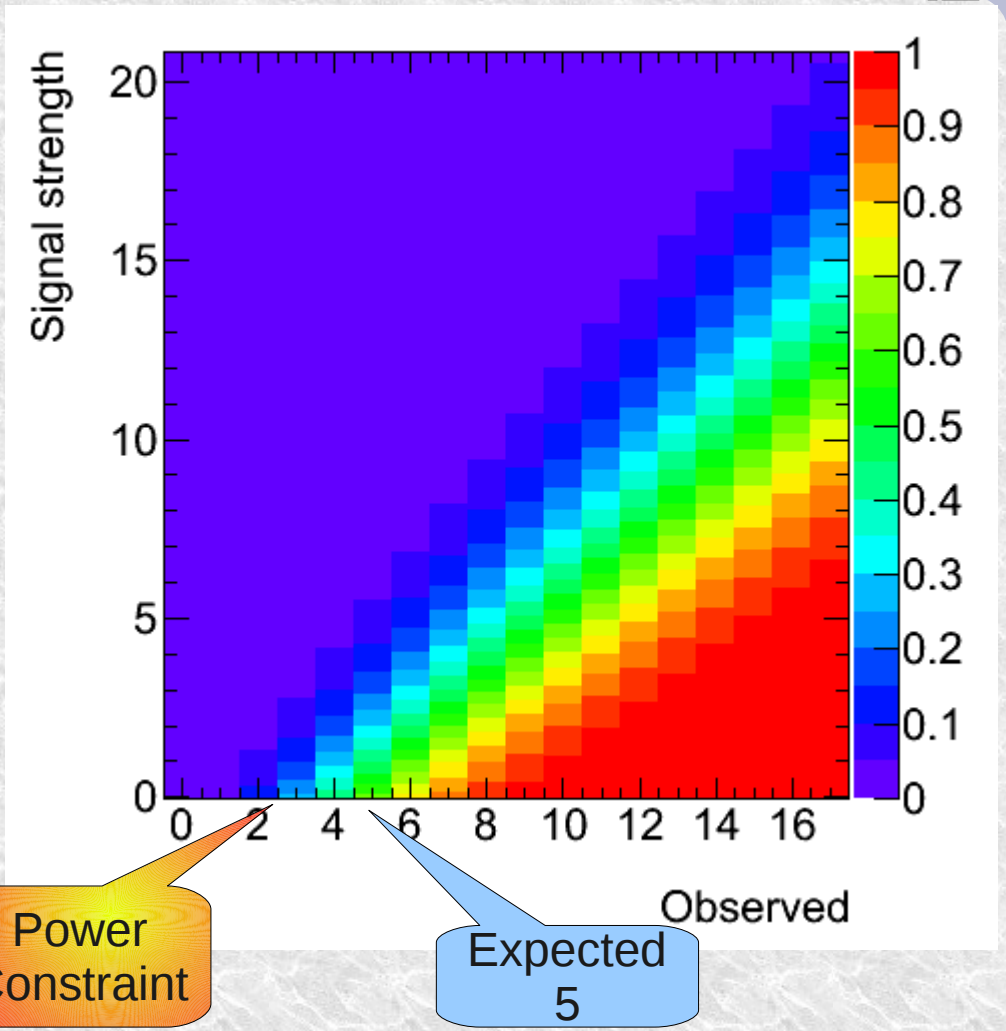
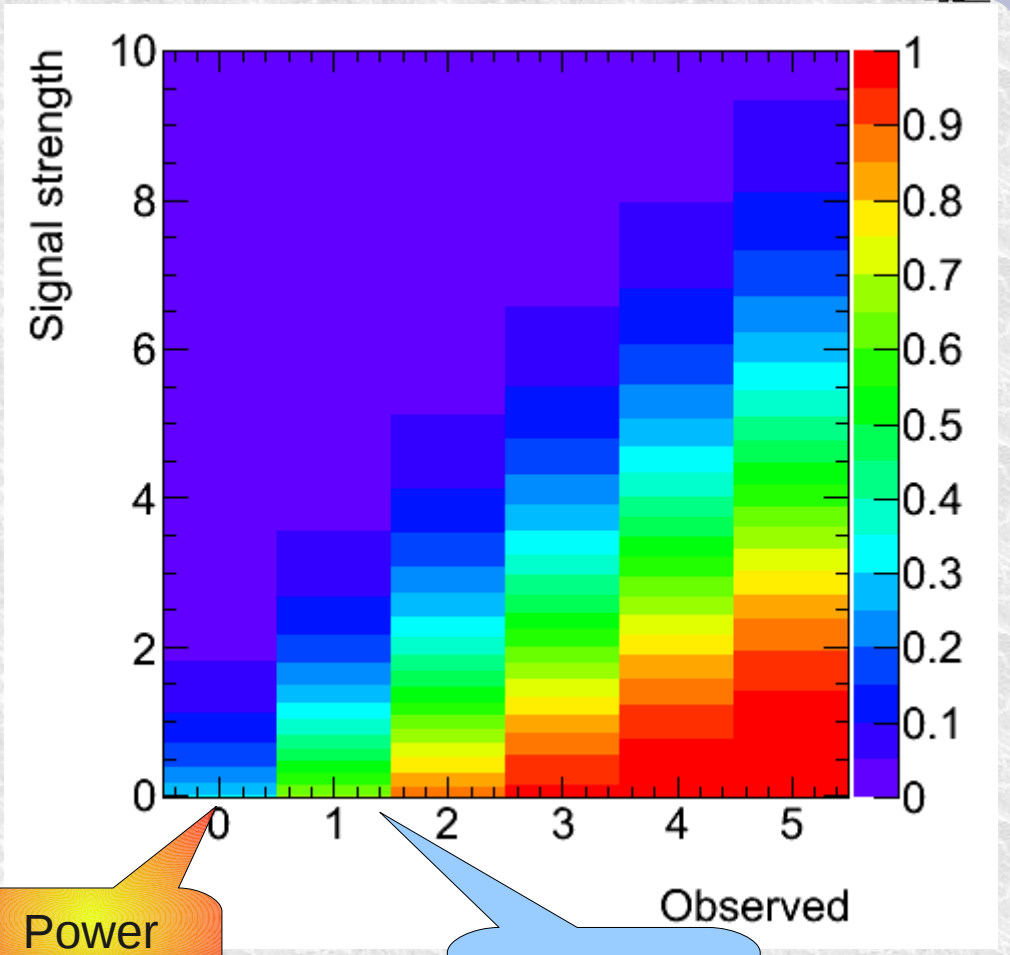
PCL applied to single bin

- One bin counting experiment
- 10 background expected
- CL_{sb} is shown as function of s,obs
- Power constraint defined as 16% @ s=0
  - 2 observed events



PCL application

- One bin counting experiment
- 1.2 background expected
- CL_{sb} is shown as function of s,obs
- Power constraint defined as 16% @s=0
- This is 0
- No power constraint applied

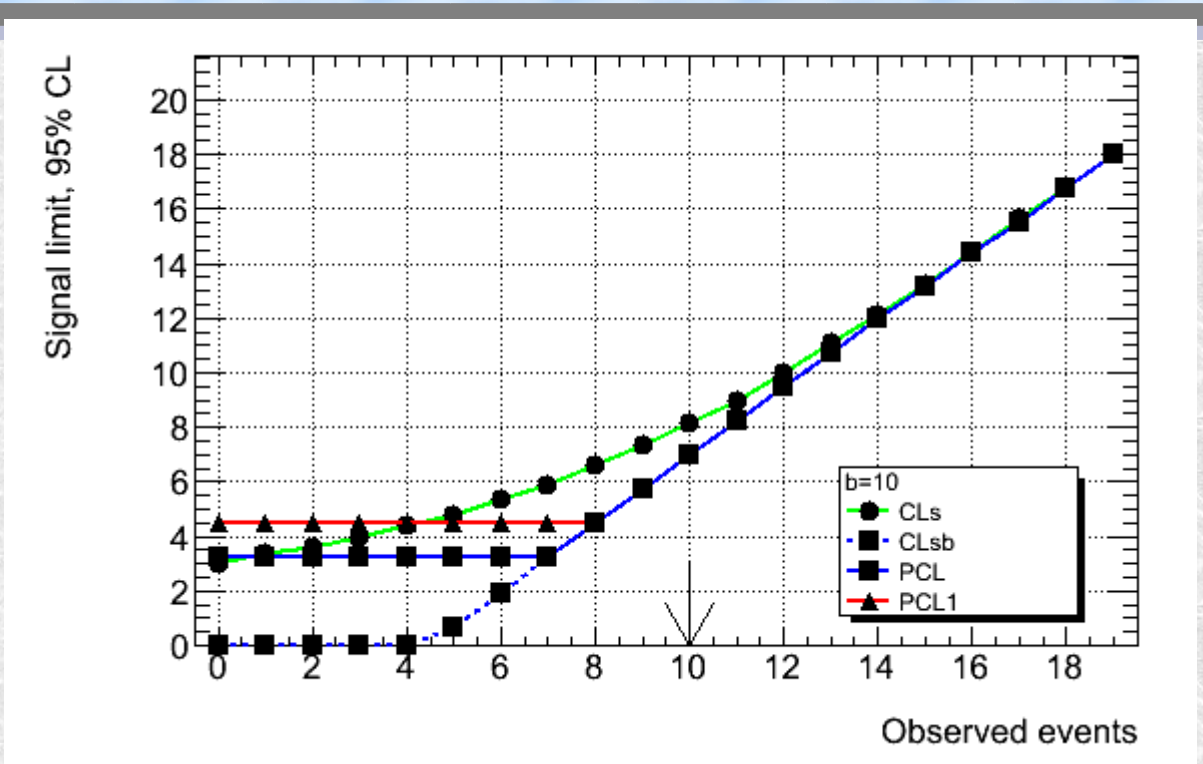


'Safe' PCL definition

- Normal PCL has a danger
  - If b<1.8 the observation of 0 has a 16% probability
  - Thus *part* of it lies inside the -1sigma band
    - So the power constraint is never invoked
  - But somehow not all of the bin should have been included
- Suggested approach:
  - Find cumulative distribution for s=0
  - Find point with 16%
  - Define power as first point *above* it
- This means the power is over-invoked, and it is AT LEAST -1σ, not -1σ

Limits versus n Obs

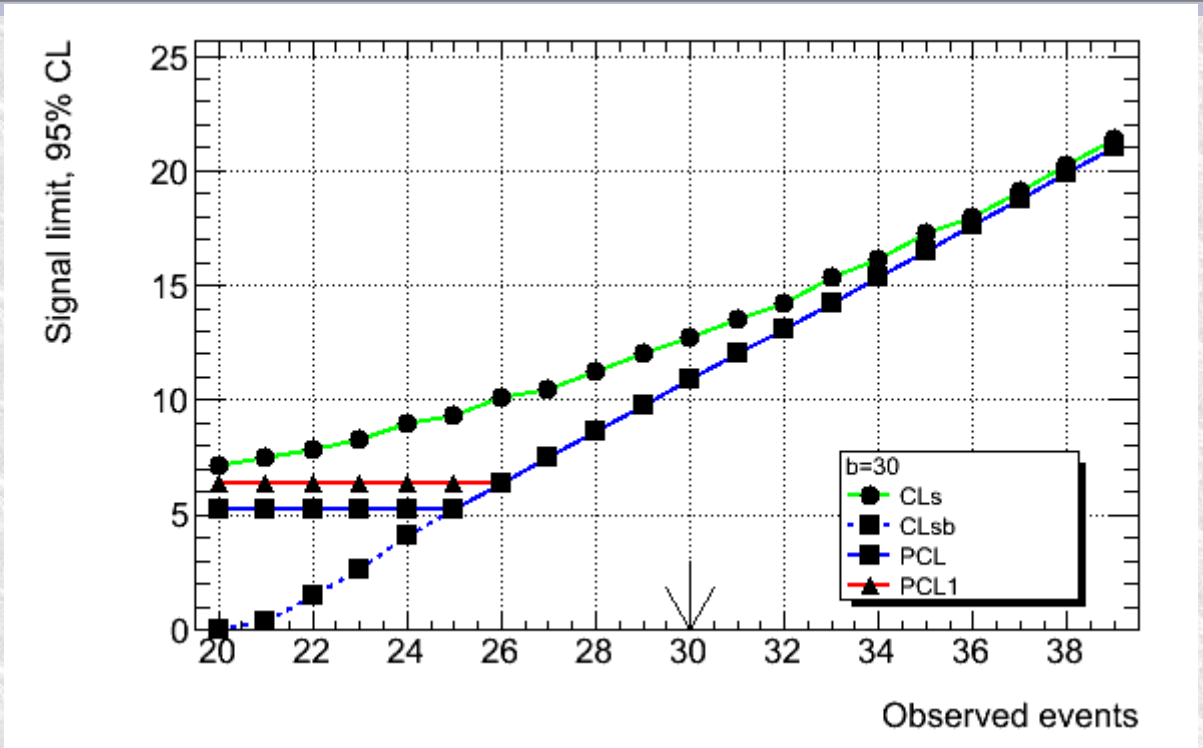
10 events expected



- With 10 expected, 16% power includes 7
  - Just excludes 8
- Conservatively treatment suggests using 8
  - Limit moves from 3 to 5
  - Effect on mean limit is rather small

Limits versus n Obs

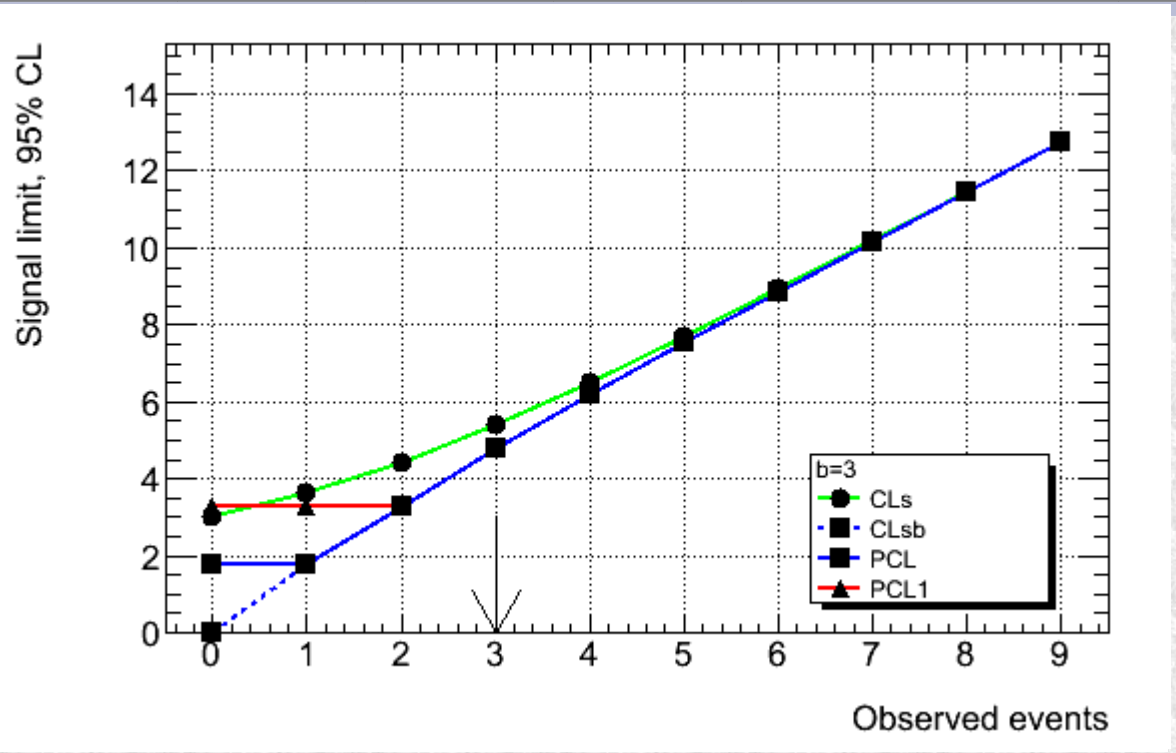
30 events expected



- With 30 expected, 16% power includes 25
  - Just excludes 26
- Conservatively treatment suggests using 26
  - Limit moves from 5 to 6
  - Effect on mean limit is rather small

Limits versus n Obs

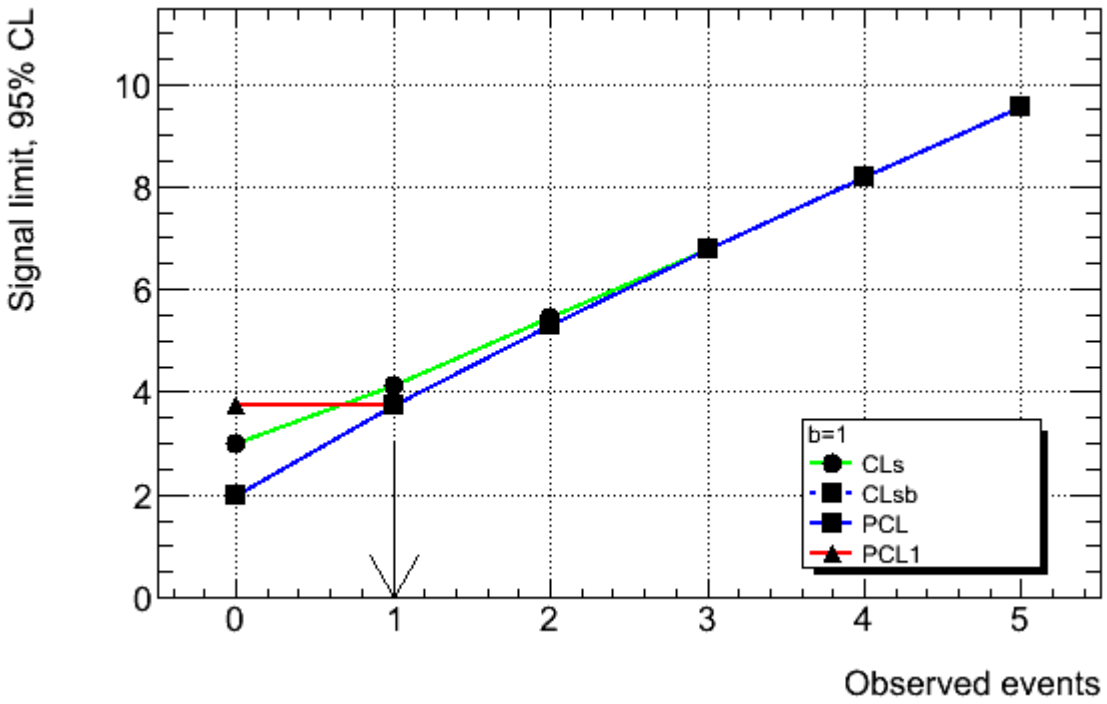
3 events expected



- With 3 expected, 16% power includes 1
  - Just excludes 2
- Conservatively treatment suggests using 2
  - Limit moves from 2 to 3
  - Effect on mean limit is not so small

Limits versus n Obs

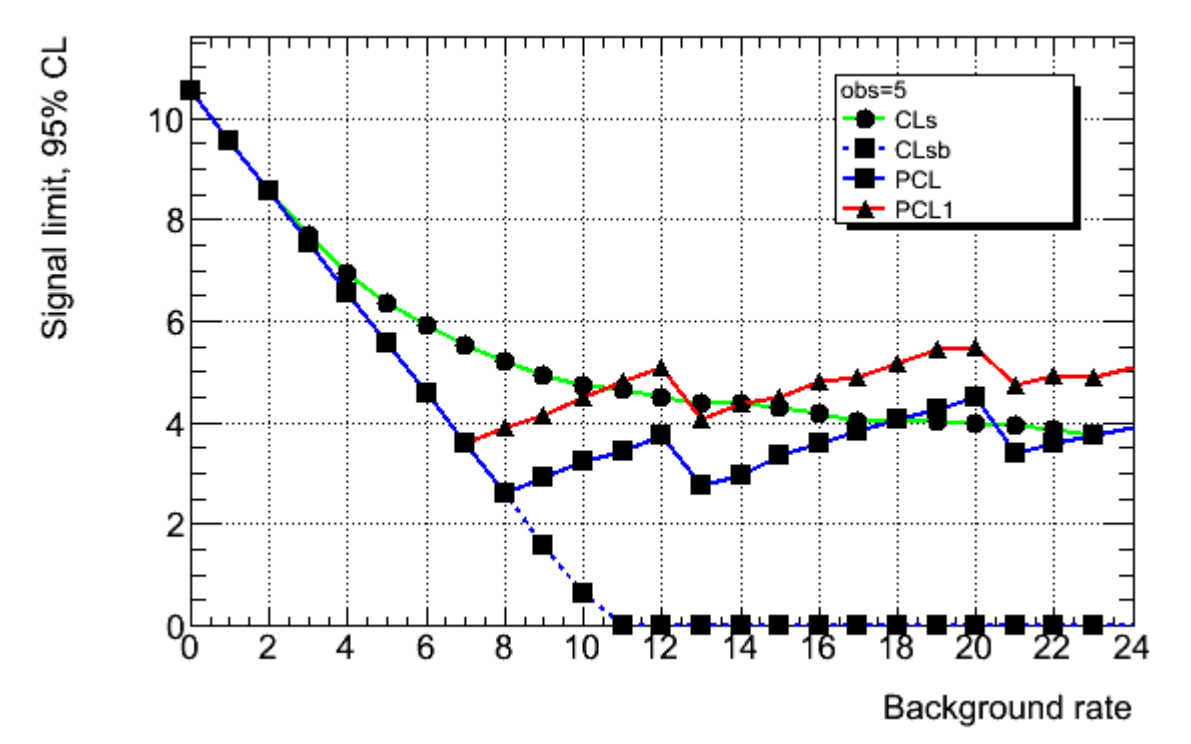
1 events expected



- With 3 expected, 16% power includes 0
  - Just excludes 2
- Conservatively treatment suggests using 1
  - Limit moves from 2 to 3.5
  - Effect on mean limit is noticeable

Limits versus background

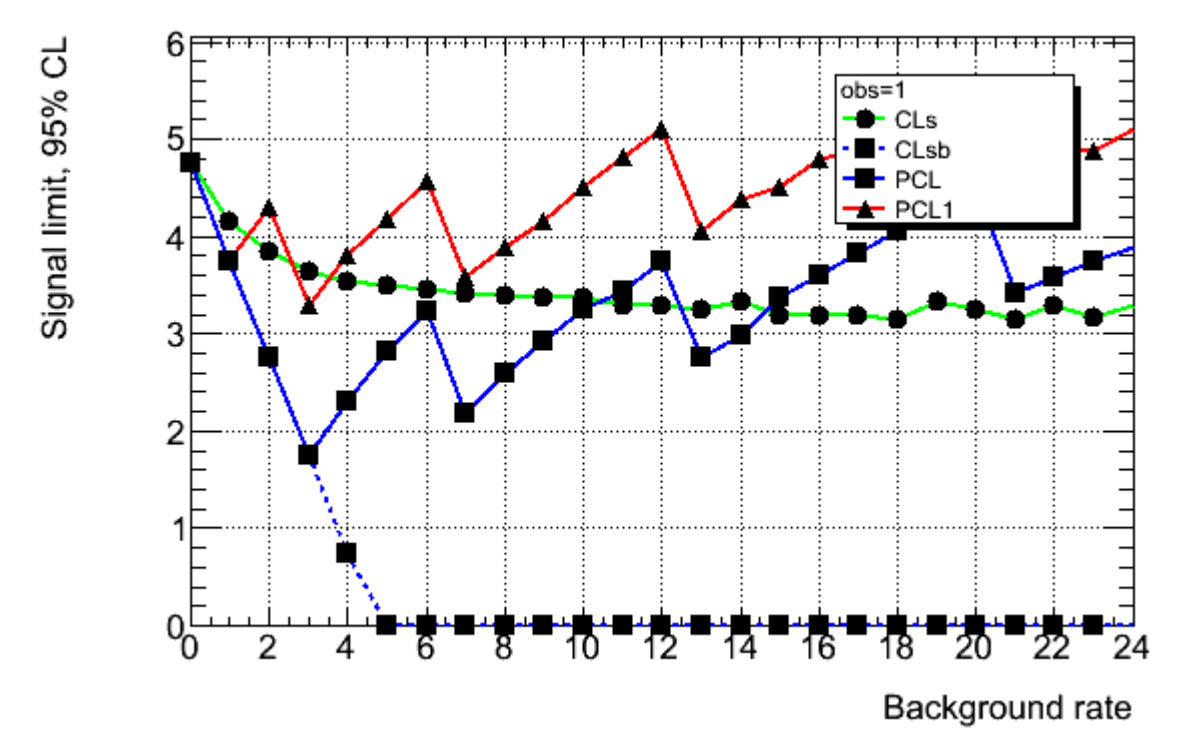
5 events seen



- CL_s has a smooth behaviour here
  - But no one should plan based on observation!
- PCL averages around 3.5 when power invoked
  - Safe version more like 4.5

Limits versus background

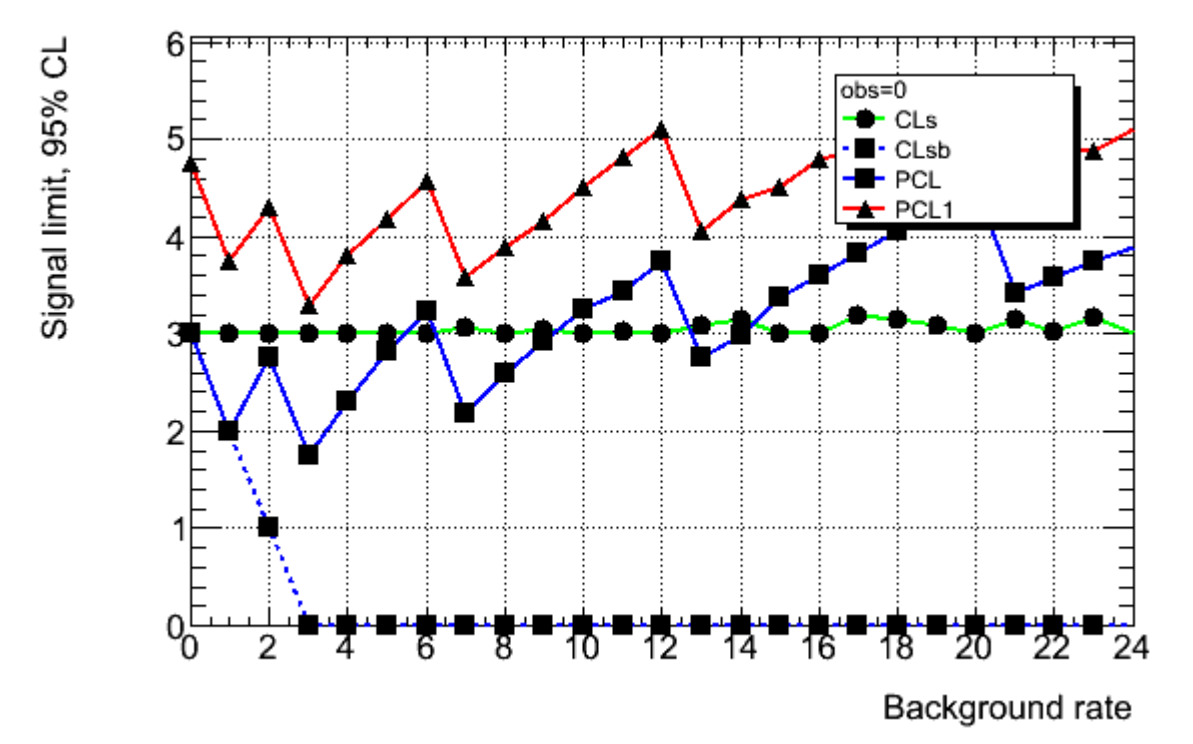
1 event seen



- CL_s limits towards 3
- PCL averages around 3 when power invoked
  - But goes below 2
  - Safe version more like 4 (except for v high bknd.)

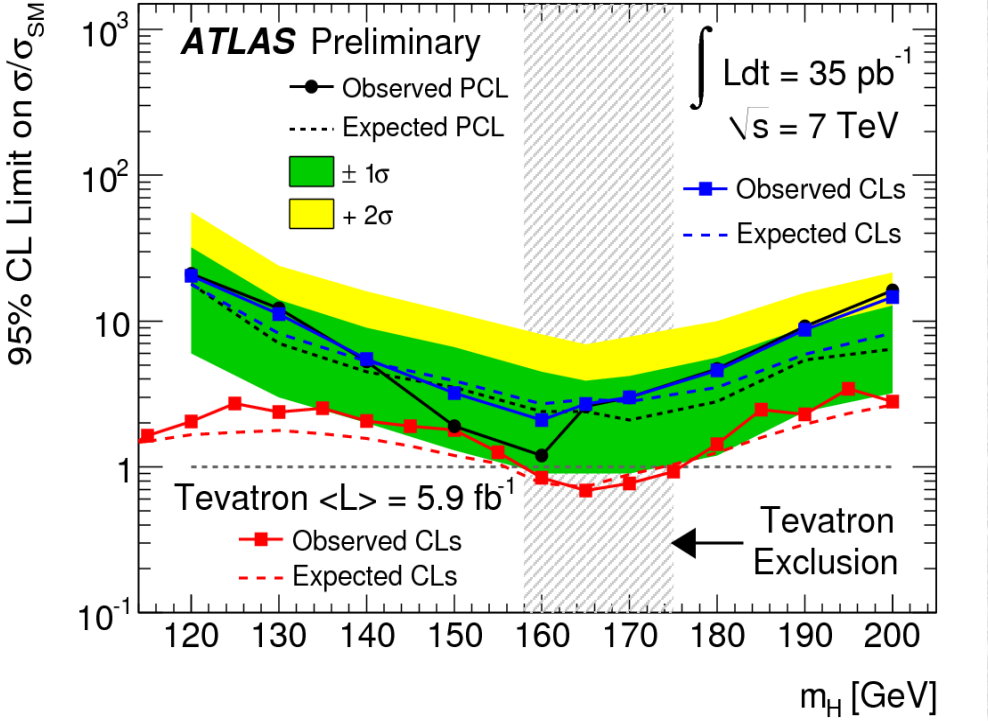
Limits versus background

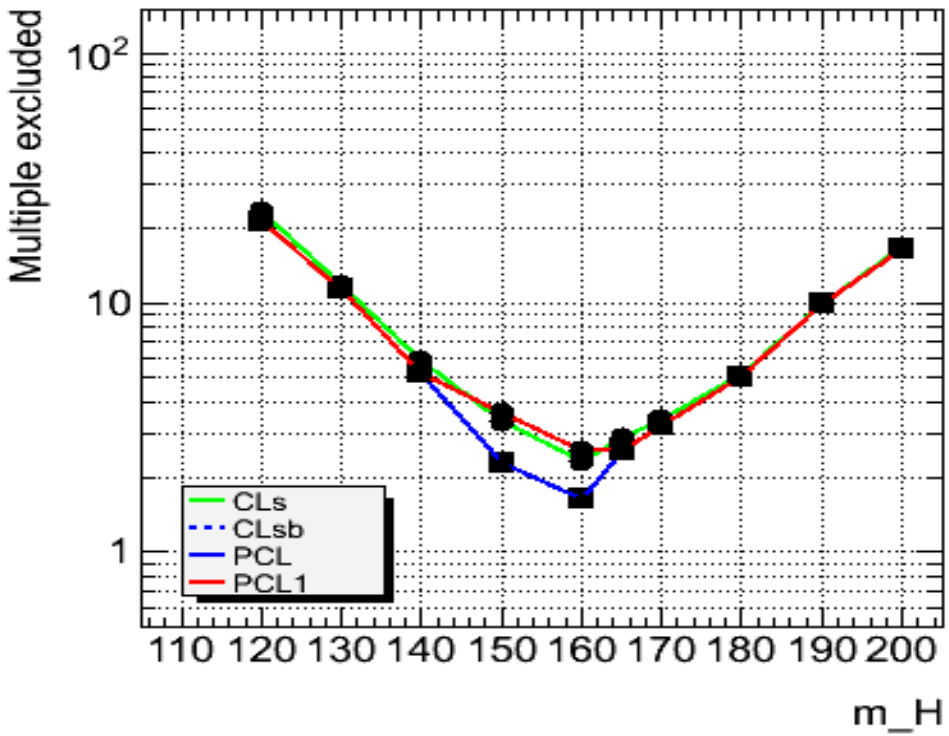
0 event seen



- CL_s limits is 3
- PCL averages around 3 when power invoked
  - But goes below 2
  - Safe version still more like 4 (except for v high bknd.)

Application to WW





- Take s, b, eff from H→WW note
  - But add all 3 bins for simplicity & ignore all systematics
  - Normal PCL looks like note (less power of course)
- Safe PCL looks very like CLs

Conclusion

- In future the power constraint should exclude boundary of -1σ region
- Original was not wrong
  - But the constraint might not be as strong as consumer thinks