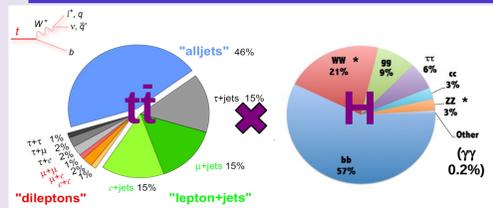


Eleni Ntomari, for the CMS Collaboration

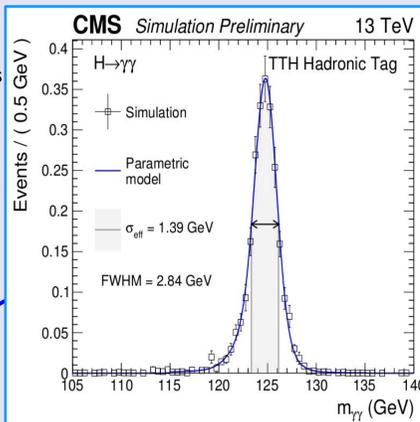
ttH: the best opportunity for top-Higgs coupling measurement



- ttH final states combine top pair and Higgs decay signatures
- tt final state depends on W decay: dileptons, lepton+jets, alljets
- ttH(bb): dileptons, lepton+jets
- ttH(yy): dileptons, lepton+jets, alljets
- ttH(multileptons): dileptons, lepton+jets

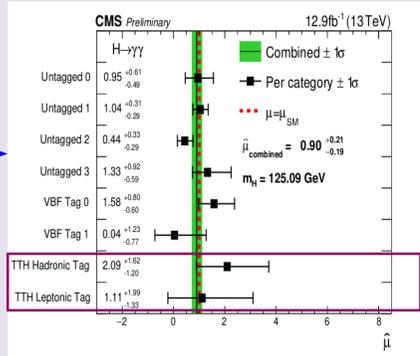
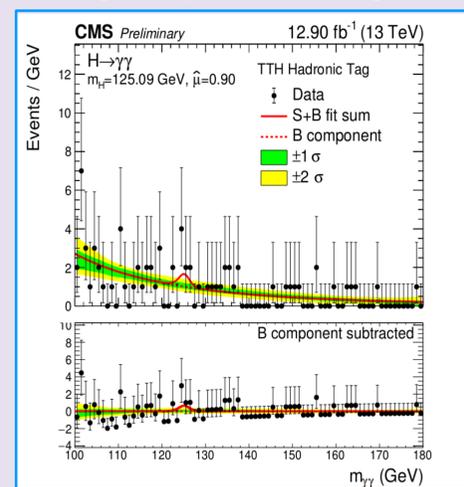
ttH(γγ) HIG-16-020

- Small branching ratio, but clean final state
- Main backgrounds:
 - irreducible: tt+γγ
 - reducible: tt+γ+jet, tt+jets → jets misidentified as isolated photons
- Challenges: suppress background, excellent $m_{\gamma\gamma}$ resolution



Part of inclusive H → γγ analysis

- Diphoton selection to separate signal from backg. (BDT approach)
- Event classification via mass resolution, signal/backg., production mechanism
- Two categories: leptonic & hadronic tag



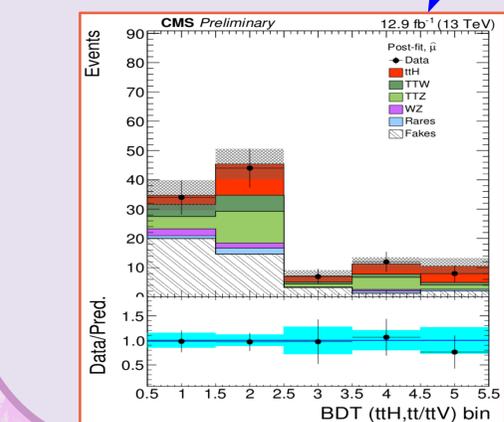
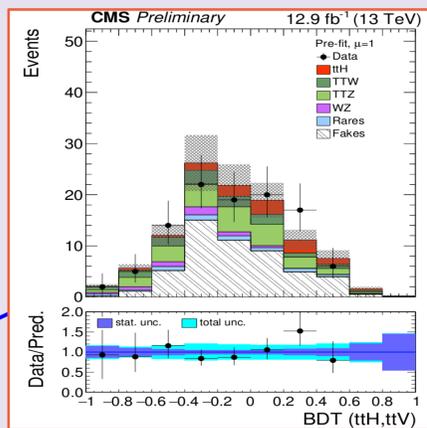
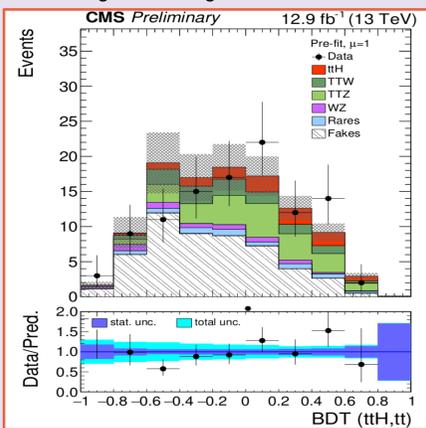
- High purity ttH selection
- statistically limited

$$\hat{\mu}_{obs} = 1.97^{+1.46}_{-0.87}$$

ttH(multileptons) HIG-16-022

- Complimentary analysis to ttH(bb) and ttH(yy)
- Main backgrounds:
 - irreducible (smallest): tt+V → from MC
 - reducible: tt+jets → from data
- Two categories: 2 same signs leptons & ≥ 3 leptons
- Subcategories: lepton charge, presence of τ_h , lepton flavour, presence of ≥ 2 b-tags, signal/background bin

- Separation of signal from tt, ttV via BDTs (and MEM) → categories division in signal/backg. bins
- Modeling of fake lepton backgrounds from control region relaxing lepton selection
- Jet mis-identification, B hadrons decay
- Charge mis-assignment



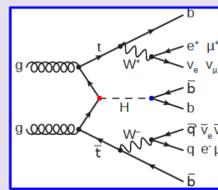
Category	Obs. limit	Exp. limit ± 1σ
Same-sign dileptons	4.6	1.7 ^{+0.9} _{-0.5}
Trileptons	3.7	2.3 ^{+1.2} _{-0.7}
Combined	3.9	1.4 ^{+0.7} _{-0.4}

Combined best fit of all sub-categories:

$$\hat{\mu}_{obs} = 2.3^{+0.9}_{-0.8}$$

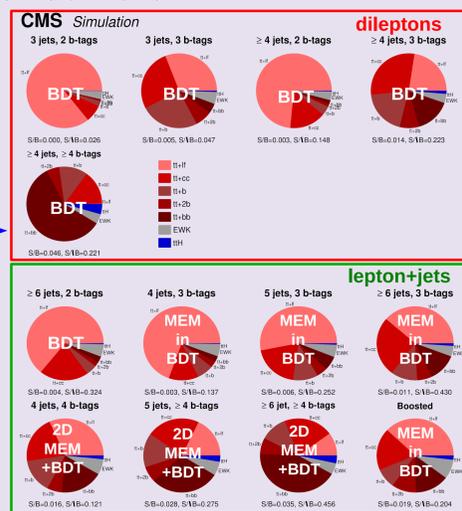
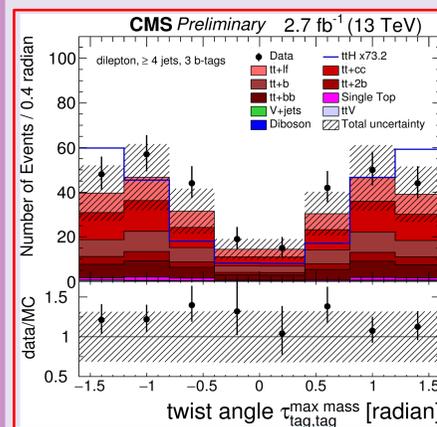
→ Some deficit in dilepton, nothing in trilepton; no significant excess overall

ttH(bb) HIG-16-004



- Largest Higgs boson branching ratio
- Overwhelming background: tt+jets
 - irreducible: tt+bb → theoretically challenging
- Many jets with similar kinematics, limited mass resolution for H → bb
- Main strategy: obtain good signal separation, constrain backgrounds
- Two categories: lepton+jets & dileptons
 - lepton+jets: high statistics
 - dileptons: minimal non tt backgrounds, minimal jet combinatorics

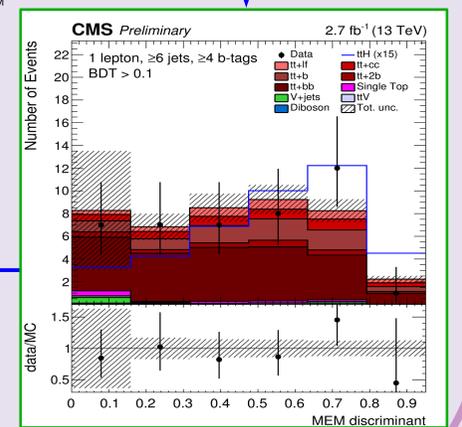
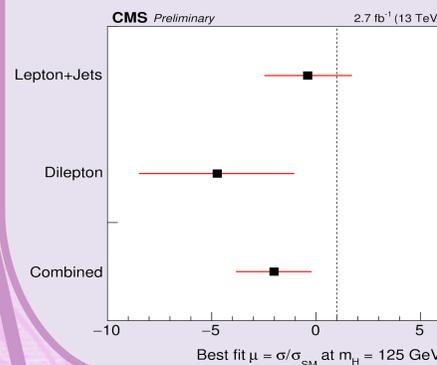
Classify by jets, b-tags multiplicities and boosted jets (lepton+jets)



Simultaneous binned maximum likelihood fit across all categories

- no significant excess, set upper limit on $\hat{\mu} = \sigma/\sigma_{SM}$
- systematics dominated

Combined best fit $\hat{\mu}_{obs} = -2.0 \pm 1.8$
→ 1.7σ below SM expectation



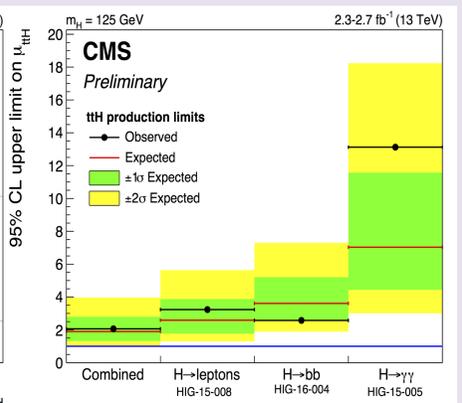
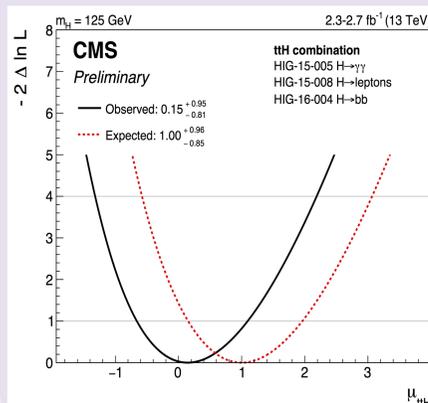
Combination of 2015 results*

- Combined fit of 3 statistically independent analysis channels:
 - ttH(multileptons), ttH(bb) and ttH(yy)
- Combined best fit:
 - SM expectation best fit:

$$\hat{\mu}_{obs} = 0.15^{+0.95}_{-0.81}$$

$$\hat{\mu}_{SM} = 1.00^{+0.96}_{-0.85}$$

→ Combined limit in agreement with SM expectation



* Not yet updated with 12.9 fb⁻¹ data