# Search for $H \rightarrow \tau \tau$ at CMS

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## **Higgs Production and Decay**

Two primary Higgs production modes



### **Di-Tau Event Signature**

**Tau Decay Modes** 

Decay Mode	Branching Ratio
$\tau \to e + \nu_e + \nu_\tau$	17.85%
$ au  o \mu +  u_\mu +  u_ au$	17.36%
$\tau \rightarrow hadrons + v_{\tau}$	64.79%

Di-Tau Final States	
$H \rightarrow \tau \tau \rightarrow e \mu$	
$H \to \tau \tau \to \mu \mu$	
$H \to \tau \tau \to e \tau_h$	
$H \to \tau \tau \to \mu \tau_h$	

 $H 
ightarrow au au 
ightarrow \mu au_h$  Event



### Hadronic Tau Decay Identification



#### Average Energy Deposits Around Tau Object



Boosted Decision Tree trained to distinguish real taus from quark/gluon jets based on nearby energy deposits

### Di-Tau Mass

- Original di-tau mass estimated from visible decay products and missing transverse energy
  - Presence of neutrinos makes direct mass calculation impossible



### **Jet Categories**



## Limit on Higgs $\sigma_H \times BR(\tau\tau)$

- Limit calculated by fit to di-tau mass
- 7 and 8 TeV
- ➢ 10 fb⁻¹ of data



### **Comparison to Other Higgs Channels**

- Negative pull on best fit  $\sigma_H$
- Downward fluctuation in data?
- Non-standard fermion couplings?
- Full 2012 dataset will answer these questions!



### References

- CMS Collaboration, "Observation of a new boson at a mass of 125 GeV with the CMS experiment at the LHC", *Phys. Lett. B* 716 (2012) 30-61
- CMS Collaboration, "Search for a standard model Higgs bosons decaying to tau pairs in pp collisions", CMS-PAS-HIG-12-018 (2012)