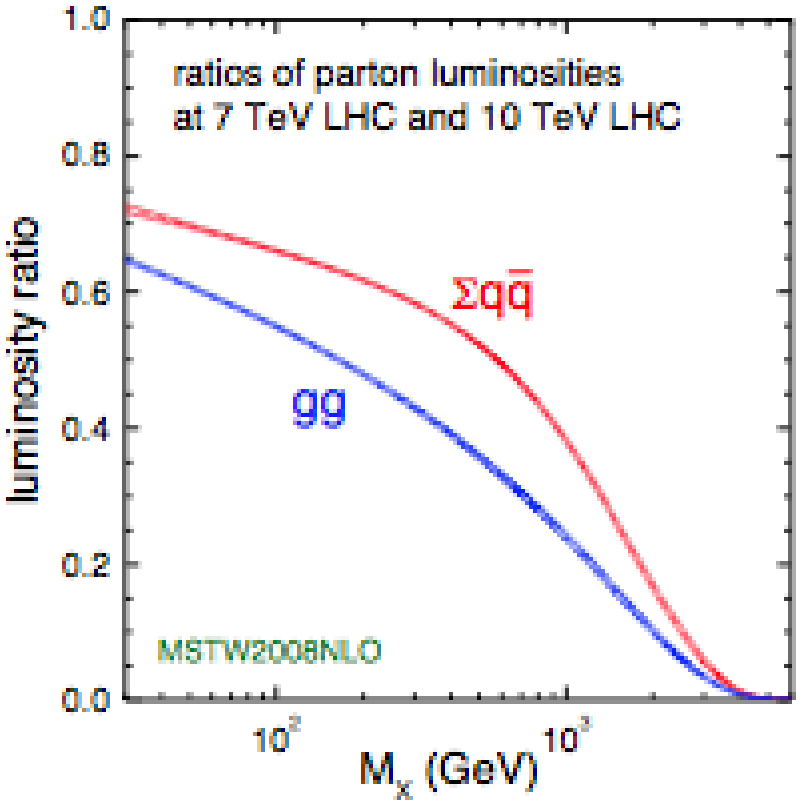
LHC Reach at 7 TeV

CMS NOTE 2010/000

General Procedure

- ***Scaling the Distribution Functions***
  - ***Ratio of parton luminosities for the LHC operating at 7 TeV and 10 TeV, as a function of the invariant mass of the produced final state.***



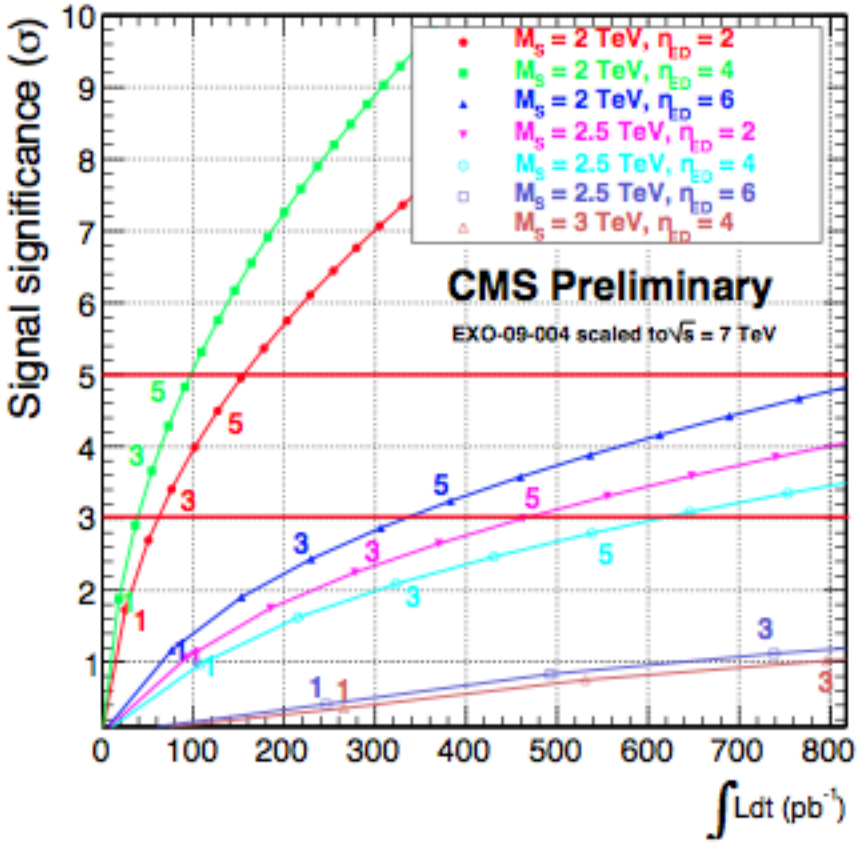
7 TeV requires approximately three times higher integrated luminosity compared to that in a 10 TeV run in order to reach the same sensitivity.

Extra Dimension

❑ *Diphoton Channel*

– *Large Extra Dimension*

n_{ED}	95% C.L. Lower Limits on M_S		
	50 pb^{-1}	100 pb^{-1}	200 pb^{-1}
2	2.0 TeV	2.2 TeV	2.4 TeV
3	2.5 TeV	2.7 TeV	2.9 TeV
4	2.1 TeV	2.2 TeV	2.4 TeV
5	1.9 TeV	2.0 TeV	2.2 TeV
6	1.7 TeV	1.9 TeV	2.0 TeV
7	1.6 TeV	1.8 TeV	1.9 TeV

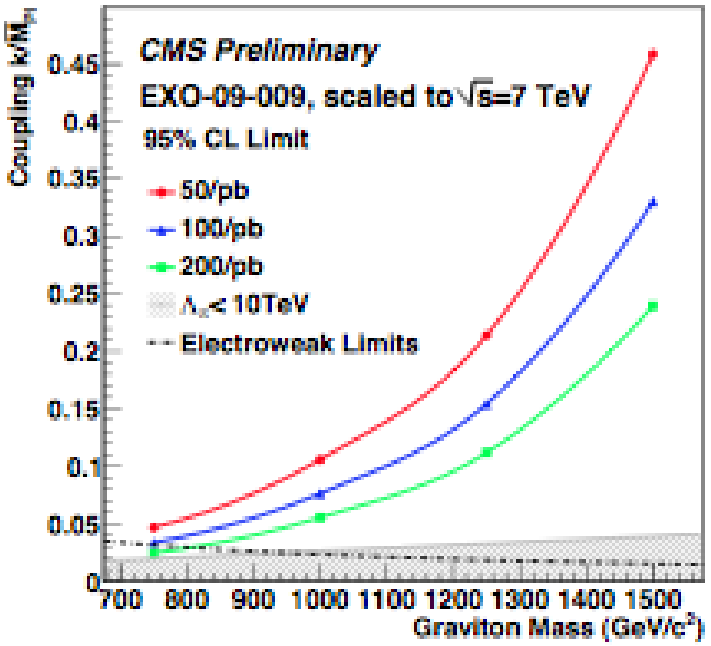


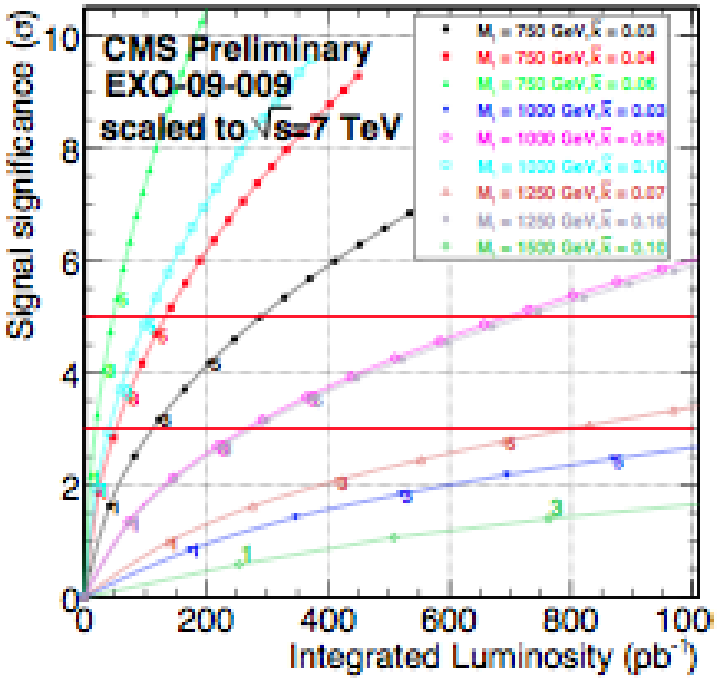
Signal is broad and also peaks at different mass values for different numbers of extra dimensions and different values of the parameter M_S

- ***Evidence (discovery) significance of 3 (5) standard deviations***
- ***A factor of ≈ 8 in the luminosity is required in a 7 TeV run compared to that at 10 TeV.***
- ***Nevertheless with 50 pb−1 of 7 TeV data, the sensitivity of the search already surpasses the current Tevatron limits***

– *Randall-Sundrum*

The 95% C.L. limit (left) and the discovery potential (right) for Randall-Sundrum gravitons in the diphoton channel, as a function of integrated luminosity at the LHC running at 7 TeV.



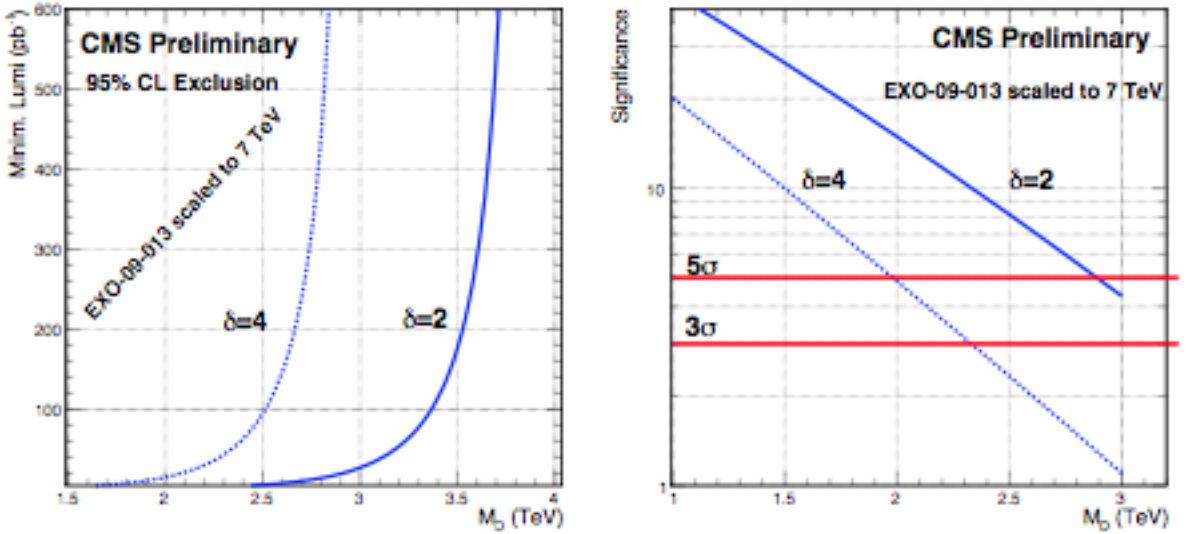


- ***Equivalent luminosity for a 7 TeV run is ≈ 4 times higher than that at 10 TeV.***
- ***Again, with just 50 pb−1 of 7 TeV data the sensitivity of the search surpasses that at the Tevatron***

❑ Monojet Channel

– Large Extra Dimensions

FThe 95% C.L. limit (left) as a function of integrated luminosity and the discovery potential (right) for an integrated luminosity of 200 pb−1, for large extra dimensions in the monojet channel at the LHC running at 7 TeV.

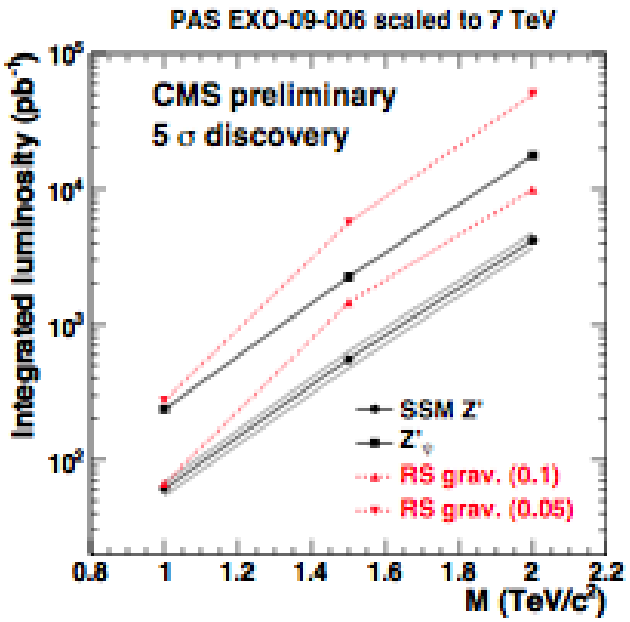


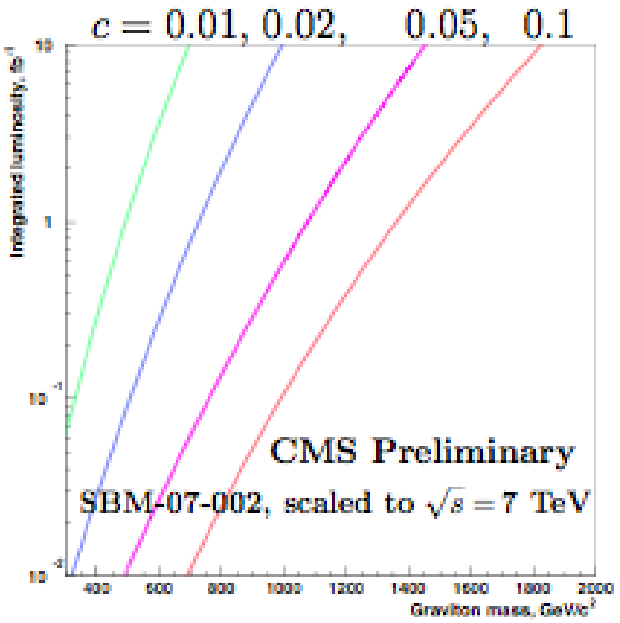
- ***3 times the integrated luminosity of a 10 TeV run is required to reach similar sensitivity at 7 TeV.***
- ***Even with as little as 10 pb−1 of integrated luminosity the sensitivity of the search is expected to surpass that at the Tevatron [19], provided that missing transverse energy tails are understood well in early LHC data.***

❑ Dielectron and dimuon channels

– Randall-Sundrum

Discovery potential at 5σ significance for electrons (left) and muons (right) for the Randall-Sundrum gravitons at 7 TeV.



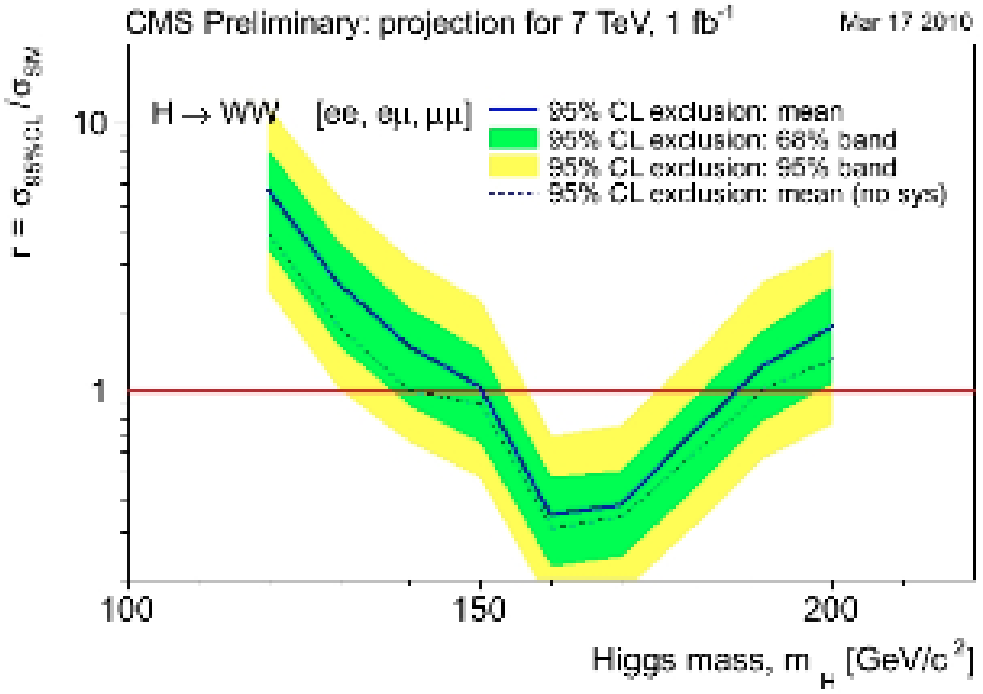


- ***Approximately three (ten) times the luminosity of a 10 (14) TeV run is needed to reach similar sensitivity in a 7 TeV run.***
- ***The sensitivity of the Tevatron search will be superseded with approximately 100 pb−1 of 7 TeV data.***

Higgs Searchs

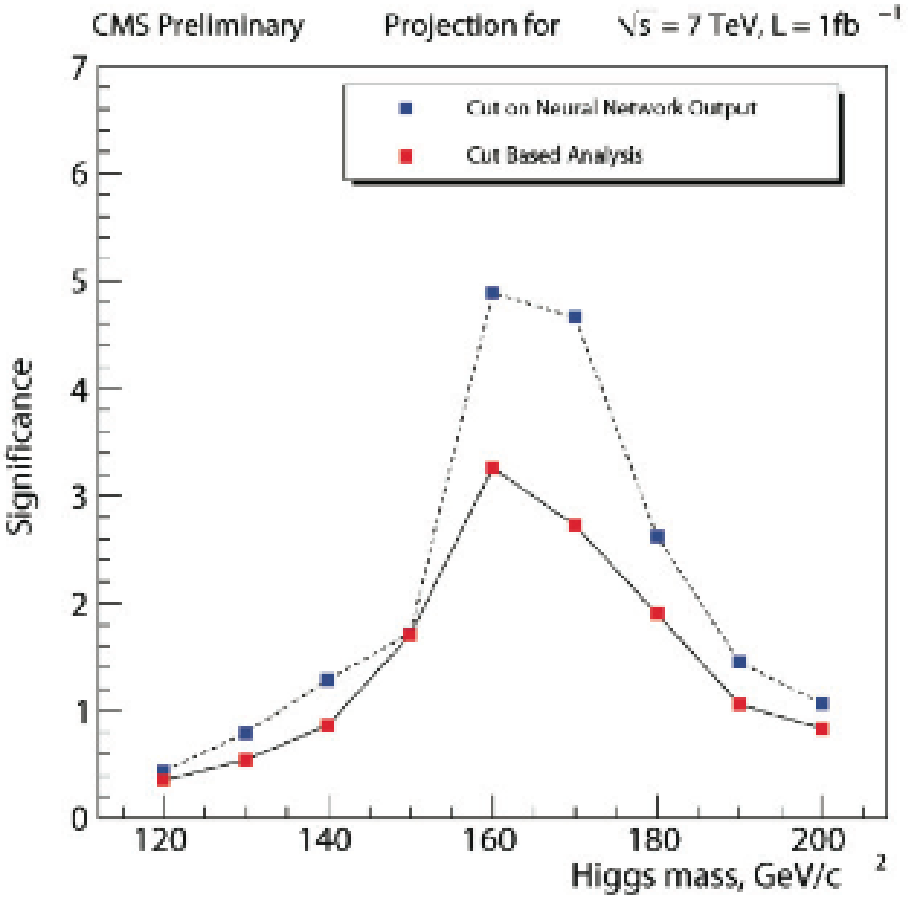
- ***Search sensitivity for an integrated luminosity of 1 fb^{-1}***

  Expected exclusion limits for the $H \to WW \to \ell\nu\nu$ search, assuming absence of signal. The expected range of exclusion is 150-185 GeV.



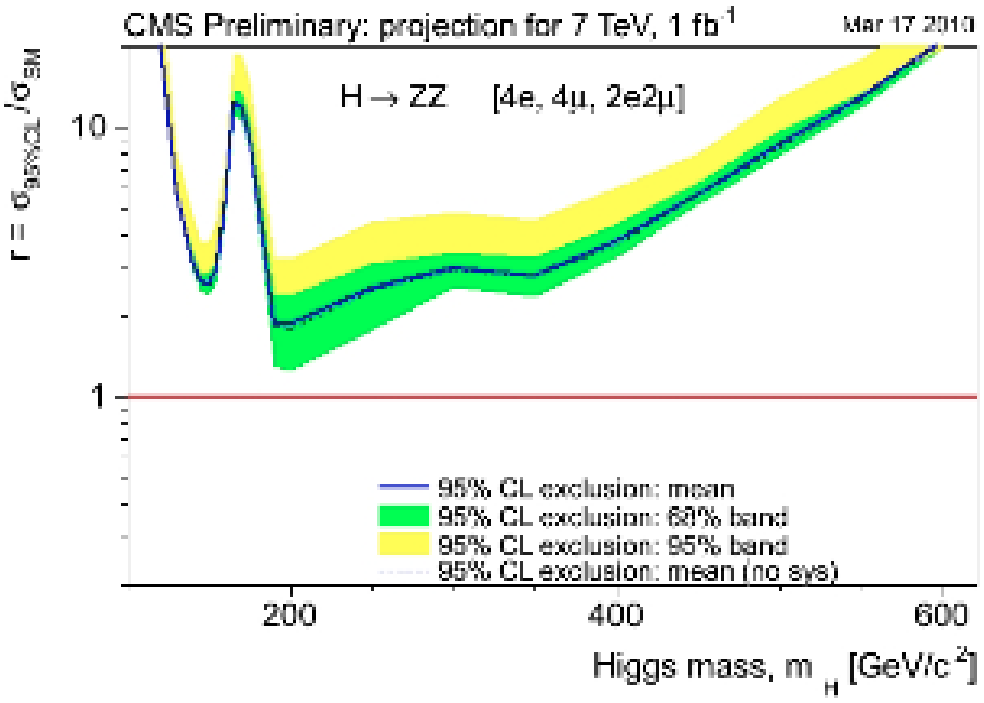
- ***In absence of a Higgs boson, the expected range of exclusion is 150 < mH < 185 GeV.***

– Expected significance for the same process

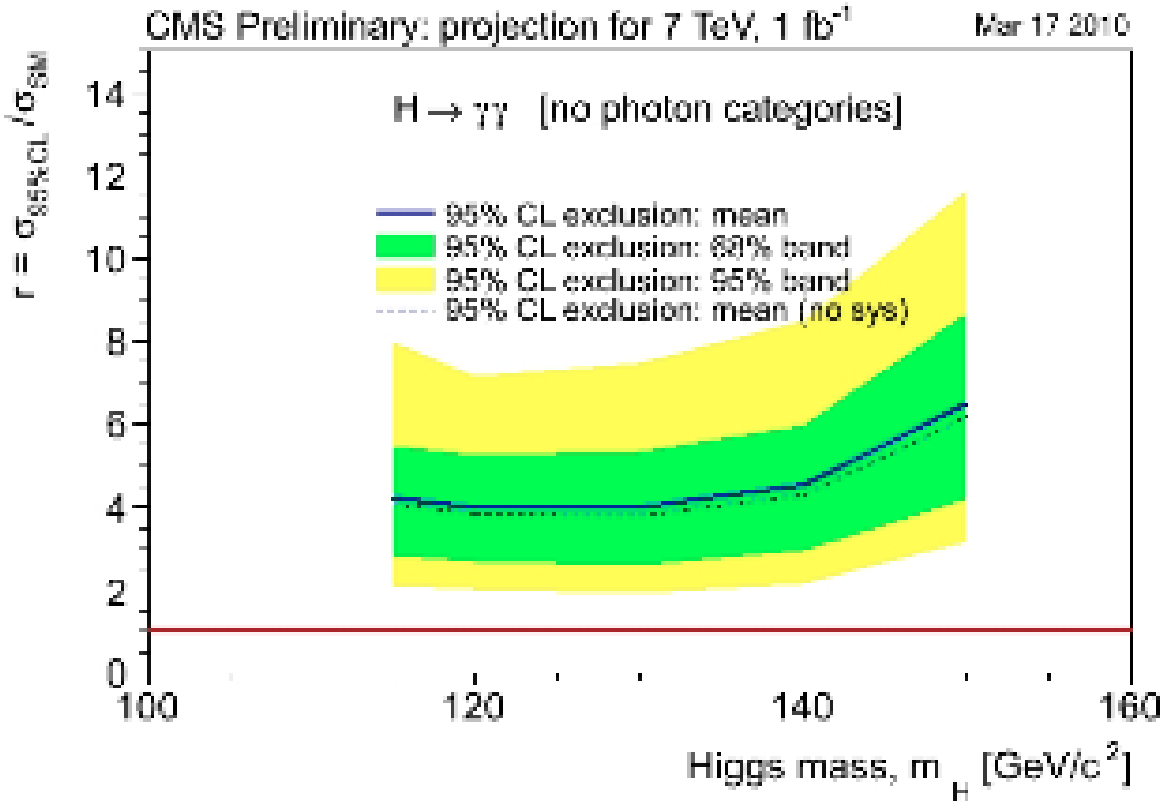


- ***This channel is expected to reach a discovery level sensitivity for the SM Higgs boson in the mass range 160 < mH < 170 GeV***

– *Expected exclusion limits for the H → ZZ → 4 leptons search, assuming absence of signal.*



– *Expected exclusion limits for the H → γγ search, assuming absence of signal.*



– *Expected exclusion limits for the SM Higgs, combining seven channels H → W W → 2l 2v [ee, μμ, eμ], H → ZZ → 4 [4e, 4μ, 2e2μ], and H → γγ.*

- ***In absence of signal, the expected mH -mass range of exclusion is 145-190 GeV.***

In the exclusion-limit plots, dashed lines show the average expected exclusion limit without systematic errors, solid lines the average with systematic errors included, and green/yellow bands indicate the expected statistical spread of the limits to be actually observed with data (68% of experimental points are expected to fall within the green bands and 95% within the yellow bands).