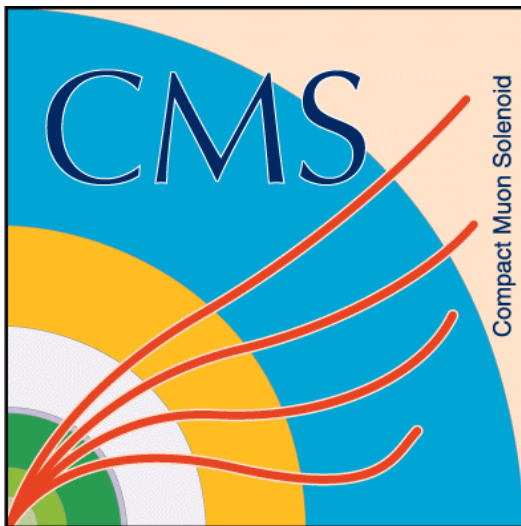




Higgs Analyses Involving Taus

Brief Review of CMS Results and Plans

A. Raspereza (DESY)

MTauTau Workshop, Würzburg

September 23rd 2011

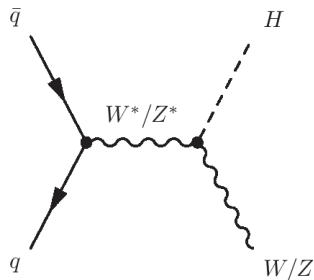
Search for SM $H \rightarrow \tau\tau$

- Latest public result : CMS PAS HIG-13-004, HIG-12-053
 - Moriond'13 top-up
 - $4.9 + 19.4 \text{ fb}^{-1}$ at 7 and 8 TeV
 - Channels analyzed : $e\tau$, $\mu\tau$, $\tau\tau$, $e\mu$, $\mu\mu$

Exploited production mechanisms / event categories

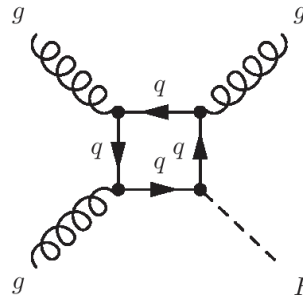
VH analysis

- Low signal yield but very clean mode
- $W/Z \rightarrow \ell + \nu / 2\ell$



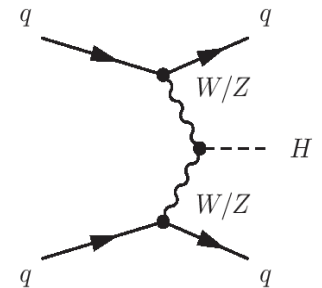
1-jet category

- Enhanced sensitivity to $gg \rightarrow H$
- Improved mass resolution



VBF category

- 2 jets with large $m(\text{jet-jet})$ and $\Delta\eta(\text{jet-jet})$

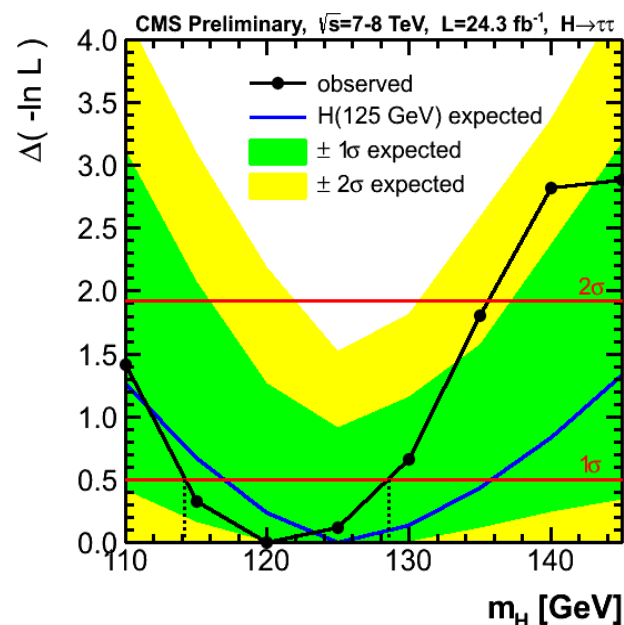
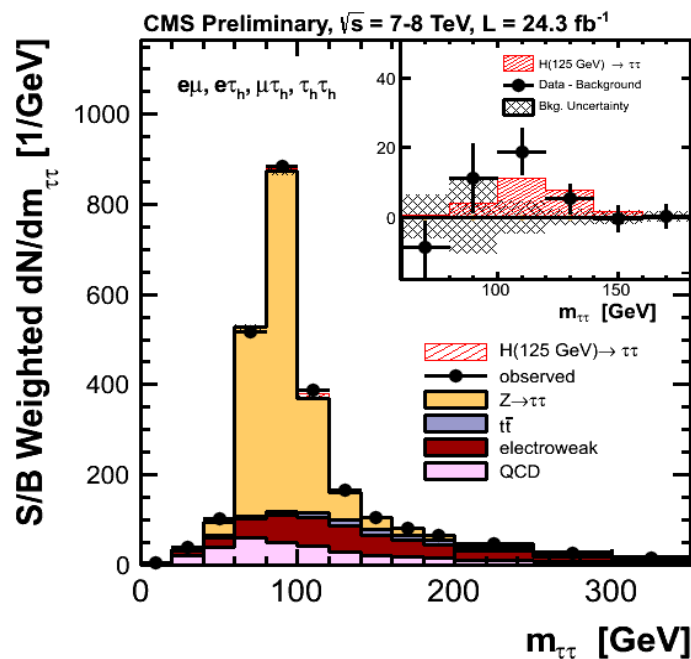
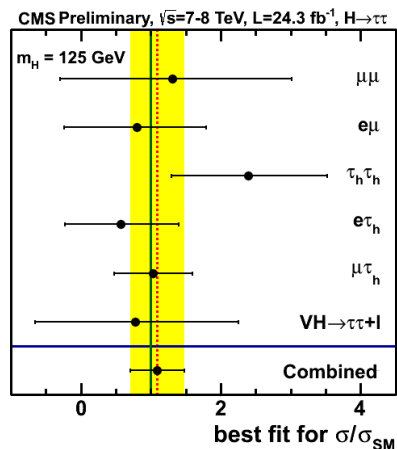
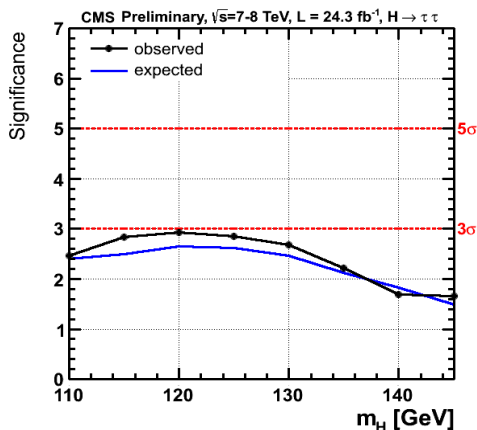


- Zero-Jet category : $Z \rightarrow \tau\tau$ Standard Candle
 - signal was not fitted in this category
 - constrains lepton efficiencies / momentum scales and background normalizations

Search for SM $H \rightarrow \tau\tau$

Broad excess observed

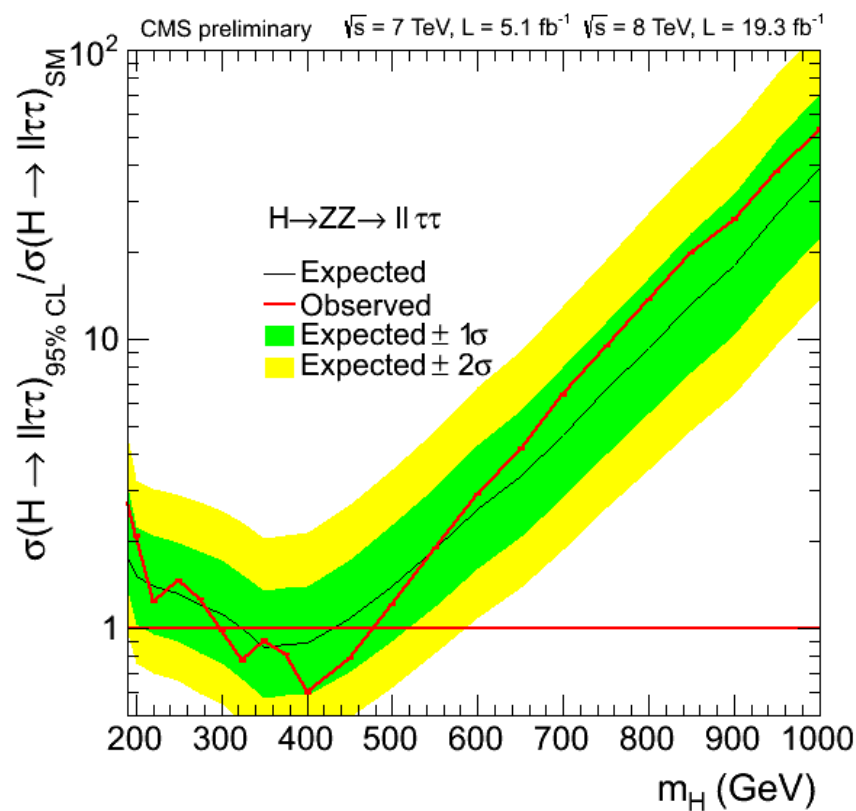
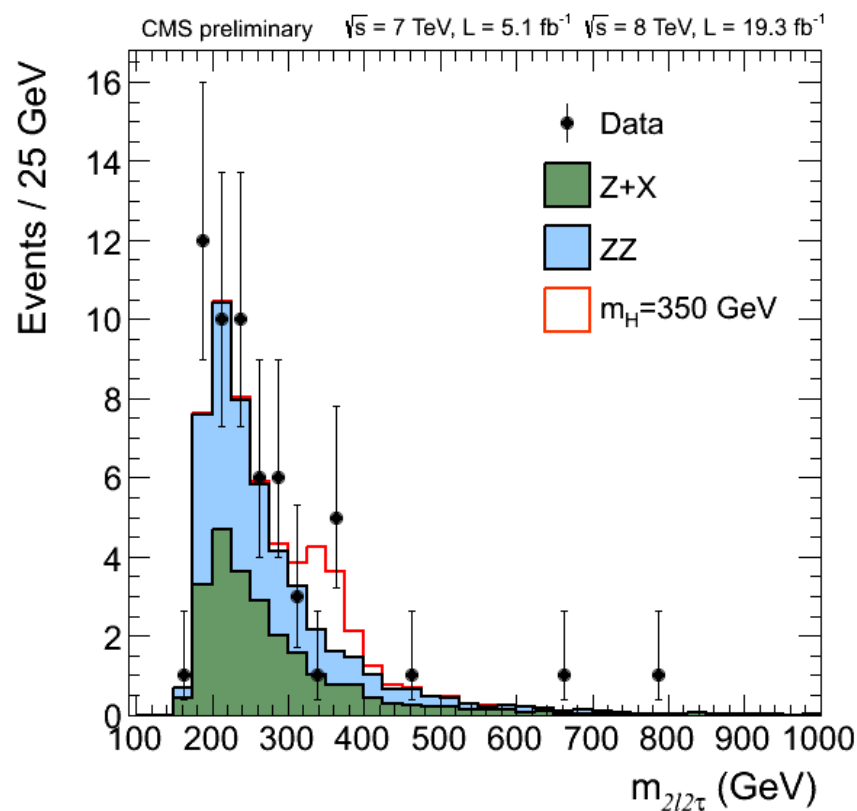
- Consistent with $H(125)$ hypothesis
- Largest significance : 2.9σ at 120 GeV



$$m_H = 120_{-6}^{+8} \text{ GeV}$$

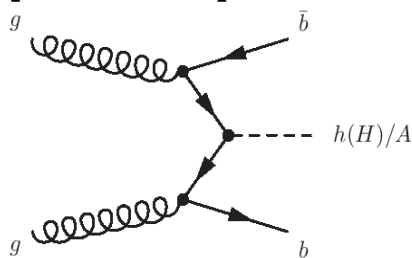
High Mass Search for $H \rightarrow 2\ell + 2\tau$

- Part of CMS $H \rightarrow ZZ \rightarrow 4\text{-leptons}$ effort
- Latest public result : HIG-13-002
 - Moriond'13 Update (5.1 + 19.3 fb⁻¹ at 7 and 8 TeV)
 - Analysis contributes to high mass searches

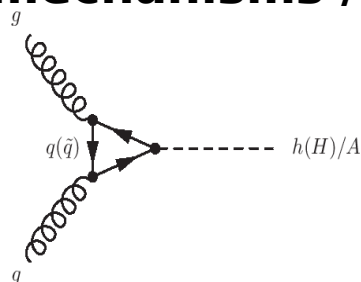
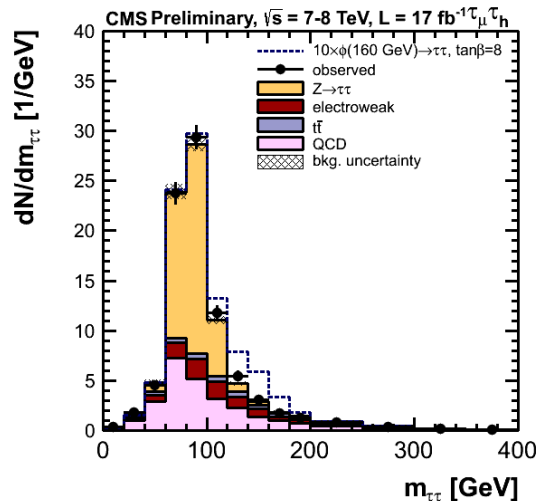


Search for MSSM $H \rightarrow \tau\tau$

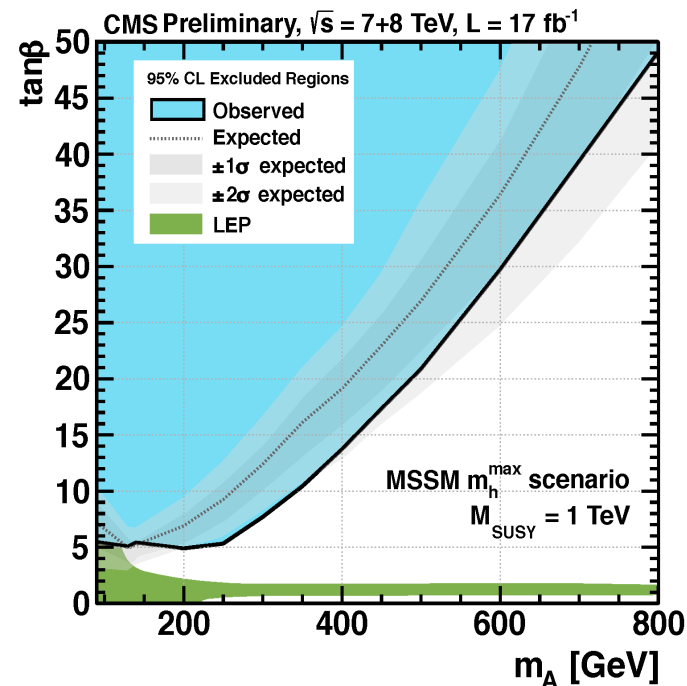
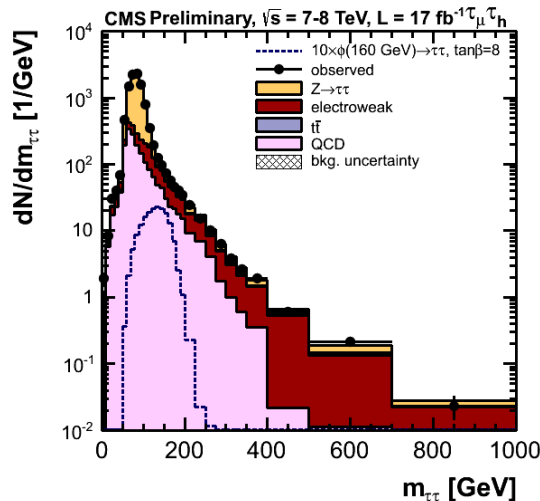
- Latest public result : CMS PAS HIG-12-050
 - HCP'12 update
 - $4.9 + 12.1 \text{ fb}^{-1}$ at 7 and 8 TeV
 - Channels analyzed : $e\tau$, $\mu\tau$, $e\mu$, $\mu\mu$
- Exploited production mechanisms / event categories



≥ 1 b-jet

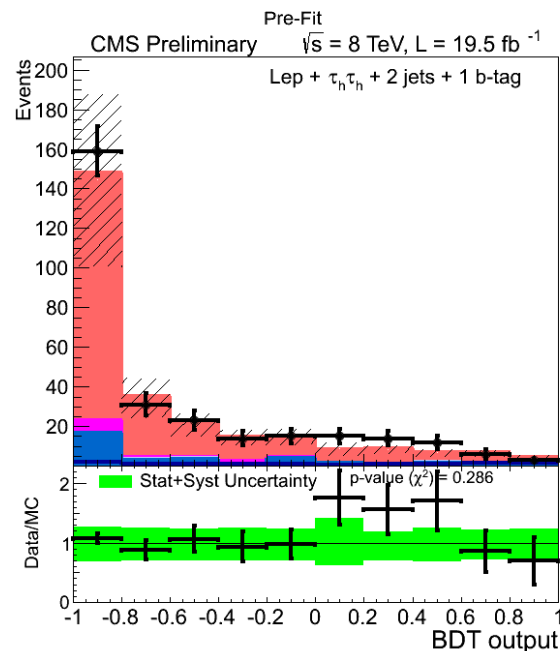
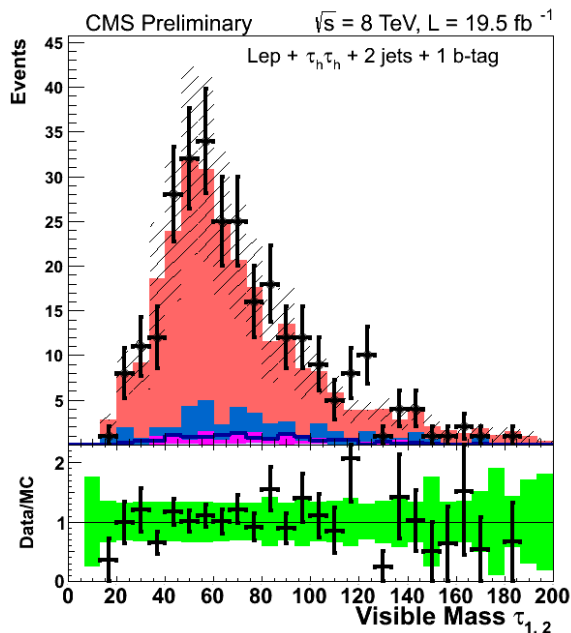
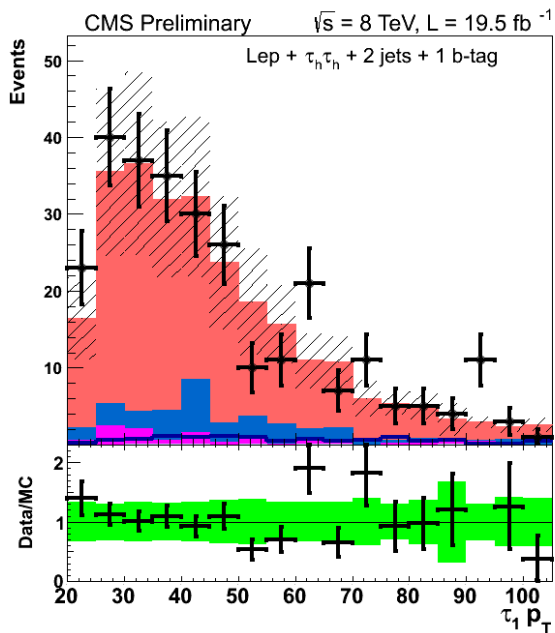


no b-jets

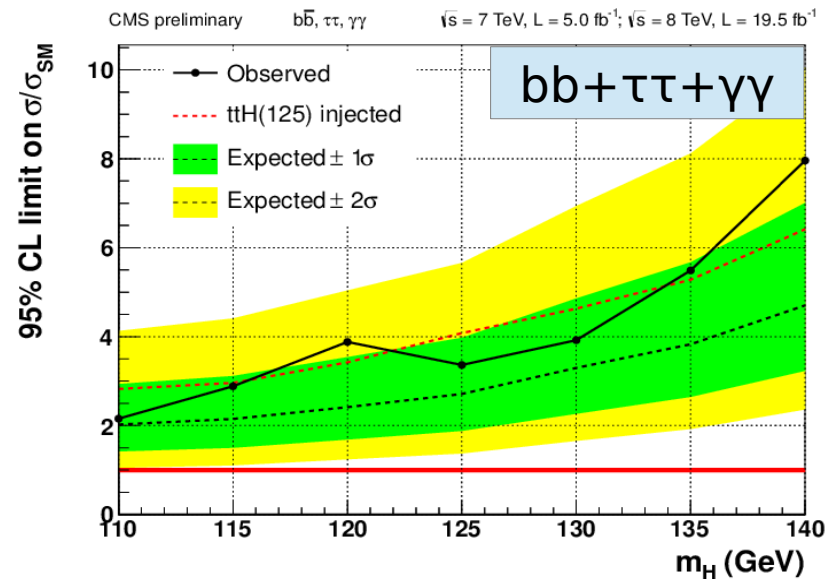
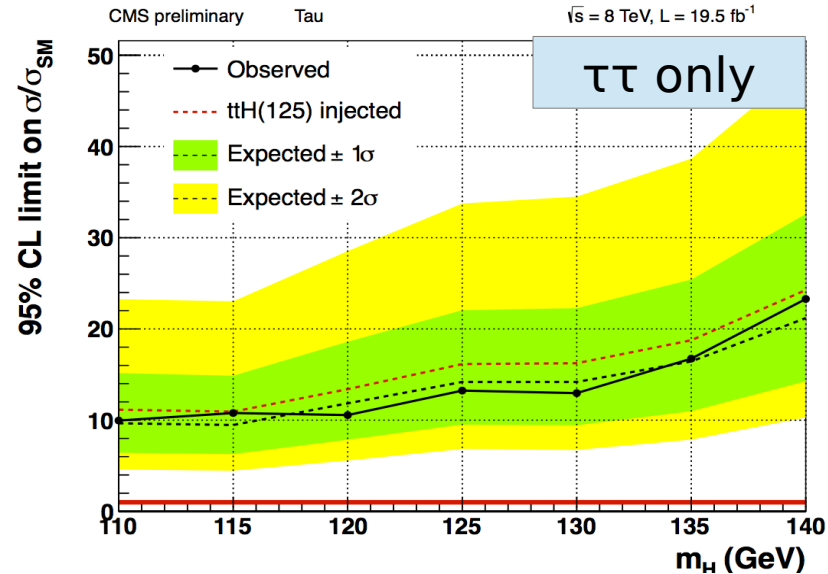
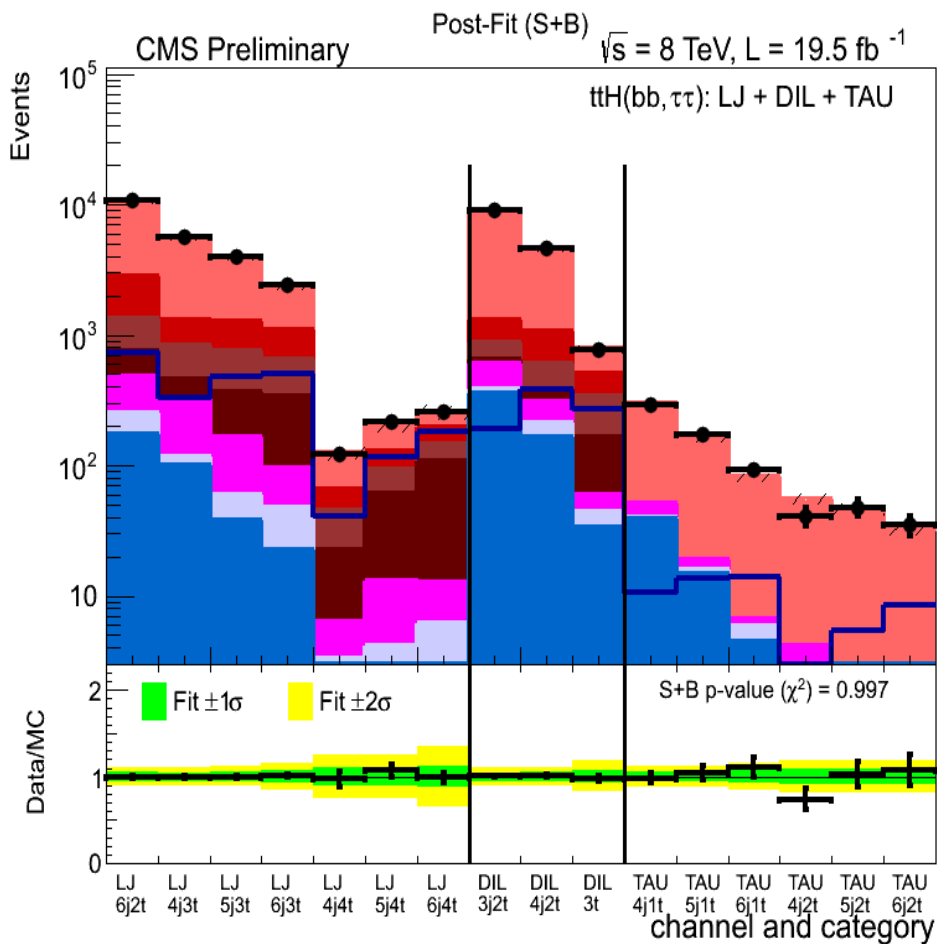


Search for $t\bar{t}H$ with $H \rightarrow b\bar{b} + \tau\tau + \gamma\gamma$

- Search for $t\bar{t}H$, $H \rightarrow \tau\tau$: new CMS analysis involving taus
- Latest public result : HIG-13-019
 - $L = 19.5 \text{ fb}^{-1}$ at 8 TeV
 - only fully hadronic channel analyzed so far
 - analysis combined with $H \rightarrow b\bar{b} + \gamma\gamma$ channels
- Analysis features
 - event categorization based on jet (b-jet) multiplicities
 - MVA discriminant in each event category $\rightarrow$ extraction of signal



Search for $t\bar{t}H$ $H \rightarrow b\bar{b} + \tau\tau + \gamma\gamma$



Future Updates and Final Results

- **Analysis searching for SM $H \rightarrow \tau\tau$**
 - **entering phase of collaboration-wide review**
 - **full coverage of di-tau final states**
 - **ee channel added**
 - **new event categories $\rightarrow$ improved sensitivity**
 - **time scale : fall 2013**
- **Analysis searching for MSSM $H \rightarrow \tau\tau$**
 - **Preliminary results (fall 2013)**
 - **under collaboration-wide review**
 - **no change in the analysis strategy**
 - **Fully hadronic channel added $\rightarrow$ improved sensitivity at higher masses**
 - **model - independent interpretations (constrains on cross sections of two production mechanisms)**
 - **Final results (Winter-Spring 2014)**
 - **Plan to have full coverage of di-tau final states**
 - **Model-independent interpretation + interpretation within modified mh-max scenario**