ATLAS: Report to the PRC

Wolfgang Ehrenfeld – University of Hamburg/DESY

On behalf of the DESY-ATLAS group

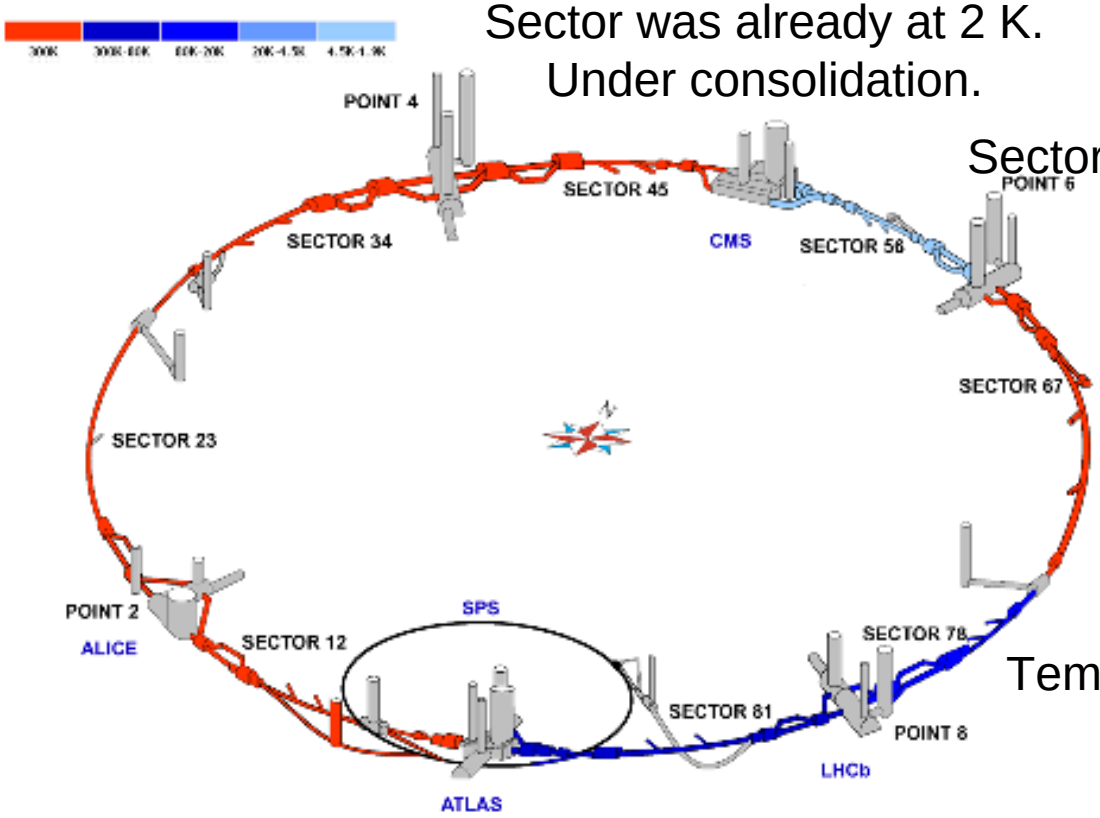
65th Meeting of the DESY PRC

1st of April 2008, Hamburg

- Current status of LHC and ATLAS
- Activities of the DESY-ATLAS group

LHC Status

- **All components installed**
- **Cooling down to operational temperature of 2 K underway**



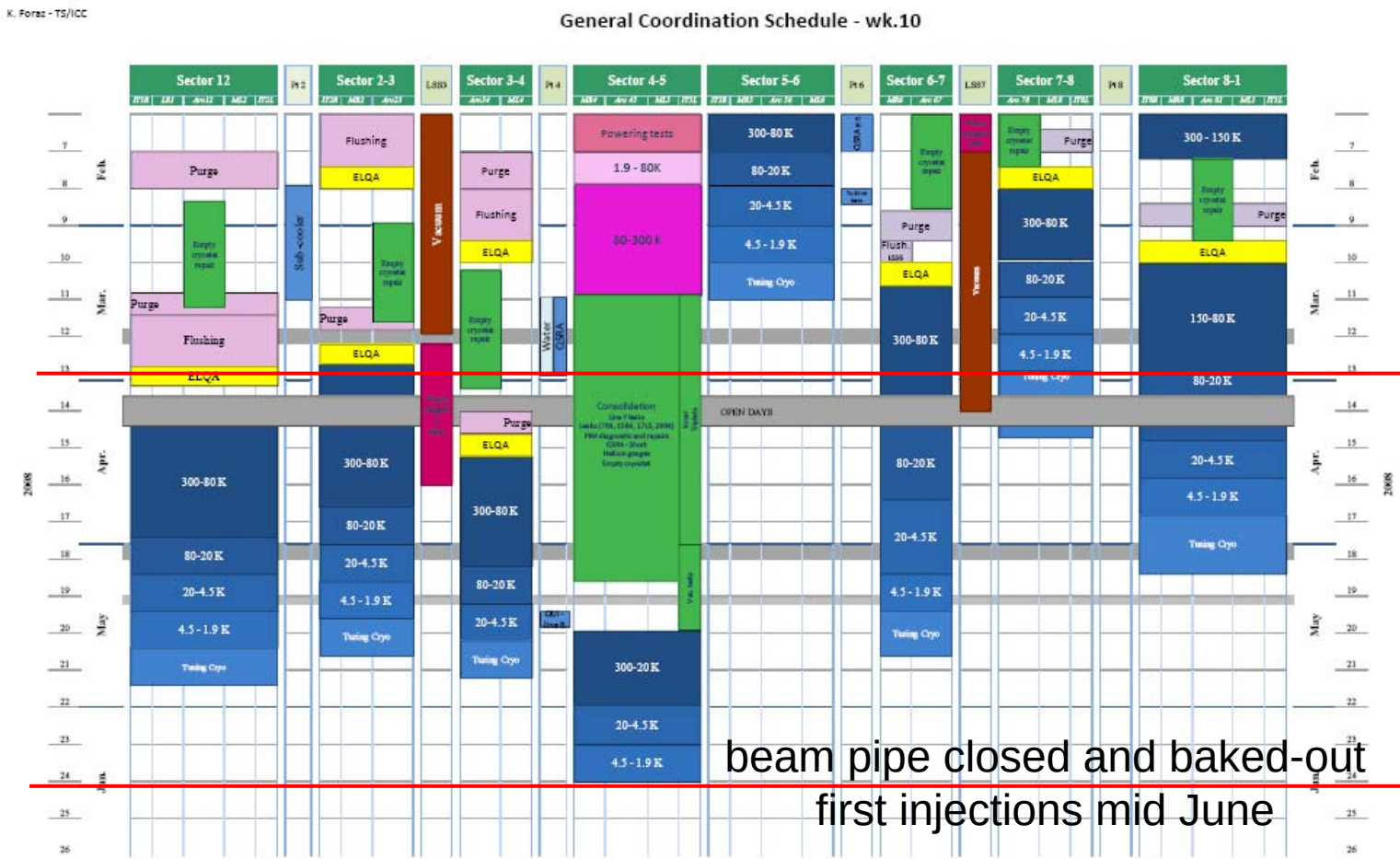
Sector was already at 2 K.
Under consolidation.

Sector constant at 2 K

Temperature between
80 and 20 K

From: http://lhc.web.cern.ch/lhc

LHC Schedule



April 2008

beam pipe closed and baked-out — mid June 2008

first injections mid June

Meanwhile other components are tested:
Injection + beam dumps

From: http://foraz.web.cern.ch/foraz/schedule.pdf

Overall commissioning strategy

- **Stage A (43x43 ➡ 156x156)** — $1.1 \times 10^{30} \Rightarrow 1 \times 10^{32}$ cm^{-2}s^{-1}
  - *Beam commissioning ➡ first physics run*
  - *Large bunch spacing: no need for crossing angle*
  - *Moderate intensities, partial squeeze*
- **Stage B (75ns operation)** — 1×10^{33} cm^{-2}s^{-1}
  - *Establish multi-bunch operation with moderate intensities*
  - *Still relaxed machine parameters (squeeze, crossing)*
  - *Push squeeze and crossing*
- **Stage C (25ns operation I)** — 2×10^{33} cm^{-2}s^{-1}
  - *Nominal crossing angle, nominal **
  - *Ultimate limit is ~50% of nominal intensity*
- **Stage D (25ns operation II)** — 10^{34} cm^{-2}s^{-1}
  - *Push towards nominal and ultimate performance*
  - *Required HW upgrade (collimators, dump).*

Time scale

(beam time is given, assuming 100% availability)

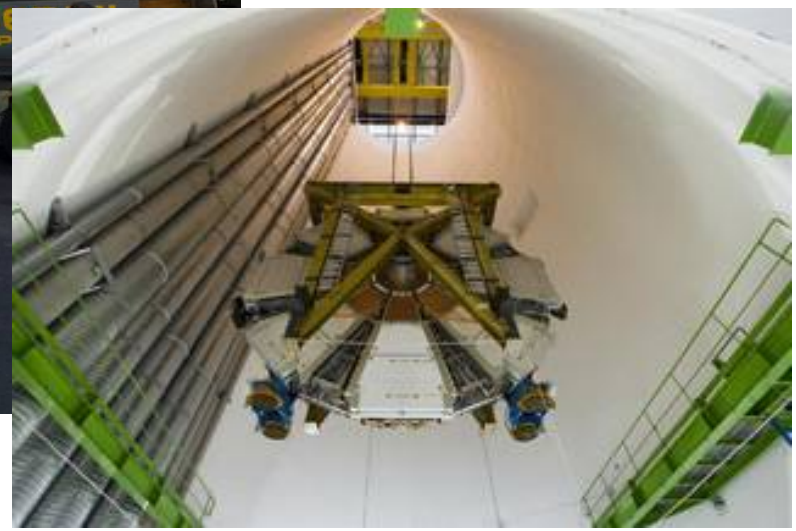
	Activity	Rings	Beam Time [day]
1	Injection and first turn	2	4
2	Circulating beam	2	3
3	450 GeV – initial commissioning	2	4
4	450 GeV – detailed optics studies	2	5
5	*450 GeV increase intensity*	*2*	*6*
6	450 GeV - two beams	1	1
7	*450 GeV - collisions*	*1*	*2*
8a	Ramp - single beam	2	8
8b	Ramp - both beams	1	2
9	7 TeV – top energy checks	2	2
10a	Top energy collisions	1	1
	TOTAL TO FIRST COLLISIONS at 7 TeV ($1.1 \times 10^{30} cm^{-2} s^{-1}$)		30
11	*Commission squeeze*	*2*	*6*
10b	*Set-up physics - partially squeezed*	*1*	*2*
	TOTAL TO PILOT PHYSICS RUN ($\sim 1.1 \times 10^{32} cm^{-2} s^{-1}$)		44

Approx. 2 months of elapsed time (50% effic.)

Atlas Detector Status

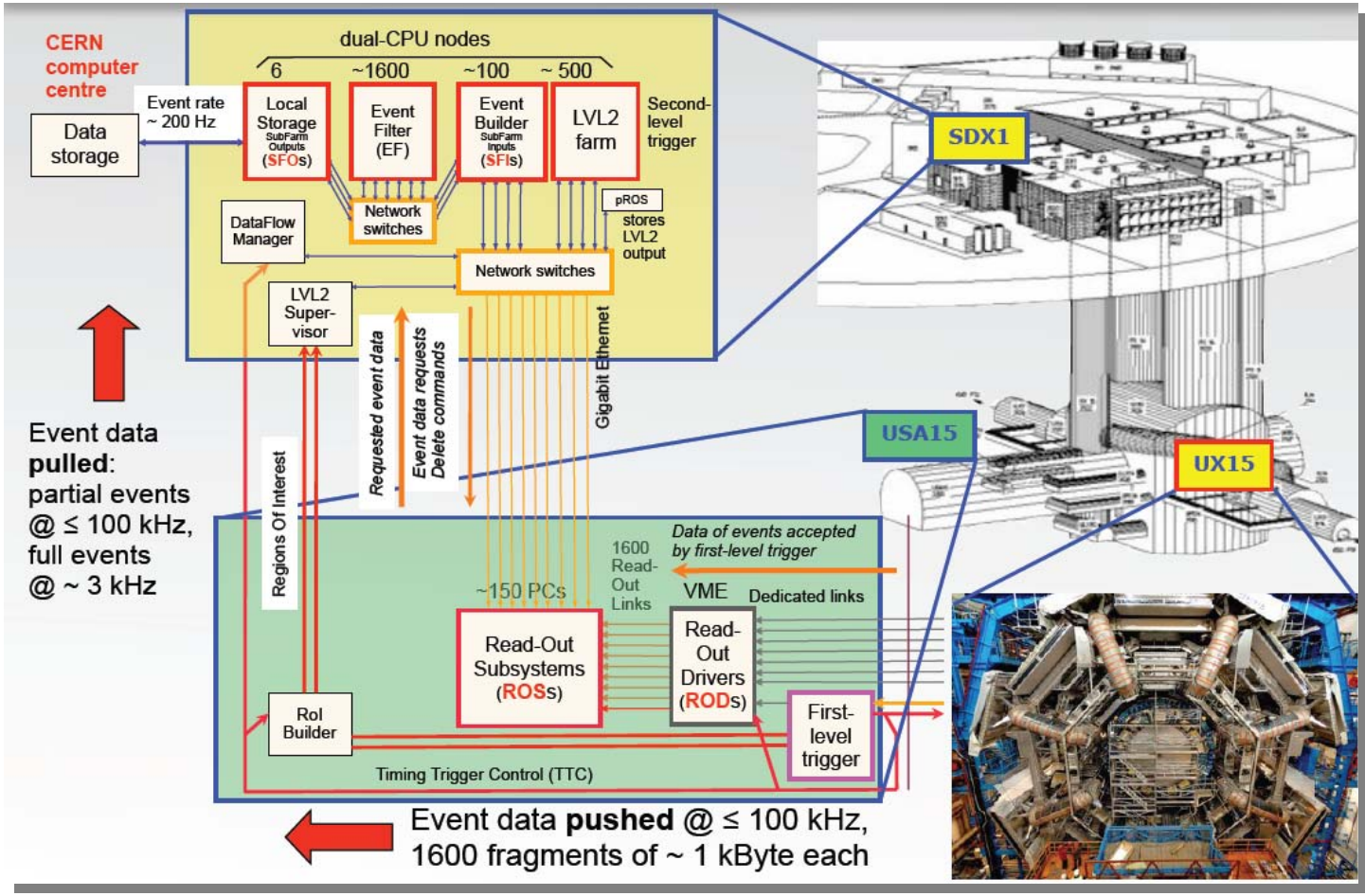
The Small Wheel was the last missing part of ATLAS!

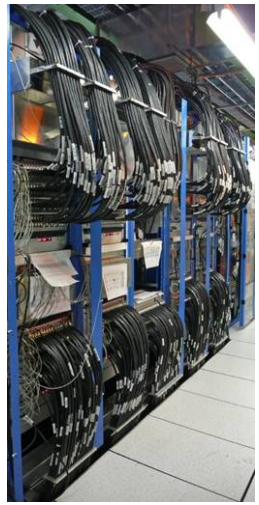
Installation of electronics and cabling is coming to an end!



ATLAS detector paper submitted to JINST

Atlas Trigger Status





Trigger Status:

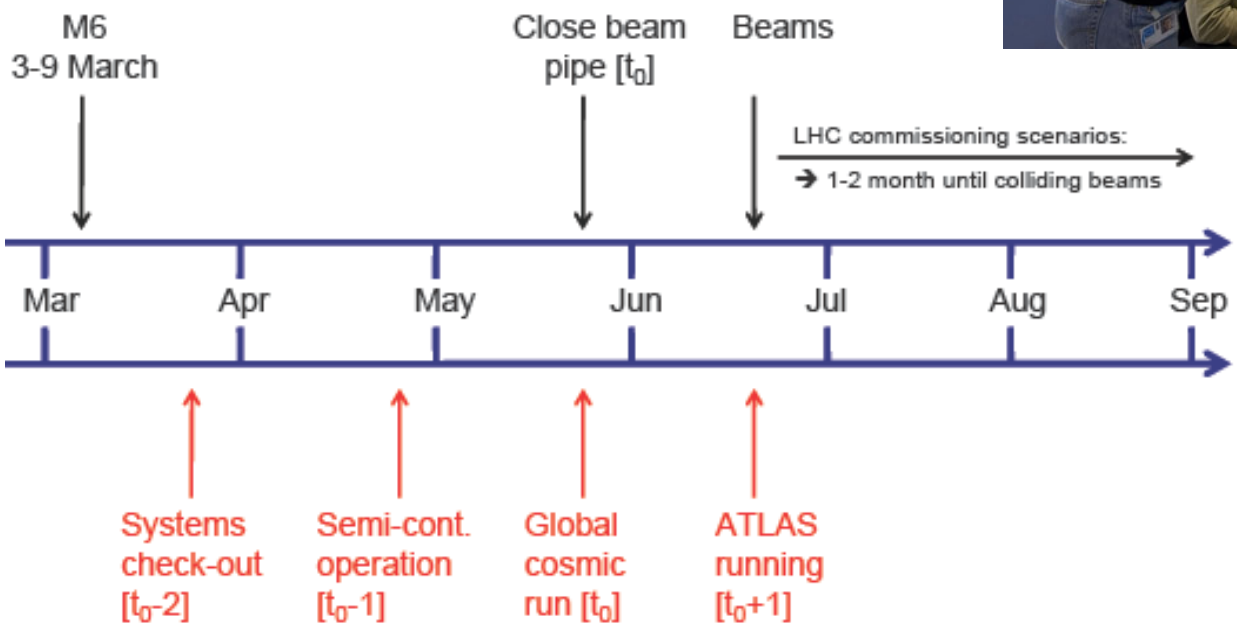
- LVL1: almost completely installed
- HLT: 2/5 of PCs installed (3/5 delayed due to financial reasons)

→ LVL1 output rate: 35 kHz instead of 100 kHz

Atlas Activities – Commissioning

Month	Date	System	Requirements, remarks	CS	Parallel
February	4-8	DAQ/HLT	Technical Run	yes	FDR, SCT
	9-10				TRT, SCT
	11-13	Tile	Calibration Triggers	yes	SCT; TRT; 13/2 11:00 DAQ/HLT 24h
	14-15	Tile	R/O debugging	Yes	TRT; TDAQ 24h up to 14/1 at 11:00
	16-17				TRT
	18-20	TRT+SCT	Scintillator trigger	Yes	
	21-24	L1Calo, Tile, LAr	Calorimetry days Lar may join if possible	Yes	TDAQ 24h period 20-2. TBC wrt ID progress
	25/2-2/3	Muons+TRT	TRT "comes in" when ready "at times"	Yes	TDAQ 24h period 27-28
March			RPC pointing trigger needed by TRT (wish)		Dedicated to HLT

← Commissioning schedule



Enormous effort is going into the commissioning and integration of the system. Many problems and solutions found. No show stoppers uncovered. On track…

Atlas Activities – Full Dress Rehearsal

- **Computer Service Challenge (CSC) coming to an end**
  - Results as documented in CSC notes under review
  - Notes will be published as book (ATLAS physics reach)
- **Main goal of Full Dress Rehearsal (FDR)**
  - **exercise data processing chain from Point1 → physics analysis**
- **Concrete steps:**
  - Prepare realistic physics and calibration data streams for 10h run, and place at P1
  - Play samples along the path: SFO → Tier-0 → Tier-1's (and Tier-2's)
  - Run calibration/alignment and data quality procedures on calibration/express streams
  - Exercise 24h sign-off procedure for launch of bulk data reconstruction
  - Reconstruct bulk data and distribute ESD, AOD and TAG for analysis
  - Test analysis model by making DPDs, delayed 2nd pass reconstruction at Tier-1's
- **FDR Phase I: 5. – 8. February 2008**
  - Simulate early data (luminosity and trigger menu)
  - Replay of same data during 3 consecutive days
  - 2 central data quality shifts per day in addition to detector quality control shifts
  - Not all goals achieved but many things exercised
- **FDR Phase II: planned for mid May**
  - Improved version of phase I

DESY Activities

ATLAS DESY Group

- **Group members from Hamburg and Zeuthen**
- **7 Diploma students, 11 PhD students, 13 fellows, 2 young investigator group leaders, 12 staff**
- **Many of them still active on HERA experiments and ILC**
- **17 talks at the spring meeting of the German Physical Society**

- **HGF Young Investigator Groups**
  - P. Bechtle (since 1st May 2007)
  - U. Husemann (since 1st April 2008)

- **Close collaboration with:**
  - IT-Hamburg and DV-Zeuthen
  - University of Hamburg: JProf. J. Haller
  - Humboldt University Berlin: Prof. H. Kolanowski, H. Lacker, T. Lohse

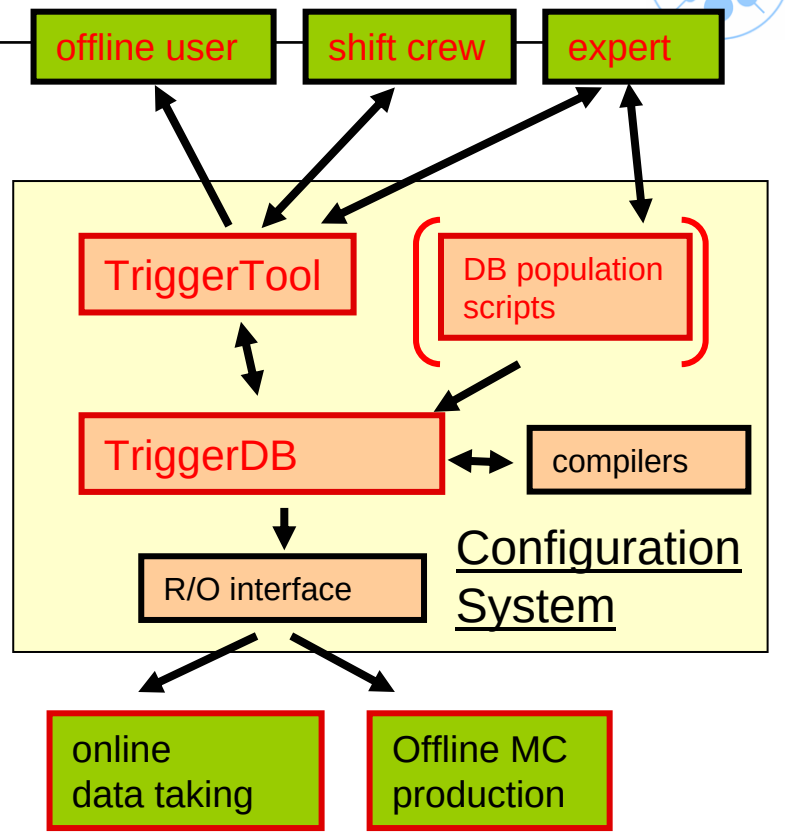
- **Our tasks in ATLAS are usually common projects of DESY and the university groups**

Technical Tasks

- **Trigger:**
  - Configuration system
  - Monitoring
  - Performance studies and optimisation of electron trigger
- **Hardware:**
  - ALFA: construction & installation
  - Pixel R&D for SLHC (new activity from U. Husemann/HGF-YIG)
- **Reconstruction/simulation of events:**
  - Development of shower simulation algorithms
  - Identification of tau leptons
- **MC generator software:**
  - Development of new interfaces and analysis tools
  - Maintenance of existing generator and interface code
- **Grid:**
  - Distributed data management and development of monitoring tools

Trigger Configuration

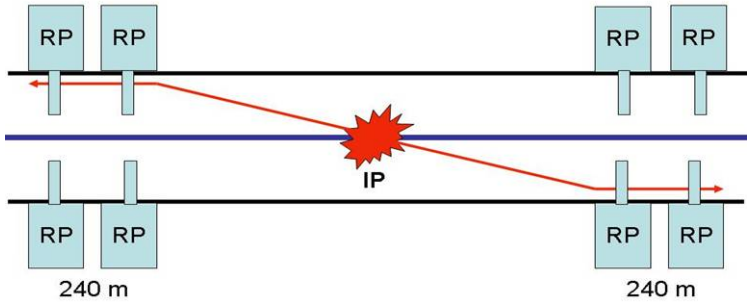
- **DESY Group is heavily involved in building the Trigger Configuration system**
  - J. Haller co-convener of Trigger Configuration group
  - Full system installed locally for testing and development
- **Status:**
  - Full trigger configuration system (TriggerDB and TriggerTool) routinely used in Milestone weeks and commissioning
  - TriggerDB can be used directly in offline Monte Carlo production
  - Trigger configuration stored as metadata in ESD/AOD and TAG
  - System and tools successfully tested in FDR



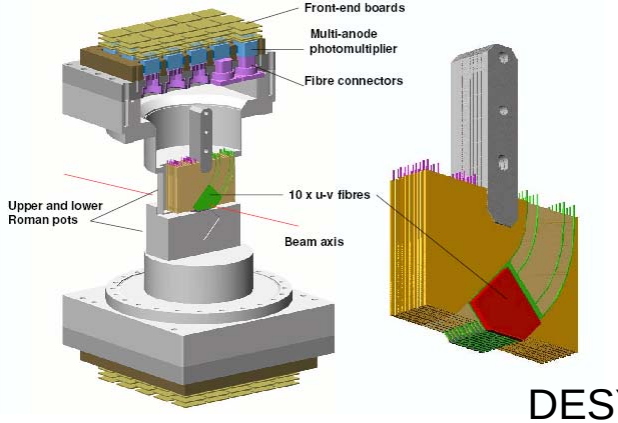
Status is quite advanced
➔ system will be fully operational for first data

DESY will play a major role in operating the system from first data on (as done for M6)

ALFA – Absolute Luminosity For ATLAS



Measure elastic pp scattering in forward region using Roman Pots



DESY tasks in close collaboration with Humboldt, Giessen

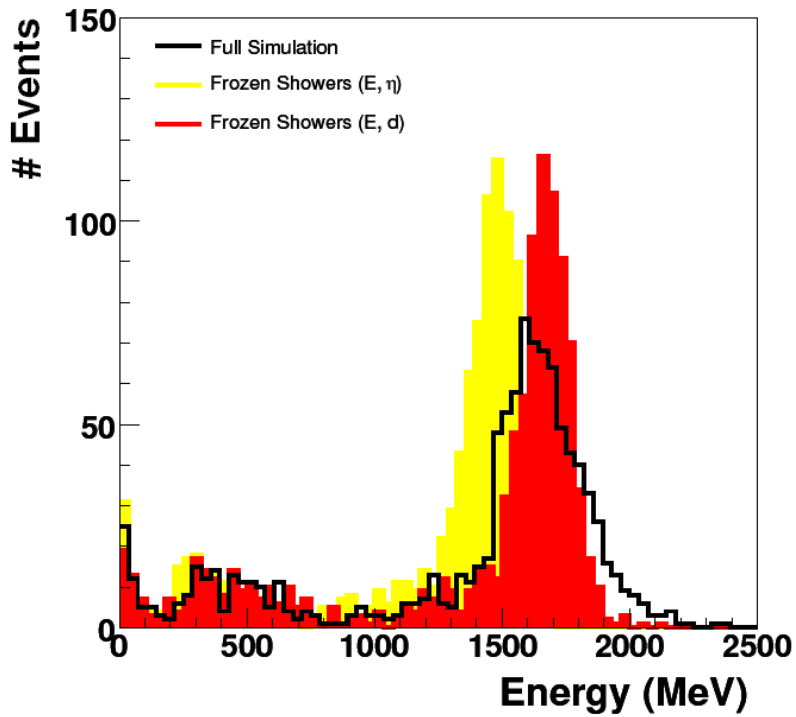
- **First results from DESY testbeam**
  - Trigger tiles in 6 GeV electron beam
  - Test setup operated successfully
  - 3 PMT types, 5 tile coatings, 3 fiber bundles/connectors

  → results promising, decide on final design
- **Fiber detector metrology:**
  - Automatic setup for measuring position at 3 points of each fiber to ≈10 μm
  - Measure all fibers in April/May

DESY contributions are on schedule. Construction of full system for installation in late 2008, early 2009.

Fast Shower Simulation

- **Use "Frozen Showers" for speed up of calorimeter simulation**
  - Follow electrons and photons with GEANT4 down to E=1GeV, then deposit remaining energy using hits from a template shower. Libraries of these template showers are generated in advance.
- **Preliminary version validated by ATLAS physics validation group**
  - General agreement between fast and full simulation good, electro-magnetic energy scale lower by ~2%
  - Energy scale fixed in barrel (ϕ averaging)
  - Energy scale understood in endcap (some regions less homogeneous than othe under study)
- **Recent activities:**
  - Workshop at DESY-HH (December 2007) - improved library for forward calorimeter
  - Improvements (software, shower libraries) are underway
  - Need to be validated again



Monte Carlo Generator Activities

- **DESY (4 physicists + 1 fellow from Göttingen) is responsible for the ATLAS generator software, coordinated by J. Katzy**
- **Tasks:**
  - Development of new interfaces and analysis tools
  - Migration of the ATLAS software to use common LCG generator code from Generator Service (GENSER) project wherever possible
  - Run Time Testing (RTT): add more generator test to the existing ATLAS software testing system
  - Maintenance of existing generator and interface code
  - User support including support to interface new generators
  - Documentation: combined system of TWiki pages for generator information and doxygen for code documentation
- **Completed activities:**
  - New interfaces for C++ versions of Pythia and Herwig
  - Migration to the LCG version of HepMC including upgrade to newest version
  - Reorganisation of MC truth helper packages throughout the ATLAS software
  - Put in place generator experts for each generator to strengthen collaboration between physics working groups and MC software (joint effort with MC group leaders)
  - Documentation: generator documentation review passed in January 2008
- **Further activities:**
  - MC experts for Pythia, Herwig++, Cascade

The National Analysis Facility

- **The National Analysis Facility (NAF) is funded by the Helmholtz-Alliance and set up at DESY by DV/IT**
- **The NAF provides additional computing resources to the German particle physics community for data analysis**
  - Additional Grid resources
  - Interactive resources
  - For more details see the presentation by Y. Kemp
- **The ATLAS DESY group will play a stronger role within the German ATLAS computing groups**
  - NAF ATLAS support (user account administration, experiment specific software installation and maintenance, storage administration, user support)
  - NAF α and β tester: α testing is still ongoing, many problems were found and fixed, usability improved
  - W. E. member of the NAF user committee for ATLAS-D

Analysis Model

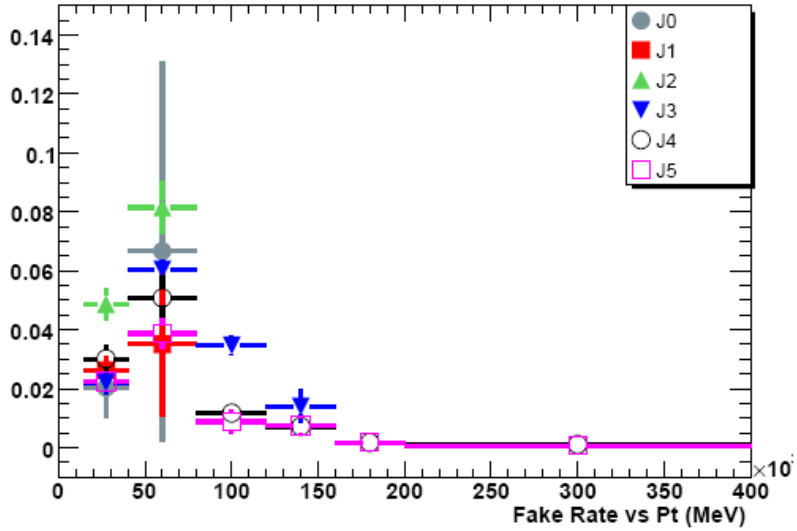
- **The CSC analysis effort is being used to test and complete the ATLAS analysis model.**
- **Derived Physics Data (DPD) is the latest addition.**
- **ATLAS DESY analysis groups are actively testing and contributing to further improvements**
  - Tau and top groups are the first to implement latest model
  - Current α and β testing drives ATLAS developments
- **Tutorials:**
  - Stay up to date with recent developments
  - Discuss further wishes with developers
  - EventView tutorial given by Amir Farbin (CERN):
    - 2 day tutorial (November 2007), 20 participants (mainly DESY)
    - usage and development of tools and analysis code in EventView
  - NAF & FDR tutorial organised by M. Barizoni (DESY/Z) and W. E. (DESY/HH)
    - 2 ½ day tutorial (13. – 15. May 2008), 40 registrations so far (DESY + ATLAS-D)
    - Usage of the National Analysis Facility at DESY
    - Analysis of FDR data: TAGs, DPDs, Data Quality and Luminosity

Physics and Preparation for Early Data

- **General Tools:**
  - Performance studies, electron trigger optimisation, efficiency derivation from data
  - τ fake rate, trigger and reconstruction efficiency measurements from data
- **Standard model:**
  - Minimum bias event structure
  - Z production, rapidity distribution (sensitive to PDFs)
  - W^+/W^- production asymmetry (from PDFs)
  - GFitter: A general fitting package (like ZFitter) of data from many sources to arbitrary theoretical models
- **Top physics:**
  - Optimise trigger thresholds for semi-leptonic and hadronic decay channels
  - Evaluate effect of possible missing-E_T or sum-E_T requirements
  - Prepare derived physics data (DPD) for general and specific top analysis
- **Supersymmetry:**
  - Discovery studies in the GMSB model (photon and tau final states)
  - Preparations for extracting of SUSY observables (mass, …)
  - Fittino: SUSY parameter determination studies with a wide variety of experimental sources and models

Taus

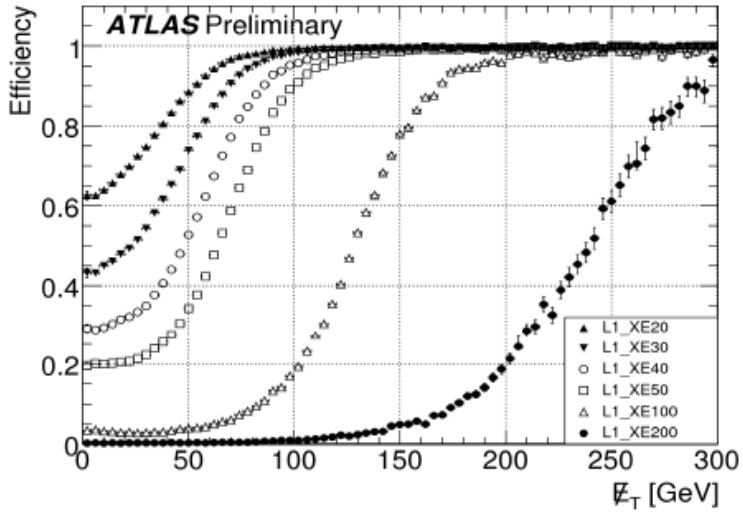
- **If tan β is high, staus are lighter than selectrons or smuon**
- → **hence SUSY events will contain more τ than e/μ**
- **Preparing tools for systematic tau studies:**
  - Automatic calculation of ID efficiencies for different ID algorithms and data samples
  - Develop selection of control samples to study tau efficiency and fake rate
    - jet control stream → ATLAS jet stream
  - Adapt and develop photon conversion finder to reject converted tracks in τ reconstruction

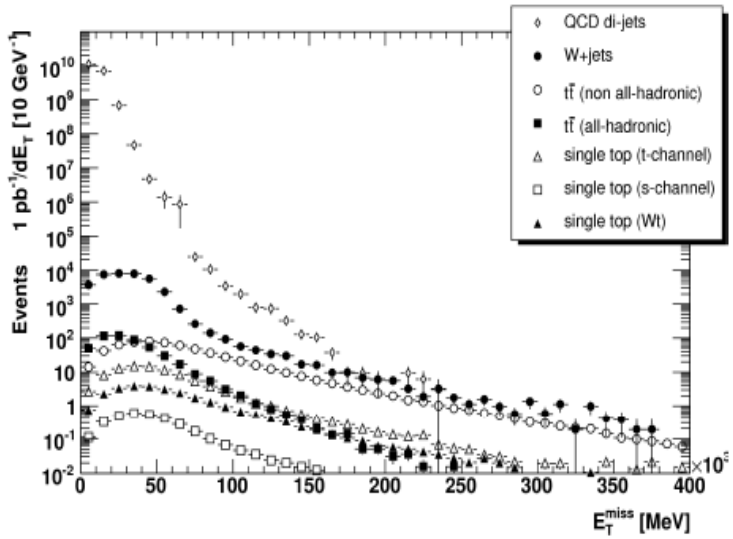


- **Infrastructure: tauDPDMaker**
  - Framework for τ specific D^1PD, D^2PD, D^3PD
  - Select events with taus and from control samples
  - Pioneered the use of many DPD related tools and principles in ATLAS
- **Contribution to CSC notes:**
  - Identification of Hadronic τ Decays with the ATLAS Detector
  - Exclusive measurements for SUSY events

Top Physics

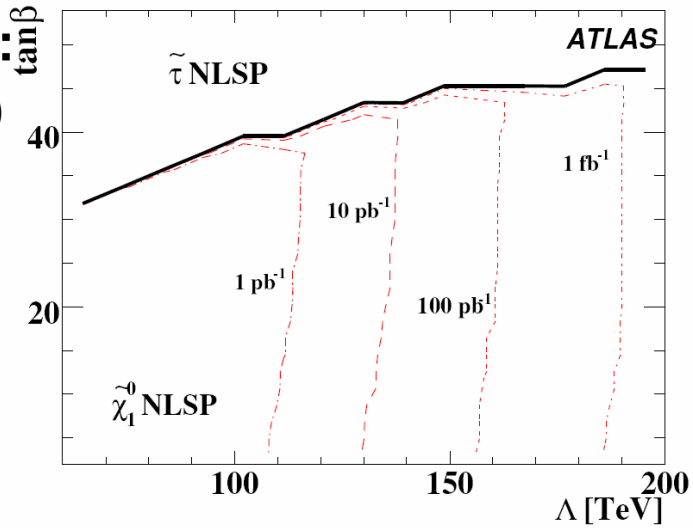
- **Trigger studies**
  - Trigger rates and efficiency in top events: jet, sum E_T, miss E_T
  - Overlap between different triggers
  - Monitor standard top triggers using "independent" triggers:
    - J23XE50, MU20XE50, MU20
    - Can be used in data
- **Contribution to CSC notes:**
  - Triggering top quark events in ATLAS
- **Recent activities:**
  - Development of DPDs for the ATLAS top group
    - Selection of high p_T lepton samples
    - top D^{1}PD → electro weak D^{1}PD
  - Exercise analysis and tools on FDR data
  - Start looking at single top production

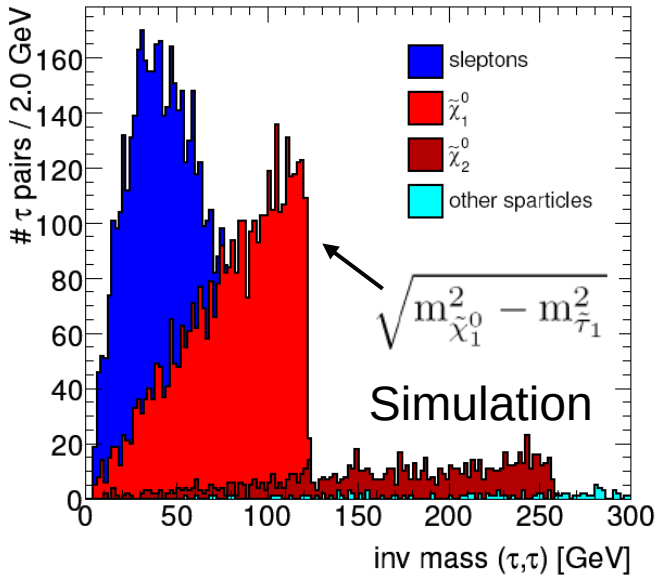


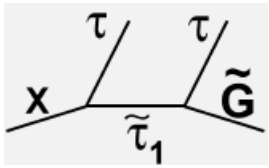


Search for New Physics

- **Study discovery potential in GMSB model:**
  - gravitino (M ~ O(eV)) is lightest SUSY particle (LSP)
  - event topology is given by next to LSP (NLSP)
    - neutralino: di-photon final state
    - stau: tau final state
  - these topologies are not realised by mSUGRA models and extend search for new physics
- **Contribution to CSC notes:**
  - Studies of SUSY signatures with high p_T photons or long-lived heavy particles in ATLAS
- **Measurement of sparticle masses:**
  - To pin down the SUSY model parameters as many observables need to be measured
  - Not easy: pp-collisions, decay cascades, LSP
  - Kinematic distributions have some information
    - $M_{inv}(\tau\tau)$ from stau decays



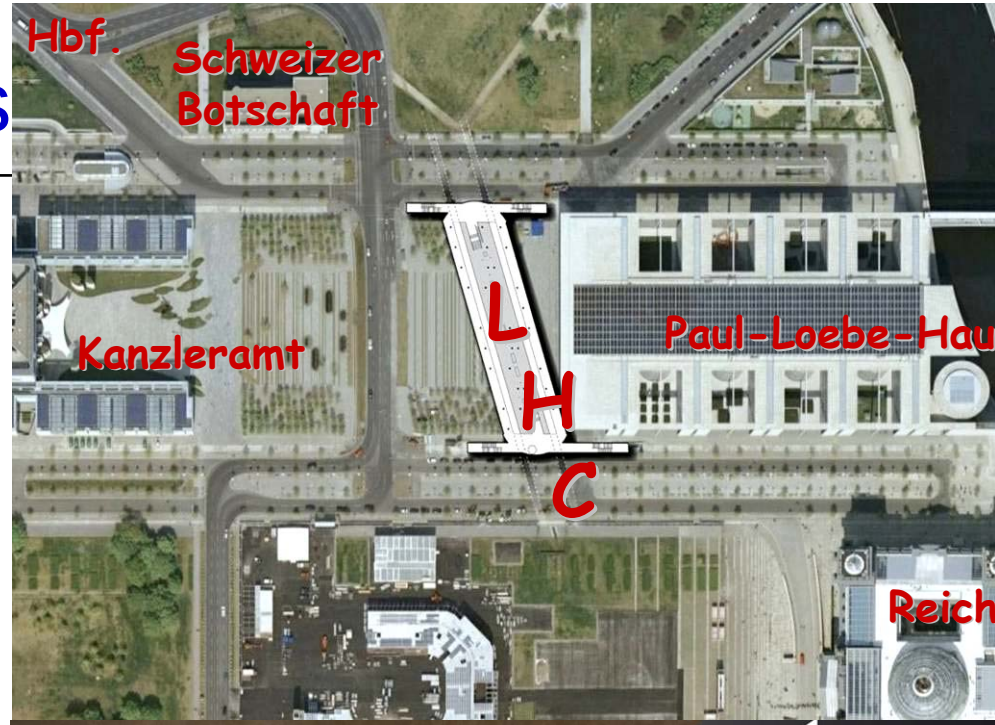




Outreach Activities

LHC Opening 2008
Exhibition in Berlin
14.10.–16.11.08

- **Organised by BMBF, GELOG, DESY-PR/CERN-LHC Communicator, Scholz & Friends**
- **Main organiser T. Naumann** (ATLAS DESY/Z, GELOG chair)
- **Location: new subway station in front of the Kanzleramt and Parlament**
- **Collecting exhibits – contributions from German institutes to the LHC**



Outlook & Conclusions

- **The LHC and ATLAS are on track for first data in summer 2008**
- **The ATLAS DESY group has grown to a substantial size**
- **All technical projects are making good progress**
- **We are preparing to take first data …**
- **… and we are preparing to analyse first data**
  - diverse interests: SM, top, SUSY
  - lot of contributions to ATLAS CSC notes