14:25 **CMS ATLAS H(125) fermion decays results** 1h 35m

CMS bb 15m

Speakers: Donato , S.Donato (Univ. Zurich)

ATLAS bb 15 15m

Speaker: T.Scanlon (University of London)

CMS leptons 15m

Speaker: A.Raspereza (DESY)

HToLeptons_CMS.pdf

ATLAS leptons 15m

Speaker: E.Coniavitis (Freiburg)

YSF talks which are relevant

SM Higgs boson to a pair of tau leptons with the CMS LHC Run II data

Speaker: Y.Wen (DESY)

Young Scientist Forum part 3

Search for SM VH -> bb with the ATLAS detector

Speaker: A.Bell (University of London)

Search with CMS for the Higgs boson produced in association with a Z or W boson in the leptonic+beauty final state

Speakers: G.Perrin (ETH Zurich) , Perrin

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Request from the organisers for these slides:

“Summarise rapidly the facts and problems”

Given that typically only one experiment has a full Run-2 analysis in each area, I will not say much on “comparison” (as written on indico) – we are in a fleeting moment of almost perfect complementarity!

Many thanks to the speakers!

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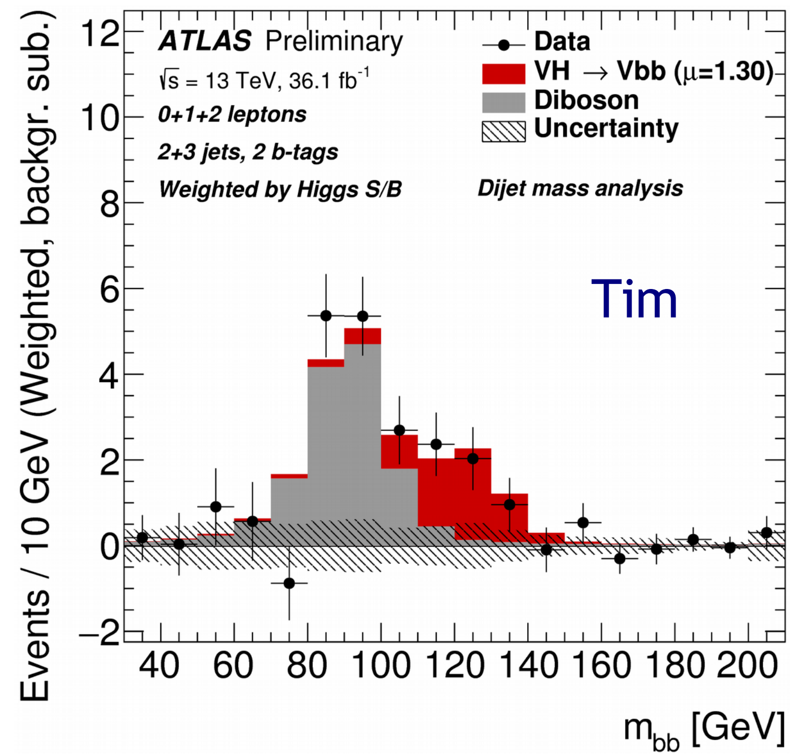
H→b$\bar{b}$

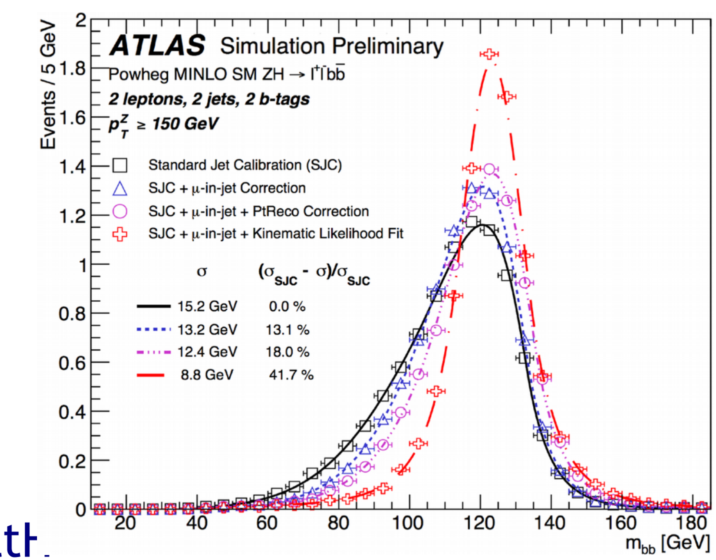
Tevatron	CDF+D0	2.8σ @m_H=125 GeV
Run-1	ATLAS+CMS	2.6σ (3.7σ e)
Run-2	ATLAS VH	3.5σ (3.0σ e)
Run-1+Run-2	ATLAS VH	3.6σ (4.0σ e)

Evidence obtained by ATLAS in VH



Experimental challenges include, with high pileup:

- Signal modelling uncertainties
- Background modelling uncertainties
- Flavour tagging
- Improved mass resolution



Next steps:

- Observation!
- Moving from search to measurements in VH
  - Modifications to analysis strategies?
  - Disentangling production diagrams?
- See channels beyond VH: VBF H→bb, VBF H(→bb)+γ, ttH
  - Boosted channel has new challenges as discussed by Silvio

VH, H(bb) Considerations

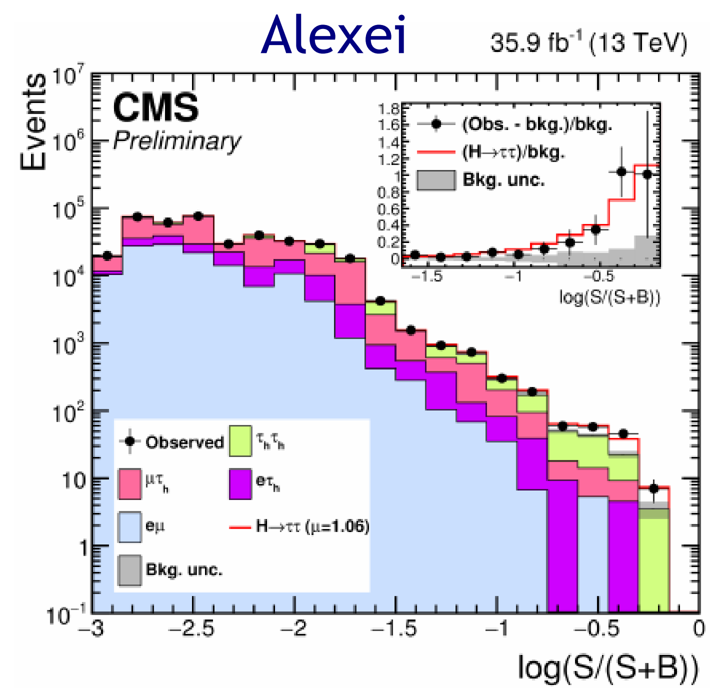
Source of uncertainty		σ_μ
Total		0.39
Statistical		0.24
Systematic		0.31
Experimental uncertainties		
Jets		0.03
E_T^{miss}		0.03
Leptons		0.01
b-tagging	b-jets	0.09
	c-jets	0.04
	light jets	0.04
	extrapolation	0.01
Pile-up		0.01
Luminosity		0.04
Theoretical and modelling uncertainties		
Signal		0.17
Floating normalisations		0.07
Z+jets		0.07
W+jets		0.07
$t\bar{t}$		0.07
Single top-quark		0.08
Diboson		0.02
Multijet		0.02
MC statistical		0.13

Tim

Limiting factors
- Signal modelling
- Monte Carlo statistics
- Flavour tagging
- Background modelling

H→ττ

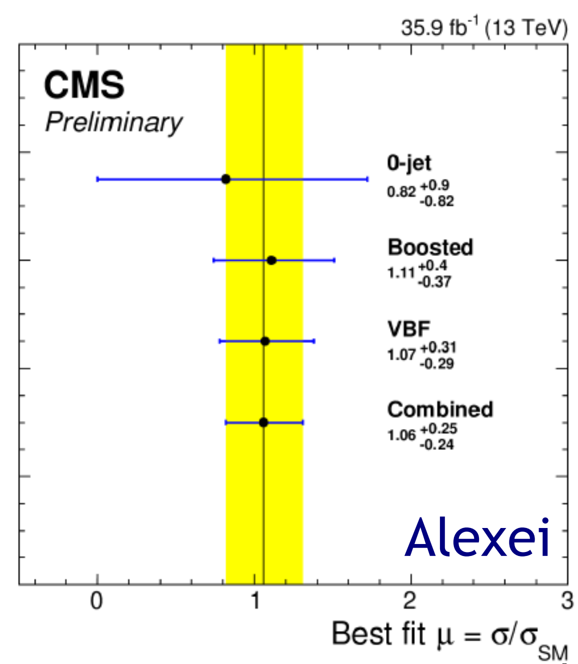
Run-1	ATLAS+CMS	5.5σ (5.0σ e)
Run-2	CMS	4.9σ (4.7σ e)
Run-1+Run-2	CMS	5.9σ (5.9σ e)



Observation of this decay in combined A+C Run-1 sample surpassed by CMS alone (Run-1+Run-2)

Experimental challenges include, with high pileup:

- τ identification and backgrounds
- τ and jet energy scale and resolution
- Control of backgrounds from data, especially Z+jets - can peak (e+h) under signal
  - Embedding or not?
  - MC statistics a large uncertainty
- Triggering (esp $\tau_{had}\tau_{had}$)
- Hadronic decay mode separation



Next steps:

- Study H properties
  - In production processes such as VBF CP test
    - Run-1 analysis shown by Elias
  - Via spin correlation – uniquely
    - Does selection affect/bias sensitivity?

CMS ττ analysis post-fit systematic error breakdown (from Yiwen's talk)

systematics

refined uncertainty model

- split jet energy scale into 27 different sources
- more detailed tau ID and scale uncertainties
- control regions in fit

Source of uncertainty	Magnitude: Prefit	Magnitude: Postfit
τ_h energy scale	1.2% on energy scale	0.2-0.3%
e energy scale	1-2.5% on energy scale	0.2-0.5%
e misidentified as τ_h energy scale	3% on energy scale	0.6-0.8%
μ misidentified as τ_h energy scale	1.5% on energy scale	0.3-1.0%
Jet energy scale	27 sources, event-by-event	-
E_T^{miss} energy scale	Event-by-event	-
τ_h ID & isolation	5% per τ_h	3.5%
τ_h trigger	5% per τ_h	3%
τ_h reconstruction per decay mode	3% migration between decay modes	2%
e ID & isolation & trigger	2%	-
μ ID & isolation & trigger	2%	-
e misidentified as τ_h rate	12% per τ_h decay mode	5%
μ misidentified as τ_h rate	25% per τ_h decay mode	3-8%
Jet misidentified as τ_h rate	20% per 100 GeV τ_h p_T	15%
$Z \to \tau\tau/\ell\ell$ estimation	Normalization: 7-15%	3-15%
	Uncertainty on $m_{\ell\ell/\tau\tau}$, $p_T(\ell\ell/\tau\tau)$, and m_{jj} corrections	-
W + jets estimation	Normalization, eμ and $\tau_h\tau_h$: 4-20%	-
	Extrap. from high-m_T region, eτ_h and $\mu\tau_h$: 5-10%	-
	Unc. from CR, eτ_h and $\mu\tau_h$: $\simeq 5-15\%$	-
QCD multijet estimation	Normalization, eμ: 10-20%	5-20%
	Unc. from CR, eτ_h, $\tau_h\tau_h$, and $\mu\tau_h$: $\simeq 5-15\%$	-
	Extrap. from anti-iso. region, eτ_h and $\mu\tau_h$: 20%	7-10%
	Extrap. from anti-iso. region, $\tau_h\tau_h$: 3-15%	3-10%
Diboson normalization	5%	-
Single-top normalization	5%	-
$t\bar{t}$ estimation	Normalization from CR: $\simeq$ 5%	-
	Uncertainty on top quark p_T reweighting	-
Luminosity	2.5%	-
b-tagged jet veto (eμ)	3.5-5.0%	-
Limited number of events	Statistical uncertainty in every bin	-
Signal theoretical uncertainty	Up to 20%	-

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Within sight: H→μμ

Run-1	CMS	< 7.4 x SM (6.5 e)
Run-2	ATLAS	< 3.0 x SM (3.1 e)
Run-1+Run-2	ATLAS	< 2.8 x SM (2.9 e)

Category splitting enhances sensitivity – boosted and VBF topologies - refine further

Statistics limited, no show-stoppers?