

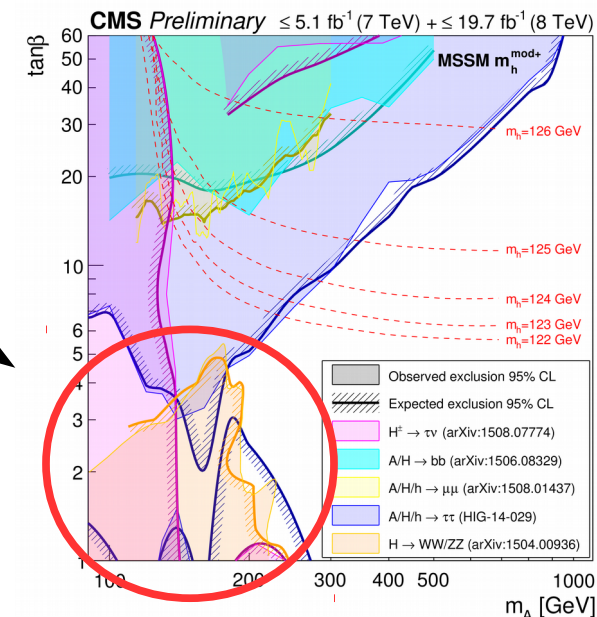
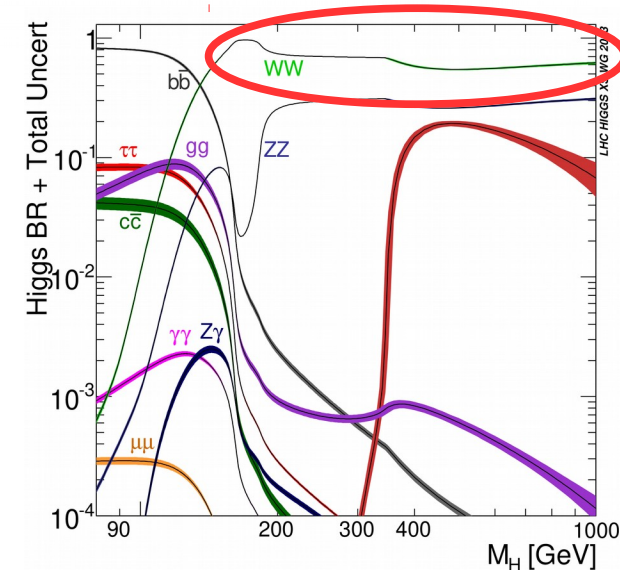
Search for a heavy scalar decaying to W boson pair with CMS

Dennis Roy (RWTH Aachen University)
on behalf of the CMS collaboration

31.07.2019

Introduction

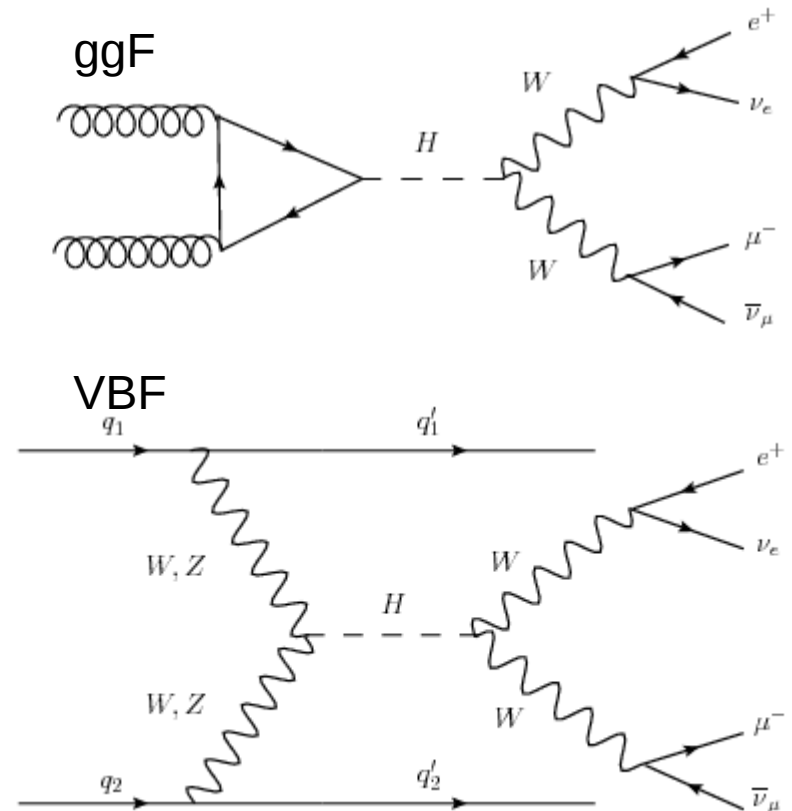
- Many BSM theories predict an extended Higgs sector
- Why $H \rightarrow WW$?
 - Model independent search: Largest branching ratio
 - MSSM: Sensitive at low m_A and $\tan\beta$



Analysis strategy

- Dileptonic analysis
 $H \rightarrow WW \rightarrow e\mu/ee/\mu\mu$
and semi-leptonic analysis
 $H \rightarrow WW \rightarrow e/\mu + qq$
- Events from ggF and VBF production
- Using 2016 data (35.9 fb^{-1})
- Signal mass range:
200 – 3000 GeV

➔ [HIG-17-033](#)



diagrams from arXiv:1305.1883

Dileptonic analysis

Categorization:

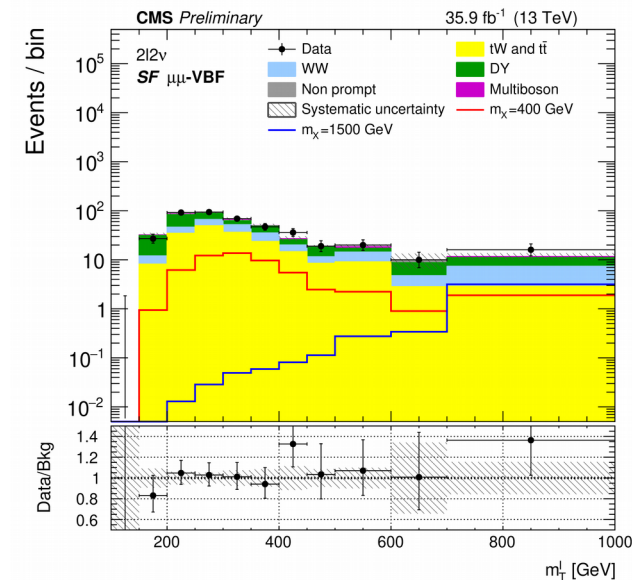
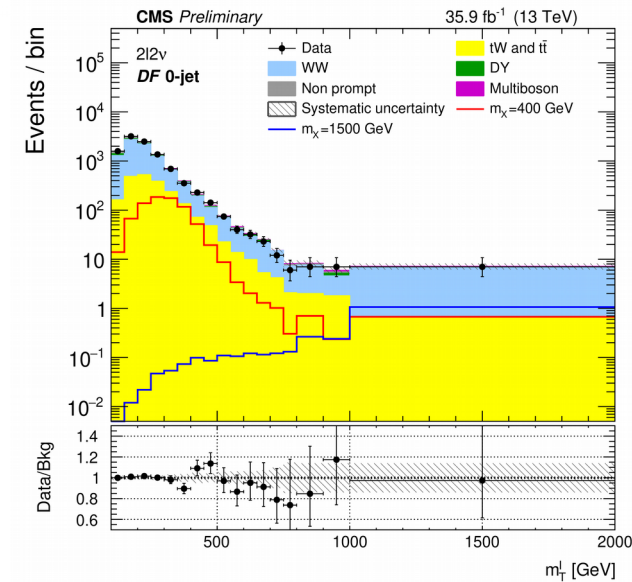
- 0 / 1 / ≥ 2 jets
- VBF: 2 jets , $m_{jj} > 500$ GeV , $\Delta\eta_{jj} > 3.5$

Signal selection, i.a.:

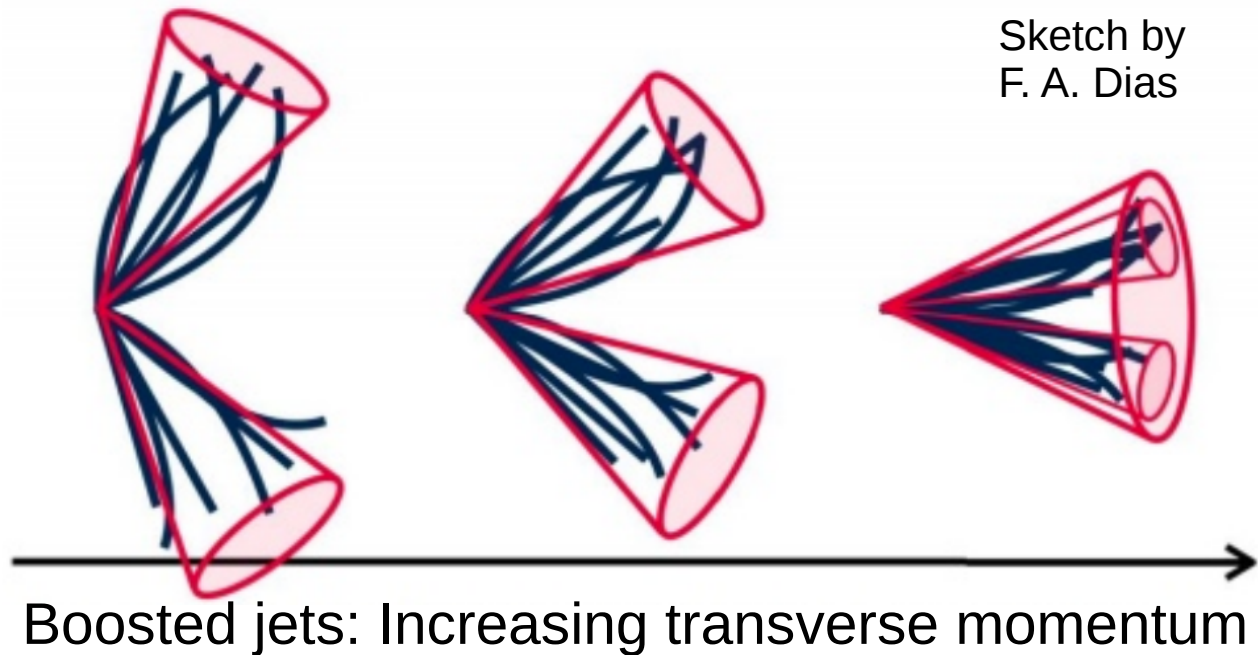
- $n_{\text{btag}} = 0$, 3. lep $p_T < 10$ GeV , ...
- **$e\mu$** : $m_{T,H} > 60$ GeV
- **$ee/\mu\mu$** : $m_{ll} > 120$ GeV

Major backgrounds:

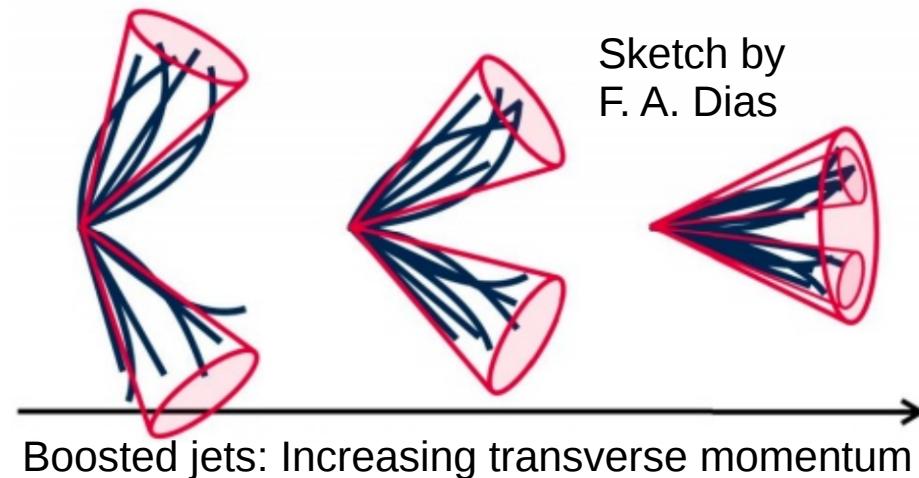
- Top, DY, WW



- High mass resonances:
 - Jets become colimated
 - Reconstruct as AK8 jet



- High mass resonances:
 - Jets become colimated
 - Reconstruct as AK8 jet
- Fatjet handling:
 - Remove pileup contribution
 - Remove soft radiation
 - N-subjettiness τ_{21} :
Identify 2-prong structure

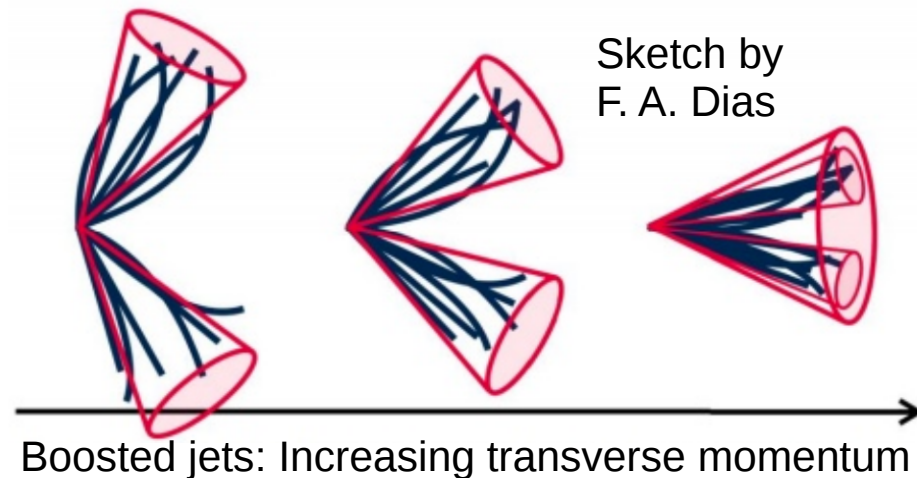


- High mass resonances:
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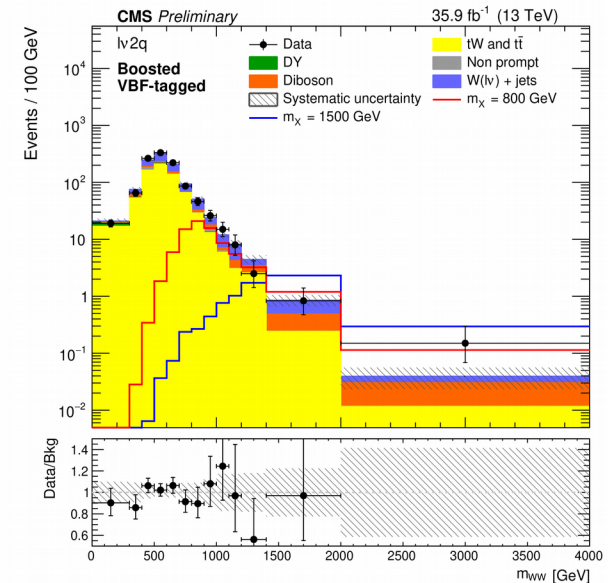
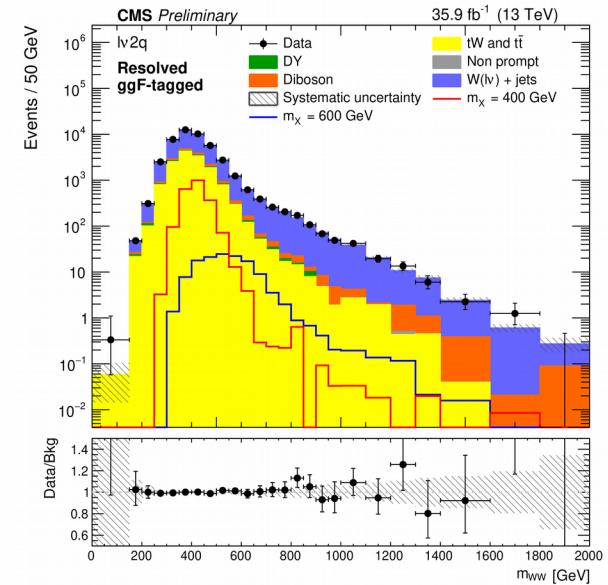
- Categorization:
 - VBF (same as dileptonic)
 - ggF-tagged: using ME LA
 - Untagged

→ Each divided to e/ μ and resolved/boosted



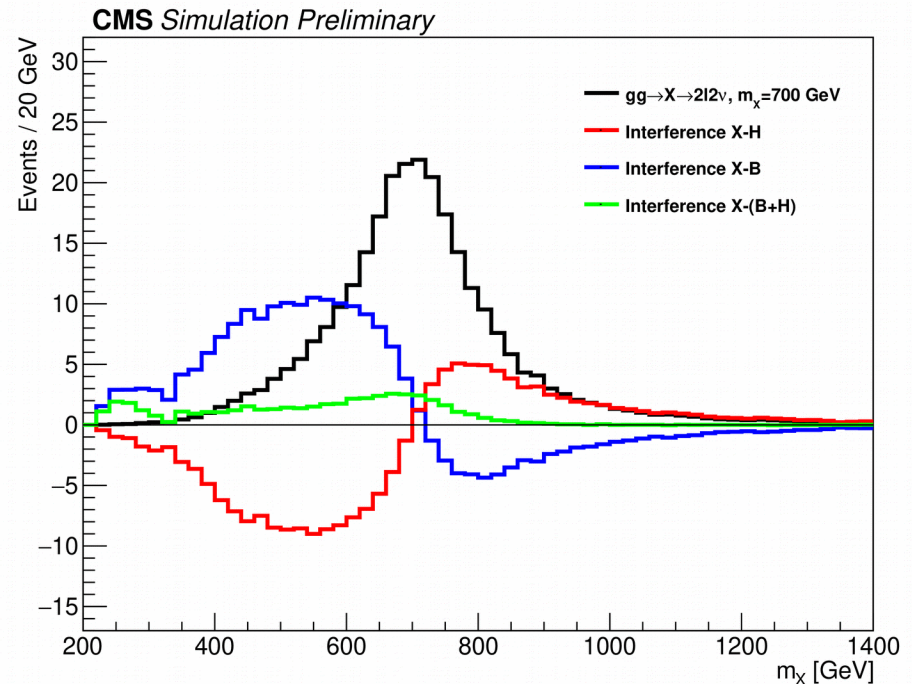
- Signal selection, i.a.:
 - $65 \text{ GeV} < m(W_{\text{had}}) < 105 \text{ GeV}$
 - $p_T^W / m_{WW} > 0.4/0.35$ (boos./res.)

- Major backgrounds:
 - Top
 - W+Jets



- Interference between a high mass signal, non-resonant WW background and SM Higgs needs to be considered
- Effect becomes more prominent at higher mass signals

$$\begin{aligned}
 \text{Yield} &= (k \cdot A_{\text{sig}} + A_{\text{SM}} + A_{\text{WW}} + A_B)^2 \\
 &= k^2 \cdot A_{\text{sig}}^2 + k \cdot 2 A_{\text{sig}} A_{\text{SM}} + k \cdot 2 A_{\text{sig}} A_{\text{WW}} + \dots \\
 &= \mu \cdot S + \sqrt{\mu} \cdot I + B
 \end{aligned}$$



Interference effects for a
700 GeV signal

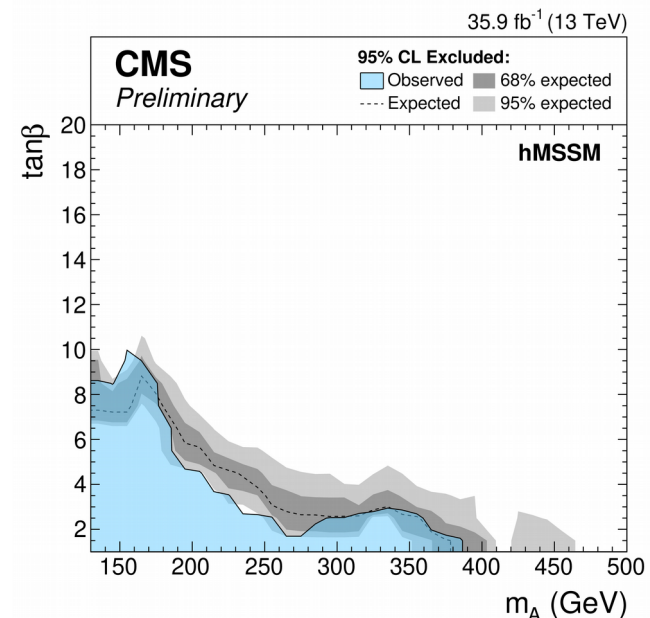
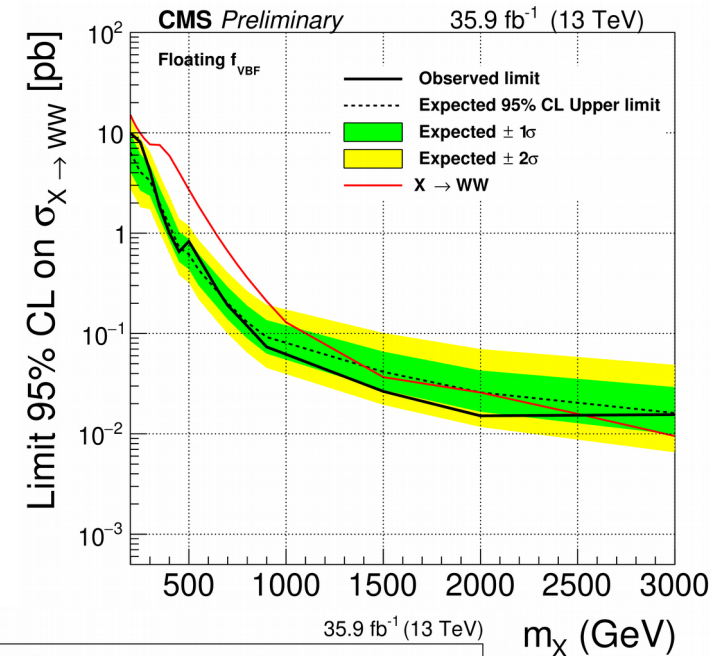
Limits

- Upper limit at 95% CL on the σ times BR
- Interpretations on MSSM and 2HDM scenarios
 - Exclusion at low m_A and $\tan\beta$ in MSSM



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- A search for a high mass Higgs boson in the $H \rightarrow WW$ channel was performed using 2016 data
 - No observed signal over background
 - Exclusion limits are presented
- Full Run 2 analysis with 137 fb^{-1} luminosity is in progress

2HDM/MSSM limits



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