H→$\gamma\gamma$: Discussion

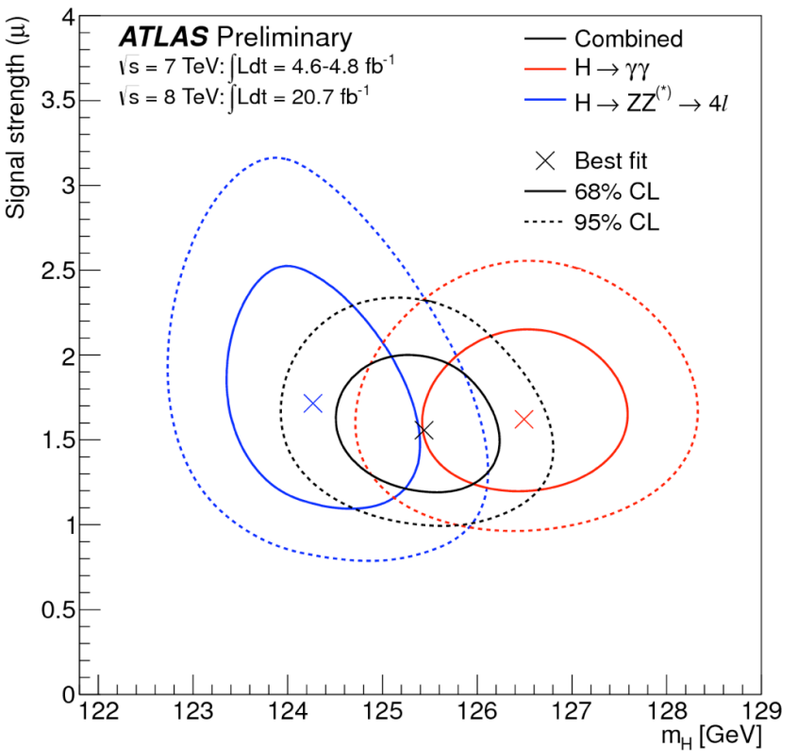
P. Meridiani, R. Turra

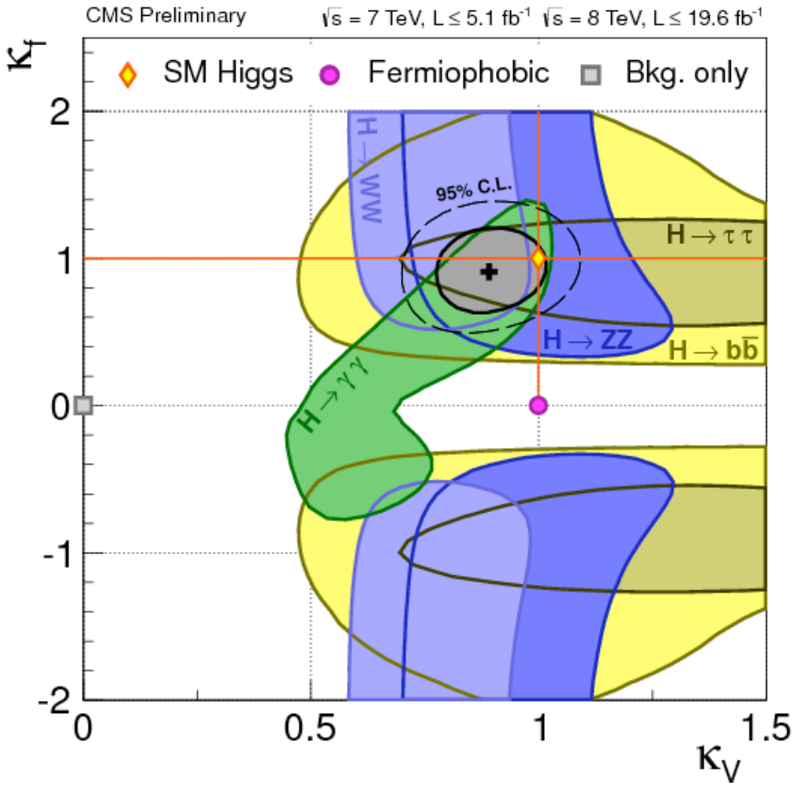
Workshop LHC
Genova, 8 Maggio 2013

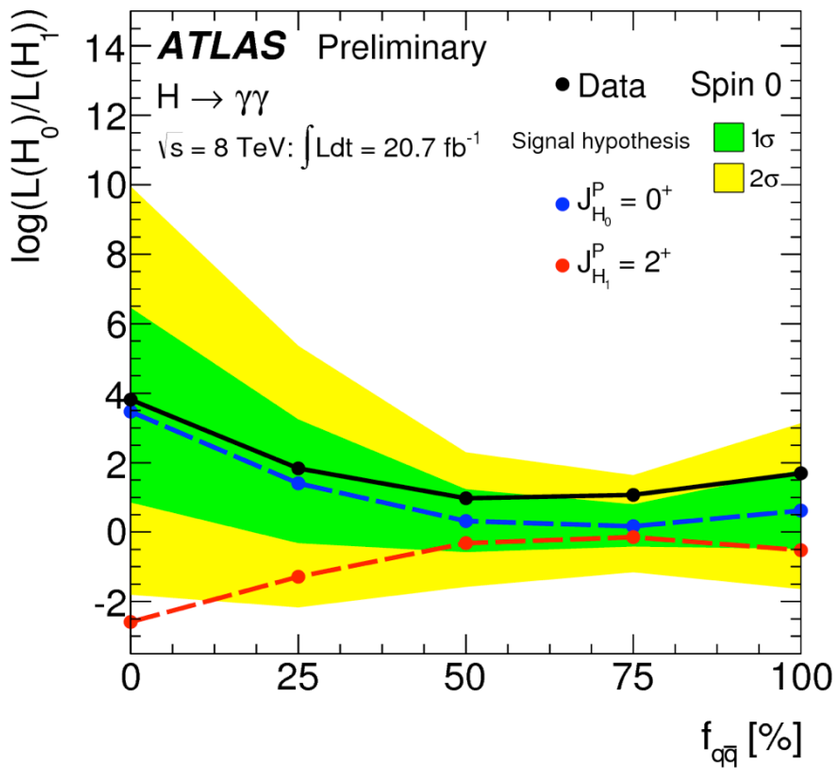
INFN
Istituto Nazionale
di Fisica Nucleare

H→γγ: main features

- **H→γγ analysis has several important features**
  - **First: A discovery channel!**
  - **Measure Higgs mass ~ 0.5% error** (currently limited by systematics)
  - **Measure Higgs cross-section ~ 30% error**(not yet limited by systematics)
  - Exclusive tags and interference between Kv and Kv in the decay allows to measure simultaneously Higgs couplings Kv & Kf
  - Can measure Higgs spin (and probably CP using jet correlations in VBF)







ATLAS vs CMS

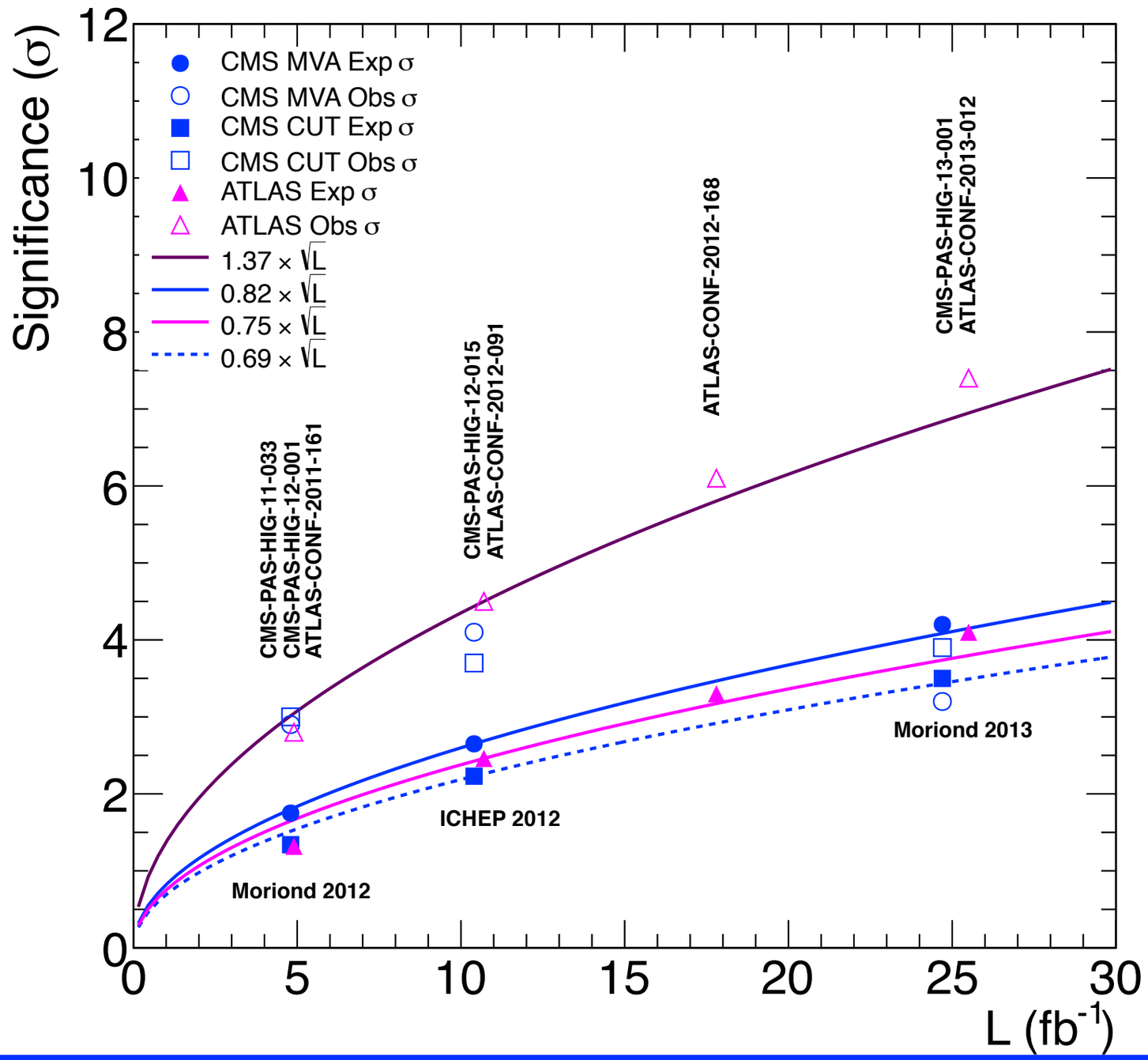
- **ATLAS vs CMS analyses are similar in terms of performance**
  - CMS has slightly better mass resolution (8-10%)

ATLAS-CONF-2013-012							
name	sigmaCB	FWHM	fwhm/2.35	ns(90%)	nb(90%)	s/b	s/sqrt(b)
Unconv Central LowPt	1.5	3.52	1.50	46.6	881	0.053	1.57
Unconv Central HighPt	1.4	3.29	1.40	7.1	44	0.161	1.07
Unconv rest LowPt	1.74	4.10	1.75	97.1	4347	0.022	1.47
Unconv rest HighPt	1.69	3.99	1.70	14.4	247	0.058	0.92
Conv Central LowPt	1.68	3.95	1.68	29.8	687	0.043	1.14
Conv Central HighPt	1.54	3.63	1.54	4.6	31	0.148	0.83
Conv Rest LowPt	2.01	4.74	2.02	88	4567	0.019	1.30
Conv Rest HighPt	1.87	4.40	1.87	12.9	266	0.048	0.79
Conv Transition	2.52	5.97	2.54	36.1	2499	0.014	0.72
Loose HighMass DiJet	1.71	4.04	1.72	4.8	28	0.171	0.91
Tight HighMass DiJet	1.64	3.87	1.65	7.3	13	0.562	2.02
LowMass DiJet	1.62	3.82	1.63	3	21	0.143	0.65
MET	1.74	4.11	1.75	1.1	4	0.275	0.55
Lepton	1.75	4.13	1.76	2.6	12	0.217	0.75
All	1.77	4.18	1.78	355.5	13647	0.026	3.04

CMS-PAS-HIG-13-001								
name	sigmaEFF	FWHM	fwhm/ 2.35	ns(90%)	~nb(90%)= nb(/GeV)*sigmaEff*2*1.64	s/b	s/sqrt(b)	nb(/GeV)
Untagged0	1.36	2.98	1.27	15.3	98.6	0.155	1.54	22.1
Untagged1	1.5	3.27	1.39	34.02	464.0	0.073	1.58	94.3
Untagged2	1.77	3.62	1.54	135.18	3312.1	0.041	2.35	570.5
Untagged3	2.61	5.03	2.14	143.91	9082.2	0.016	1.51	1060.9
DiJetTight	1.79	3.53	1.5	8.28	20.0	0.415	1.85	3.4
DiJetLoose	1.87	3.76	1.6	10.35	76.1	0.136	1.19	12.4
Muon	1.85	3.57	1.52	1.26	4.2	0.297	0.61	0.7
Electron	1.88	3.62	1.54	0.81	4.3	0.188	0.39	0.7
MET	1.79	3.85	1.64	1.53	10.6	0.145	0.47	1.8
All	2.02	3.86	1.64	350.64	13071.9	0.027	3.07	

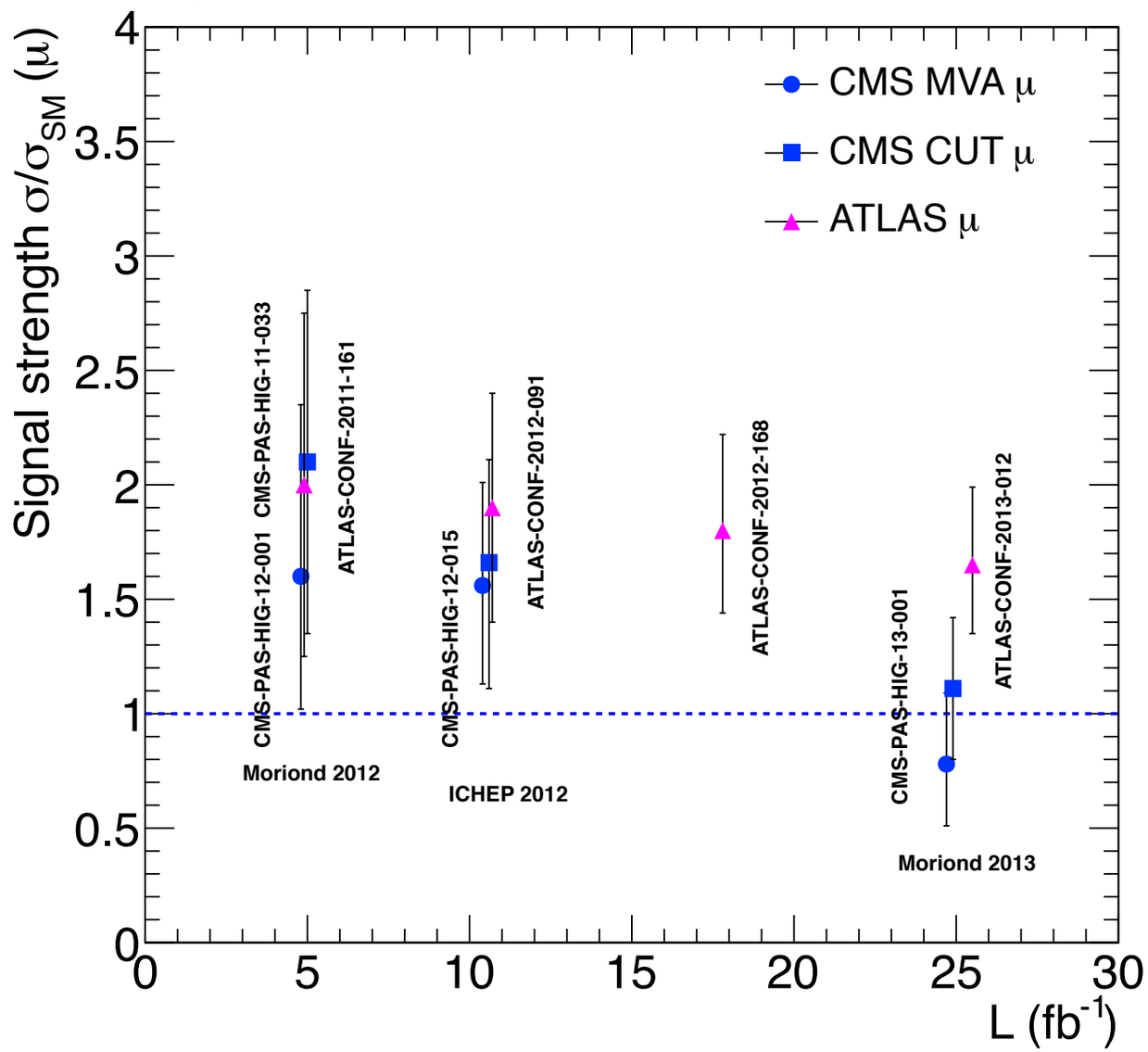
Significance Evolution Vs Time

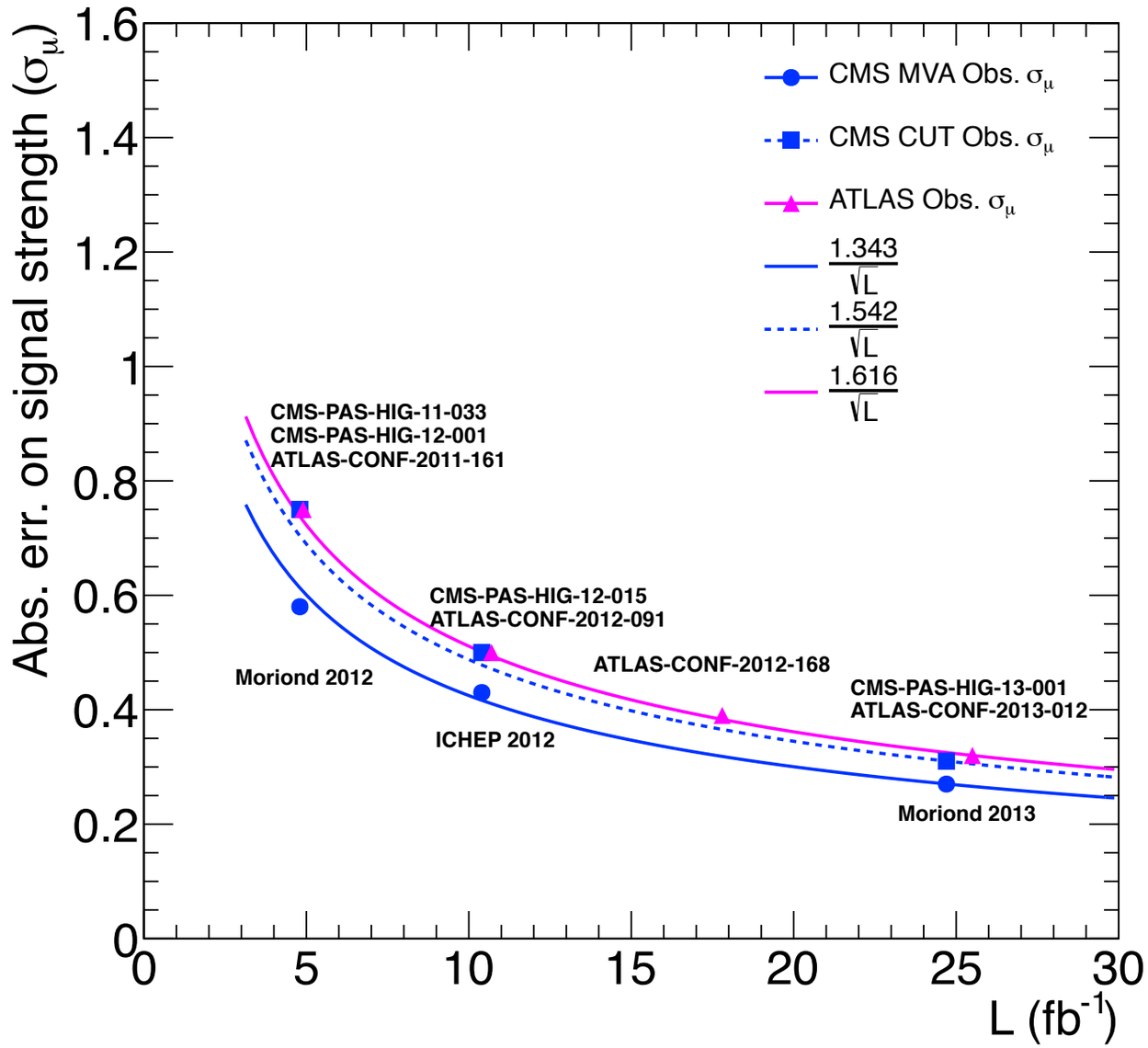
- ATLAS analysis shows more improvement with time
  - But CMS has introduced MVA in Moriond 2012 including DiJet Tag



Mu Vs Lumi

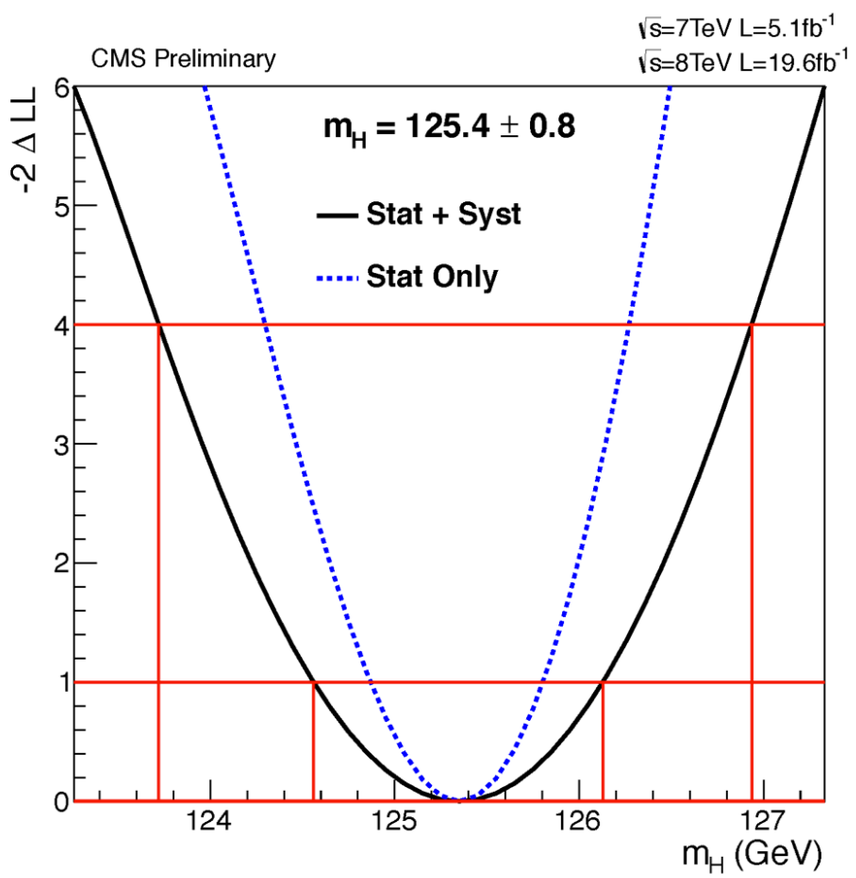
- **Error on μ seems still to improve with sqrt(L). We have not yet reached systematic limit**
  - Some systematics seems to improve with sqrt(L) (e.g. background systematics for CMS)
  - Improvement seen in expected significance for ATLAS is not present for the error on μ. Due to the different treatment of background systematics?
  - Systematic error will be dominant for values around 0.15-0.18 (dominated by theory systematics)





Mass Measurement

- Already systematically limited (systematic error ~0.5%)
- Main systematic error coming from e→ɣ extrapolation and from Z H_T (~90 GeV) to H (~125 GeV)
  - Have to rely on G4 modeling of electromagnetic showers and material description in simulation
- Can be improved with dedicated hard work



Improvements Towards Final Publications And Later

- **Improvements for the final 7+8 TeV publication**
  - Re-reco of 2012 data
  - Some possible improvements for categorization and background estimation
  - Do not expect improvement on signal strength error >10%
- **For the future after restart with more statistics**
  - Can optimize analysis for the absolute inclusive cross-section measurement (minimizing systematic error)
  - Also dedicated analysis can be optimized for the mass measurement using only unconverted photons in central region of the detector