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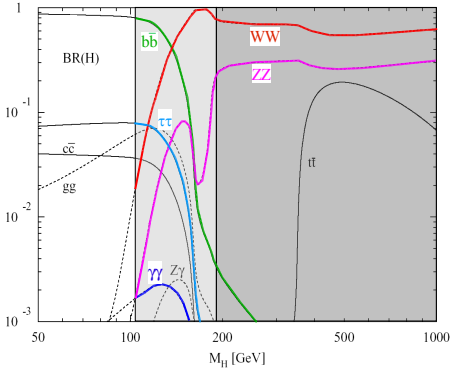
Status of the Higgs analyses at MPI

ATLAS MPI Meeting • MPI • 18.09.2006

Overview of the Higgs searches at MPI

SM Higgs decay channels at LHC:



SM Higgs:

Motivation: cover the whole allowed mass region.

- $(t\bar{t}, W, VBF)$ $H \to b\bar{b}$
- VBF $H \to \tau\tau \to (\ell\nu\nu)(anything)$
- VBF $H \to WW \to (\ell\nu)(anything)$
- $H \to ZZ^{(*)} \to (\ell^+\ell^-)(\ell^+\ell^-)$

Neutral MSSM Higgs:

Motivation: expertise in μ- and τ- reconstruction.

- $A/H \to \mu^+\mu^-$
- $A/H \to \tau^+\tau^- \to (\ell\nu\nu)(anything)$

Related software development:

- b-tagging
- τ-identification (using TopoClusters)
- forward jet reconstruction (VBF channels)

Current Status

SM	$(t\bar{t}, W, VBF)H \to b\bar{b}$	S.Kotov, J.Yuan	Complete	FULL/FAST
SM	$(VBF)H \to \tau\tau \to (\ell 2\nu)(\ell 2\nu)$	S.Horvat, S.M-Möck,C.Valderanis	Complete	FAST
SM	$(VBF)H \to \tau\tau \to (\ell 2\nu)(h\ \nu)$	M.Groh, S.Horvat	Validation	
SM	$(VBF)H \to WW \to (\ell\nu)(\ell\nu)$	S.Horvat, S.Kaiser, O.Kortner	Validation	
SM	$H \to ZZ^{(*)} \to 4\ell$	N.Benekos, S.Horvat,O.Kortner	Complete	FULL
MSSM	$(bb)A/H \to \mu\mu$	G.Dedes, S.Horvat	Complete	FULL/FAST
MSSM	$(bb)A/H \to \tau\tau$	G.Dedes, S.Horvat	Validation	

Complete analyses (completed before the CSC data production):

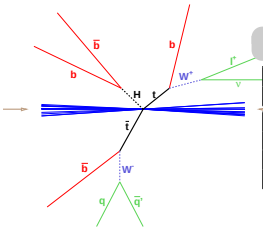
- Using FAST (AtlFast) and/or
  FULL (V10.0.4, "Rome-Layout") detector simulation.
- Cuts optimized for the low-luminosity up to $\mathcal{L}$=30 fb^{-1}.
- Pile-up, cavern background and misalignment still missing,
  to be done with the CSC data (Dec 2006).

Validation:

- Preparation for the studies on the CSC data (V11.0.42, V12.0.2).

Complete: $ttH, H \to b\bar{b}$

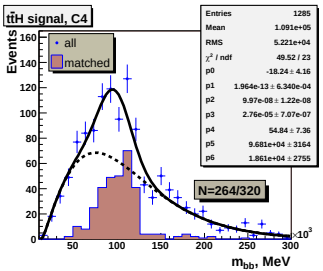
- S.Kotov, Higgs Working Group Meeting, 19.07.2006.



Performance of different jet reconstruction algorithms:

	Particle	$t\bar{t}H$		$t\bar{t}b\bar{b}$	
		Cone4	Cone7	Cone4	Cone7
Rec. efficiency, %	b-jet	52.2	42.9	47.1	41.5
	light jet	72.9	54.4	76.0	62.1
Mean $\Delta p_t/p_t$ shift, %	b-jet	-10.5	0.4	-9.6	0.9
	light jet	-8.2	3.4	-9.0	2.8

- Cone4: highest efficiency, but an additional jet energy recalibration is needed.

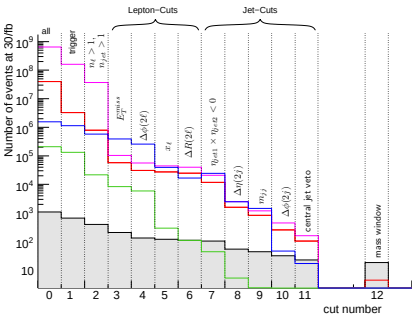


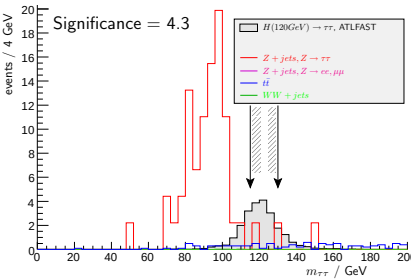
After recalibration:

- Mass shift reduces, -23 GeV → -3 GeV
- Higgs peak broadens, 19 GeV → 27 GeV
- Significance = 2.5

Complete: *VBF* $H \to \tau^+\tau^- \to (\ell\nu\nu)(\ell\nu\nu)$

- C.Valderanis, LHC-D Higgs Meeting, 07.03.2006.

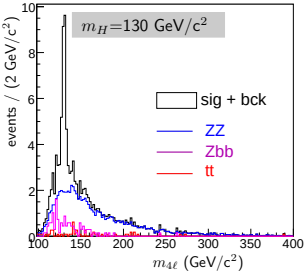


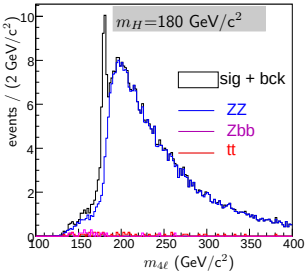


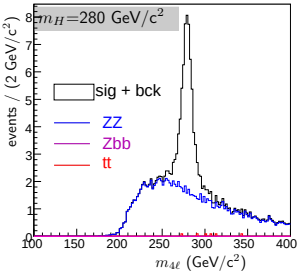
	H 120	QCD $Z \to \tau\tau$	QCD $Z \to ee, \mu\mu$	EW $Z \to ll$	tt	WW
all	1089	40 M	645 M	15 M	1,56 M	210.000
$N_l \geq 2, N_{Jet} \geq 2$	289	790.464	37 M	965.696	576.198	21.730
$E_T miss$	152	57.573	103.950	67.582	390.324	8.384
x_l	122	27.300	44.586	6.868	39.426	294
$\Delta R(2l)$	114	24.625	39.767	4.407	16.598	110
$\Delta\eta(2j)$	52	1.582	2.489	316	2.468	5
m_{jj}	46	819	1.180	219	1449	2
Jet veto	33	103	159	12	17	0,5
ΔM	15,5	4,4	0,5	0	1,8	0,06

Complete: $H \to ZZ^{(*)} \to (\ell^+\ell^-)(\ell^+\ell^-)$

- S.Horvat, Higgs Working Group Meeting, 19.07.2006.





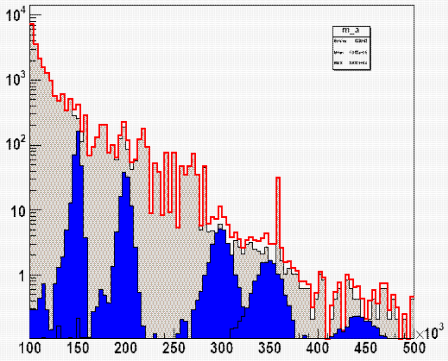


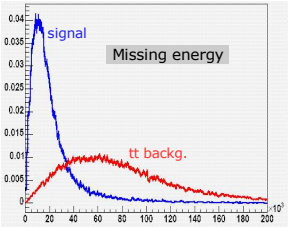
	m_H =130 GeV ($\delta m = \pm 5$ GeV)	m_H =160 GeV ($\delta m = \pm 6$ GeV)	m_H =180 GeV ($\delta m = \pm 7$ GeV)	m_H =280 GeV ($\delta m = \pm 20$ GeV)
N_{signal}	17.2±0.1	20±1	21.4±0.3	49.1±0.1
N_{ZZ}	8.7±0.3	8.8±0.3	21.0±0.5	31.1±0.6
$N_{Zb\bar{b}}$	2±2	2±2	1±1	0±2
$N_{t\bar{t}}$	0±0.4	0±0.4	0.5±0.4	0±0.4
Significance (no K-factors)	5.0±0.3	5.5±0.5	4.5±0.2	8.7±0.4

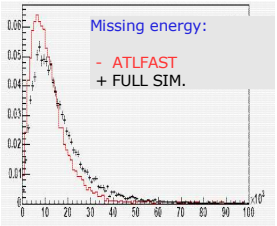
Complete: $(bb)A/H \to \mu^+\mu^-$

- G.Dedes, Higgs Working Group Meeting, 18.01.2006.

bbA signal ($\tan\beta = 30$)+$t\bar{t}$ background



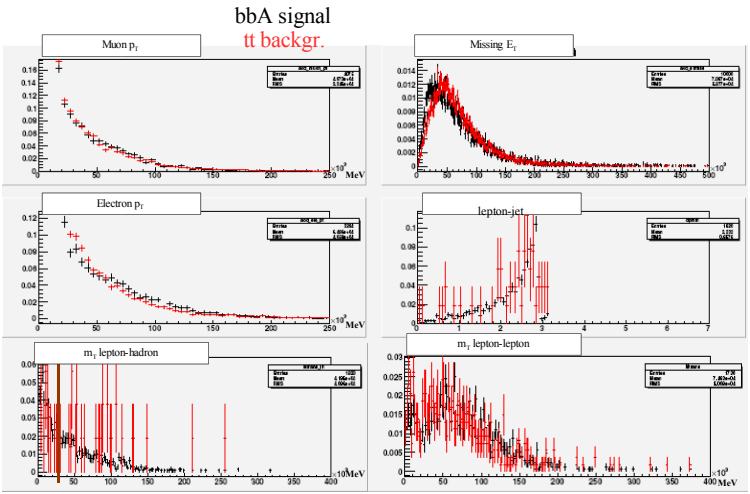




Significance	150 GeV	200 GeV	300 GeV	350 GeV	450 GeV
ATLFAST	12.1	4.6	5.1	2.4	1.1
FULL			4.4		

Validation stage: $(bb)A/H \rightarrow \tau^+\tau^-$

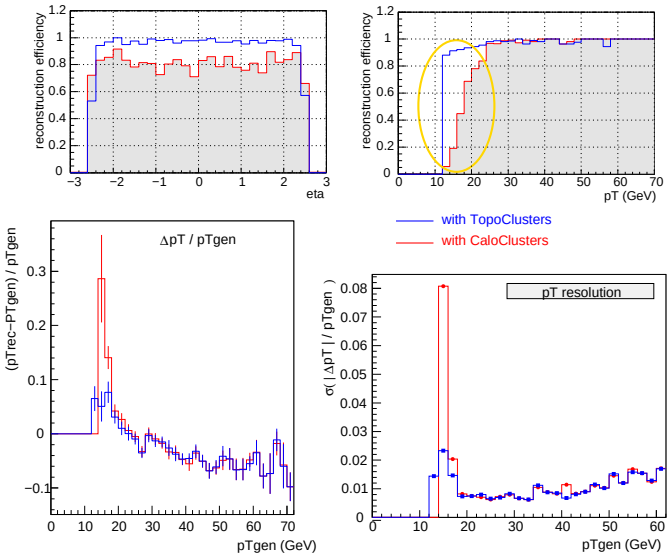
- G.Dedes, Higgs Working Group Meeting, 19.07.2006.



Statistics for the $t\bar{t}$-background still too small.

Related Software: τ-identification

- M.Groh and S.Horvat, Tau Meeting, 27.06.2006



TopoClusters: possible improvements at low p_T.

Plans

- Prepare the analyses for the CSC data.
- Include the trigger studies.
- Include additional detector effects (pile-up, misalignment ...).
- Study the possibilities to estimate the background from the data. (energy calibration, cross-sections...)

Commitments to the Higgs Working Group:

- Contribution to 6 Higgs CSC notes related to mentioned analyses.
- Editing and coordination of the work for the $A/H \rightarrow \mu\mu$ CSC note.

$\Downarrow$

CSC data production,
validation and development of reconstruction algorithms,
optimization of analyses

Deadline for the first drafts of CSC notes: end of December 2006 !

Remarks on the Monte-Carlo Production

Before the CSC era:

All data sets have been produced privately at FZK, RZG and MPI,
since no official (centrally produced) bug-free data were available.

- ATLFAST: 70×10^6 events
- FULL SIMULATION (V10.0.4): 1.5×10^6 events $\equiv$ 105 days·100 CPU

Waiting for the stable CSC production:

Cetral CSC data production is far behind the schedule: $\Rightarrow$
Preparation for the CSC studies and commitments to the HiggsWG
are impossible without (at least a partial) private production.

- estimated total number of CPU-s needed: $\sim$180
  FZK not so helpfull anymore, loaded with jobs from the central production.
- need a GRID-certified site to register the produced data