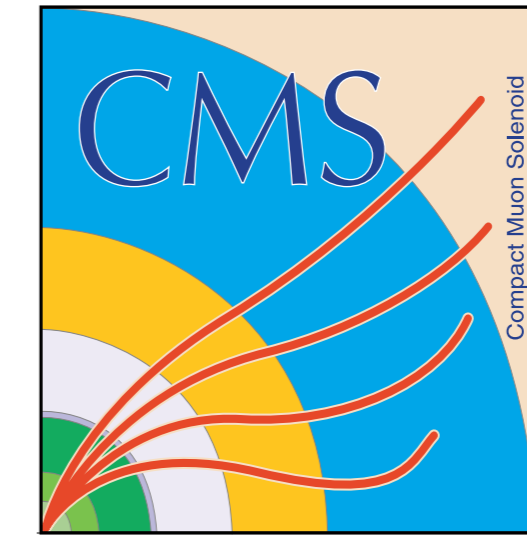
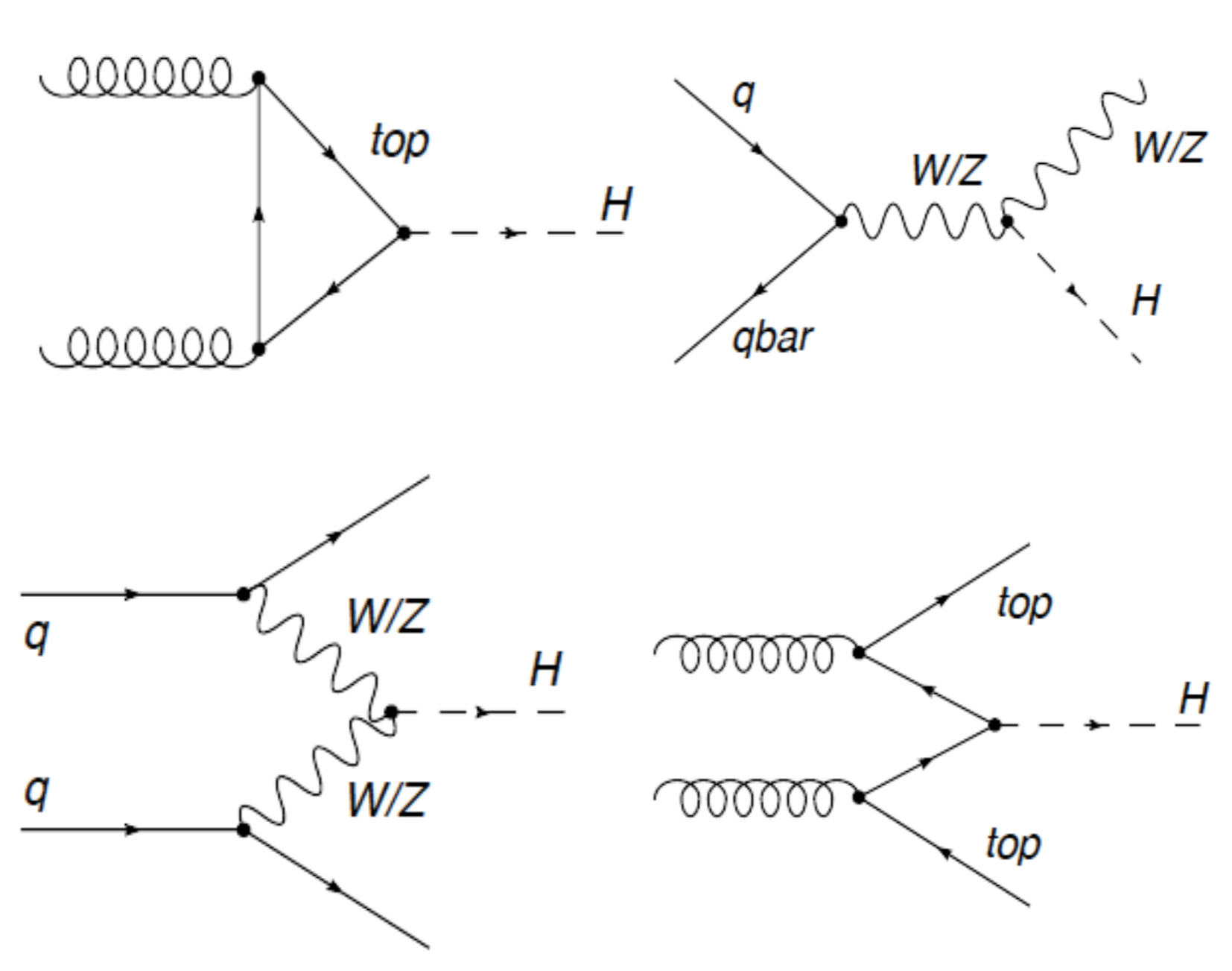


Higgs Physics at the HL-LHC with CMS detector

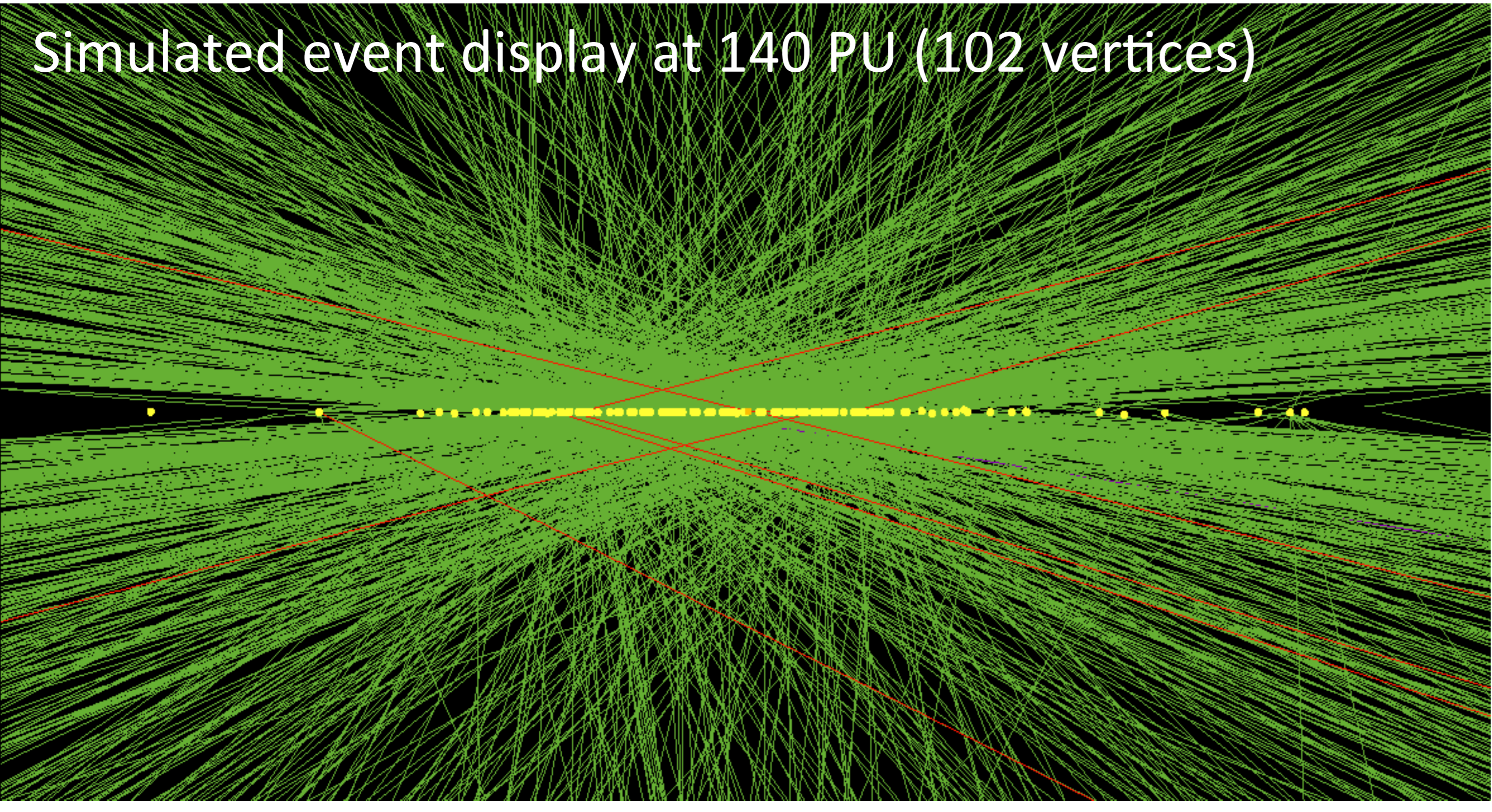


High luminosity LHC (HL-LHC): Higgs factory

	Higgs bosons at $\sqrt{s}=14\text{TeV}$
HL-LHC, 3000fb^{-1}	170M
VBF (all dec.)	13M
ttH (all dec.)	1.8M
$H \rightarrow Z\gamma$	230k
$H \rightarrow \mu\mu$	37k
HH (all)	121k



HL-LHC: challenging environment



- Overall design goal of 3000fb^{-1} integrated luminosity
- Pileup: 140 average simultaneous interactions
- High level radiation doses
- CMS has a comprehensive plan for detector upgrades to cope with these challenges

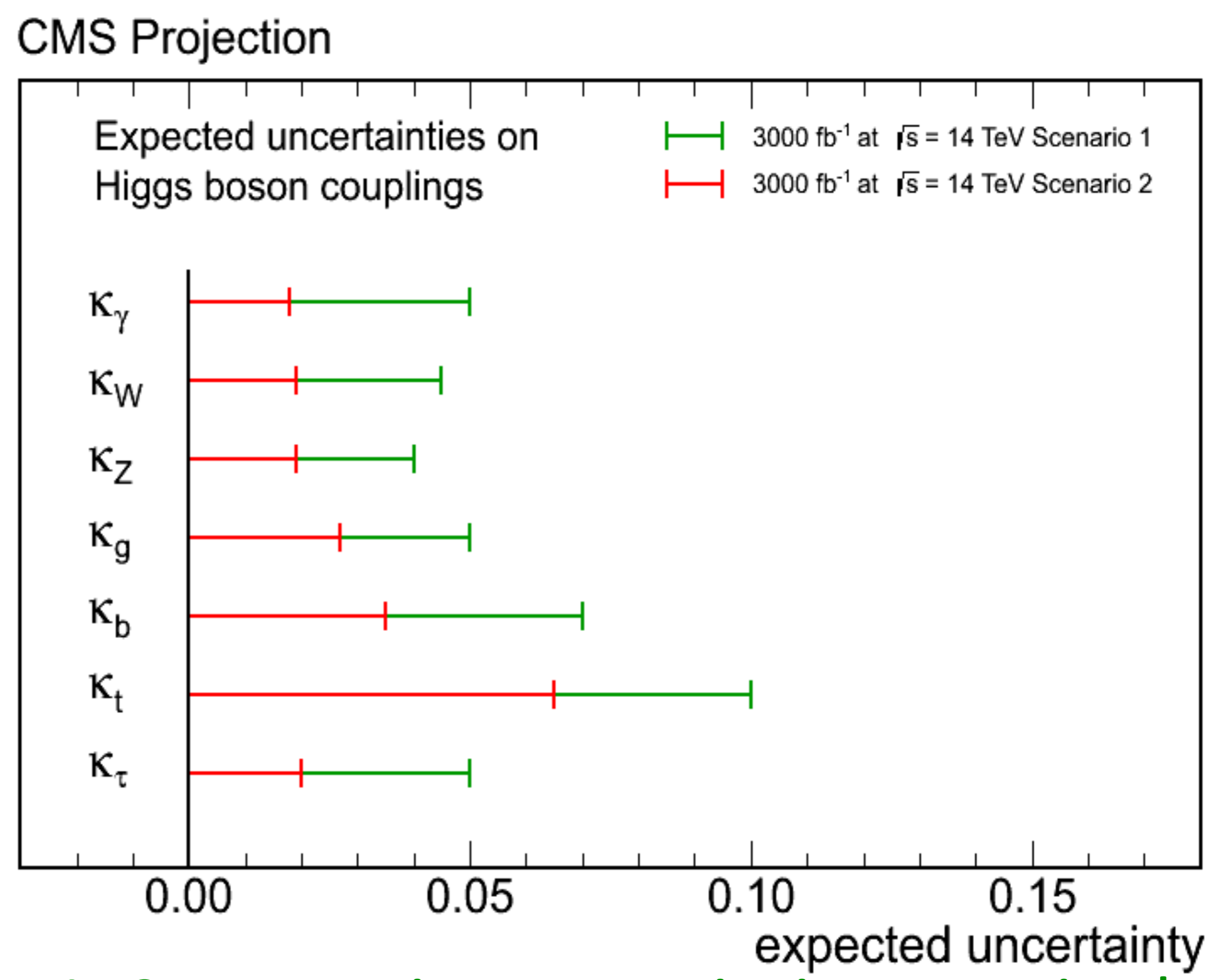
Higgs portal to new physics

- New era in particle physics
 - Precision tests of the SM Higgs Boson
 - Higgs Boson coupling precision measurements to probe for new physics
- $$g = g_{SM} [1 + \Delta]$$
- $$\Delta = O(v^2 / \Lambda^2)$$
- Less than 5% percent accuracy on the coupling uncertainty needed to be sensitive to $\Lambda \sim 1\text{TeV}$ new physics scale

Extensive HL-LHC Higgs Program

- Precision coupling measurements
- Study of rare and forbidden decays
- Search for BSM Higgs Bosons
- Higgs pair production cross section

Higgs coupling projections



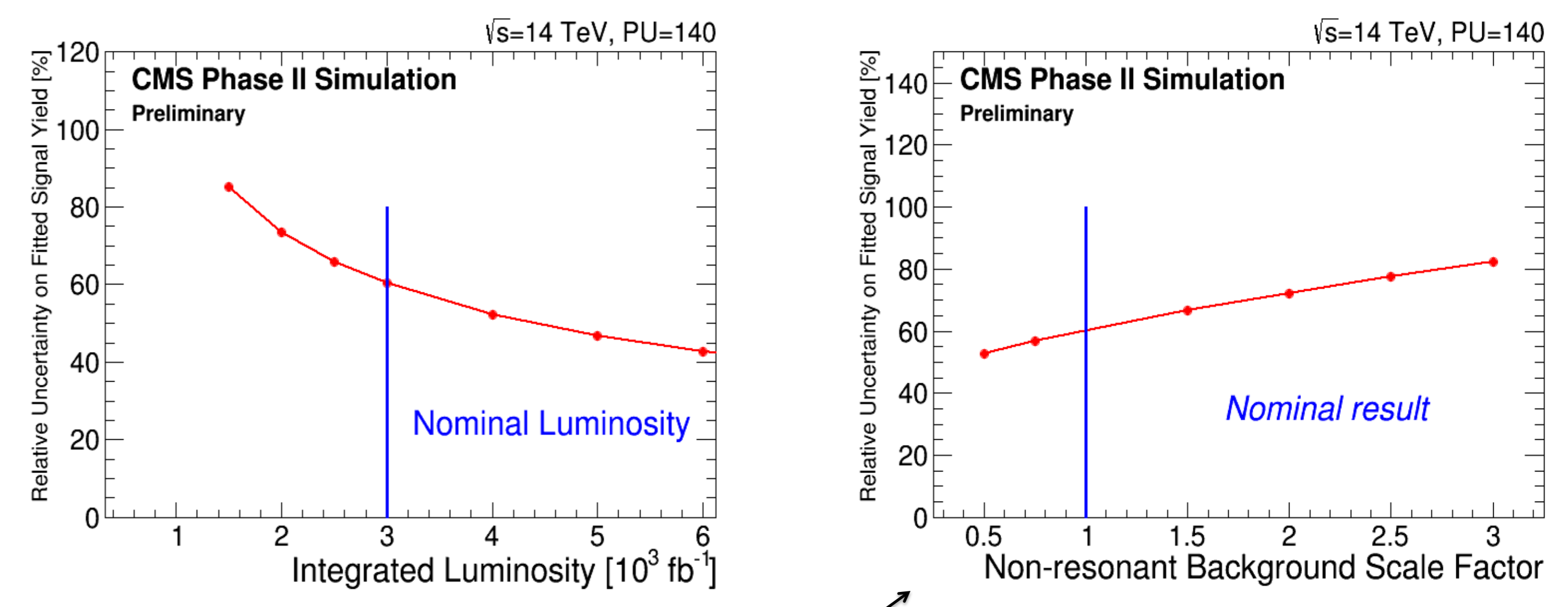
- Scenario 1: Systematic uncertainties remain the same
- Scenario 2: Theoretical and systematic uncertainties are scaled

Higgs pair production

- One of the exciting prospects of HL-LHC
 - Cross section at $\sqrt{s}=14\text{ TeV}$ is 40.2 fb [NNLO]
 - Challenging measurement
 - Destructive interference
-
- bbγγ [320 expected events] and bbWW [30000 expected events] preliminary studies by CMS
 - bbbb and bbττ under consideration

HH->bbγγ

- Parameterized object performance tuned to CMS Phase II detector at $\langle\text{PU}\rangle=140$
- 2D fit of M_{bb} and $M_{\gamma\gamma}$ distributions to extract the signal



- The average expected relative uncertainty on cross section as function of integrated luminosity and scale factor for the non-resonant background

Summary

- Higgs couplings will be measured with few percent uncertainty
- First preliminary Higgs pair production studies at HL-LHC by CMS