Unbinned fit
in Zy boosted analysis

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Compare binned vs unbinned

Many thanks to Enrique, Shu and Zhijun for preparing basic materials from the binned side for the comparisons

We have compared limits (med, bands and obs)

1. Without any systematics
2. With all systematics
3. With/without some individual systematics (JER, Rtrk_track)

Unbinned fit uses exactly the same parameters as binned

1. signal model, shape parameters, and signal efficiencies
3. background model
4. uncertainty inputs except spurious signal

Unbinned fit uses now RooGuassian terms instead of RooBifurGaussian terms (before) to the asymmetric uncertainty modeling for the sake of combination

We calculate the relative differences between binned and unbinned

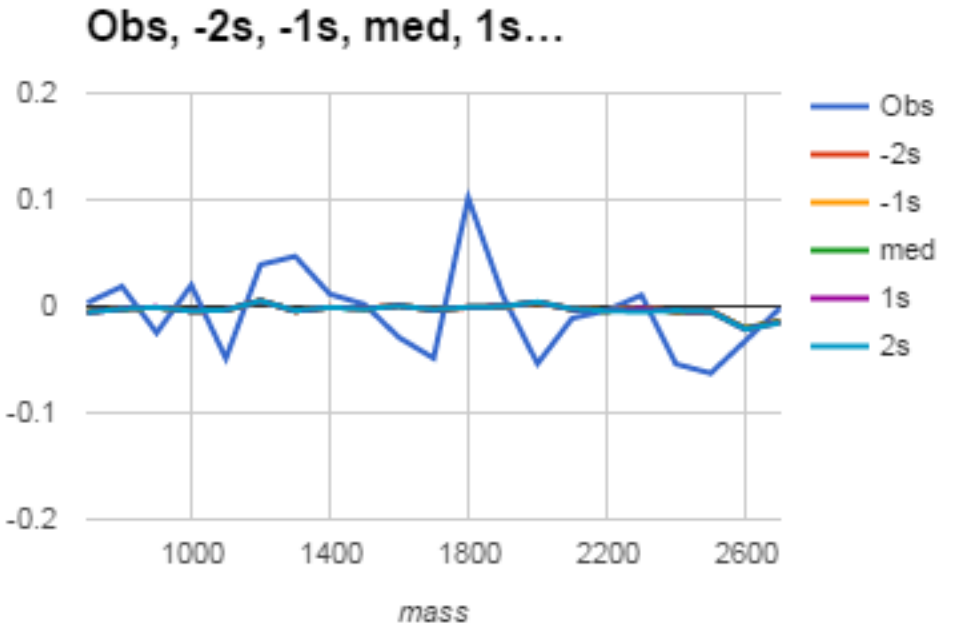
(binned – unbinned) / average(binned, unbinned)

All comparisons can be retrieved from

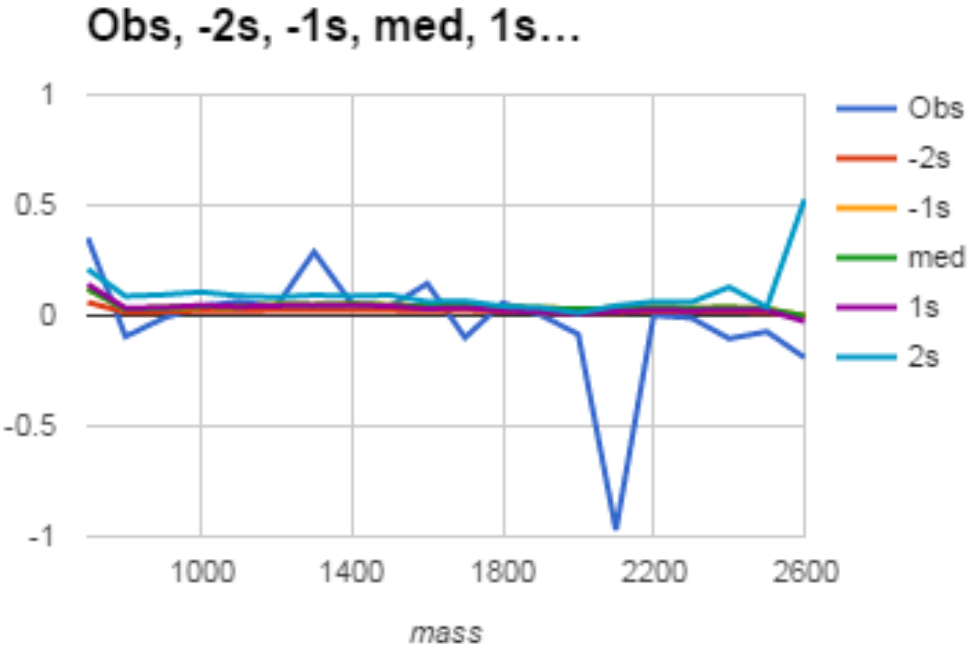
https://docs.google.com/spreadsheets/d/16bAkQkosh-VaUHm4EjDMHm8CgRnGrse_WPoSWh5fFr0/edit#gid=0

Comparisons

Without any systemctics
Median+bands agree very well
Only obs fluctuates a bit, but well under 10%



With all systemctics
Median+bands agree well generally
Obs jumps, especially, at 2.1TeV, there is a huge difference. This is caused by Rtrk_track that varies the CB mu by a 3-4% (CxAOD bug, to be updated).
It can have big impact when high mass, e.g. 2000GeV * 4% = 80GeV



Comparison removing Rtrk_track

In order to demonstrate the fact that Rtrk_track causes the huge different @ 2.1TeV, limits are compared with Rtrk_track removed

@2.1TeV
With Rtrk_track, unbinned obs=27.4316 exp=14.2744
Without it, unbinned obs=8.76978 exp=14.0663

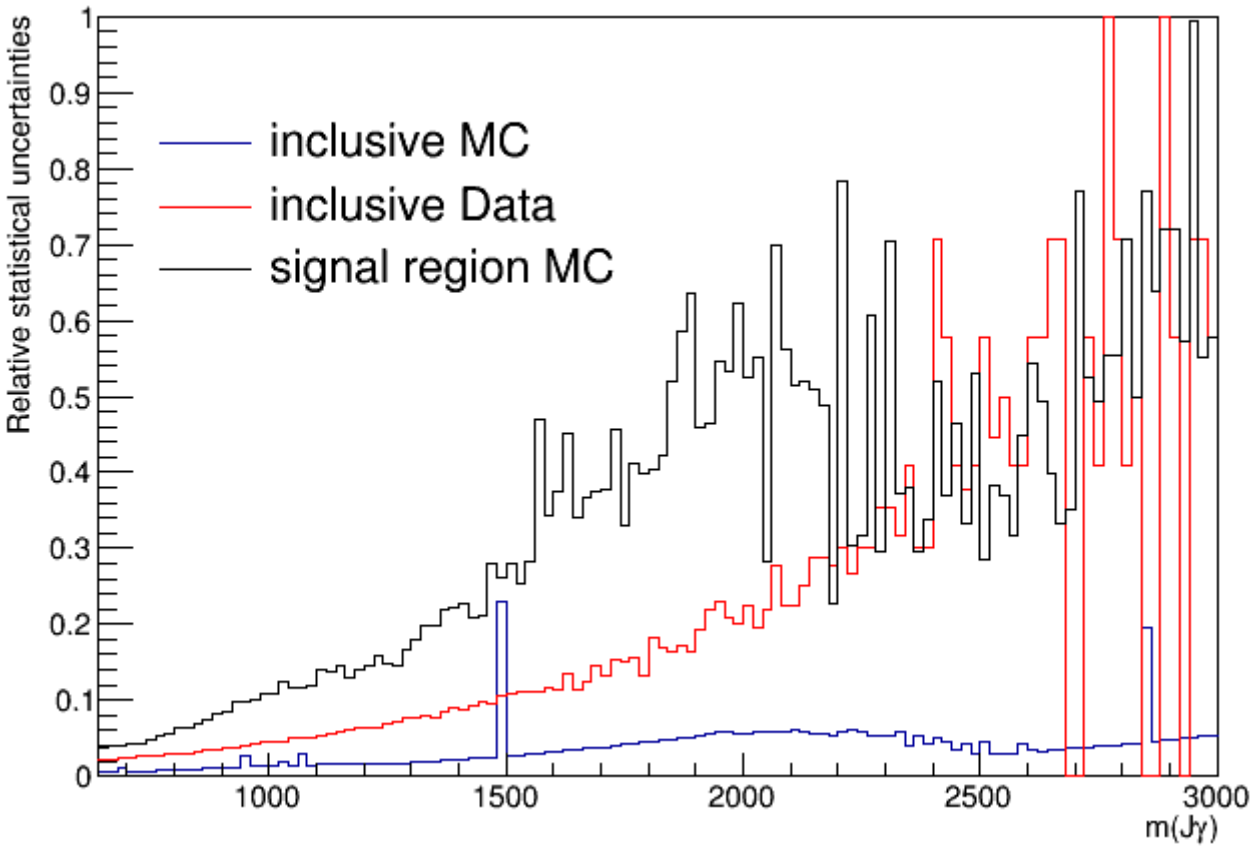
Removing Rtrk_track, obs drops

All JES will be updated with bug fixed in CxAOD

Spurious signal (stats)

To evaluate SS, one needs to fit S+B model to a background only MC sample with a very large statistics, in which its own statistical fluctuation is small enough to impact on SS evaluation.

SR yjet MC is the perfect sample to do SS, but it has limited statistics
Compare the relative statistical uncertainties below, SR MC (~11K evts), inclusive data (~29K evts) and inclusive MC (~630K evts)

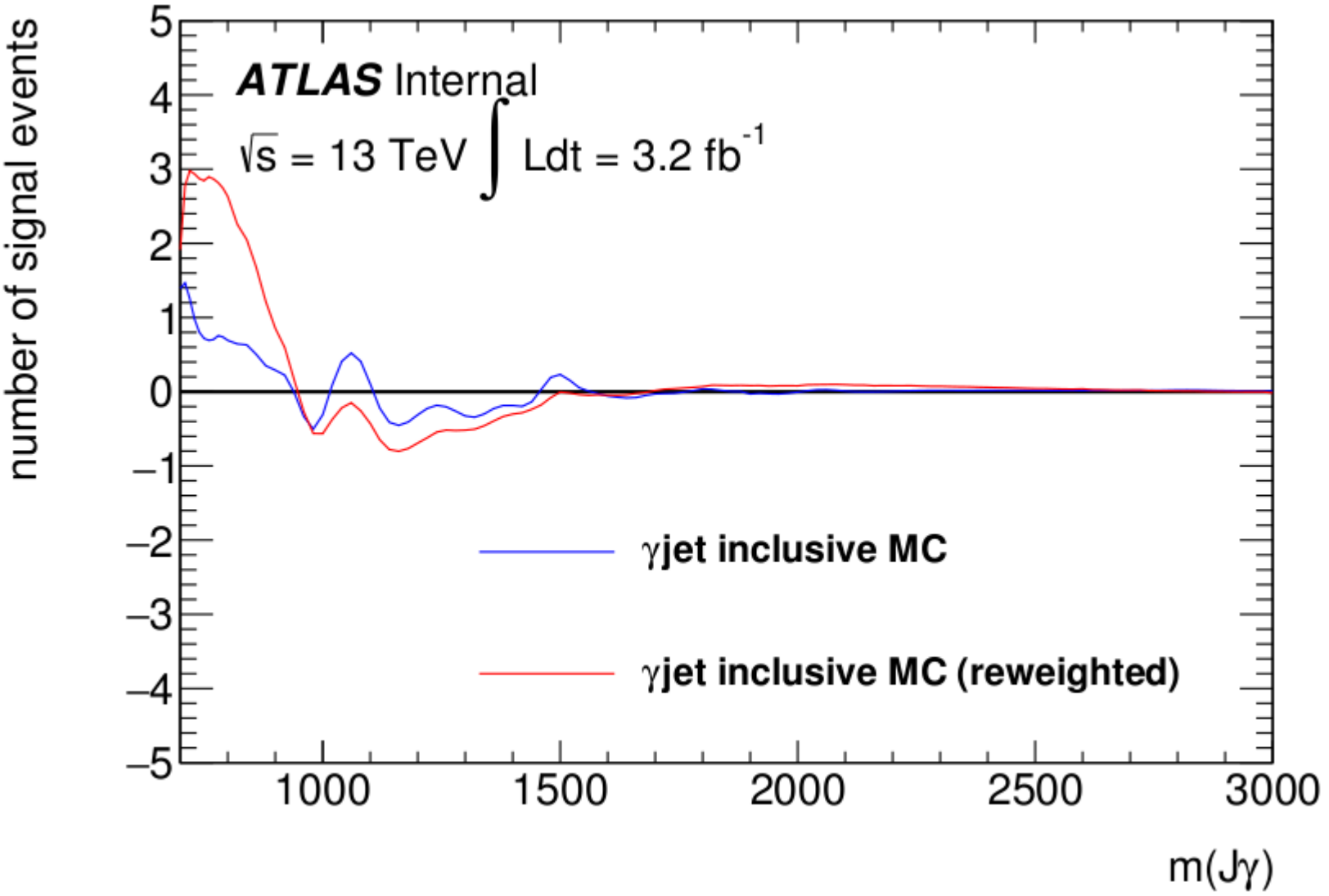


SR MC has largest stats error among all and flattens out in high mass region (enhanced with pT sliced sample)

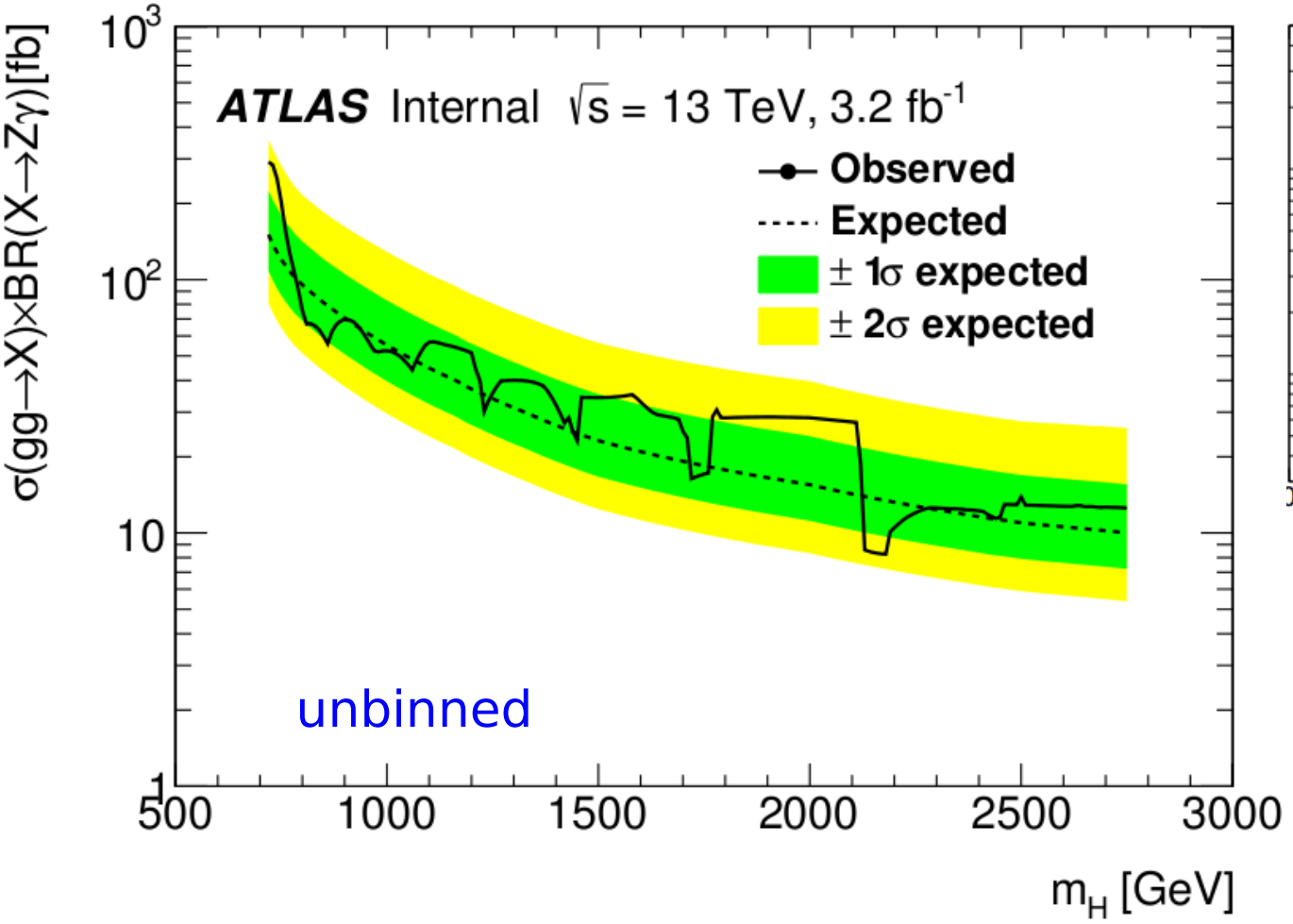
Inclusive MC has the smallest stats error among all (the best candidate for SS in terms of stats)

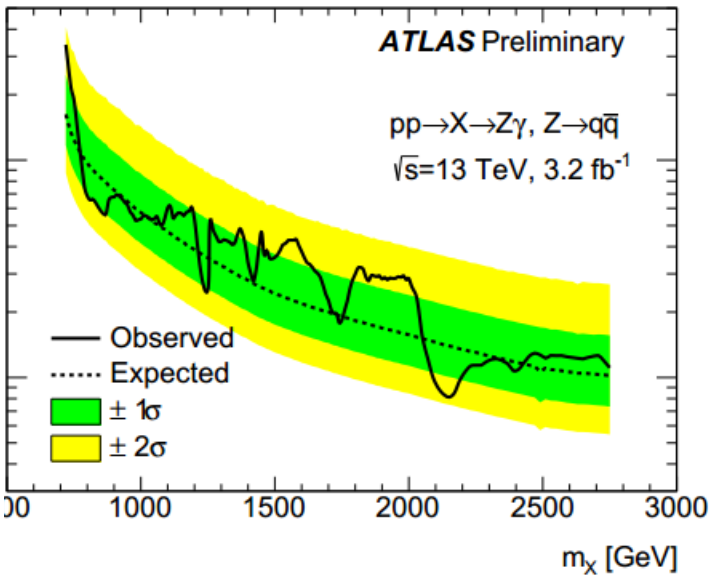
Spurious signal yield

Spurious signal yields are plotted against mass
SS with the reweighted sample is enlarged in low mass generally, because low mass events have higher weights

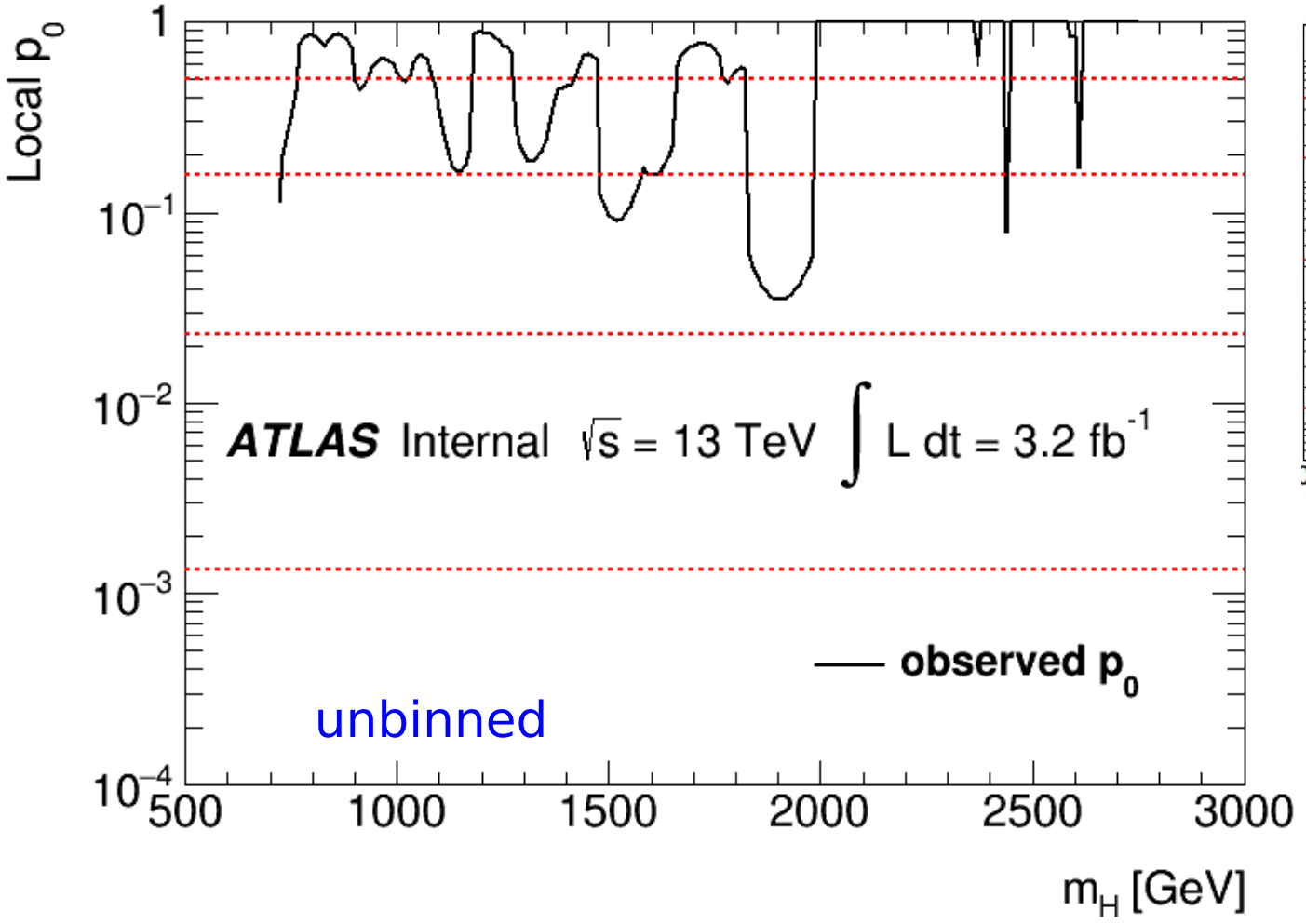


Limit setting

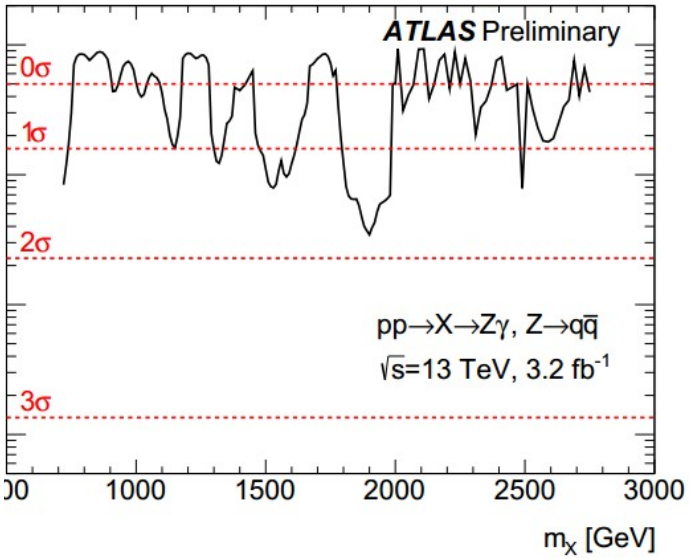




Local p0 scan

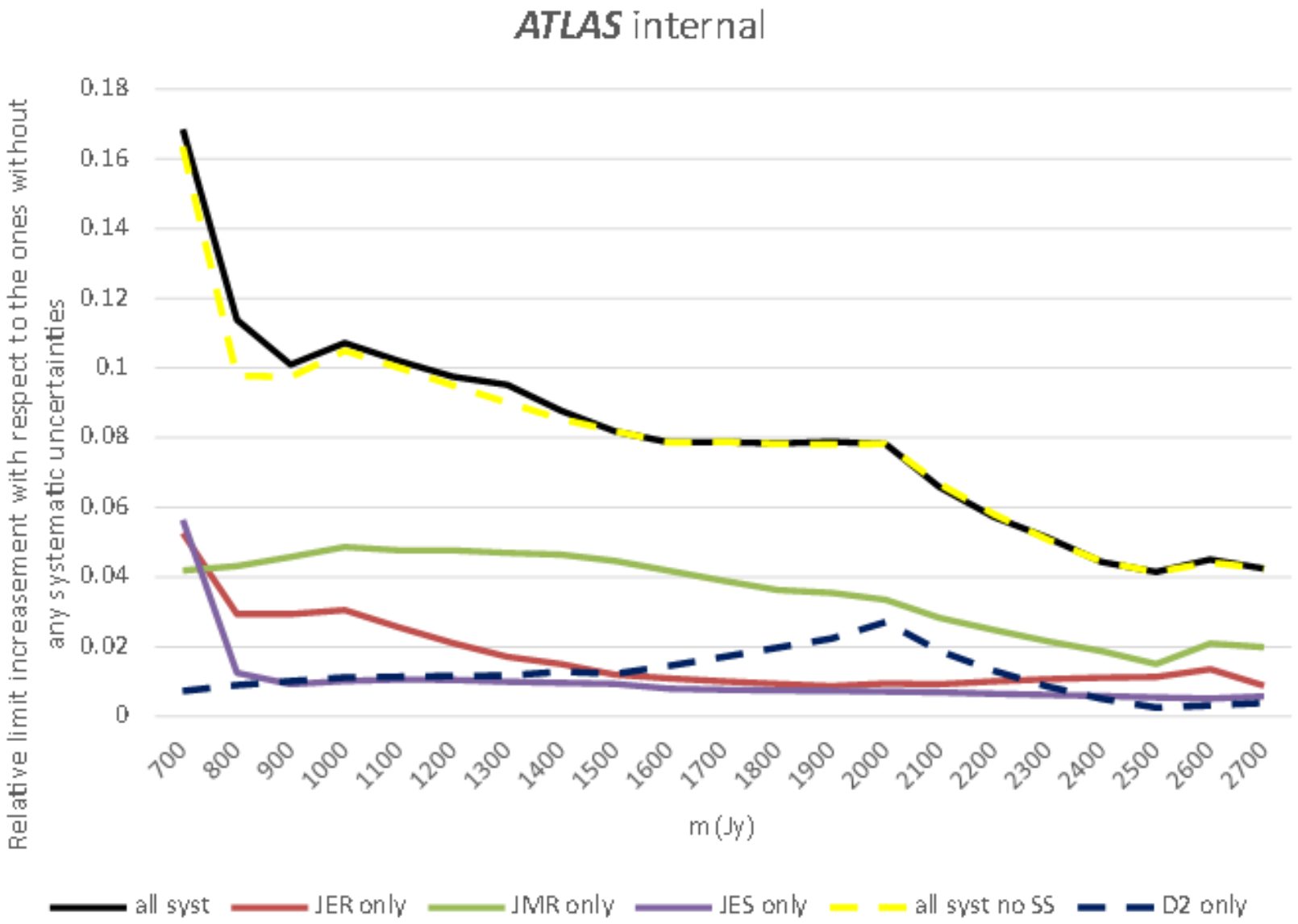


unbinned



binned

Ranking uncertainties (by limit)



Ranking (numeric)

	Mass [GeV]					
Uncertainty Source	750	1000	1500	2000	2500	2750
Jet mass resolution	13%	8%	2%	1%	1%	1%
Jet energy resolution	2%	2%	0.3%	0.2%	0.2%	0.1%
Jet energy scale	11%	8%	8%	7%	5%	2%

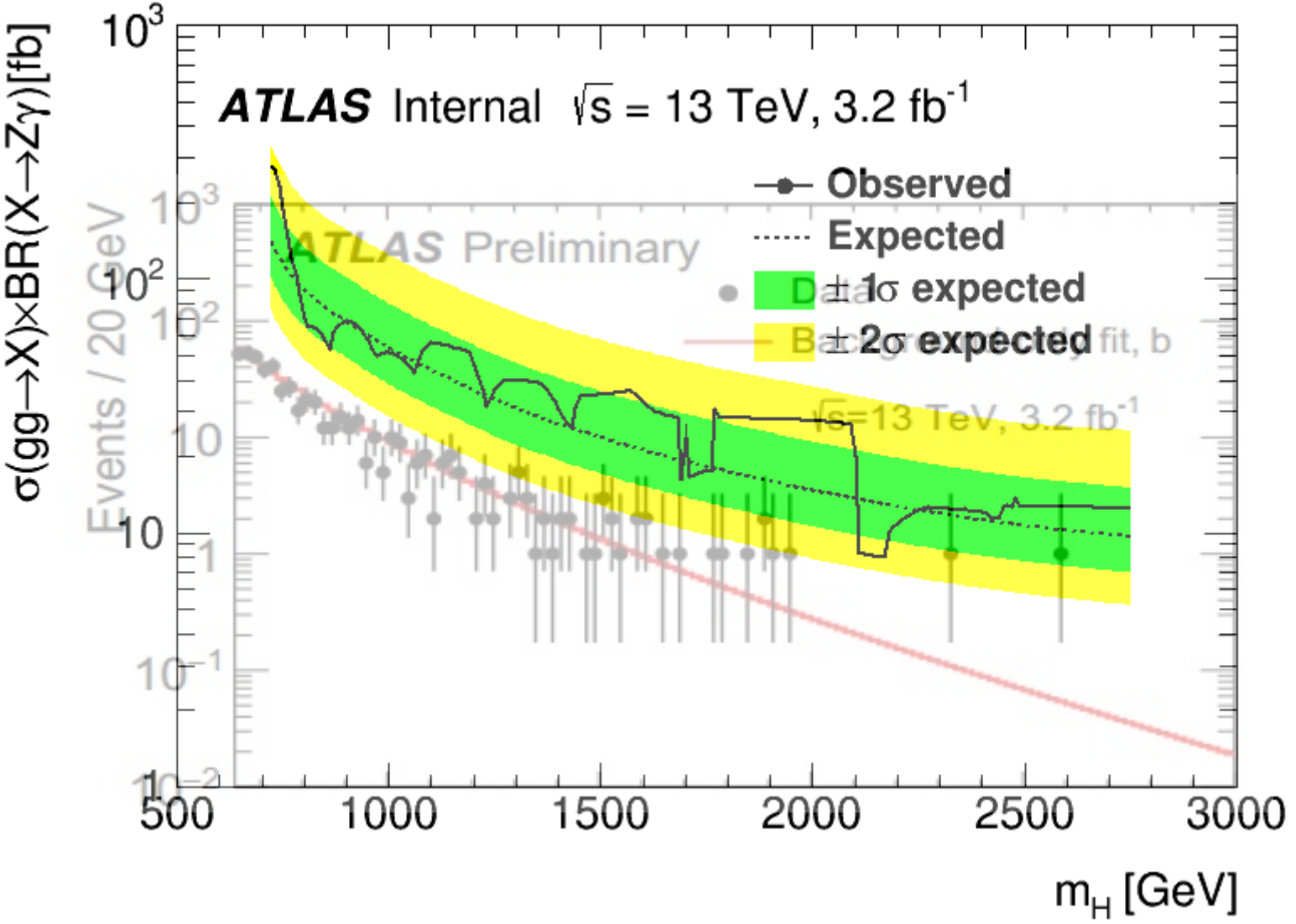
Previously in INT note
(calculated with asymptotic formula)

	Mass [GeV]					
Uncertainty Source	700	1000	1500	2000	2500	2700
Jet mass resolution	4.2%	4.9%	4.5%	3.4%	1.5%	2.0%
Jet energy resolution	5.3%	3.1%	1.2%	0.9%	1.1%	0.9%
Jet energy scale	5.6%	1.0%	0.9%	0.7%	0.5%	0.6%
Run-I D2 scale	0.7%	1.1%	1.2%	2.7%	0.3%	0.4%

Updated
(calculated with asymptotic limit)
JES to be updated with bug fixed in CxAOD

Backup

S


ATLAS Internal √s = 13 TeV, 3.2 fb-1
Observed
Expected
±1σ expected
±2σ expected
ATLAS Preliminary
√s=13 TeV, 3.2 fb-1
σ(gg→X)×BR(X→Zγ)[fb]
Events / 20 GeV
m_H [GeV]
500
1000
1500
2000
2500
3000

S