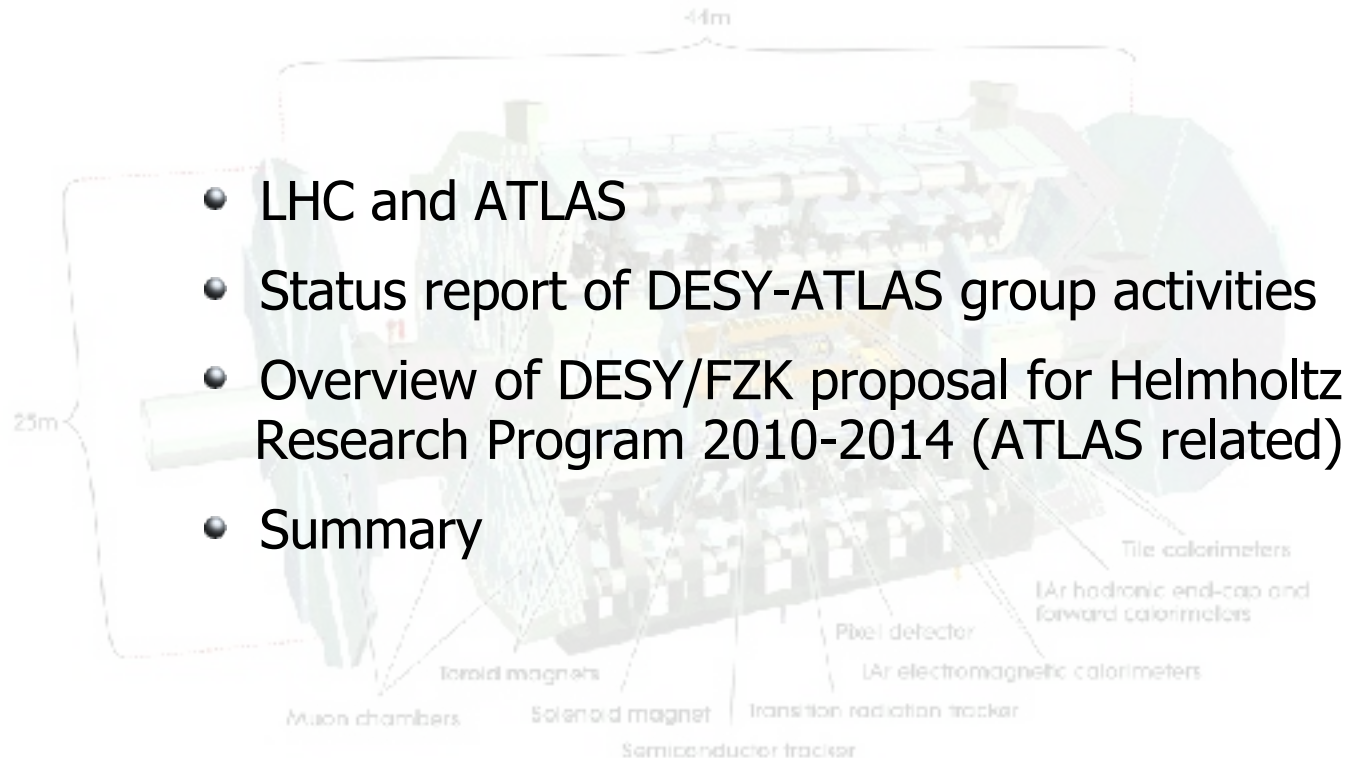


# ATLAS: Report to the PRC

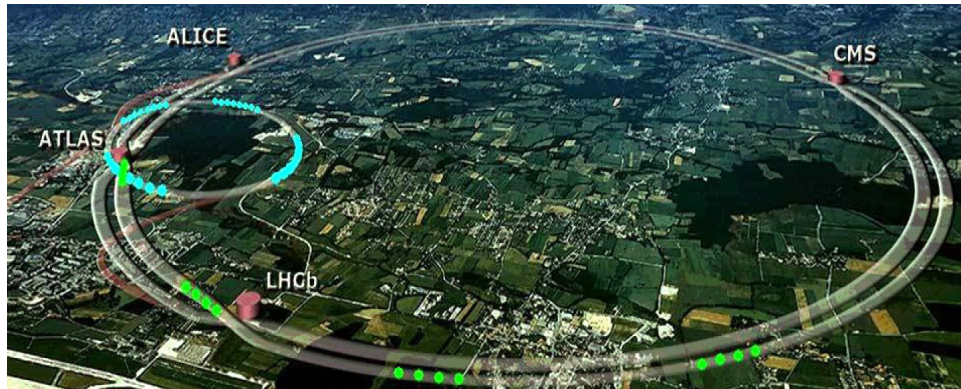


R. Plačakytė on behalf of **DESY-ATLAS** group

66<sup>th</sup> DESY PRC meeting, 1-2 October 2008, Zeuthen

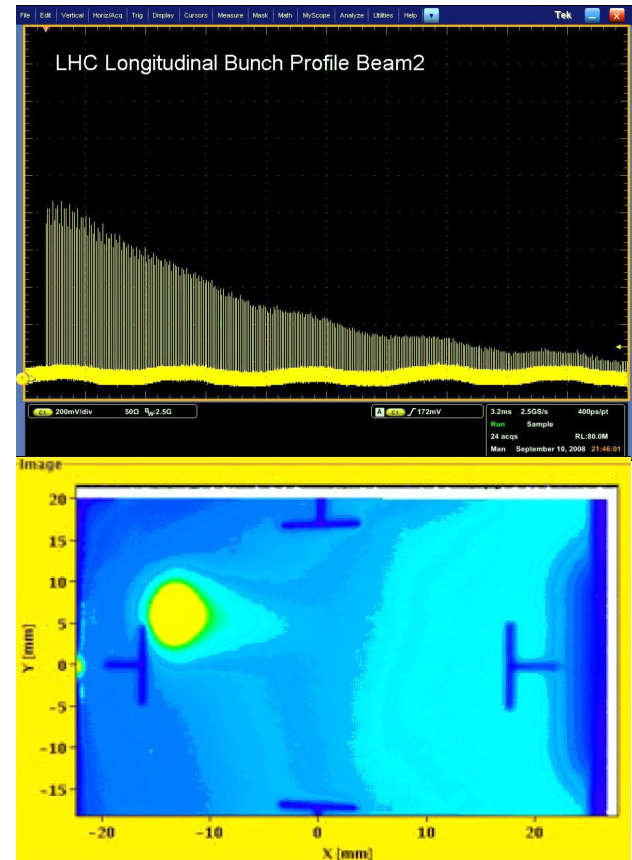


# LHC status



## LHC start:

- **10 September:** "The first beam was successfully steered around the full 27 km ..."  
(CERN Press Release)
- **10-18 September:** "After a spectacular start on 10 September, the LHC enjoyed a mixed first week of commissioning with beam"  
(LHC Progress Report, week 1)
- **19 September:** helium leak into sector 3-4 of the tunnel (faulty electrical connection between two magnets) "... bringing the date for restart of the accelerator complex to early spring 2009. LHC beams will then follow."  
(CERN Press Release)

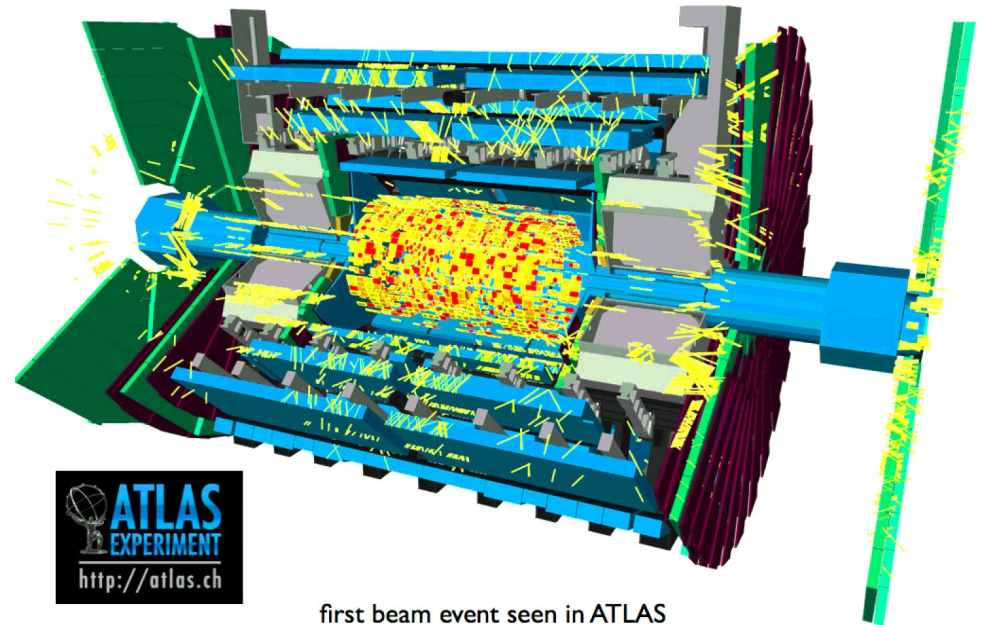




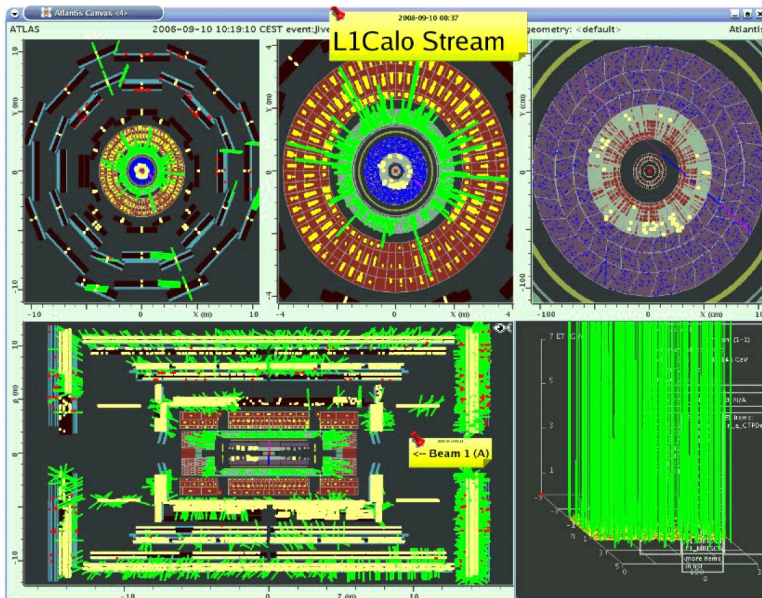
# ATLAS detector



First beam and first events in ATLAS (10 September 2008)



first beam event seen in ATLAS



“ATLAS is ready and anticipates incredible discoveries about our universe in the coming months and years”

(ATLAS News)

# DESY-ATLAS group

- **Group members** (Hamburg and Zeuthen):

- 7 diploma students
  - 10 PhD students
  - 15 fellows
  - 2 YIG leaders
  - 13 staff

many group members are also involved in HERA experiments and ILC project

- **DESY-ATLAS group** works in close collaboration with:

- University of Hamburg
  - Humboldt University in Berlin
  - IT Hamburg and DV Zeuthen

DESY-ATLAS group members are involved in DESY **Analysis Center** activities:

- MC generators ('Terascale Monte Carlo School' 21-24 April 2008 )
  - statistics tools (Terascale Statistics Tools school, 29 Sep – 2 Oct 2008)
  - parton distribution functions (PDFs) ("School on PDF's" 12-14 November 2008)

# DESY-ATLAS group activities

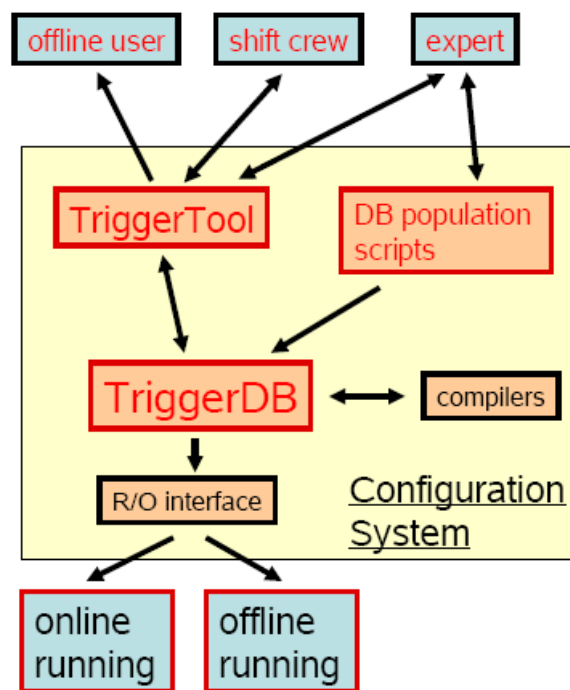
- **Trigger:**
  - Configuration
  - Monitoring
  - Efficiency determination
- **Hardware projects:**
  - ALFA
  - Pixel detector for sLHC
- **Software and computing**
  - Tier 2 center, NAF, data monitoring and distribution
  - Generator interface
  - shower parametrisation (Frozen Showers)
  - Derived Physics Data DPD's (top, SUSY, tau, e)
- **Physics analysis**
  - Standard Model and new physics
  - tau reconstruction and identification efficiency
  - MC validation

# Trigger Configuration

co-convenor: J. Stelzer  
("Trigger Core Software" group)

A three level ATLAS trigger system designed to reduce the 40 MHz  $pp$  collision rates to few hundred Hz (storage limit).

at any time complete trigger chain needs to be configured



## Trigger Configuration:

- configuration parameters for LVL1 and HLT
- store all information (history)
- configuration of offline trigger simulation
- quick response to changing experimental conditions
- different levels of access (experts, shift crew, users in data/simulation reconstruction) and operation (checks)

TriggerDB

TriggerTool

DESY-ATLAS group is involved in all configuration tasks

# Trigger Monitoring & Efficiency determination

**Trigger Monitoring** - powerful trigger diagnostic tools (online and offline)

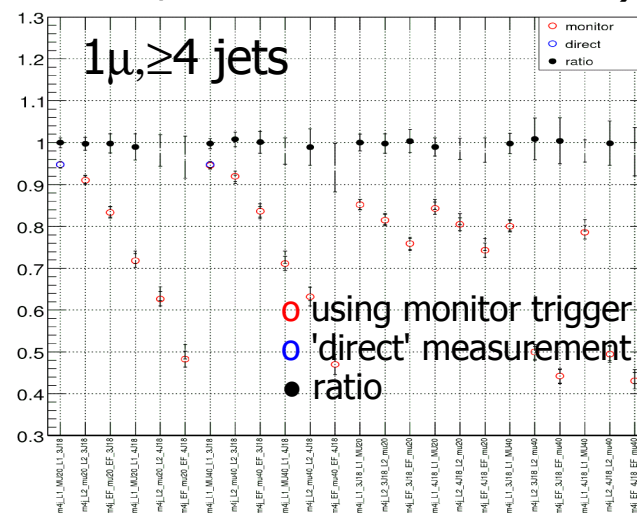
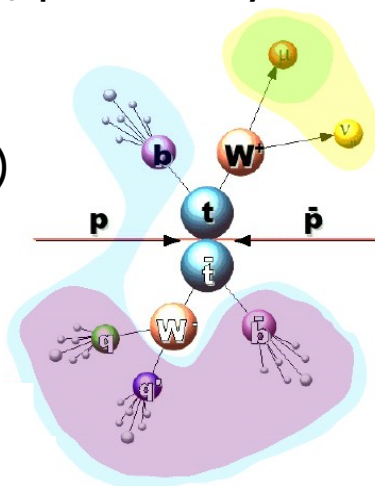
ATLAS-DESY with Humboldt University groups share tasks of:

- coordinating trigger monitoring activities (M. zur Nedden, M. Medinnis)
- trigger rate monitoring
- operational monitoring (display)

## Trigger Efficiency determination from data

Standard Model  $Z \rightarrow e^+e^-$  events used to determine single electron efficiency  
("Tag&Probe" method, preliminary studies with MC, to be done with data)

Top trigger efficiency  
(t-tbar events using  
"Tag&Probe" method)  
work in progress





# Trigger: plans for the next funding period

- **Trigger Configuration & Monitoring**

trigger must adapt to evolving luminosity and data analysis requirements  
→ evolving trigger configuration and monitoring systems

## Plans for next funding period:

**DESY-ATLAS** group planned involvements within **Helmholtz Research Programme “Elementary Particle Physics” 2010-2014:**

- continue to contribute to the trigger projects (Configuration and Monitoring )  
(moving from developments to trigger algorithms and operation, especially the monitoring of shift work)
- estimation of trigger efficiencies from real data



# ALFA

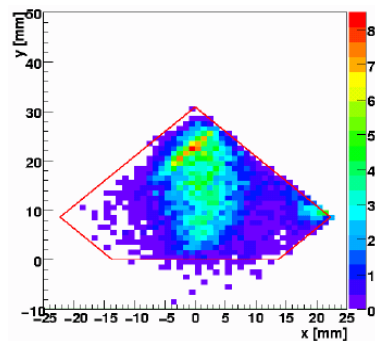
- **ALFA – Absolute Luminosity For Atlas**

Roman pots at  $\sim 240$  m from IP, measure elastic  $pp$  scattering at very small angles

DESY responsibilities (in collaboration with Humboldt and Giessen):

- multi-anode PMT's (acquisition, tests)
- detector metrology (precision measurement of fiber positions)
- titanium fiber support structure
- trigger counters

CERN beam test with fully equipped Roman Pot in August 1-26: first results from online reconstruction



8 detectors in total, built one prototype

- full detector will be built in 2009, installation and operation 2010

**Plans for next funding period:**

commissioning and operation of the detector, data analysis

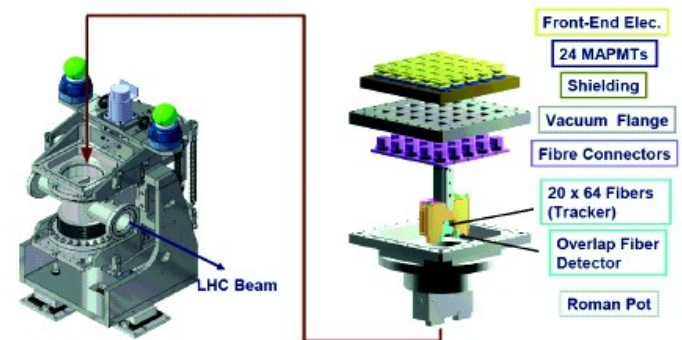
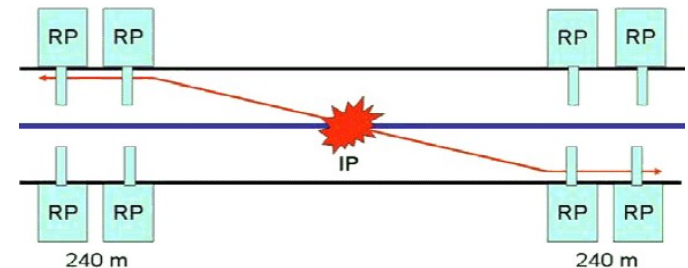


Figure: Exploded view of an ALFA Roman Pot Unit

testbeam coordinator: K.H. Hiller

# Plans for the next funding period

## **ALFA detector:**

possibility to study hard diffraction (proton tagging) in nominal optics runs

Additional forward detector to measure diffractive events:

## **ATLAS Forward Physics (FP420, silicon pixel) detector**

- special interest for DESY (experience in diffractive physics and detector design)

## **LHC luminosity upgrade in 2015-16: sLHC ( $10^{35} \text{ cm}^{-2}\text{s}^{-1}$ )**

challenge: 400 simultaneous interactions (high occupancy, large radiation doses )

With the luminosity upgrade the full inner detector in ATLAS will be replaced with all-silicon tracker

## • **DESY group:**

- participation in pixel detector upgrade and “generic” R&D  
time line: Technical Design Report (TDR) around 2010, detector construction around 2012

# Pixel upgrade for sLHC

Plans for next funding period:

(YIG U. Husemann)

## • Pixel detector upgrade for sLHC

with the luminosity upgrade and replacement of the inner tracker **ATLAS-DESY group** plan to participate in two projects:

- MC simulation studies (within international R&D proposal for planar pixel sensors):
  - optimisation of detector layout: radii of layers, pixel size, overlap
  - studies of hit clustering, tracking and b-tagging under sLHC conditions
  - first studies with FATRAS fast simulation package from October 2008
- Generic R&D project: silicon detector system integration
  - novel powering schemes for silicon detectors: reduction of “dead” material and power dissipation
  - first studies of powering via DC-DC coupling started in September 2008
  - optionally: radiation-hard high bandwidth optical links

TU Dortmund, University of Bonn, HU Berlin and MPI+HLL Munich

University of Bonn, RWTH Aachen

participation in the pixel detector construction (to be decided after R&D phase)

# Computing

## DESY-ATLAS group participates in

- NAF ATLAS support (ATLAS specific user support)
- W. Ehrenfeld is a chair of NUC (National Analysis Facility NAF User Committee)
- operation of the Tier-2 center
- management and monitoring of ATLAS world wide data distribution
- DESY-ATLAS group member is a librarian in the release management of the ATLAS offline software
- participation in the operation of the GridKa cloud

### Plans for next funding period:

similar to triggers, **computing** has to adapt to requirements of the experiment

- data processing and re-processing (GRID operation)

*(more details in the next talk by Volker Guelzow)*

# Analysis Model

coordinator: D. Côté

- Derived Physics Data (**DPD**) – latest ATLAS data format specialised for specific use cases (contrary to ESD/AOD)

Basic principle:

store data in smaller format

(disc consumption and simultaneous data access problems)

with specialised data (analysis oriented)

- typically 10% of AOD (Analysis Object Data) size
- may contain more of specific information (AOD+ESD)

**ATLAS-DESY** group is involved in

- co-coordinating DPD project,
- contributes to DPD definitions for top-quark, SUSY , e and tau and analyses

## Plans for next funding period:

The content of DPD's must be constantly adjusted according to data rates and analysis requirements → part of **ATLAS-DESY** group responsibility



# Fast Shower Paramerisation

- Fast Parametrisation of electromagnetic showers in ATLAS calorimeter:  
**Frozen Showers (FS)**

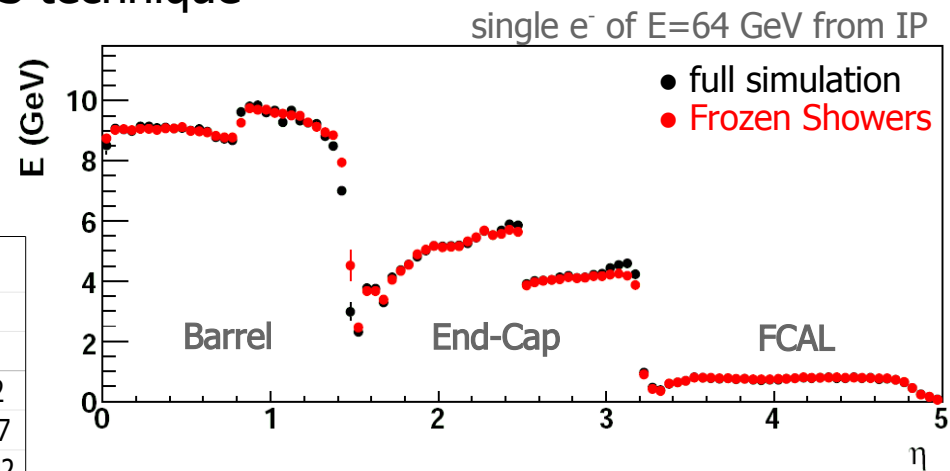
Full simulation (GEANT4) of typical QCD event in ATLAS LAr calorimeter takes  $\sim 15$  min (largely due to simulation of electromagnetic showers)

- simulation time can be reduced with FS technique

→ Good results achieved in

- agreement with full simulation
- simulation time

	Di-jets		SUSY		Z- $\gamma\gamma$		Z- $\tau\tau$	
	Fast	Full	Fast	Full	Fast	Full	Fast	Full
	Time/Event (%)							
EMB	1,83	1,44	4,04	4,50	1,50	1,39	1,95	1,62
EMEC	16,69	23,87	16,21	28,24	15,29	28,61	15,78	24,77
FCAL	18,83	39,35	13,46	24,30	18,22	37,07	17,56	36,42
HEC	5,28	2,39	6,41	2,62	4,44	1,72	4,95	2,20
Tile	1,20	0,47	8,97	3,29	0,72	0,25	1,56	0,66
Tracker	24,65	10,48	20,31	7,97	26,85	9,70	25,44	10,75
Muons	8,25	3,23	5,96	2,20	9,26	3,24	8,73	3,56
Other Lar	11,76	11,75	11,63	19,60	12,45	12,12	12,14	13,01
Other	5,89	2,81	5,51	2,49	5,90	2,45	6,01	2,92
Uncounted	5,63	4,20	7,50	4,79	5,37	3,46	5,89	4,09
Ratio	2,80		2,60		3,11		2,54	



→ validation of FS simulation is being done by physics working groups

# MC and Generators

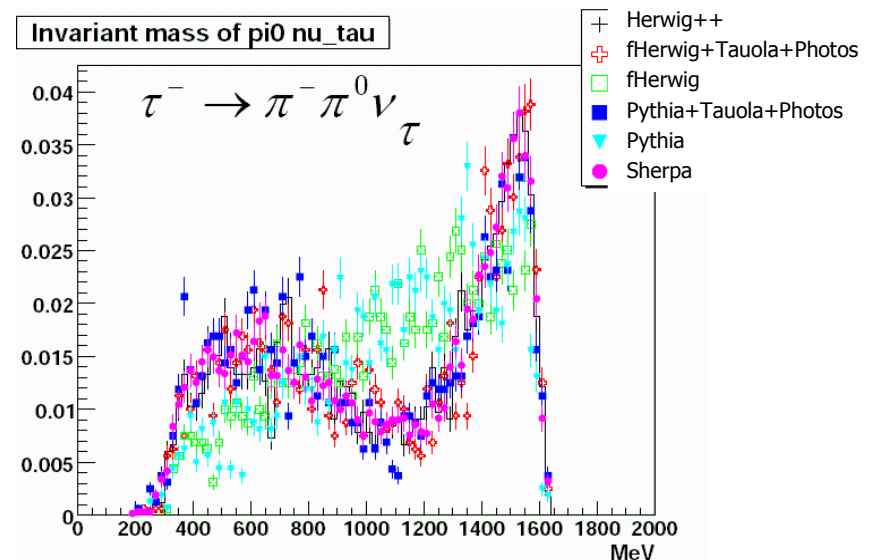
ATLAS MC group coordinator: J. Katzy (from 1<sup>st</sup> of October)  
ATLAS MC software manager: E. Lobodzinska (substituting J. Katzy)

- **DESY-ATLAS MC group** (5 members)

responsible for development and maintenance of ATLAS MC software

- generator responsables (Herwig++, Pythia 6, Cascade)
- generator validation and comparisons for various physics processes
  - especially new generators (Herwig++, Pythia 8, Sherpa)

Good agreement between new generators  
and  $\tau$  decays as described in Tauola



# Physics analysis

→ Physics analyses are performed in close collaboration with [University of Hamburg](#) and [Humboldt University](#) in Berlin

- **Physics BSM: Supersymmetry (SUSY)**
  - discovery studies in the GMSB model
  - Fittino: SUSY parameter determination studies with a variety of experimental sources and models
  - Gfitter (a generic fitter project for HEP model testing)
  - tau SUSY searches
- **Standard Model**
  - $Z$ ,  $W^\pm$  production (sensitivity to PDFs, tau/e efficiency estimation, background for top and searches)
  - top-quark physics
  - minimum bias events

**Highest priority to physics analyses with first data**

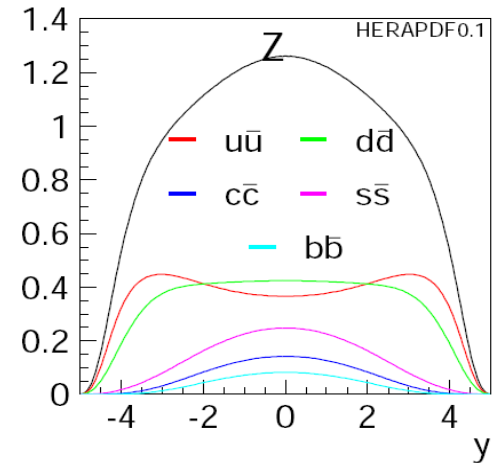
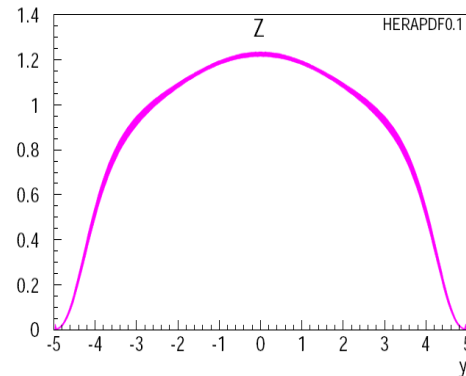
# Physics example: $Z \rightarrow e^+e^-$ and PDFs

## Motivation:

- analysis with first data
- efficiency, calibration for BSM
- sensitivity to PDF's

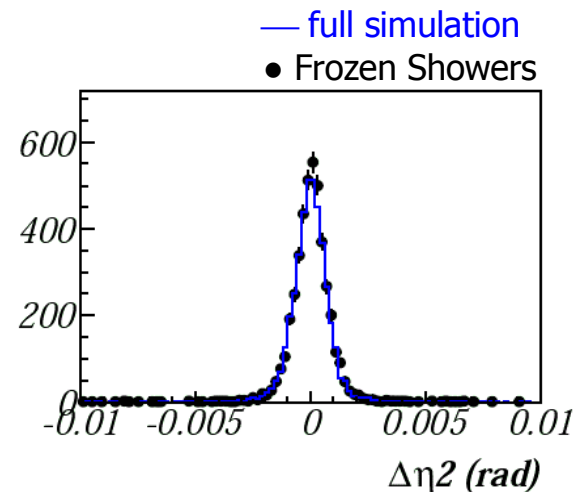
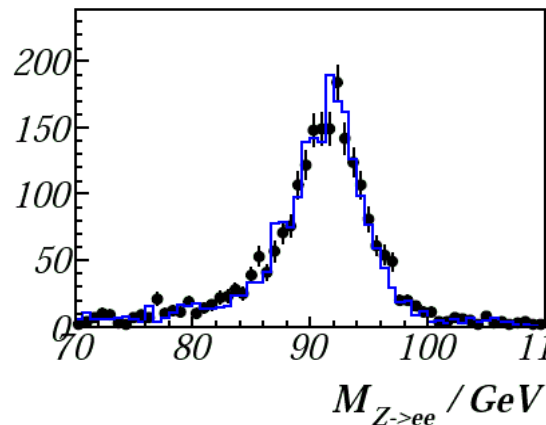
Standard Model  $Z \rightarrow e^+e^-$  cross section is well predicted at NNLO

- theory uncertainty < 2%



→ Z rapidity distribution is sensitive to PDF flavour decomposition

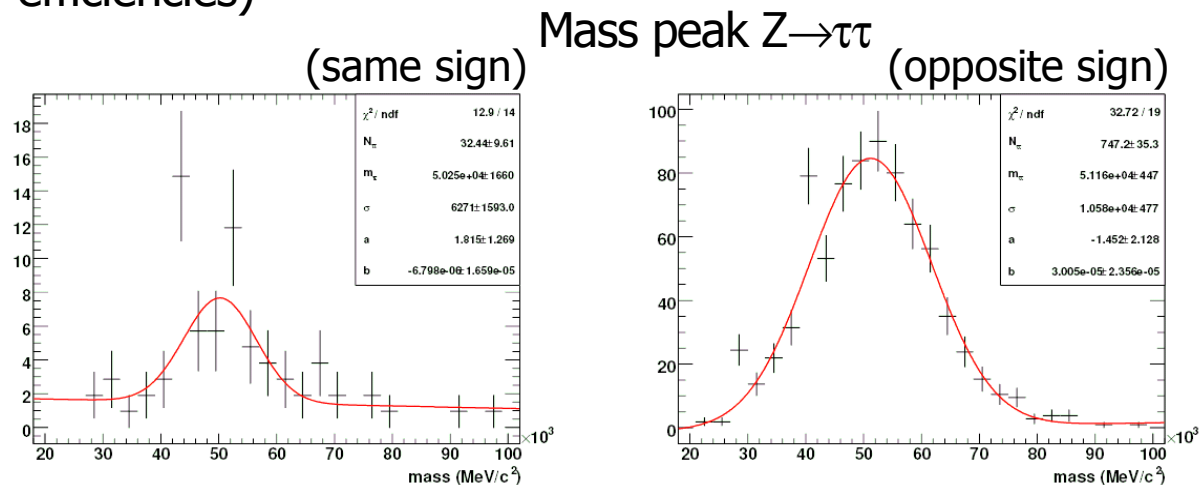
- can be used to constrain PDF's (luminosity independent)
- Frozen Showers could be used to get large MC statistics for detailed studies



# Physics example: $\tau$ efficiency using $Z \rightarrow \tau\tau$ events

- $\tau$  leptons play important role in many different physics analyses (SM and new physics)
- extract global  $\tau$  reconstruction and identification efficiency using  $Z \rightarrow \tau_h \tau_h$  events (studies include determination of charge missidentification, background estimation, combination with trigger efficiencies)

result as pre-study for  
measurement of systematic  
uncertainties in first data

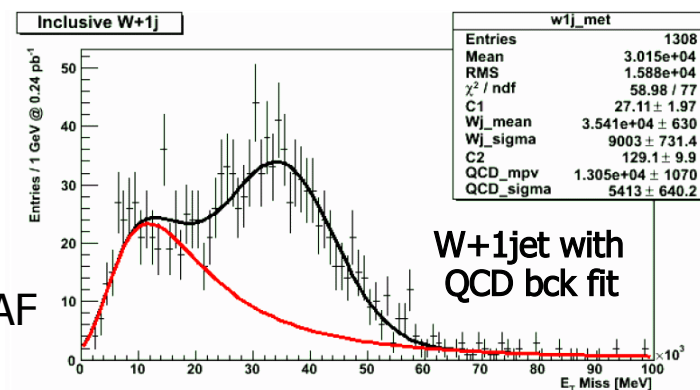


- Energy calibration and cuts for  $\tau$  reconstruction
  - determination of "safe" variables for first data using  $Z \rightarrow \tau\tau$  events (implemented into official ATLAS reconstruction software)



# Physics example: Top physics

- LHC will be the “top-quark factory”
  - precision measurement of top properties in the SM
  - searches for BSM physics in the top sector
  - key background for Higgs and SUSY searches
  - complex signature: tool for detector studies (e.g. calibration)
- ATLAS-DESY group involvements:
  - **recent activities:**
    - top trigger efficiency determination
    - top-based trigger monitoring
    - preparation for first physics:
      - W+jets from FDR data, analysis tools on the NAF
    - single top selection
    - search for fourth generation fermions
  - **physics with first data:**
    - W/Z+jets (jet multiplicity, heavy flavour content)
    - top pair production cross section
    - searches for new physics with top



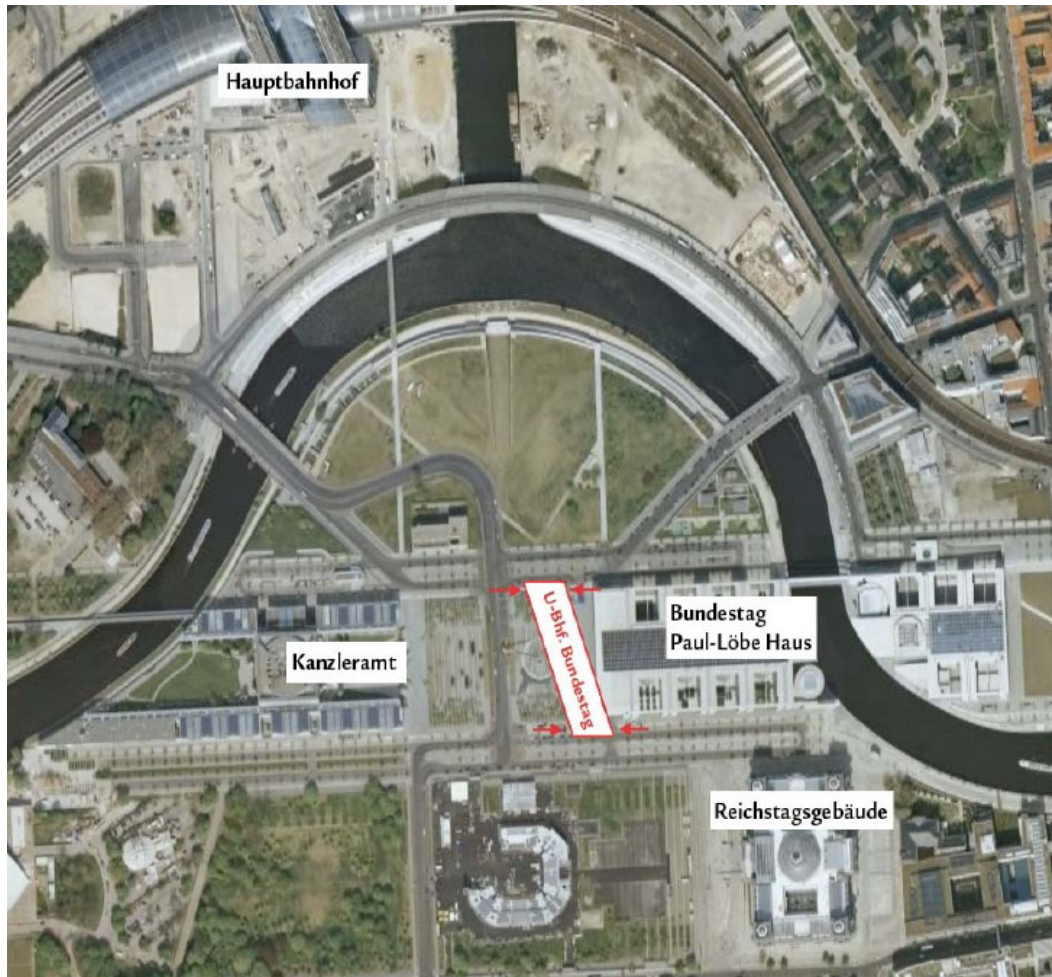
# Physics Analysis: plans for the next funding period

## Plans for next funding period:

### DESY-ATLAS group:

- continue with high precision Standard Model analyses  
(MC generator tuning, PDF's from  $Z/W^\pm$ , top physics)
- contribute to searches for new physics
- hopefully do precision measurements in unexplored sectors

# Outreach Activities



## LHC Opening Exhibition in Berlin

The exhibition in the “Bundesstag”  
subway station, Berlin:

**15 October – 16 November 2008**

in cooperation with German institutes  
and Federal Ministry for Education  
and Research (BMBF)

organiser: **T. Naumann**  
(ATLAS-DESY, GELOG chair)

# Summary

- **DESY-ATLAS group** plays an important role in various ATLAS technical and physics analysis topics
- The group **planning** for the next funding period involves
  - continue (and intensify) work on current projects  
(trigger, forward detectors, computing)
  - first data: strong emphasis on physics analysis
  - preparation for sLHC (pixel upgrade)