Wuppertal´s
Physics interests in top physics

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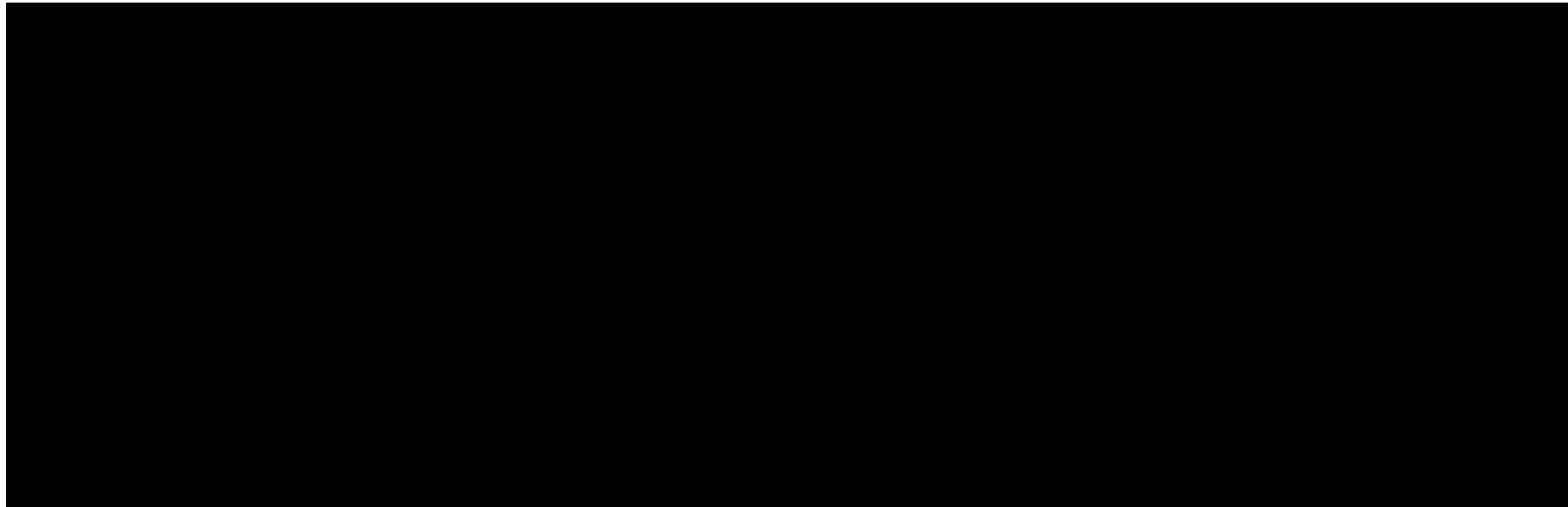
Outline

- Introduction of Wuppertal´s group members

- Wuppertal´s experience from DØ

- Plans for ATLAS top physics
  - tools
  - physics

- Top as window for new physics
  - $t\bar{t}$ resonances at DØ
  - resonant $t\bar{t}$ production via intermediate Higgs

- No conclusion (later...) + Outlook

Wuppertal´s Group Members

- Prof. P. Mättig, Prof. C. Zeitnitz, Dr. Daniel Wicke

- Diploma Students:

  Sebastian Fleischmann (Tracking)
  Tatjana Lenz (Vertexing)
  Sebastian Reuschel (c-tagging)   (+ ...)

- Ph.D. Students:

  Marisa Sandhoff (Xsection + tools)
  Stefan Sandvoss (to be defined)
  Anca Siebel (Higgs)

- Postdocs:

  Grant Gorfine (b-tagging)
  + N.N.

Top physics in Wuppertal
- from DØ to ATLAS -

- Highlights of Wuppertal DØ analyses:

- ◆ W helicity (C. Schmitt)

- ◆ t$\bar{t}$ resonances (M. Vaupel)
  (see slide 9)

- ◆ top cross section measurement
  in all jet channel (H. Hoeth)

- ◆ b fragmentation in top decays (Y. Peters)
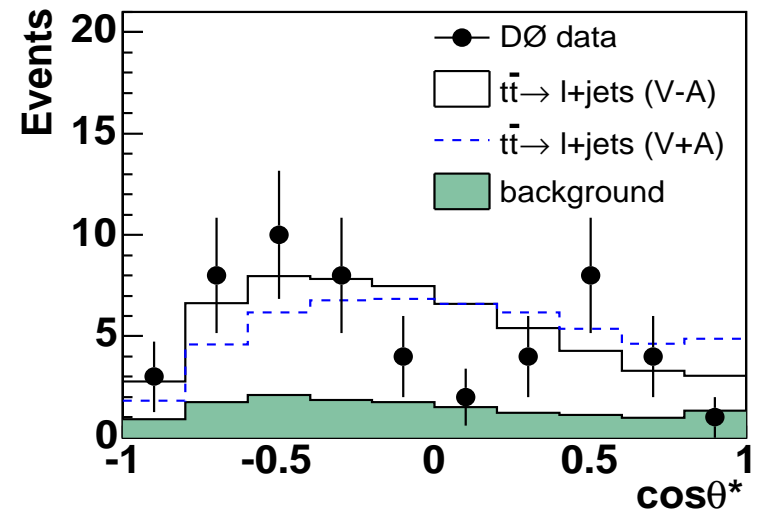
- exploit this knowledge for ATLAS analyses

Top interests

- significant contribution to the ATLAS pixel detector (development & deployment)

  $\Rightarrow$ special interest for top physics and b-tagging

- considering the top quark´s role of commissioning (top as tool to understand the detector)

- technical tools for top physics:
  see Grant Gorfine´s talk on Friday

Wuppertal´s plans for top physics

- Measurement of top X-Section

  - first paper (?!)

  - would like to contribute to

    - optimization of top selection

    - understanding and optimization of b-quark tagging

    - studies to discriminate and estimate background

  - develop tools for top physics

- Close collaboration with other German ATLAS groups

Physics tools for top analysis I

- HitFit

  - developed for DØ

  - tool to reconstruct the full 4-vectors of the $t\bar{t}$-system and its decay products

  - each permutation of decay products gets a weight (χ^2 of the fit)

    $\Rightarrow$ we began to transfer HitFit to ATLAS, generalize it for all top decay channels

    $\Rightarrow$ improve mass resolution by including b-tagging and c-tagging

Physics tools for top analysis II

- JetFinding
  - ◆ kT - algorithm implementation in DØ (T. Schliephake)
  - ◆ Cone-, kT- Algorithm´s influence on b-tagging
    - ✦ Which algorithm gives better association parton $\leftrightarrow$ jet?
    - ✦ Which algorithm performs better to include decay products of the b?

      $\Rightarrow$ **Problem:**

      Particle history in AOD container incomplete!!!

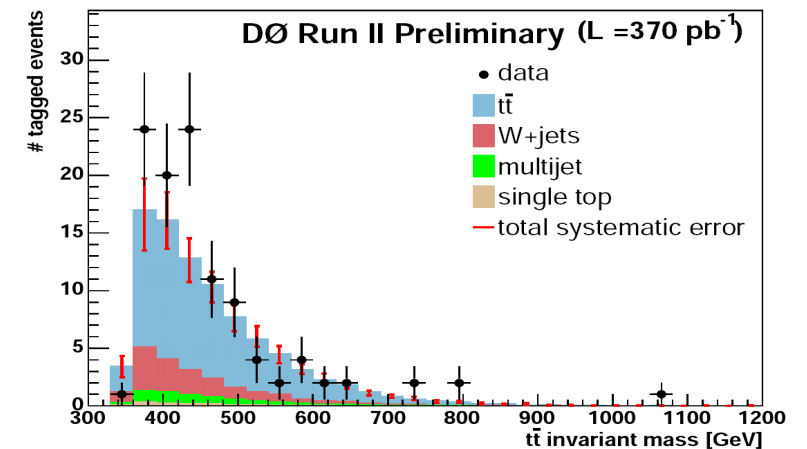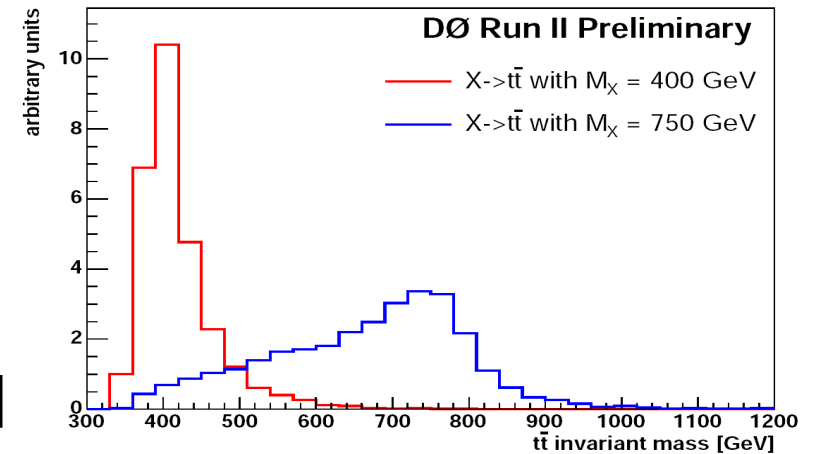   No analysis possible!

      Have to run over ESD and rebuild the particle history AOD container!

Top quark as window for new physics I (M.Vaupel)

- No t$\bar{\text{t}}$ resonance in SM

- But e.g. in "topcolour assisted technicolor" leptophobic Z´ predicted

  - ◆ SM t$\bar{\text{t}}$-production as background

  - ◆ Correct description of SM background needed

  - ◆ Paper with higher statistics will come out soon

DØ Run II Preliminary

X->t$\bar{\text{t}}$ with M_X = 400 GeV
X->t$\bar{\text{t}}$ with M_X = 750 GeV

arbitrary units

t$\bar{\text{t}}$ invariant mass [GeV]

DØ Run II Preliminary (L =370 pb^{-1})

- data
- t$\bar{\text{t}}$
- W+jets
- multijet
- single top
- total systematic error

tagged events

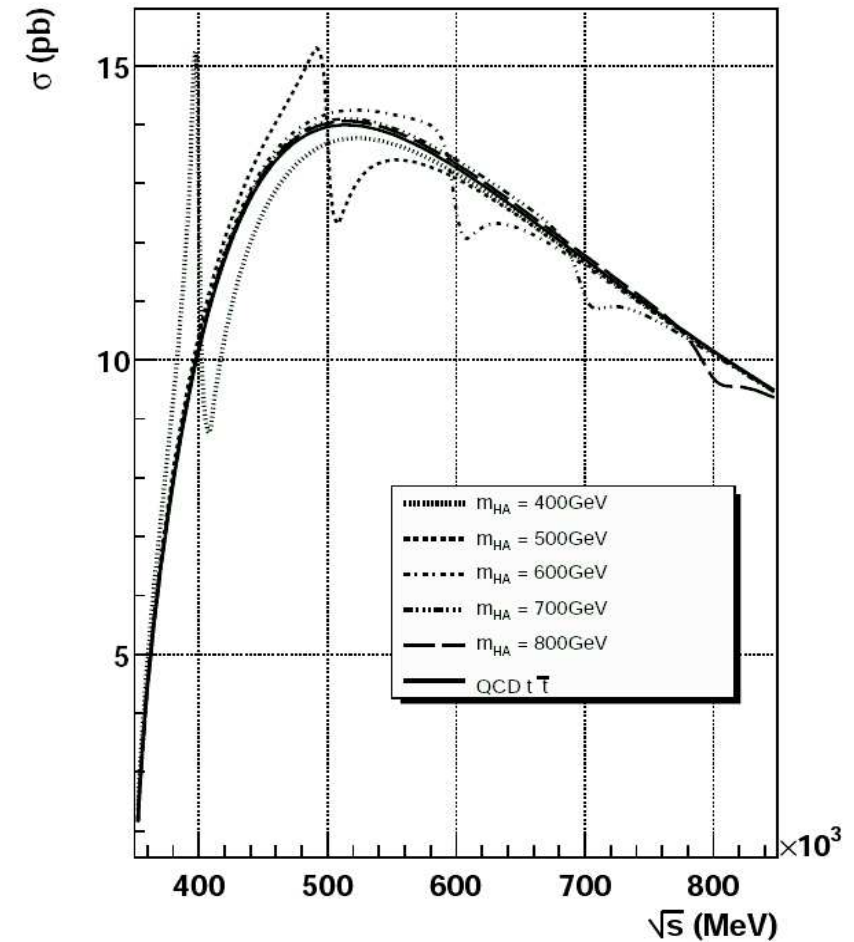t$\bar{\text{t}}$ invariant mass [GeV]

Top quark as window for new physics II (A. Siebel)

MSSM H^0/A^0

- Top production:
  - Standard model: $gg \rightarrow t\bar{t}$
  - Possible resonant production through intermediate Higgs boson
  - MSSM:
    $BR(H^0/A^0 \rightarrow t\bar{t}) \approx 100\%$
    for $m_{H/A} > 2m_t$ and $\tan\beta \approx 1$

Legend:
- $m_{HA} = 400\,GeV$
- $m_{HA} = 500\,GeV$
- $m_{HA} = 600\,GeV$
- $m_{HA} = 700\,GeV$
- $m_{HA} = 800\,GeV$
- QCD $t\bar{t}$

y-axis: σ (pb)
x-axis: $\sqrt{s}$ (MeV) $\times 10^3$

Outlook

- Depending on ATLAS/LHC progress

  and development of the group

  - interests in other top topics
    - (V-A)
    - FCNC
    - …

- Conclusion: Later....