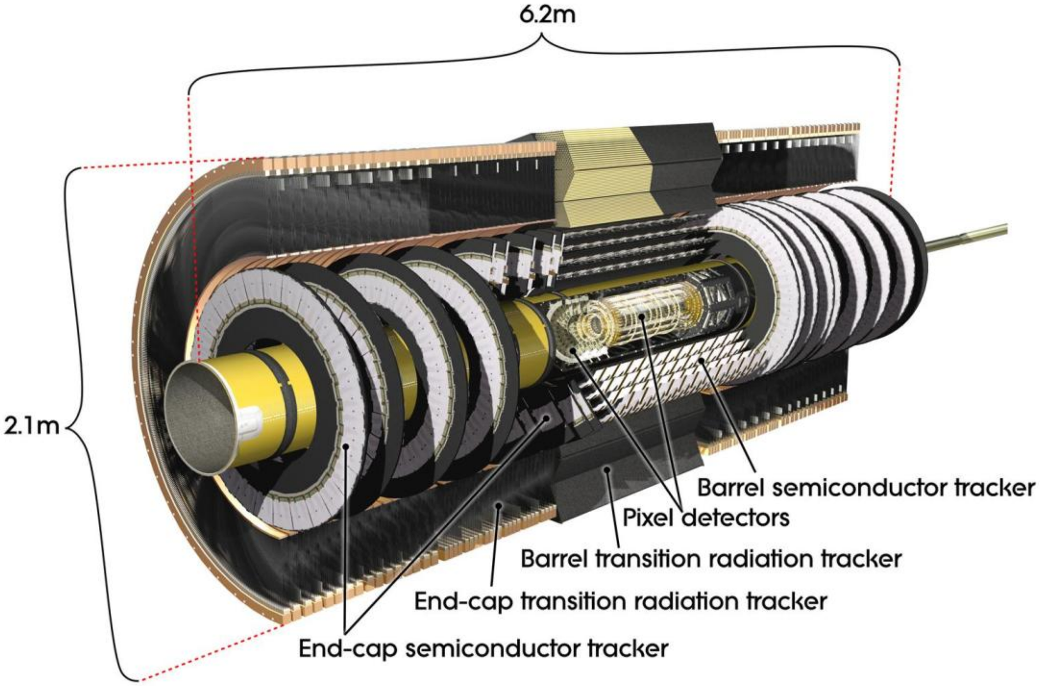
The ATLAS Inner Detector operation, data quality and tracking performance.

Ewa Stanecka on behalf of ATLAS ID collaboration

INP PAS Cracow

The ATLAS Inner Detector

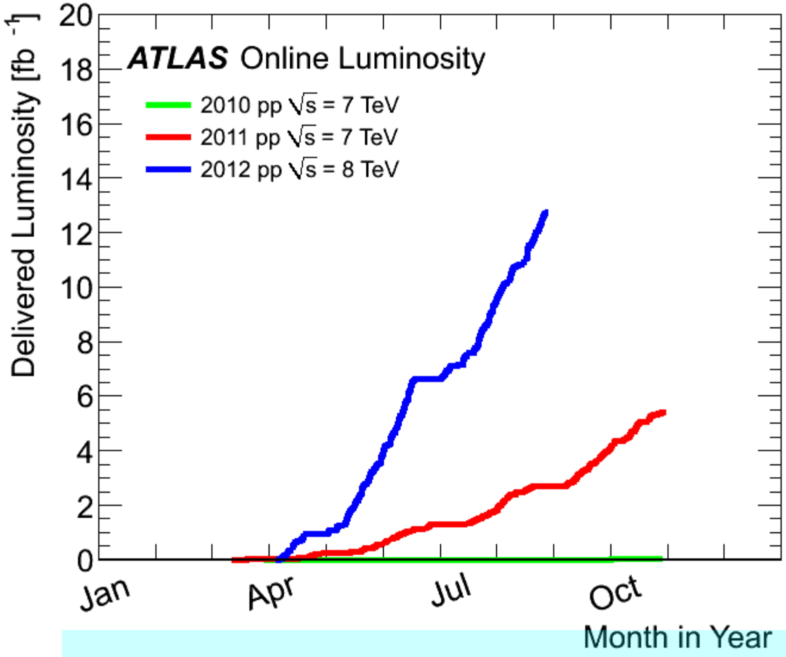
- ➢Precision tracking at LHC luminosity over 5 units in η
- ➢ Precise primary/secondary vertex reconstruction
- ➢ Excellent b-tagging in jets
- ➢ Electron, muon, tau, b- and c-hadron reconstruction
- ➢ Transition radiation in the TRT for electron identification
- ➢ covers : |η| < 2.5 (2.0 for TRT)

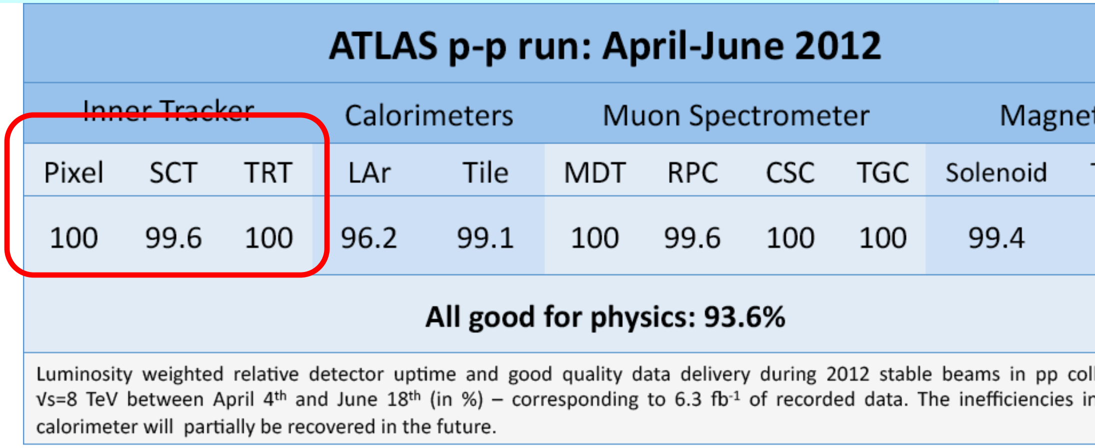


The ID is composed of three Sub-detectors, of different technologies:

- ➢ **Transition Radiation Tracker (TRT)**
- ➢**Semi-Conductor Tracker (SCT)**
- ➢**Pixel detector:**

Data Taking and Data Quality





ATLAS p-p run: April-June 2012

Inner Tracker			Calorimeters		Muon Spectrometer				Magne
Pixel	SCT	TRT	LAr	Tile	MDT	RPC	CSC	TGC	Solenoid
100	99.6	100	96.2	99.1	100	99.6	100	100	99.4

All good for physics: 93.6%

Luminosity weighted relative detector uptime and good quality data delivery during 2012 stable beams in pp coll √s=8 TeV between April 4th and June 18th (in %) – corresponding to 6.3 fb^{-1} of recorded data. The inefficiencies ir calorimeter will partially be recovered in the future.

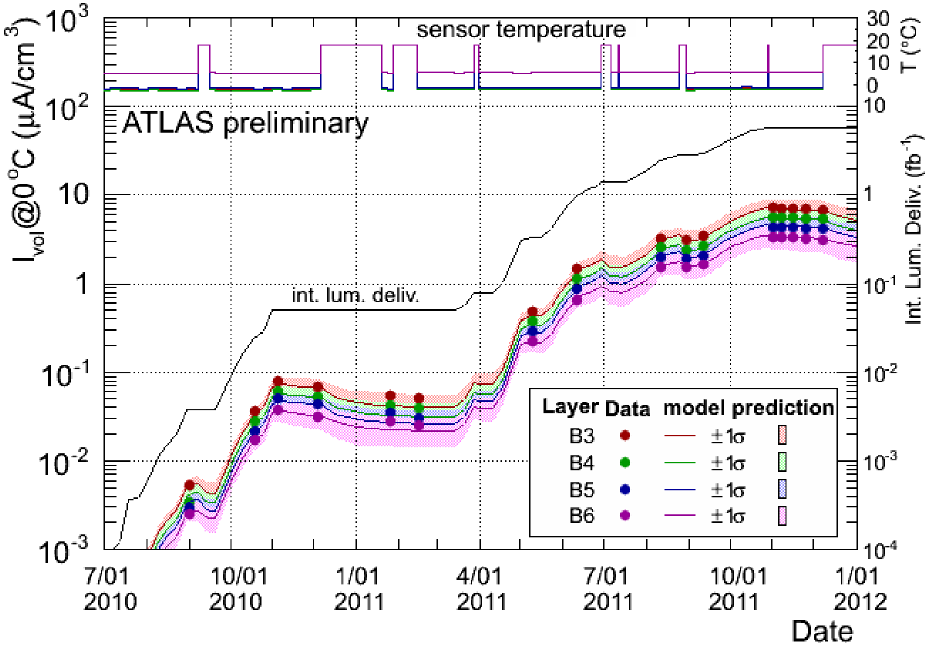
Excellent data taking performance, for all ID detectors during 2010, 2011 and 2012. Close to 100% availability.

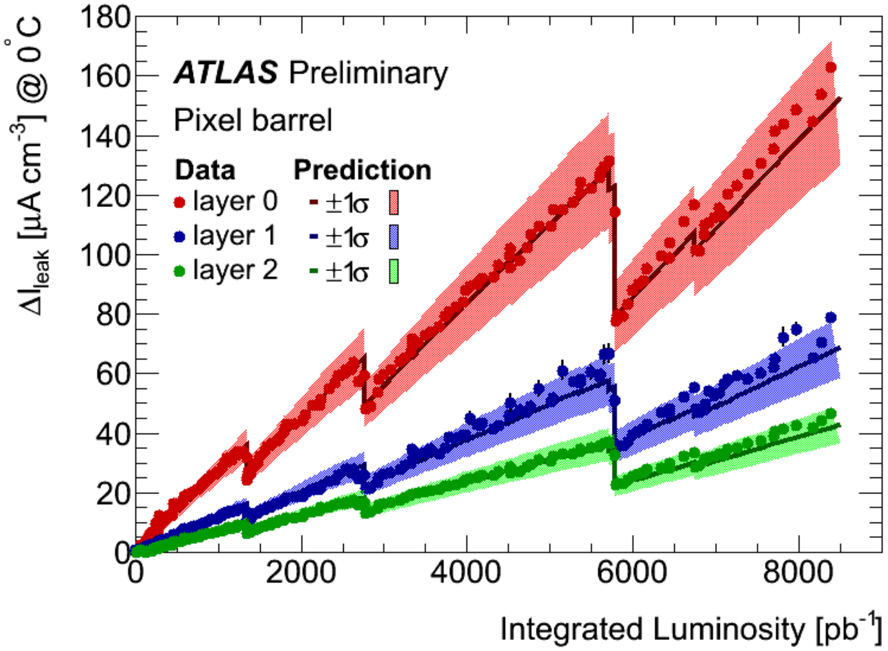
Detector Operation

Continuous work in the **Detector Control System (DCS)** and **Data Acquisition (DAQ)** in order to maximize data taking efficiency.

Radiation Damage

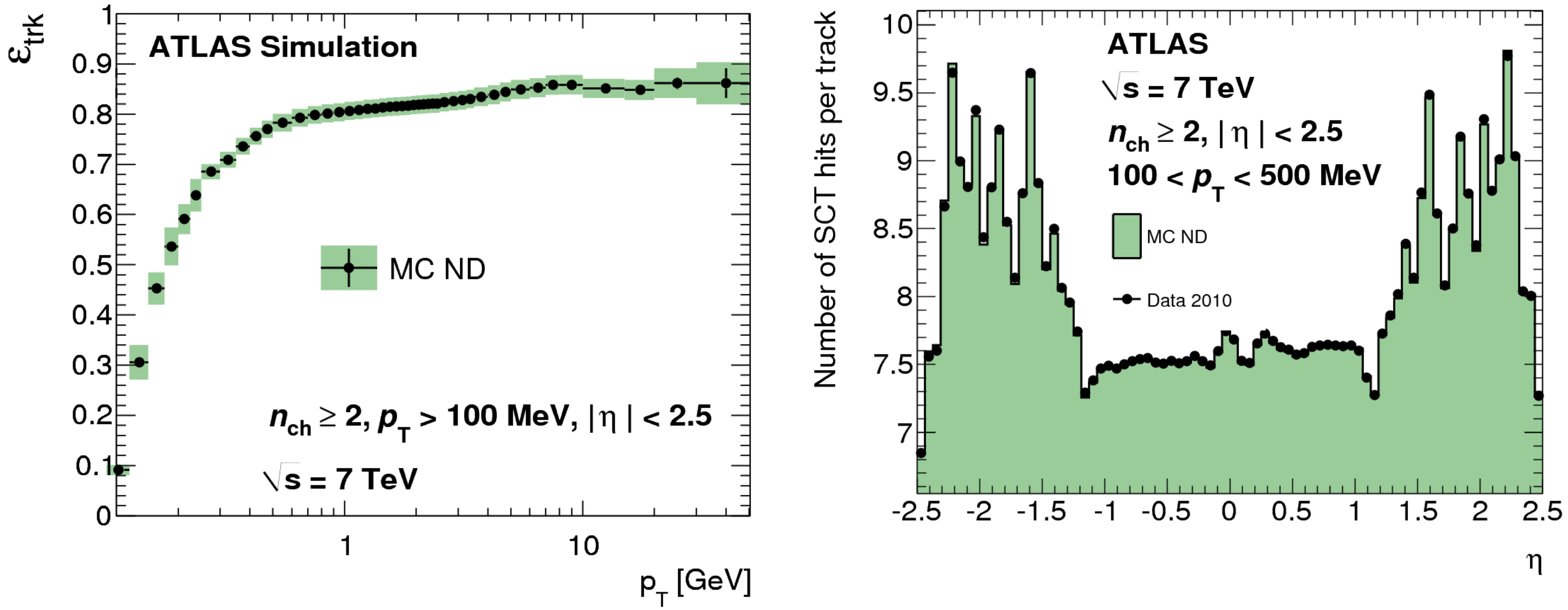
- ➢Radiation damage effects in SCT and Pixel became visible in 2011 and they are increasing with luminosity and time.
- ➢ Monitoring of radiation damage via the increase of sensor leakage current





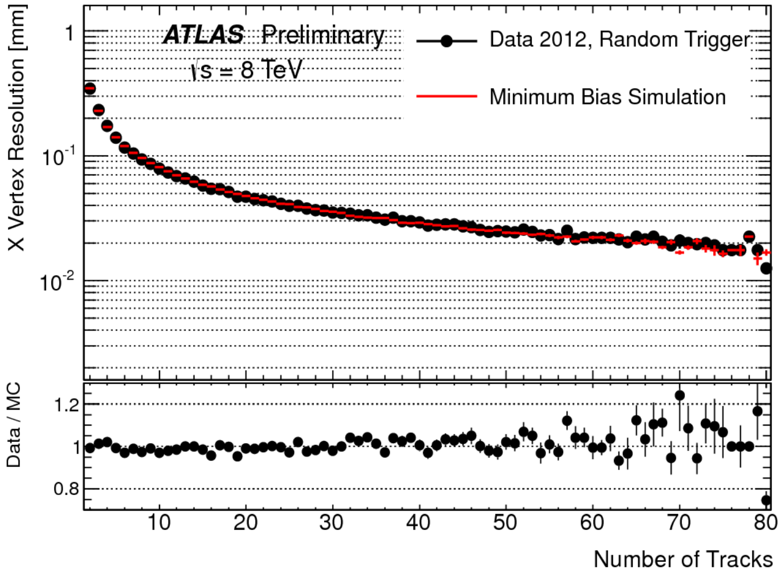
Track and Vertex Reconstruction Performance I

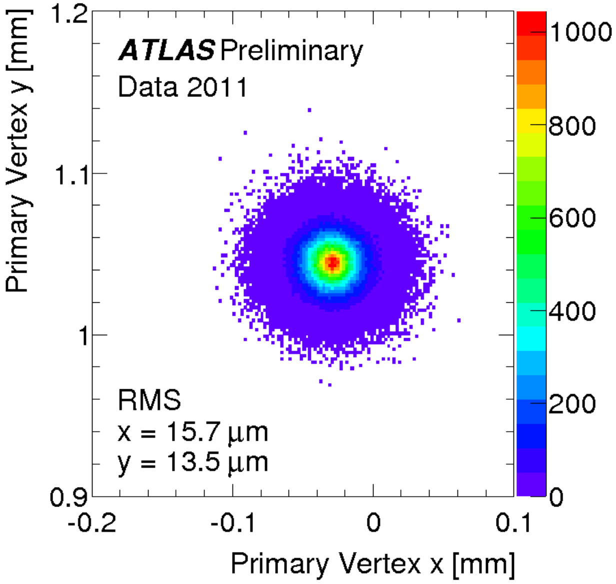
- Multi-stage track indentification algorithms:
  - **inside-out** algorithm**,** reconstructs most primary tracks.
  - **outside-in, r**econstructs secondary tracks eg. conversions, hadronic interactions, V^0 decays



Track and Vertex Reconstruction Performance II

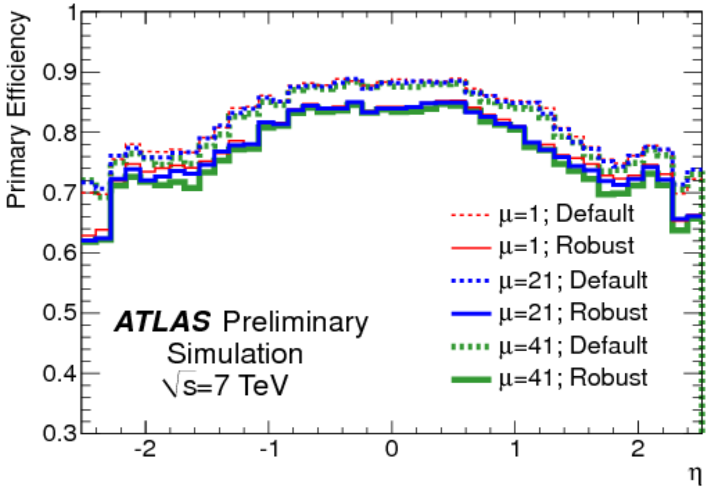
- ➢Current vertexing algorithm: iterative vertex finder, adaptive vertex fitter
- ➢Routinely determine the beam spot from average vertex position over a short time period.
- ➢ The beam spot position is used as a three-dimensional constraint.
- ➢ Vertex resolution determined from data using split vertex technique

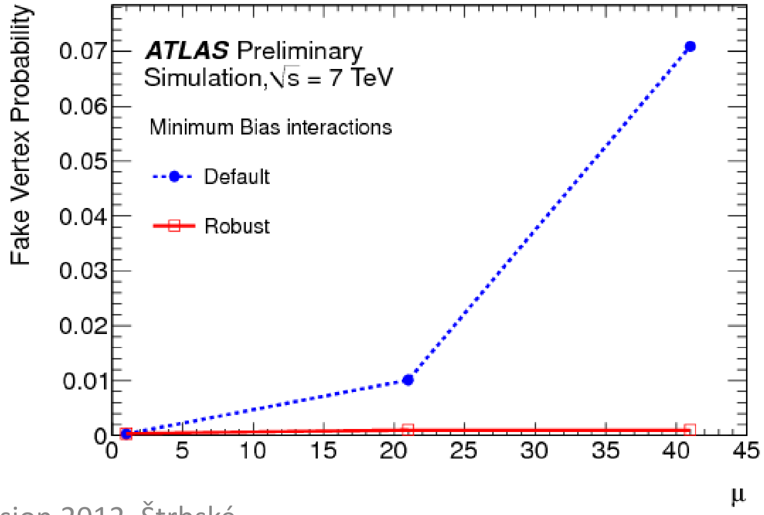




High Pile-up

- The luminosity delivered by LHC is currently the biggest challenge for ID track and vertex reconstruction
- The increased detector occupancy can result in degraded track parameter resolution due to incorrect hit assignment, decreased efficiency and fake tracks from random hit combinations.
- This in turn impacts vertex reconstruction, resulting in a lower efficiency and an increased fake rate.
- **In order to minimise pile-up impact "robust track selection" was defined**
  - Moderate drop in primary track reconstruction efficiency for significant reduction in fake track fraction
  - Negligible fake primary vertex probability

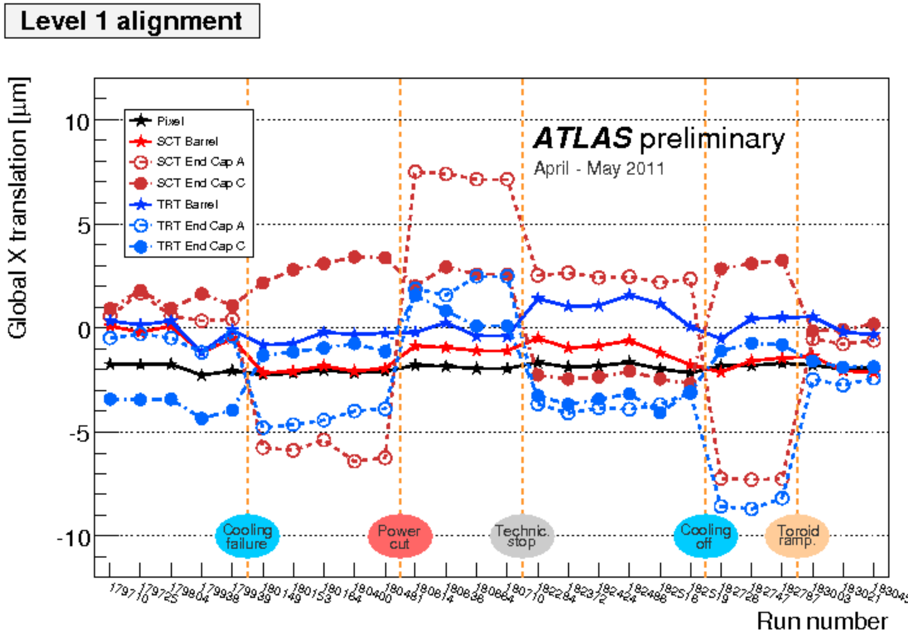




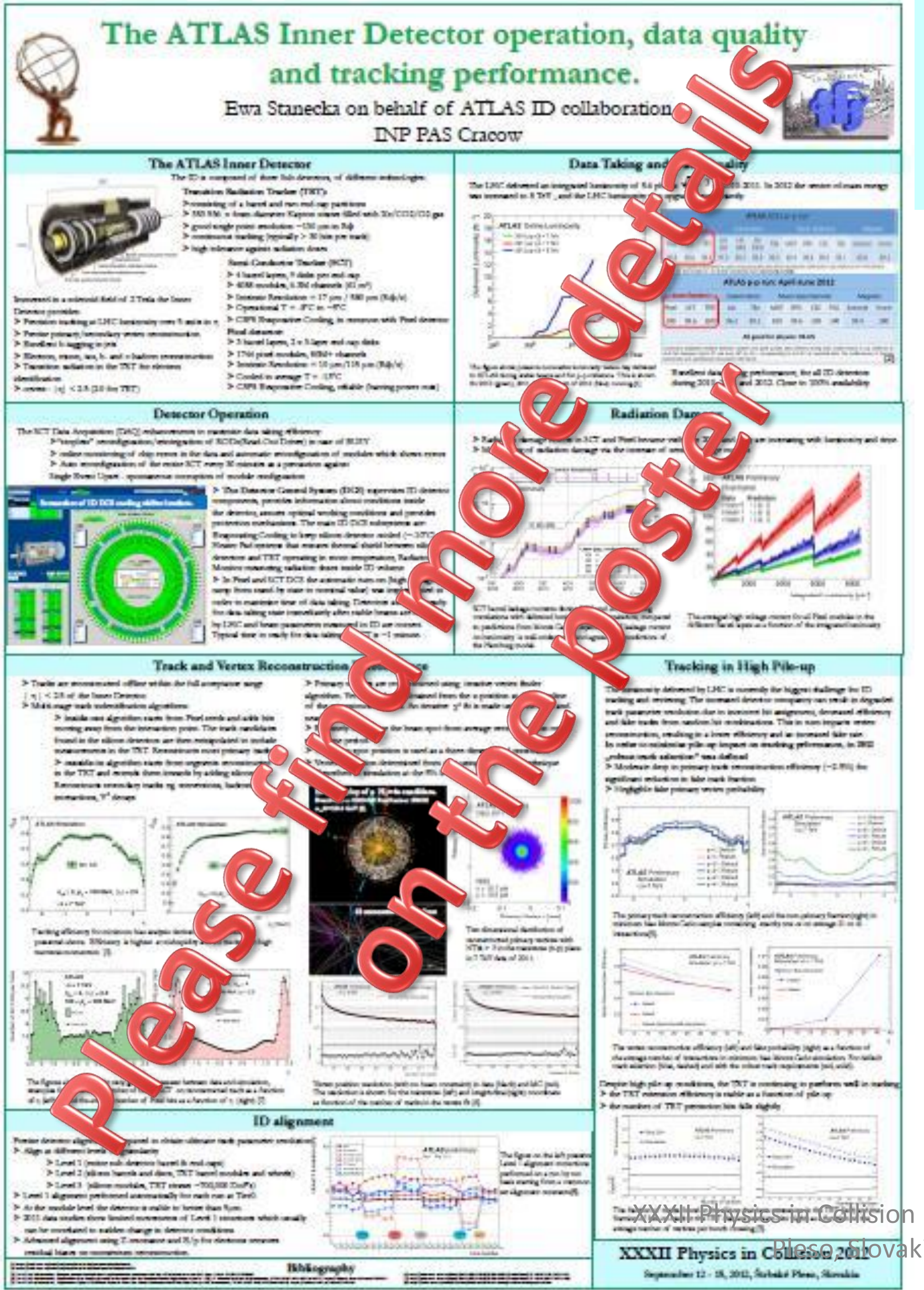
Alignment

Precise detector alignment is required to obtain ultimate track parameter resolution

- Align at different levels of granularity
  - Level 1 (entire sub-detector barrel & end-caps)
  - Level 2 (silicon barrels and discs, TRT barrel modules and wheels)
  - Level 3 (silicon modules, TRT straws ~700,000 DoF's)
- 2011 data studies show limited movements of Level 1 structures which usually can be correlated to sudden change in detector conditions.
- Advanced alignment using Z resonance and E/p for electrons removes residual biases on momentum reconstruction.



Summary



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Detector Operation

Radiation Damage

Track and Vertex Reconstruction

Tracking in High Pile-up

ID alignment

Bibliography

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Please find more details on the poster

- ➢excellent data taking efficiency
- ➢enhancements in DAQ and DCS in order to maximize data taking efficiency
- ➢ SCT and Pixel radiation damage agrees with theoretical predictions
- ➢ excellent tracking and vertexing performance
- ➢ track and vertex reconstruction is robust even in data containing significant pile-up
- ➢ the Inner Detector alignment is integrated in ATLAS computing model and uses a combination of advanced techniques in order to achieve the best hit and momentum resolution.