ATLAS Polish group: plans for 2010 and beyond

- Group composition
- Responsibility for the operation of the detector
- Status of the computing infrastructure
- Commissioning of the detector (analyses)
- Combined performance and physics analyses
  - High p_T physics
  - Heavy ion physics
  - Forward physics
- Involvement in the upgrade of the ATLAS detector for SLHC

Group composition

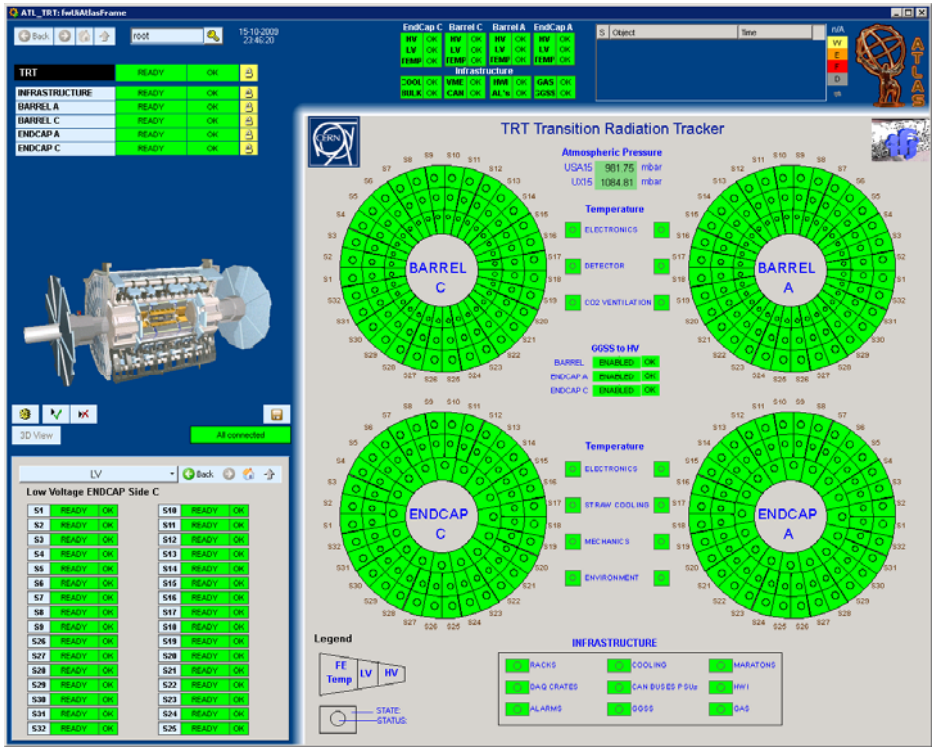
- ATLAS Polish group:
  - IFJ-PAN Cracow
    - 14 physicists, 6 eng+techn, 6PhD students
  - AGH Cracow
    - 7 physicists, 2 eng+techn, 1 PhD student
- Significant contribution, support and responsibilities for detector construction, commissioning and operation.
- Physics analyses (in past/present): conveners of working groups, core off-line software developers

Responsibilities for the TRT detector:

- Detector Control System
  - Monitoring of the operation
  - Stabilization of gas gain
  - Stabilization of detector temperature
  - Setting gas flow and gas components concentrations

IFJ-PAN: Z. Hajduk,
J. Olszowska,
E. Banas,
D. Derendarz

AGH: T. Kowalski,
B. Mindur



Numbers of controlled items:

HV Channels: 1984

LV Bulk Channels: 232

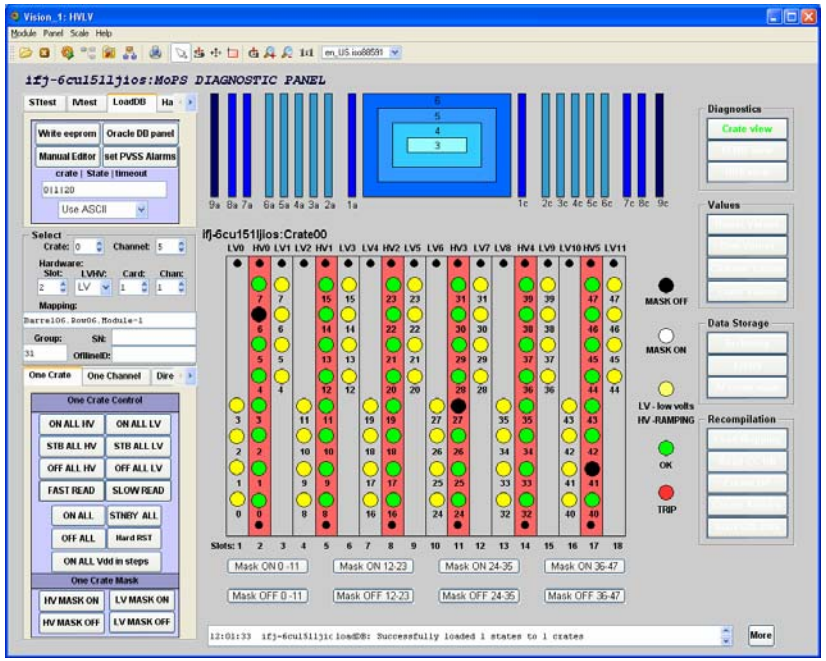
LV FE Channels: 5376

Temperature sensors: 3600

Responsibilities for the SCT detector:

IFJ-PAN: E. Gornicki
P. Malecki
AGH: S. Koperny

- Maintain the system of 8100 SCT HV power supplies
- Maintain the DCS system covering the control of LV and HV PS digital SCT processors (14 000)



Available computing infrastructure

IFJ-PAN:

Staff: M. Turala, A. Olszewski

PhD: A. Zemla, B. Zabinski

Tier2 cluster @ Cyfronet AGH

- MC production and end-user analysis
- For Polish users local interactive access and batch jobs
- Grid functionality (UI, CE, SRM) + special services (Squid)
- Hardware
  - 2400 Xeon cores @ IBM H21 + HP C220 Blades
  - 245 TB (raw) @ 6x SUN X4500 Thor
- Resource sharing
  - ATLAS 40%, LHCb 10%, (ALICE, CMS), EGEE 45%
  - ATLAS 2009 (2010) pledge: 450 (600) kSi2k, 120 (220) TB
- ATLAS resource sharing
  - ATLAS CPU: 50% MC, 50% user analysis
  - ATLAS storage: 50% MC, 25% Group, 25% User scratch
  - Polish localgroup: no job priority, 10 TB exclusive storage
- Network connection 2x10GE Pionier to DFN via Poznań PCSS

Tier3 cluster @ IFJ

- Code development and end-user analysis
- Local interactive access and batch jobs
- Grid access with full functionality (UI, CE, SE)
- Hardware
  - 2 access nodes IntelCore2 6750@2.66GHz
  - 8x 4 cores @ Xeon 5140@2.33GHz 8GB RAM
    6x 8 cores @ Xeon 5430@2.66GHz 16GB RAM
  - Common home 1.1 TB
  - Experiment storage
    ATLAS Sun Thumper 26 TB
    LHCb+Belle 9 TB
- Network connection 1Gbps to Pionier 10GE via Cyfronet ACK
- Supported experiments: ATLAS, LHCb, Belle
- Up to 10 users

Available computing infrastructure

IFJ-PAN:
Staff: M. Turala, A. Olszewski
PhD: A. Zemla, B. Zabinski

- 300 cores available for ATLAS
- Convenient access to ATLAS data via local Tier2 computing center CYFRONET-LCG2 with fast network connection to IFJ Tier3 for local analysis.

Tier3 cluster @ IFJ

- Code development and end-user analysis
- Local interactive access and batch jobs
- Grid access with full functionality (UI, CE, SE)
- Hardware
  - 2 access nodes IntelCore2 6750@2.66GHz
  - 8x 4 cores @ Xeon 5140@2.33GHz 8GB RAM
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Tier2 cluster @ Cyfronet AGH

- MC production and end-user analysis
- For Polish users local interactive access and batch jobs
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Analyses with cosmic ray data registered in the Inner Detector

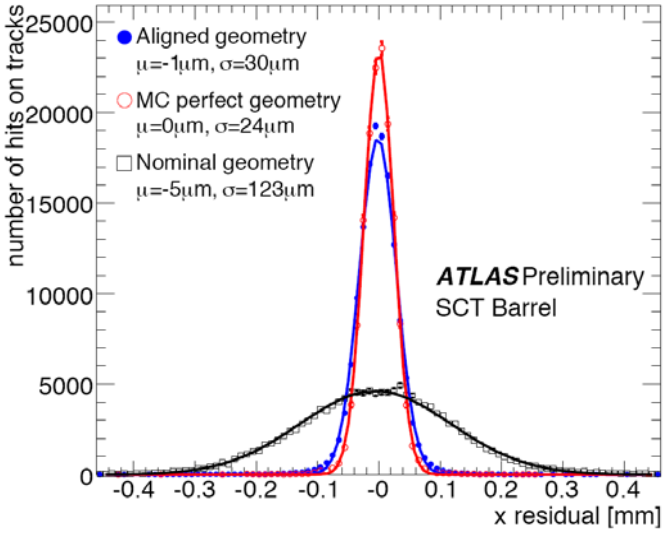
Millions of tracks collected by ATLAS detector during last 14 months.

Alignment of the Inner Detector of ATLAS

IFJ-PAN:
Staff: P. Brückman

- Cosmic ray data were analysed and the ID alignment constants (Pixel+SCT+TRT) for the start-up of the LHC has been extracted using several complementary alignment methods.
- Understanding of the detector remarkable already, best set of constants will be used for first collision data.
- In 2010 the alignment team will have to:
  - consolidate the alignment on colliding beam data.
  - analyse, understand and remove systematic distortions of the detector using combined detector properties (e.g. E/p for electrons) and selected physics channels (e.g. resonant decays of J/Ψ, *Y* and *Z*).

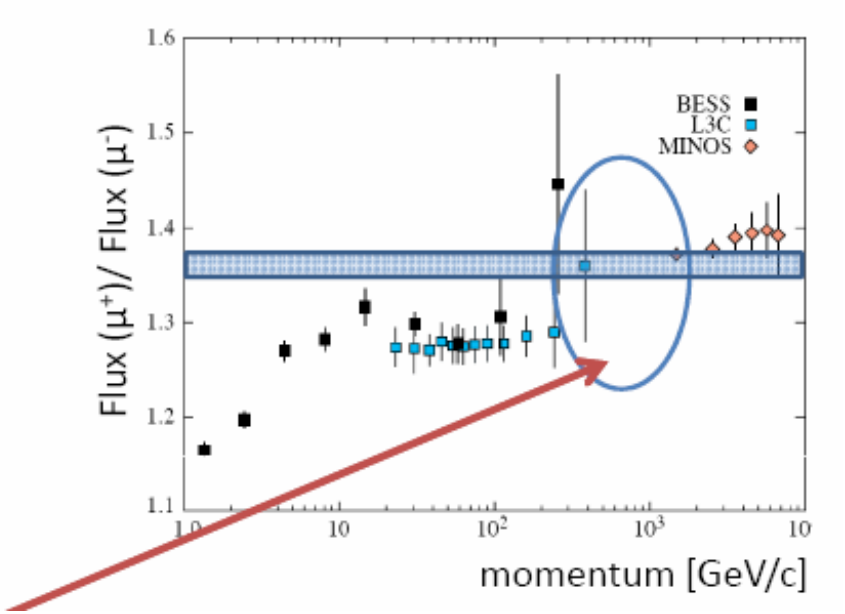
Results on 2008 data



Ratio μ+/μ- in Cosmic Ray Data

IFJ-PAN:
PhD: Pa. Malecki

- Motivation and challenges
  - Predicted to chage with momentum based on pion/kaon model of interactions in atmosphere
  - Not well measured so far where betwe it changes, between 300-GeV -1 TeV
  - Potential first real physics measuremer which requires understanding of the Ir Detector performance to 1% level
  - With 2009 July cosmic data
    - Have statistical sensitivity in the unmeasured momentum range
    - Required level of systematic accuracy may be feasible.



High p_T physics

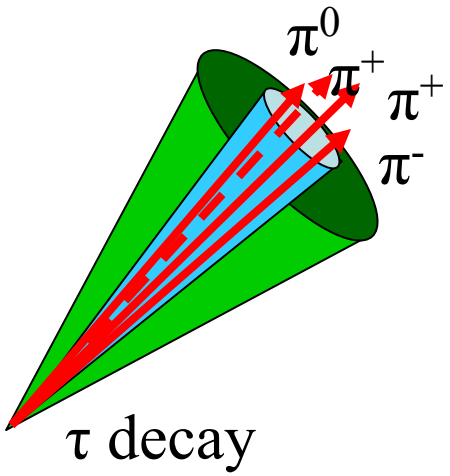
IFJ-PAN

Staff: P. Bruckman A. Kaczmarska, P. Malecki, E. Richter-Was, M. Turala, M. Wolter

PhD: Pa. Malecki, A. Zemla

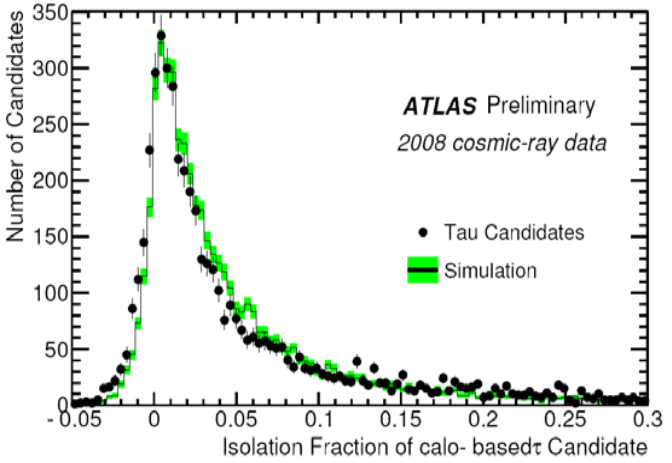
Off-line reconstruction for hadronically decaying tau

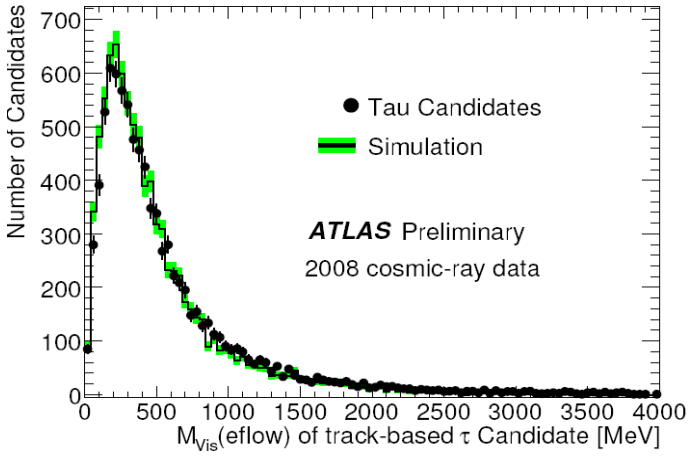
- Tau reconstruction is performed by two complementary algorithms, one seeded by a track from the ID, and the other from a cluster of energy in the calorimeter.
- Identification with cut-based and multi-variate methods
- In 2010 the core-software team will have to:
  - Consolidate algorithm on colliding beam data.
  - Optimise performance: reconstruction and identification



Analysis of Cosmic Ray Data

- Tau leptons are not expected in cosmics, we observed only muons faking tau candidates
  - goal: test the stability of the tau-jet algorithms with real data
  - study algorithm performance in data and compare to Monte Carlo predictions.
- Fake taus in cosmic events coming from each algorithm differ:
  - Most fake taus for the track seeded algorithm come from minimum ionizing muons with low momentum. These muons leave a track in the ID that fakes track-seeded tau .
  - Alternatively, cosmic air showers and muons that undergo hard bremsstrahlung in the calorimeters are the source of fake tau candidates for the calo-based algorithm, as the energy deposit in calorimetry for such cases is large enough.

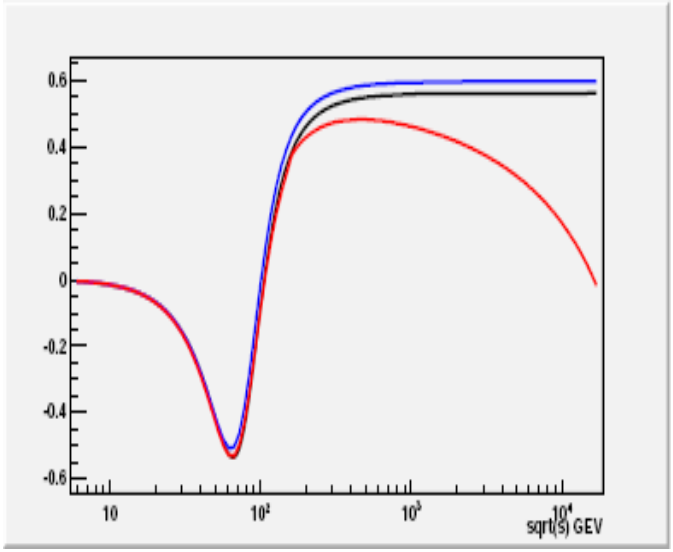




Interfaces of Monte Carlo generators

- **TAUOLA** – a simulation package for tau decays (Z. Was IFJ PAN et al.).
- Tauola C++ interface will be integrated with ATLAS software: part of the ATLAS simulation chain executed after standard MC generators like Pythia or to emulate tau events from observed muon events in the data.
- New feature of C++ interface: EW corr. from SANC lib.

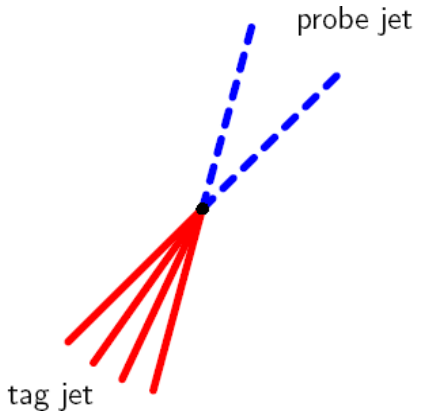
Polarisation in resonances decay

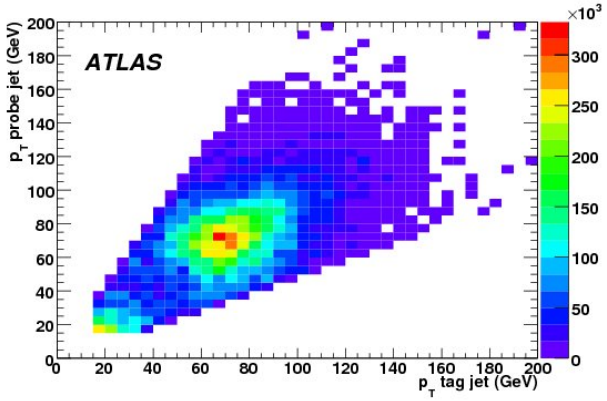


Lines: black - default, blue - Born, red -ew corr. on.
Down Quarks, cos theta= -0.2

Tau fake rates with few pb^{-1}

- Find a rate of QCD jets misidentified as hadronically decaying taus. Important for many discovery channels (Higgs, SUSY..), which use hadronically decaying taus.
- QCD jet production has a high cross-section and we will not produce enough MC statistics for QCD background estimation. Also some QCD jet parameters might be a way off in MC simulation.
- Data driven analysis – find a set of criteria selecting a sample of unbiased QCD jets out of data (huge x-section, no efficient selection required).
  - Require jet back-to-back and with comparable transverse momenta
  - About % statistical error on fake rates determination will be reached with $10pb^{-1}$.



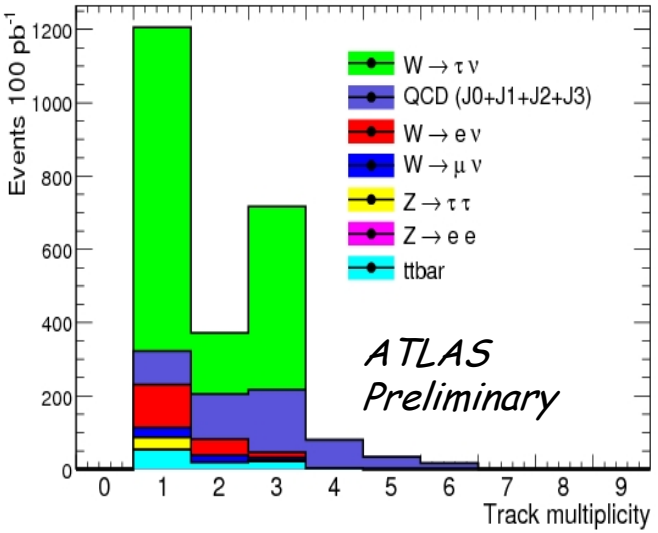


Correlation plot for E_T of tag and probe jets.
Jet sample E_T^{gen}=70-140GeV used.

First true tau's with 30-100 pb^{-1}

- Observability of W -> τ ν
  - The most abundant source of taus in SM processes.
  - Observe excess of events in track multiplicity spectra
- Cross-section measurement Z -> ττ
  - 10 x smaller xsection but more interesting topology.
  - Observe excess of events in invariant mass of visible decay products, then reconstruct complete invariant mass (collinear approximation).
- Study τ leptons from ttbar as one of the most significant sources of τ leptons, complementary to W → τν and Z → ττ, typically in higher energy range.

For 100pb^{-1}@ 14 TeV
expect 1550 signal evt
650 bgd evt
about 50% less for 7 TeV



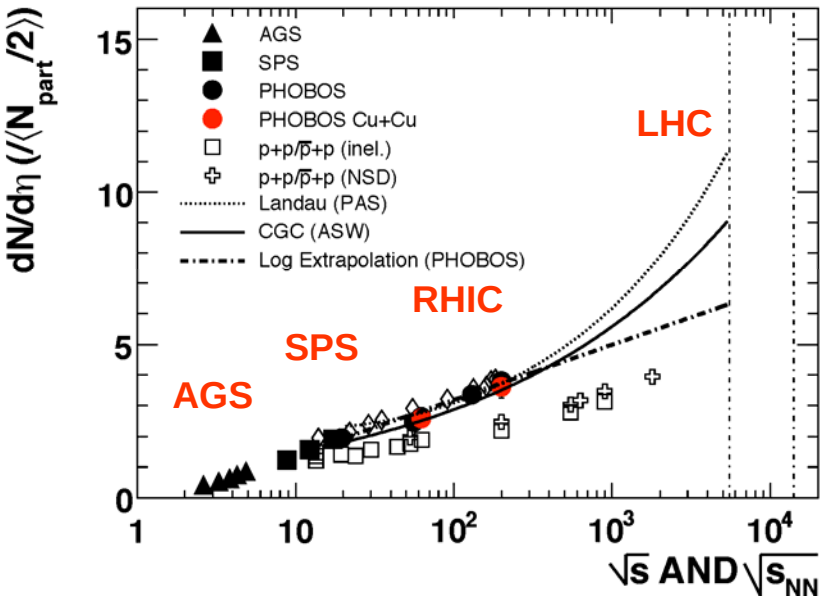
Heavy ion physics

IFJ PAN:
Staff: B.Wosiek, A.Olszewski,
A.Trzupek, K.Woźniak
PhD: D.Derendarz, B. Żabiński

Global p+p and Pb+Pb event characteristics

- Pb+Pb collisions expected in 2010
- Some analysis techniques and algorithms will be tested with p+p data
- Day-1 measurements: $dN_{ch}/d\eta$, $dE_T/d\eta$, *elliptic flow*:
  - Dynamics of hot and dense medium (perfect fluid)
  - Properties of the initial state (energy/gluon density, ...)
  - Test of model predictions

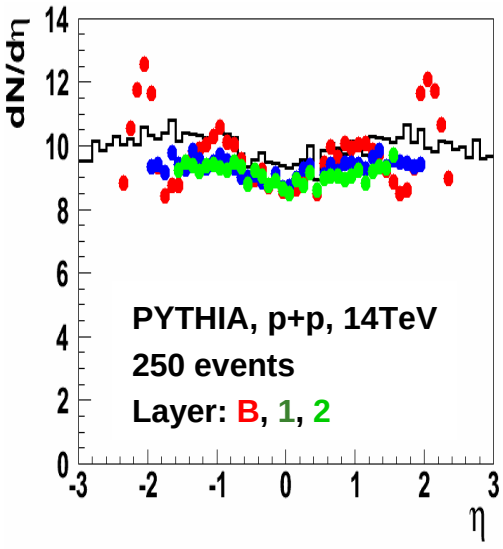
$dN_{ch}/d\eta$ in Pb+Pb at LHC energy

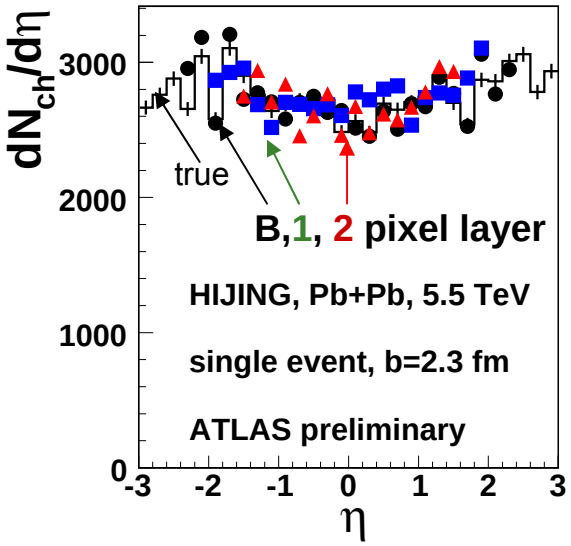


Global p+p and Pb+Pb Event characteristics

Charged Particle Multiplicity

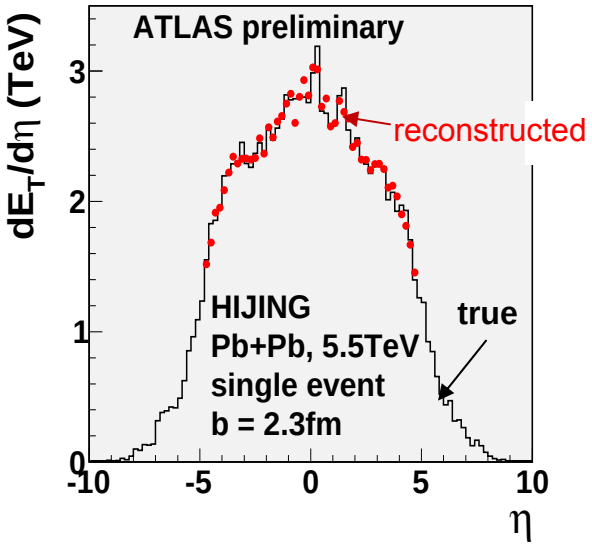
(Si Hit Counting Method)





Transverse Energy Flow

(Calorimeter Cells)

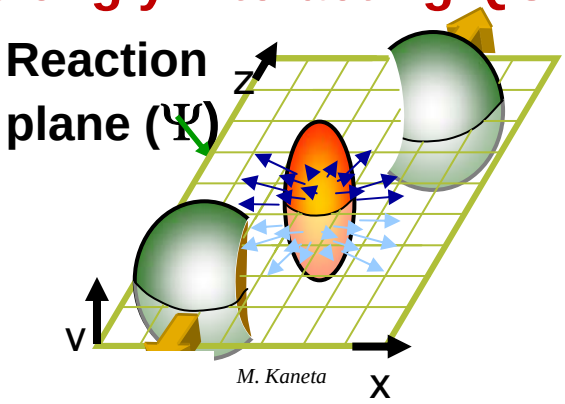


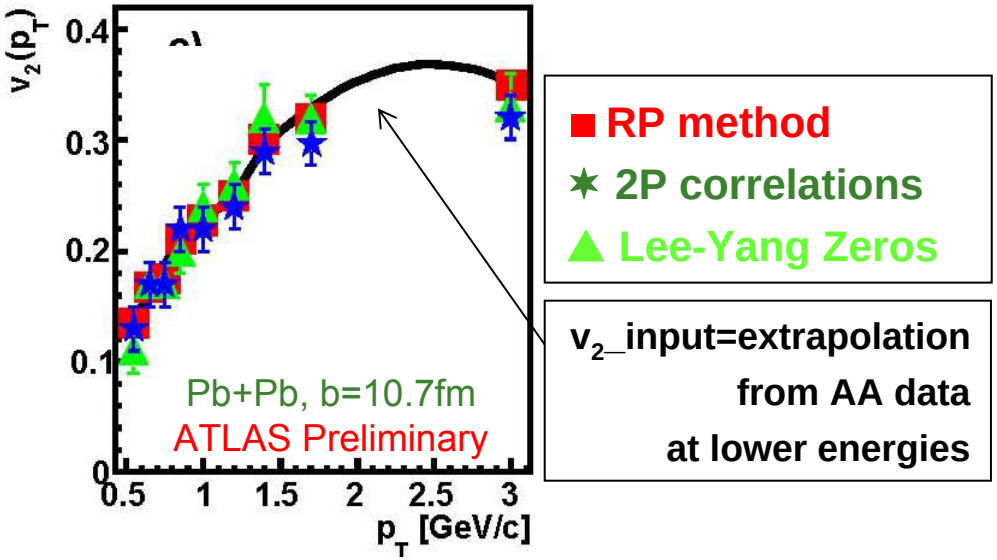
- MC study showed that ATLAS can provide good estimate of event-by-event multiplicity and transverse energy in p+p and Pb+Pb collisions
- In 2010 reconstruction methods of dNch/dη and dET/dη will be further developed, tested and applied to minimum bias p+p data

Azimuthal anisotropy of produced particles in Pb+Pb

- v_2 in ATLAS is reconstructed by using: charged particles (p_T~0.5–3GeV), pixel clusters, calorimeter cells($|\eta|$<5) at different centraliti
- In 2010 further development of reaction plane, 2-particle correlations and Lee-Yang-Zero methods of v_2 determination
- p+p data will be used to check uniformity of signals (especially azimuthal angle distributions) use in v2 reconstruction

Strongly interacting QGP





v_2 – elliptic flow

$$dN/d(\phi-\Psi_0) = N_0 (1 + 2v_1 \cos(\phi-\Psi_0) + 2v_2 \cos(2(\phi-\Psi_0)) + \dots)$$

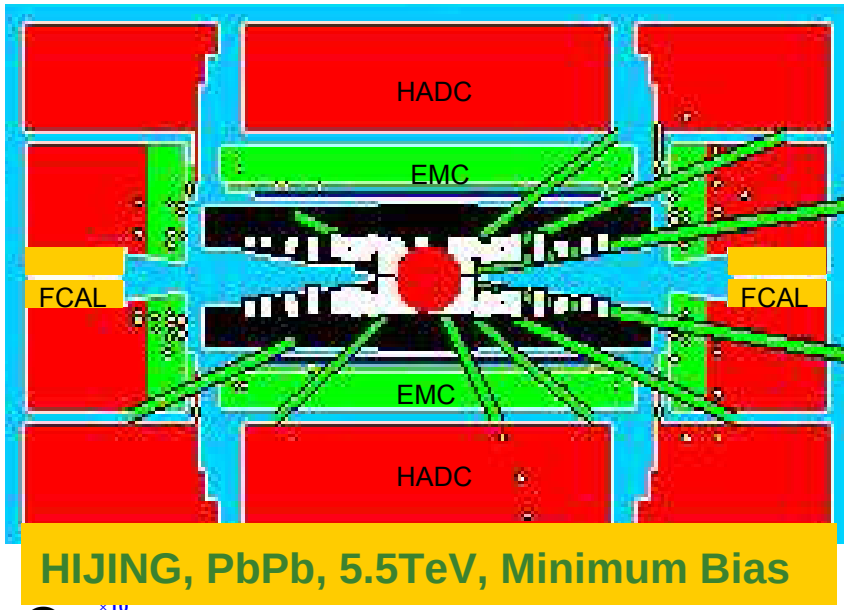
Determination of Collision Centrality

- ATLAS calorimeters:
  - **electromagnetic (green)**
  - **hadronic(red)**
  - **forward (orange)**
- Strong monotonic correlations of

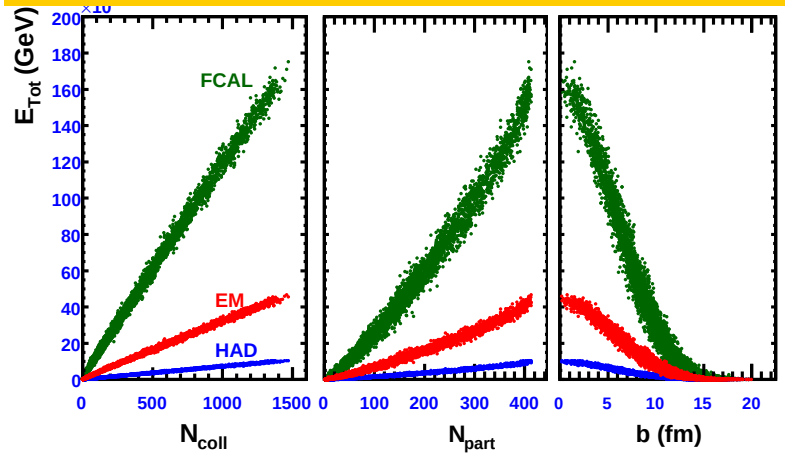
$$E_{Tot} = \sum_{cells} E_{Tot}$$

with collision parameters (Ncoll, Npart, b) allow to assign each Pb+Pb event to predefined centrality bin

- Task for 2010: Mantain and further develop Athena algorithm for centrality determination



HIJING, PbPb, 5.5TeV, Minimum Bias

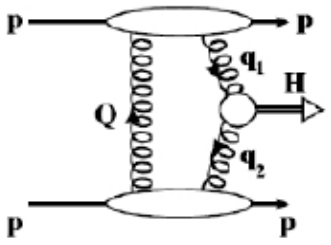


Forward physics

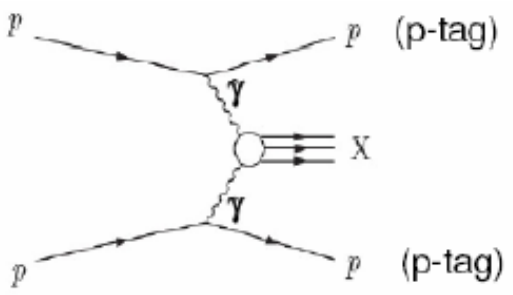
IFJ-PAN:
Staff: J. Chwastowski, L. Gorlich
J. Turnau, Z. Hajduk, K. Korcyl
PhD: R. Staszewski, M. Trzebinski
Mgs: P. Banka, K. Szczepaniec
AGH:
Staff: M. Przybycien, L. Adamczyk

Physics with forward proton(s) tag at LHC

- Physics motivation
  - Central inclusive Higgs production
  - Photon-photon physics
  - Photon-proton physics with W&Z in final state



- Status of forward proton taggers
  - ALFA detector : Roman pot at 240m, mainly for elastic and total cross-sections and luminosity measurement. To be installed soon.
  - Proton taggers at 220m and 420m
    - LoI approved in June as 2 stages project.
    - Optimistic timescale 2012 and 2015



Plans for analyses in next months

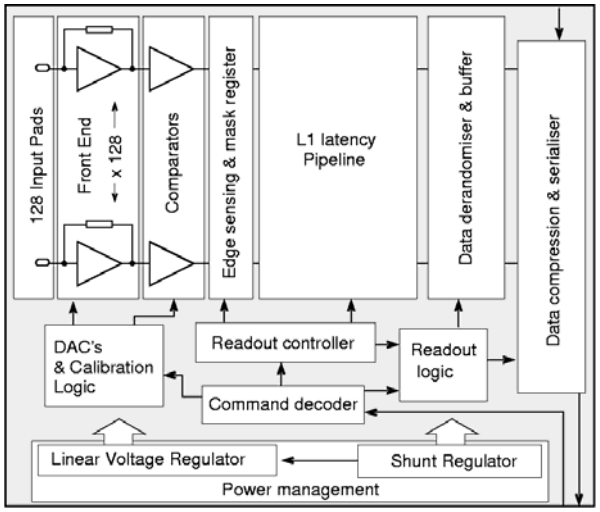
- Studies for single diffraction using minimum bias data and rapidity gap method (no taggers).
- Studies for single diffraction with ALFA using MC simulated samples.
- Studies for diffractive production of heavy bosons (W, Z) using MC simulated samples.
- Involvement in validation of Forward Physics Monte Carlo (FPMC) and G4 simulation of beam line and 220m detector

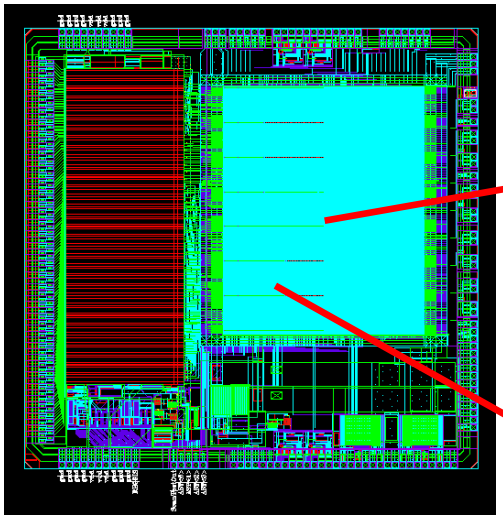
Upgrade of ATLAS detector

AGH-Kraków
Staff: W. Dąbrowski, M. Dwużnik, K. Półtorak, K. Świentek

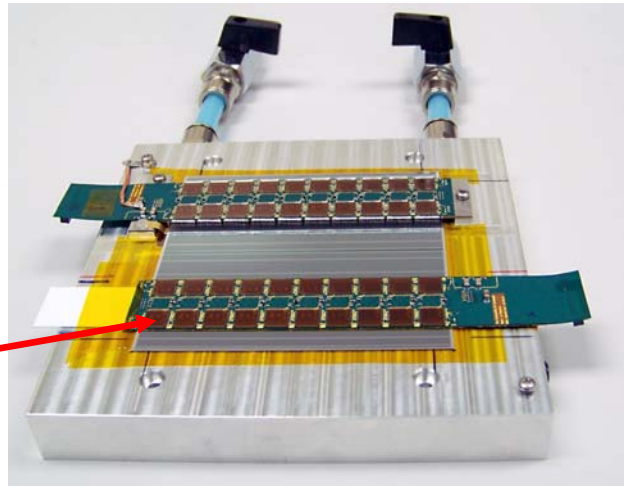
Development on sensors and readout electronics

ABCN-25 (in 0.25 μm technology) for readout of short silicon strips developed in 2007-2008 serves now as main test vehicle for the upgrade module development.

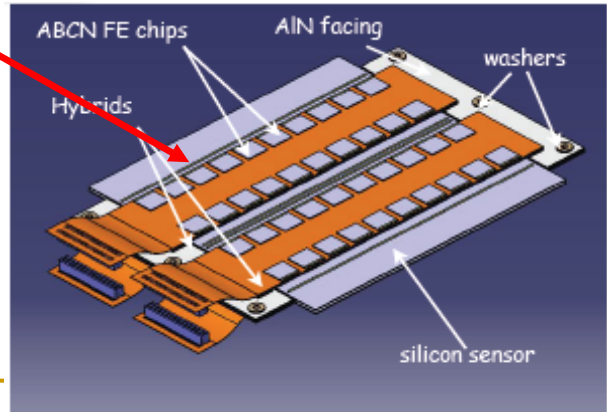




Liverpool single-sided module



KEK-Geneva double-sided module



ABCN-25 development team:

AGH-Kraków (W. Dąbrowski, M. Dwużnik, K. Półtorak, K. Świentek)
CERN (F. Anghinolfi, J. Kaplon, K. Półtorak)
U. Geneva (D. La Marra, S. Pernecker, S. G. Sevilla)
U. Pennsylvania (N. Dressnandt, M. Newcomer)

Summary

- ATLAS – Polish Group

  involved in many* activity areas of the ATLAS project
  - Detector operations
  - Physics analyses (p+p, HI, FP)
  - Future detector upgrades

* Not all activities reported here