



Max-Planck-Institut für Physik  
(Werner-Heisenberg-Institut)

MAX-PLANCK-GESELLSCHAFT

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# Higgs Activities at MPI



ATLAS Higgs-D Treffen • Munich • 28.-29.11.2006

# Overview of the Higgs searches at MPI

(★★★ optimized; ★★ TDR-like; ★ starting; ● to start)

## SM Higgs:

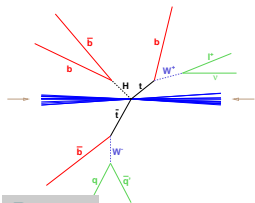
- ★★★  $(tt, W, VBF) H \rightarrow b\bar{b}$  [Sergei Kotov, Jianming Yuan]
- ★★  $VBF H \rightarrow \tau\tau \rightarrow (l\nu\nu)(anything)$  [Manfred Groh, S.H., Makis Valderanis]
- ★  $VBF H \rightarrow WW \rightarrow (l\nu)(anything)$  [S.H., Steffen Kaiser, Oliver Kortner]
- ★★★  $H \rightarrow ZZ^{(*)} \rightarrow (l^+l^-)(l^+l^-)$  [S.H., Oliver Kortner]

## MSSM Higgs:

- ★★★  $A/H \rightarrow \mu^+\mu^-$  [George Dedes, S.H.]
- ★★  $A/H \rightarrow \tau^+\tau^- \rightarrow (l\nu\nu)(anything)$  [George Dedes, S.H.]
- $H^\pm \rightarrow \tau^\pm\nu$  [Thies Ehrich, S.H., Sergei Kotov]

## Related software development:

- ★★★ b-jet reconstruction, b-tagging [Sergei Kotov]
- ★  $\tau$ -identification (using TopoClusters) [Manfred Groh, S.H.]
- ★ forward jet reconstruction (VBF) [Steffen Kaiser, Oliver Kortner]
- jet reconstruction with first data (900 GeV) [F.Legger, to start in 2007]

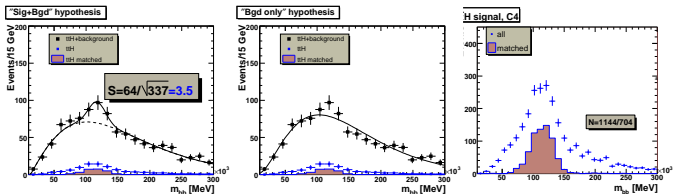


Done:

- Neural-Network analysis on the FULLY SIM. ("Rome") data; enough statistics to train the NN on fully simulated data.
- Comparison of performances of different jet reconstruction algorithms (Cone4, Cone7,  $k_T$ ).
- Comparison of analyses on ATLFAST and FULLY SIM. data.

To Be Done:

- ATLAS Note (in addition to the CSC note) under preparation.
- Optimization of (b-)jet selection, specific to this channel (get the maximum  $S/\sqrt{B}$ ).
- Reproduction/completion of the analysis on the CSC data.

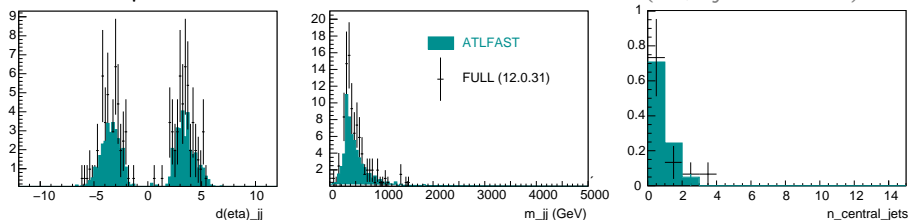


Done:

- ATLFast study of the lepton-lepton channel (TDR-like).

Being Done:

- Contribution to the CSC data production (12.0.31):  
8138-8141, 8150-8153, 8162:  $Z \rightarrow (ee, \mu\mu, \tau\tau) + n\ jets$ .
- Comparison of FULL and ATLFast sim. ( $Z + 2jets$  for  $\ell - \ell$ ):



To Be Done:

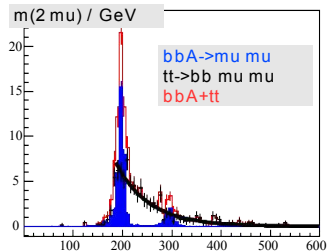
- **Lepton-lepton channel with fully simulated data** (ASAP: PhD).
- Extend to the lepton-hadron channel (with the CSC data), **make use of the improvements in the tau-reconstruction.**
- Multivariate methods for the background suppression.

### Being Done:

- Jet performance studies have just started.

### To Be Done:

- Perform the analysis on the CSC data, using multivariate methods.
- ATLFAST for getting enough statistics? - **ATLFAST validation.**
- Emphasis on the **forward-jet reconstruction, influence of the pile-up effects on the jet distributions.**

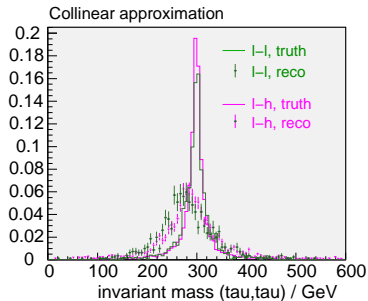


### Done:

- Optimized analysis with ATLFAST and FULL ("Rome") data; concentrated to the high-mass region ( $m_A > 200$  GeV).

### To Be Done:

- Reproduce the analysis with the CSC data, combine with the searches in the low-mass region.
- **Comparison of different generators**, for the systematic uncertainties.
- **ATLFAST data needed** for a reliable cut optimization (most important: good description of  $E_T^{miss}$ -reconstruction).
- Main interest: influence of the changes in the muon performance due to the **misalignment, pile-up and cavern background effects**.



### Being Done:

- First validation plots for the CSC data (leptons,  $\tau$ -jets,  $b$ -jets,  $E_T^{miss}$ ).
- Study of the lepton isolation in the  $\tau$ -jet environment.
- Cut based analysis (lepton-lepton, lepton-hadron) with the available signal and  $t\bar{t}$  data  $\Rightarrow$  still some differences w.r.t. TDR.

### To Be Done:

- Take all other backgrounds, cut optimization.
- Main interest: lepton-hadron channel  
(make use of the optimized  $\tau$ -reconstruction, study the pile-up effects on the  $b$ -jets,  $\tau$ -jets).

# Points of common interest?

## Short-term (CSC data are just coming up):

- Available **generators**, known problems and solutions.
- **Comparison of different reconstruction algorithms** for muons<sup>\*\*\*</sup>, electrons, jets<sup>\*</sup>, b-jets<sup>\*\*\*</sup>,  $\tau$ -jets<sup>\*</sup>,  $E_T^{miss}$ .  
(Define a systematic way to share this work.)
- **ATLFAST validation against the full simulation.**
  - ATLFAST with fast shower for the jet-related studies
  - fast simulation of the inner detector (FATRAS<sup>\*</sup>)
  - changes in the muon parametrization due to the misalignment, pile-up and cavern background

## Longer-term:

- **Pile-up effects (and how to minimize them)**  
jet reconstruction, central jet veto, lepton isolation...
- **Complementary** selection of the **mass points for the analyses, comparison of the results.**
- **Statistics tools**, common definition of the signal significance.