Slovenia@ATLAS

Borut Paul Kerševan

Faculty of Mathematics and Physics,
University of Ljubljana
and
Jožef Stefan Institute

Participating institutions

- Slovenia joined the ATLAS collaboration in 1996.
- Slovenian ATLAS members employed by:
  - Jožef Stefan Institute and
  - Faculty of Mathematics and Physics, University of Ljubljana.

- The collaboration is consolidated through the Experimental particle physics dept. (F-9) at the Jožef Stefan Institute.

Univerza *v Ljubljani*
Fakulteta za *matematiko in fiziko*

Institut
"Jožef Stefan"
Ljubljana, Slovenija

Manpower

- Slovenian group at ATLAS:
    - 12 senior staff,
    - 0 post-doc,
    - 4 PhD students:
        - A funded position for ~1 PhD student/year,
    - 1 Master student.

- **A small group, aiming to cover diverse activities and tasks within ATLAS.**

▸ **11** Physicist
▸ **4** Physics PhD student
▸ **1** Physics masters/diploma student
▸ **0** Undergraduate/summer student
▸ **1** Engineer with PhD
▸ **1** Engineer without PhD
▸ **0** Engineering student
▸ **0** Technician or equivalent
▸ **0** Administrator/other

Univerza *v Ljubljani*
Fakulteta za *matematiko in fiziko*

**Institut
"Jožef Stefan"
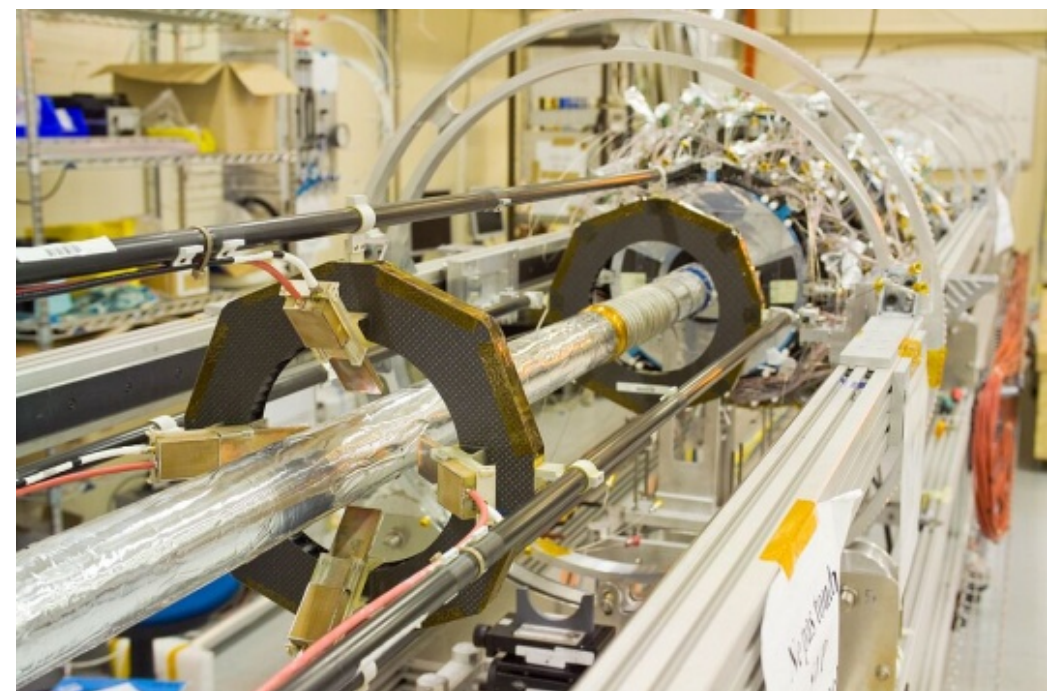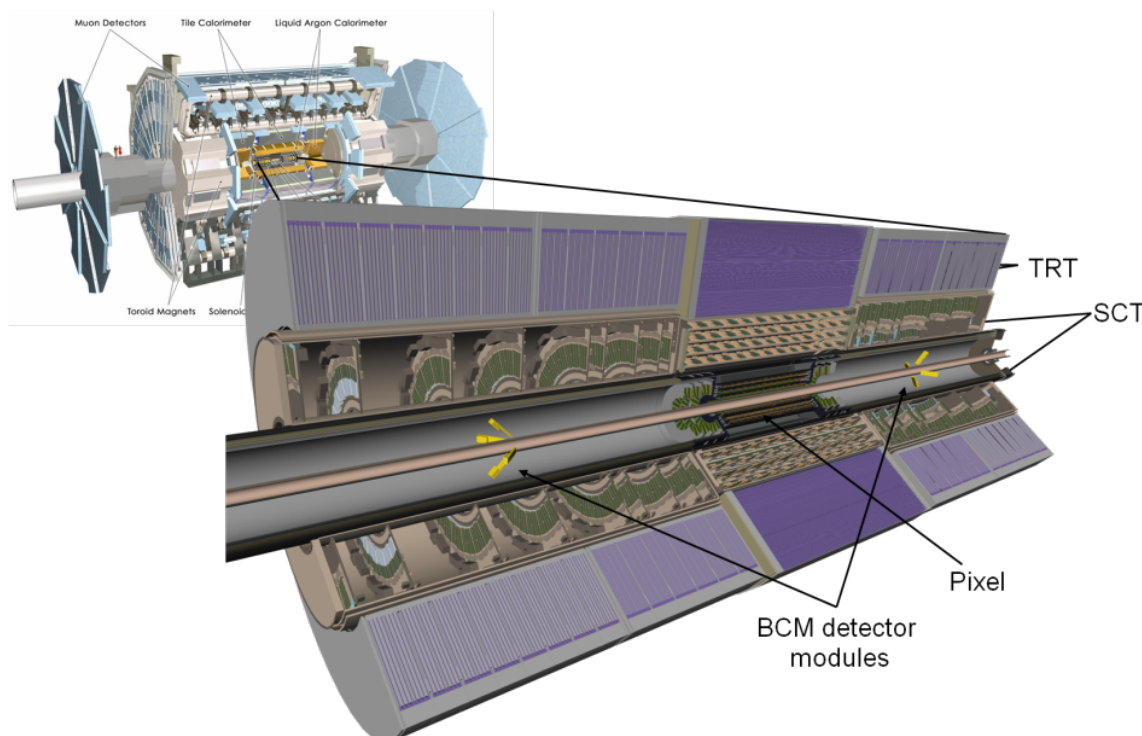Ljubljana, Slovenija**

ATLAS Hardware

**A brief overview of past, present and future involvement.
More details in a dedicated talk!**

ATLAS Hardware

- **Sub-detector development:**
  - **BCM**: Bunch by bunch safety device with MIP sensitivity and sub-ns timing. Installed in ID volume at r=55 mm and z=1.9 m. Used for beam diagnostics. Can abort the beam upon anomalous conditions. Was used as primary on-line luminometer during Run 1. *Lead institute for production, commissioning and operation.*

  - **BLM**: LHC machine beam protection system with diamond sensors replacing ionization chambers. Installed around the beam pipe at ID end plate. Integrates ionization current for 40 us (and repetitive factors of 2 longer). Connected to the LHC beam abort system. *Production, commissioning and operation in collaboration with CERN-BE (R/O electronics) and OSU (sensor supply).*

  - **DBM**: Luminosity telescopes with pixelated diamond sensors using single FE-I4 pixel chip. Installed with IBL. Construction deficiencies rendered several modules non-operational. Foreseen usage as bunch-by-bunch luminometer with single planes and adaptive fiducial region. *Production, commissioning and operation in collaboration with Bonn, CERN, OSU and Toronto.*
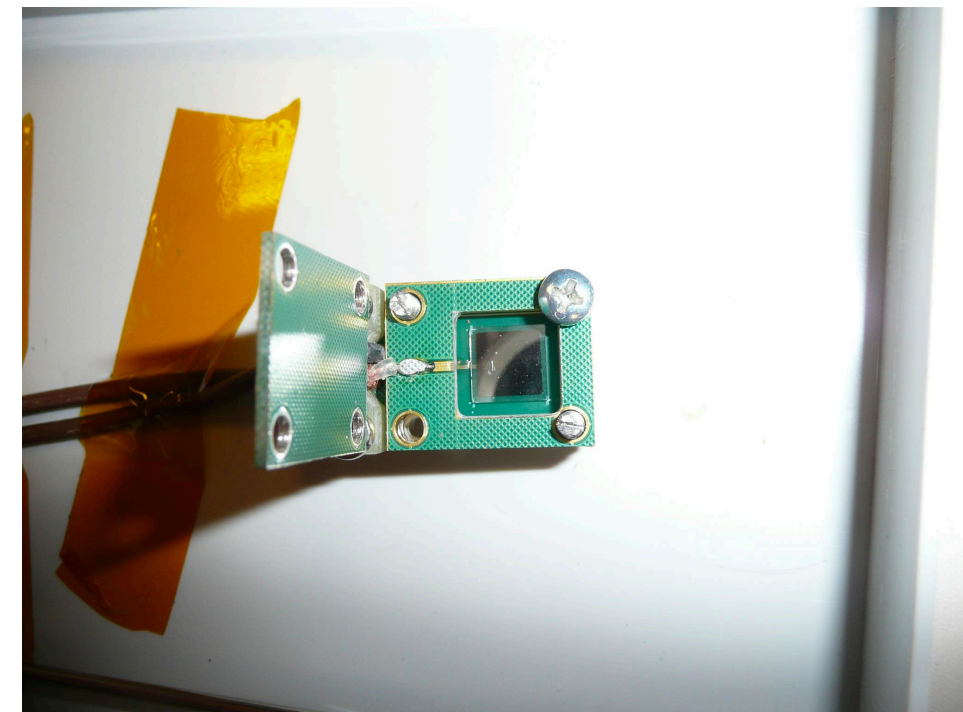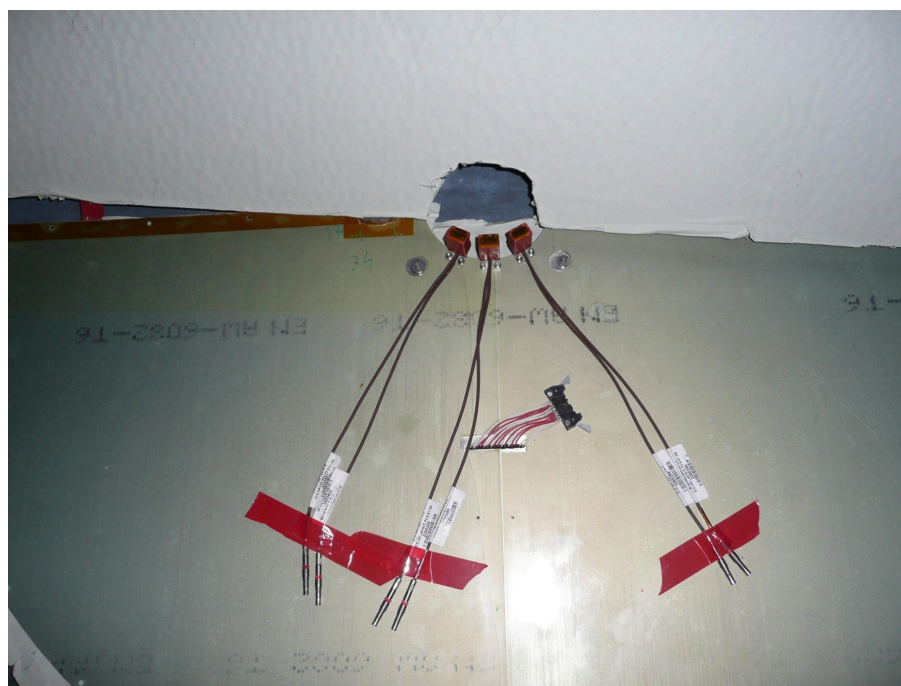

5

ATLAS Hardware

- **Sub-detector development:**
  - **BCM**: Bunch by bunch safety device with MIP sensitivity and sub-ns timing. Installed in ID volume at r=55 mm and z=1.9 m. Used for beam diagnostics. Can abort the beam upon anomalous conditions. Was used as primary on-line luminometer during Run 1. *Lead institute for production, commissioning and operation.*

  - **BLM**: LHC machine beam protection system with diamond sensors replacing ionization chambers. Installed around the beam pipe at ID end plate. Integrates ionization current for 40 us (and repetitive factors of 2 longer). Connected to the LHC beam abort system. *Production, commissioning and operation in collaboration with CERN-BE (R/O electronics) and OSU (sensor supply).*

  - **DBM**: Luminosity telescopes with pixelated diamond sensors using single FE-I4 pixel chip. Installed with IBL. Construction deficiencies rendered several modules non-operational. Foreseen usage as bunch-by-bunch luminometer with single planes and adaptive fiducial region. *Production, commissioning and operation in collaboration with Bonn, CERN, OSU and Toronto.*
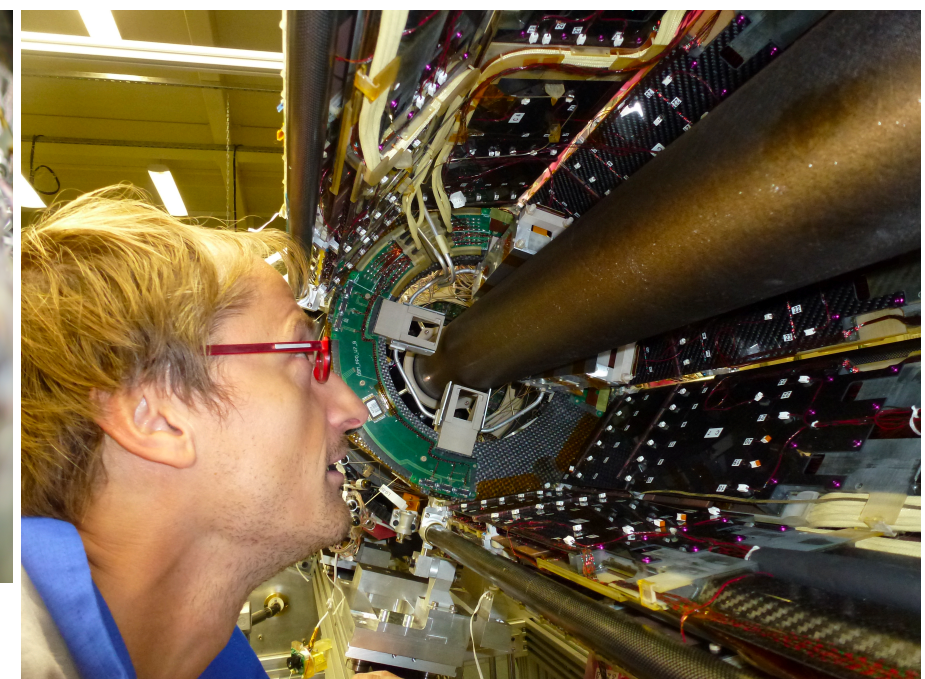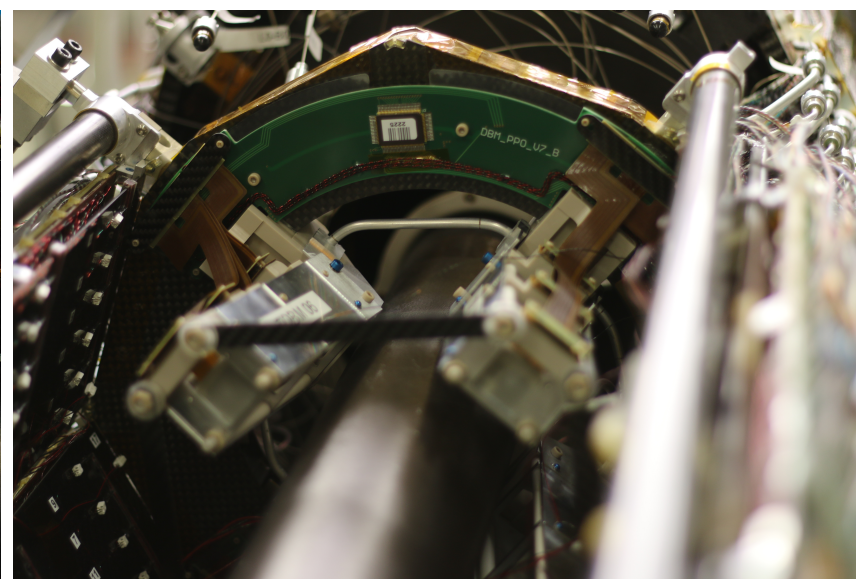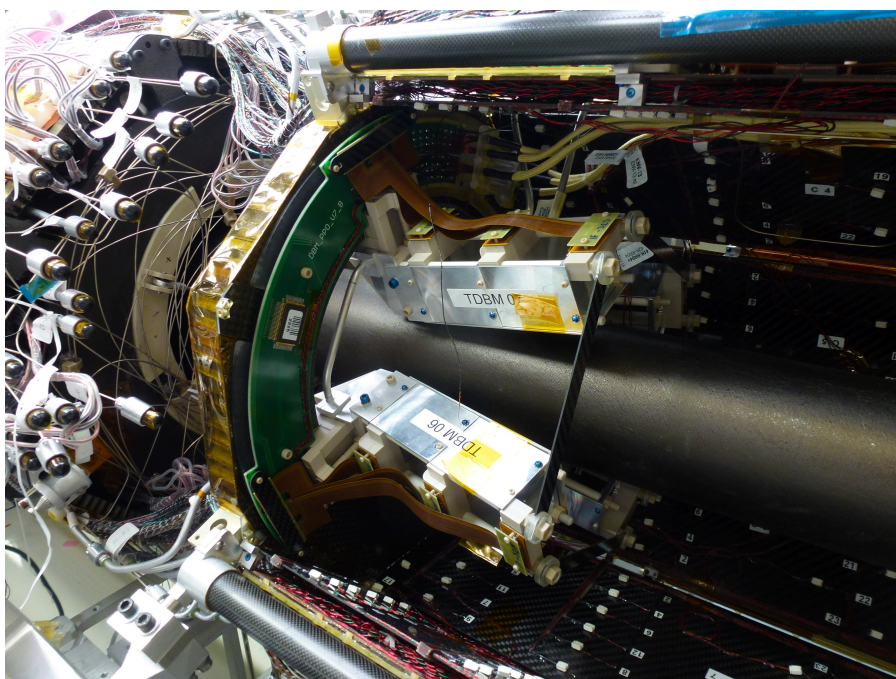
ATLAS Hardware

- **Sub-detector development:**

 - **BCM**: Bunch by bunch safety device with MIP sensitivity and sub-ns timing. Installed in ID volume at r=55 mm and z=1.9 m. Used for beam diagnostics. Can abort the beam upon anomalous conditions. Was used as primary on-line luminometer during Run 1. *Lead institute for production, commissioning and operation.*

  - **BLM**: LHC machine beam protection system with diamond sensors replacing ionization chambers. Installed around the beam pipe at ID end plate. Integrates ionization current for 40 us (and repetitive factors of 2 longer). Connected to the LHC beam abort system. *Production, commissioning and operation in collaboration with CERN-BE (R/O electronics) and OSU (sensor supply).*

  - **DBM**: Luminosity telescopes with pixelated diamond sensors using single FE-I4 pixel chip. Installed with IBL. Construction deficiencies rendered several modules non-operational. Foreseen usage as bunch-by-bunch luminometer with single planes and adaptive fiducial region. *Production, commissioning and operation in collaboration with Bonn, CERN, OSU and Toronto.*

ATLAS Hardware

- **Specific development and testing of sub-system components:**

  - **Radiation monitors:** Radiation monitoring is useful to cross check radiation background simulations and to understand radiation damage in sensors and readout electronics. *Development, production installation and maintenance of online radiation monitoring system in ATLAS.*
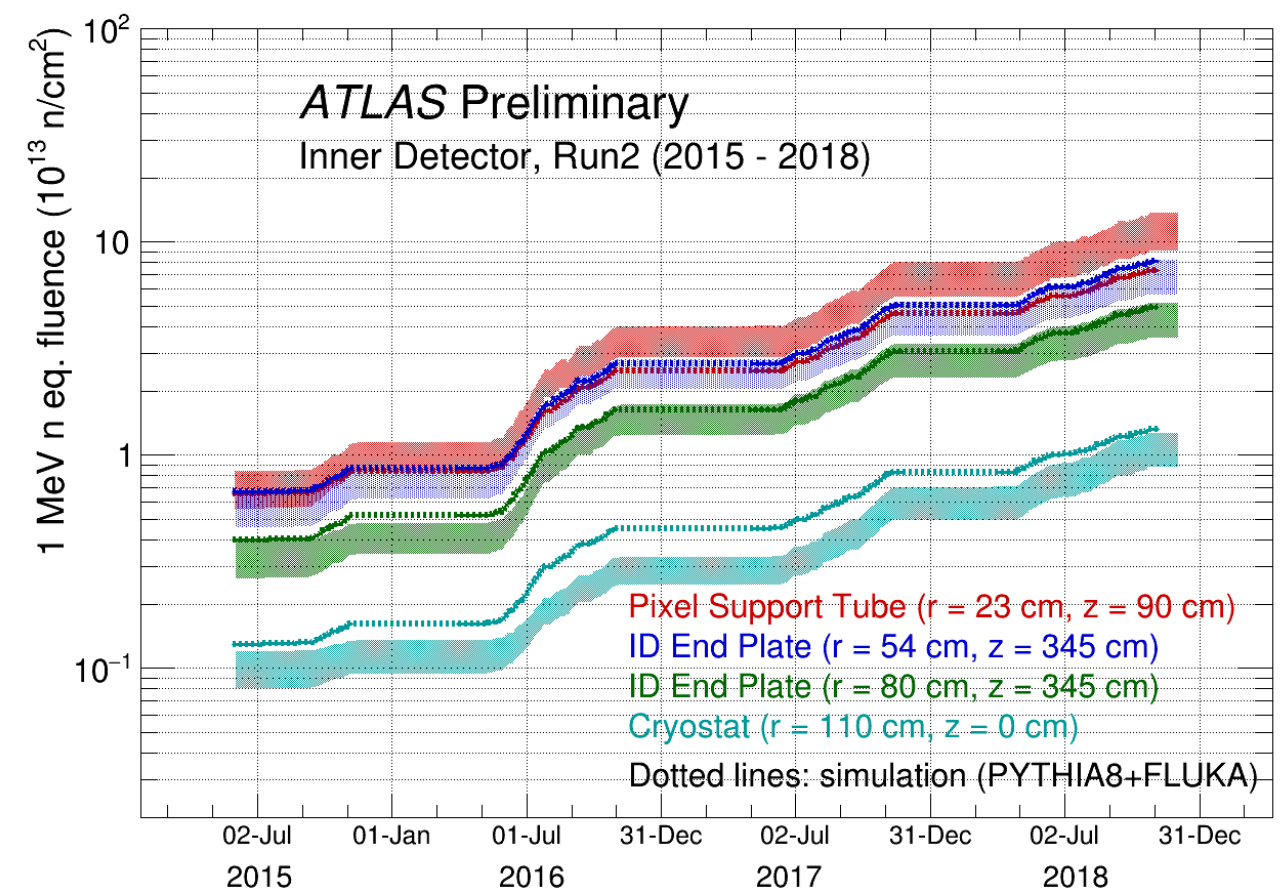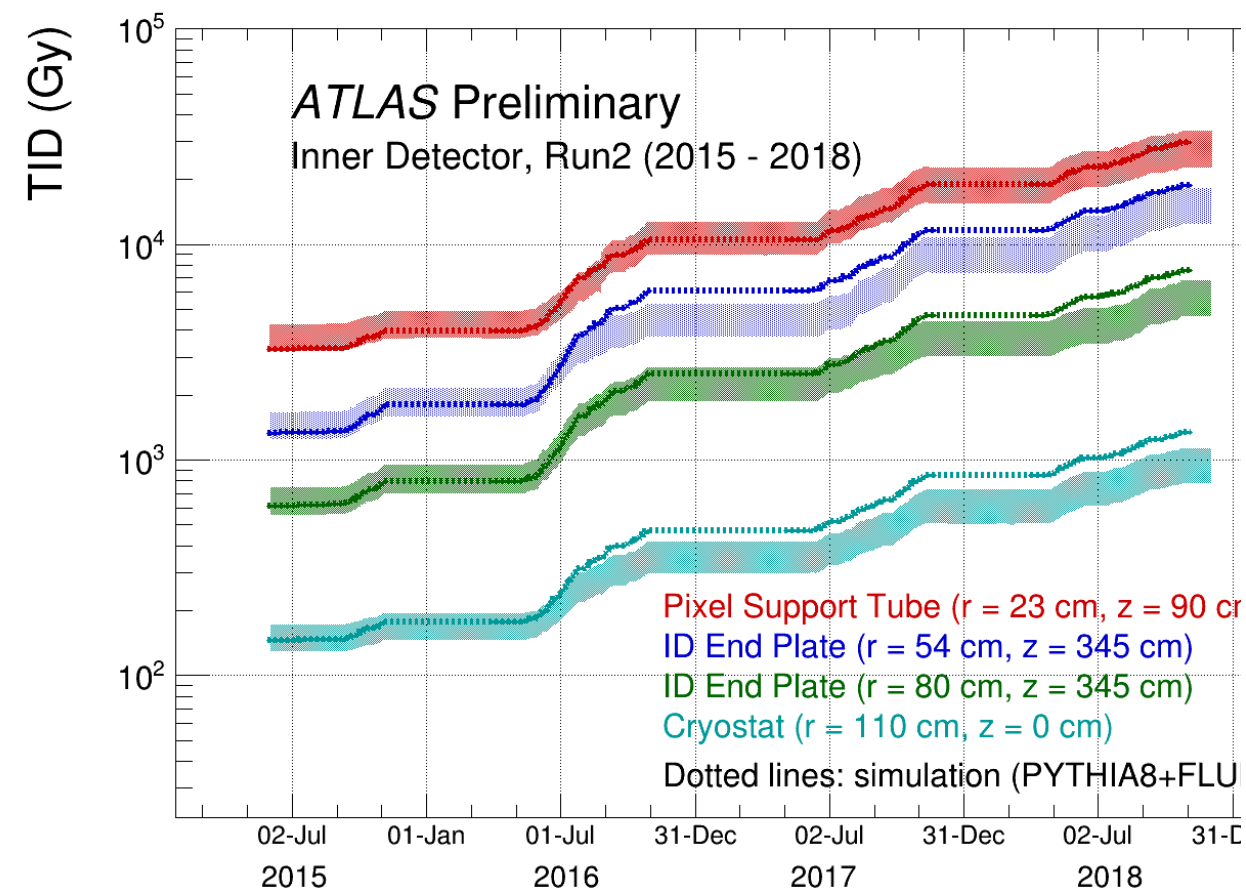

Measurement and simulation of TID and 1 MeV eq. neutron fluences vs time in Inner Detector in Run 2

ATLAS Hardware

- **Specific development and testing of sub-system components:**

  - **SCT:**
    - irradiation studies of SCT front end readout chips (ABCD3T),
    - radiation quality assurance during ABCD3T chip production,
  - **Radiation hardness study of n-p silicon detectors:**
    - irradiation studies and QA for ITk strip sensors for ATLAS upgrades,
    - charge collection studies of CMOS pixel detectors for ATLAS upgrade.

  - **Irradiation performed at the JSI research reactor TRIGA in Podgorica.**
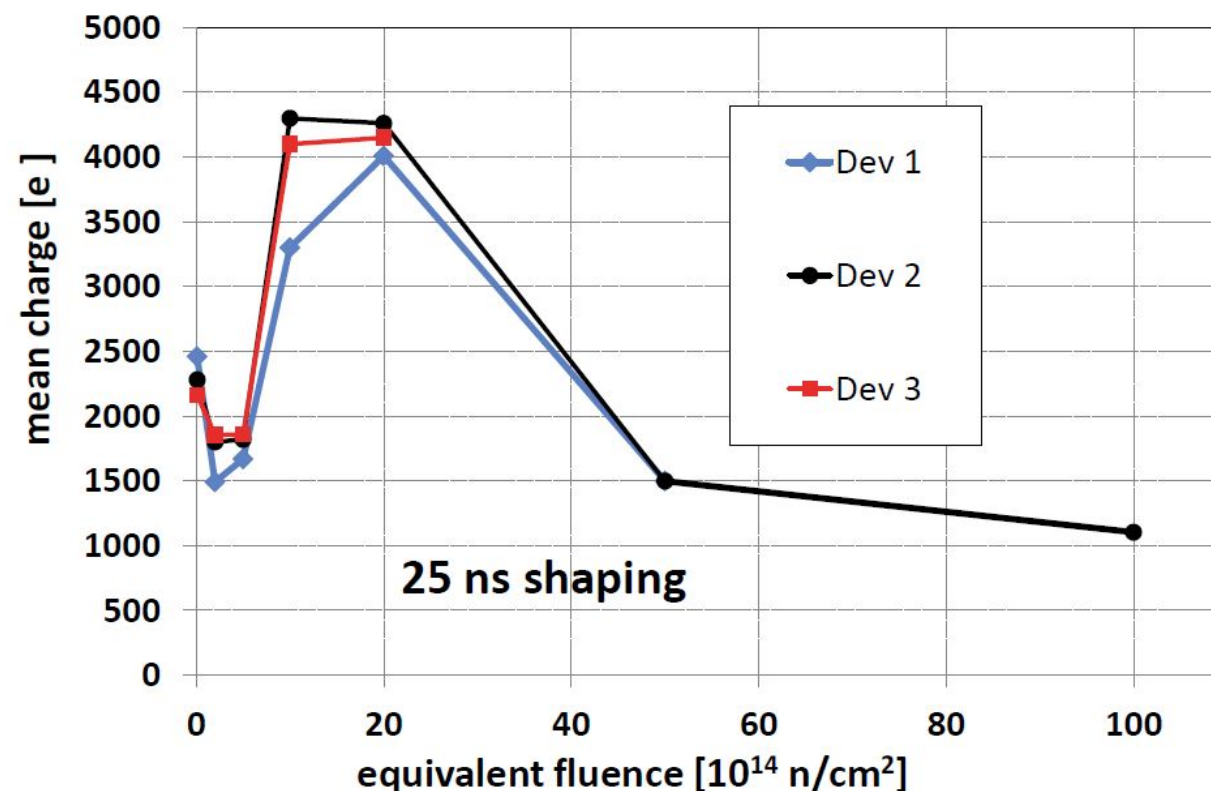
From: 2016 JINST 11 P04007
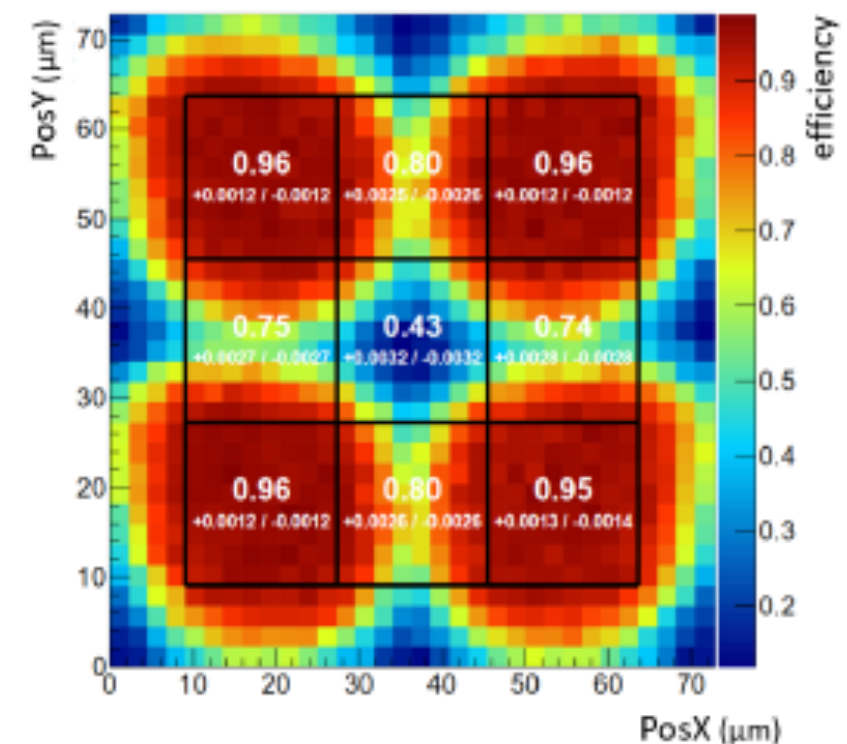
From B. Hiti et al., PoS (in preparation)

ATLAS Hardware

- **Specific development and testing of sub-system components:**

  - **Low mass tapes for SCT:** development of industrial process in collaboration with ELGOLINE.
    - About 4000 flexible tapes with a length up to 4 meters. 2 layers, Al and Cu conductors, radiation hard,
      http://merlot.ijs.si/~cindro/low_mass.html
  - **Flexible heaters for ATLAS, voltage controllers, cable testers…**
    - Successful collaboration with the Slovenian industry!
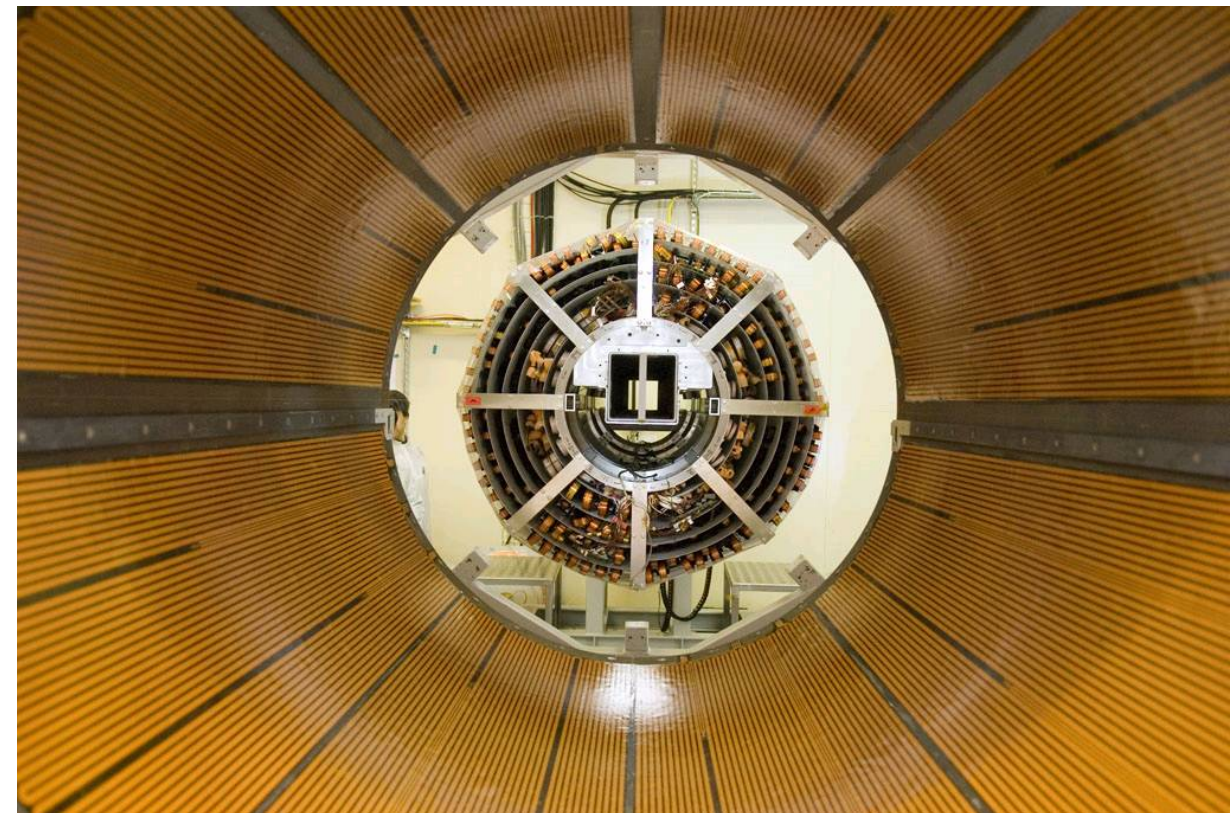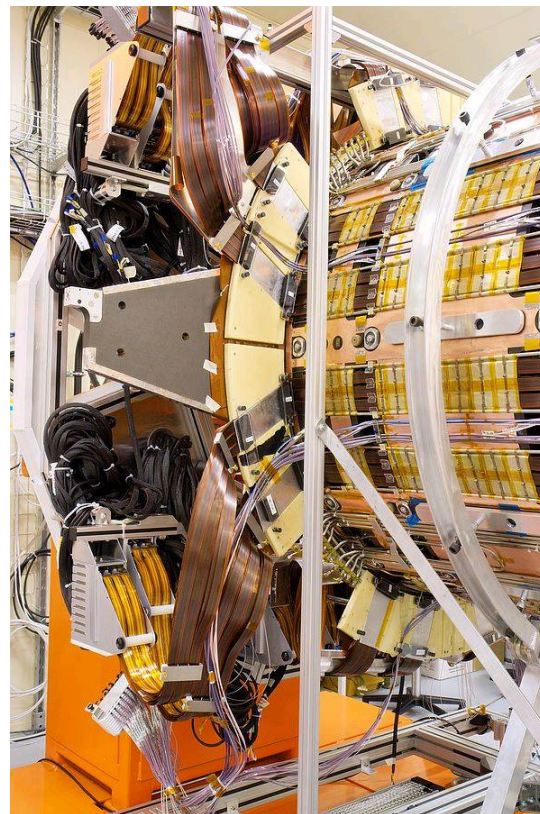
ATLAS Hardware: Upgrade

- **Hardware for ATLAS upgrade(s): R&D and production:**

  - **BCM prime:** Fast beam monitoring device (sub-ns timing) with two monitoring levels: MIP and "very large" signals. Diamond sensors and custom CMOS FE tailored to the two signal levels. Installed in inner end-cap pixels of ITk. MIP can be used for luminosity and beam background monitoring, "very large": aims at beam anomalies dangerous for ATLAS. Slow, integrating BLM system integrated in installation package.
  - **Irradiation tests:** Charge collection studies of ATLASI ITk strip sensors, irradiations of sensors, electronics and materials at the TRIGA research reactor.
  - **HV CMOS:** Studies (and explanation of radiation dependence of) charge collection mechanisms in various HV-CMOS prototypes, Edge-TCT measurements, test beam with Ljubljana beam telescope.
  - **Flexible circuits for endcap ITk:** flexible multilayer circuits assembled with carbon corres and used as local support for silicon modules, distribution of electrical signals, control levels at transmission of digital signals with frequencies up to 650 MHz
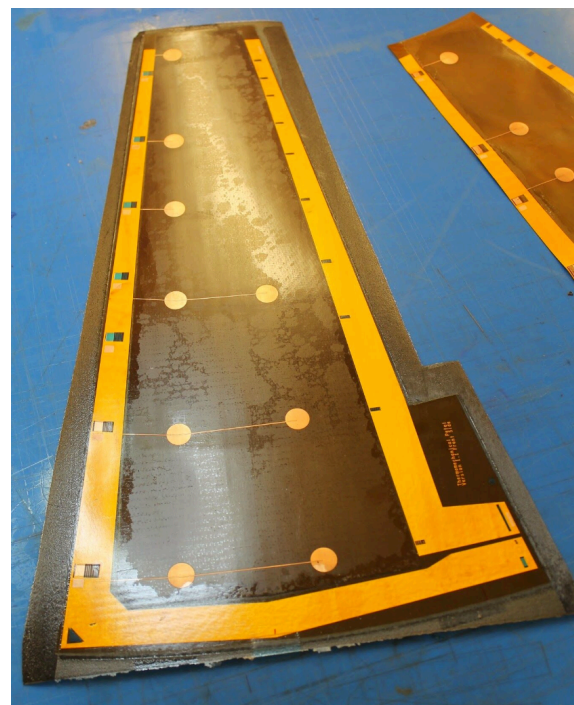
ATLAS Software

- **In the past, strong involvement Monte Carlo generators :**
  - **Development of the AcerMC generator** for main backgrounds involving heavy quarks and electroweak bosons (used e.g. for the Higgs discovery analyses).
  - **Development and support of ATLAS MC generator software:**
    - Interfaces to MC generators and grid production wrappers (job transforms)
    - Interfaces to dedicated MC generators Tauola, Photos, Pythia, …
  - **Expert work on MC generator implementations and use:**
    - In particular Pythia expertise (tuning, jet/QCD systematics).

ATLAS Software

- **Participating in ATLAS simulation software development:**
  - implementing the pile-up simulation chain for grid production (including beam gas, halo, etc…).
  - Participation in the development of the fast calorimeter simulation update.
  - Participation of the very fast simulation and digitization of the Inner detector.
  - Work on central analysis software.
  - **MC+MC pile-up overlay method implementation and validation:**
    - Will be used in production even before Run 3. (Performance: https://atlas.web.cern.ch/Atlas/GROUPS/PHYSICS/PLOTS/SIM-2018-002/)
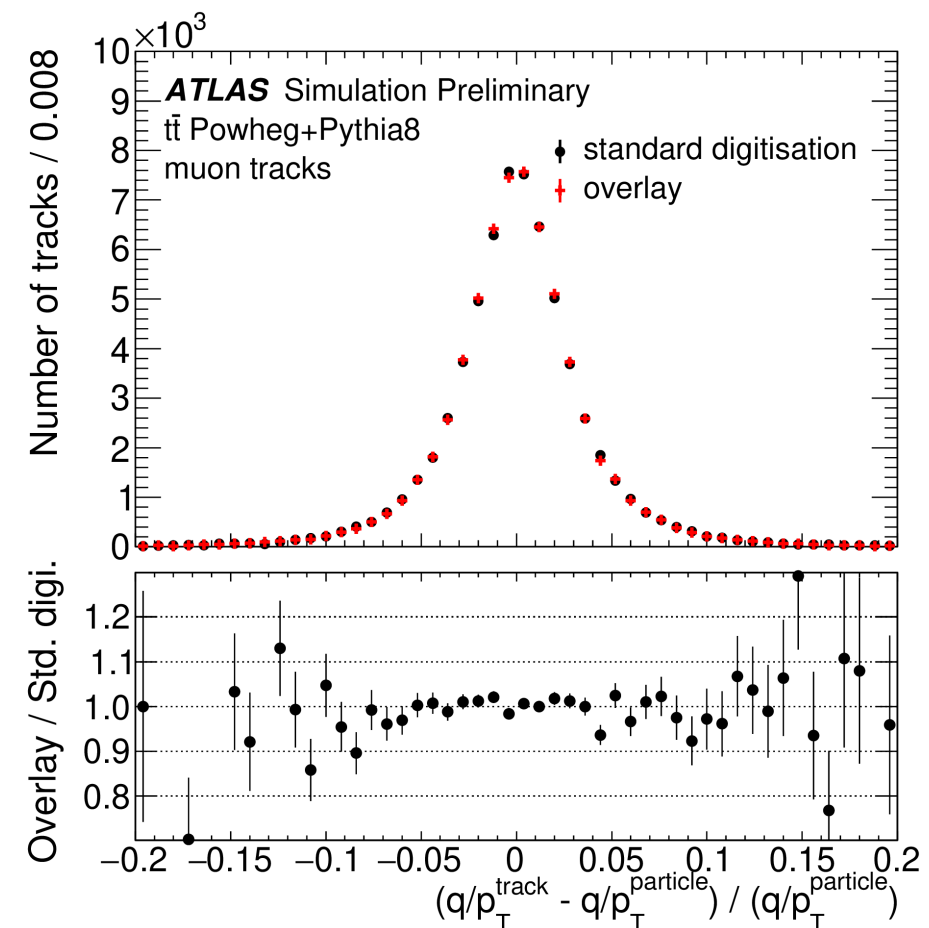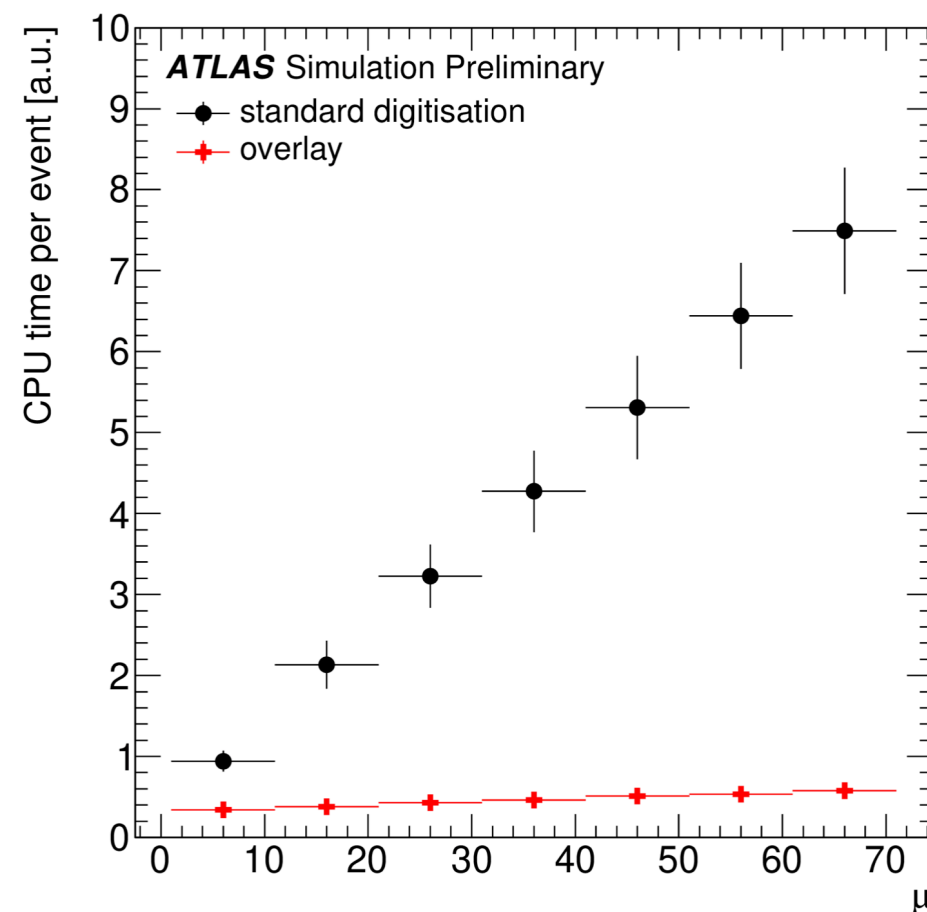
ATLAS Software & Computing

- **ATLAS Distributed Computing software and Computing:**

  - participating in the MC production chain setup, user interfaces, group production …
  - ADC core software: ATLAS ControlTower interface between ADC system, NorduGrid ARC and dedicated resouces (clusters, HPCs…).
    - **….more in Andrej's talk.**

ARC Control Tower
A flexible generic distributed job management framework

J.K. Nilsen[1], D. Cameron[2] and A. Filipčič[3]

[1] University Center for Information Technology, University of Oslo
[2] Department of Physics, University of Oslo
[3] Department of Experimental High Energy Physics, Jozef Stefan Institute

E-mail: j.k.nilsen@usit.uio.no, david.cameron@cern.ch, Andrej.Filipcic@ijs.si

Abstract. While current grid middleware implementations are quite advanced in terms of connecting jobs to resources, their client tools are generally quite minimal and features for managing large sets of jobs are left to the user to implement. The ARC Control Tower (aCT) is a very flexible job management framework that can be run on anything from a single users laptop to a multi-server distributed setup. aCT was originally designed to enable ATLAS jobs to be submitted to the ARC CE. However, with the recent redesign of aCT where the ATLAS specific elements are clearly separated from the ARC job management parts, the control tower can now easily be reused as a flexible generic distributed job manager for other communities. This paper will give a detailed explanation how aCT works as a job management framework and go through the steps needed to create a simple job manager using aCT and show that it can easily manage thousands of jobs.

ATLAS Operations

- **Participation in the ATLAS Online, Upgrade and Computing operations:**
  - **Computing:** Participating in ADC operations and operating the Slovenian Tier-2.
    - **….more in Andrej's talk.**
  - **Online operations:**
    - ATLAS control room shifts at P1:
      - Shift leaders, Run Manager,
      - BCM, BLM, DBM: DAQ and DCS experts, run coordinator.
  - **Upgrade operations:**
   - Upgrade Construction: Phase-II ITk.
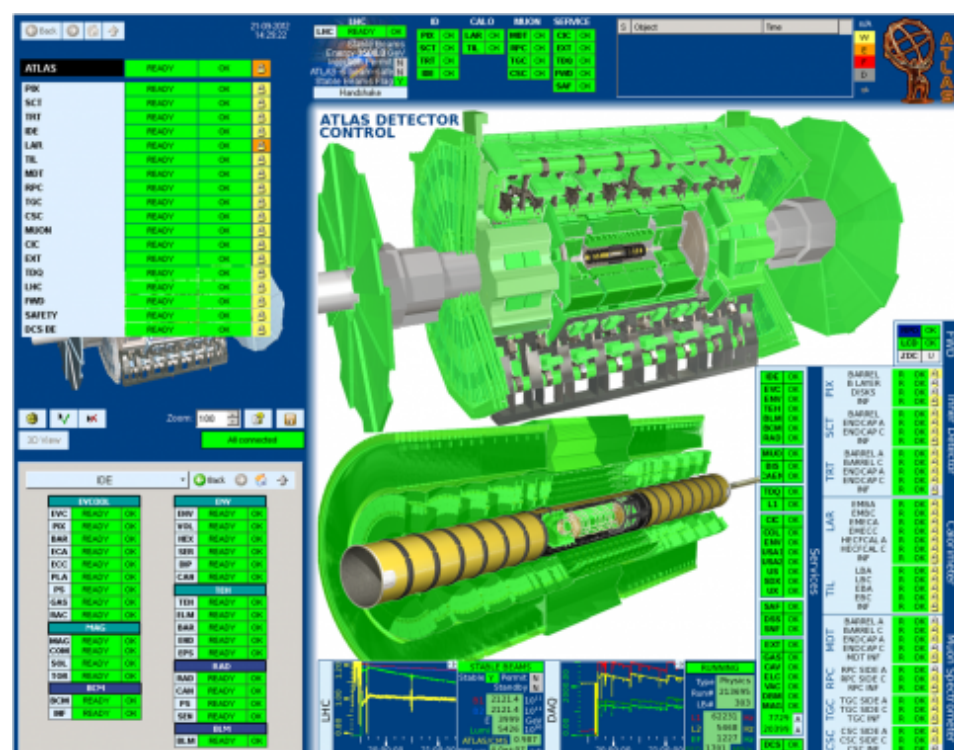
ATLAS Physics & Performance

- **Participation in several physics analyses and dedicated performance studies:**
  - **Performance studies before data taking:**
    - invisible Higgs searches at ATLAS.
    - Top quark mass determination: QCD systematics studies.
  - **Data analyses in the Exotics group:**
    - Search for electron-jets.
    - Same sign final states, joint multi-lepton 'analysis cluster':
      - H++ search,
      - W_R heavy neutrino search,
      - Type III Seesaw search (current) and
      - New physics search using weak boson polarization studies (starting).
  - **Performance studies:**
  - Work on the charge flip probability and software and on the fake backgrounds determination.
  - Charge flip performance studies for HL-LHC upgrade (TDR contribution).

Identification of electron jets: f_{EM}

In electron-jets, the electrons typically deposit all of their energy in the electromagnetic calorimeter → require high electromagnetic fraction
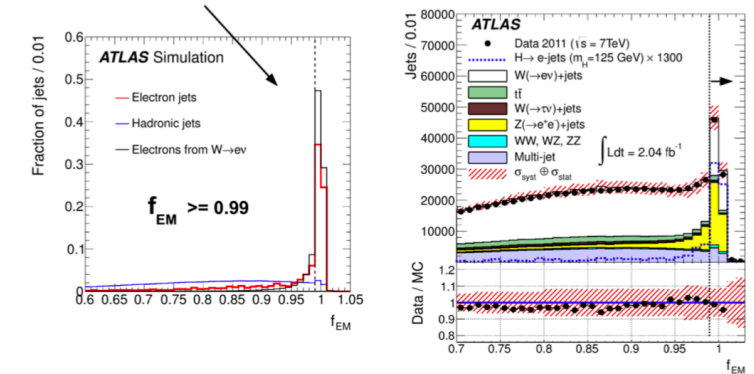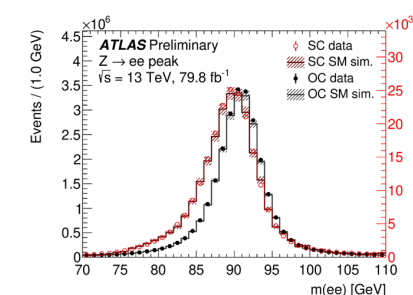
Electromagnetic fraction f_{EM} – the fraction of the jet energy deposited in the electromagnetic calorimeter divided by the total jet energy deposited in both the electromagnetic and hadronic calorimeters

A. Tykhonov (University of Ljubljana)   Doctoral dissertation: Searches for dark matter and lepton jets with the ATLAS detector

Lower limit on m(H±±) at 95% CL

Free parameters:
$B(H^{\pm\pm} \to e^\pm e^\pm) +$
$B(H^{\pm\pm} \to e^\pm \mu^\pm) +$
$B(H^{\pm\pm} \to \mu^\pm \mu^\pm) = B(H^{\pm\pm} \to \ell^\pm \ell^\pm)$

- The mass limit is derived for all combinations of the partial branching ratios.
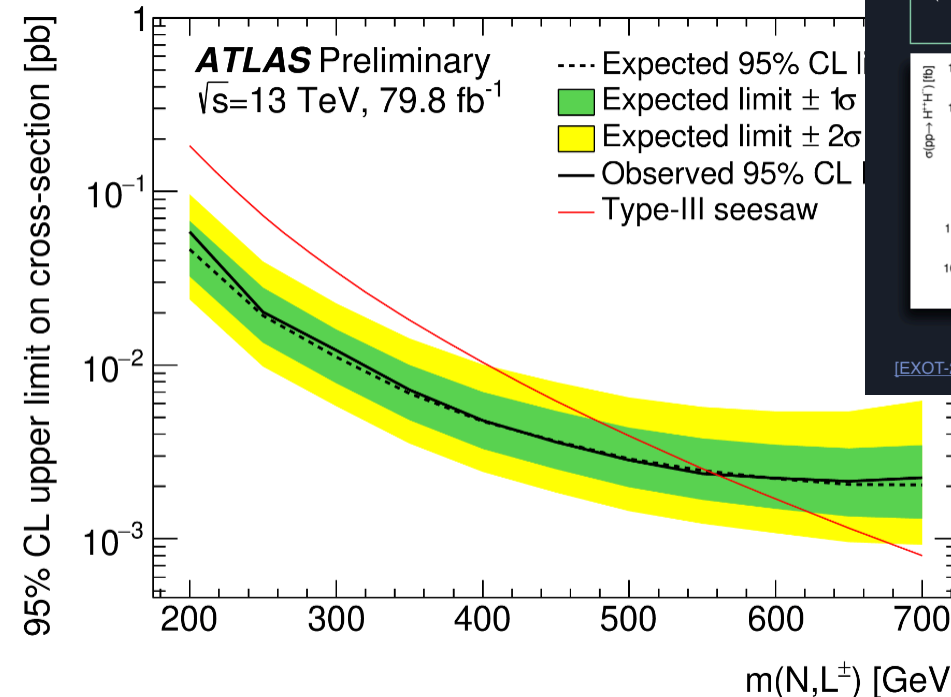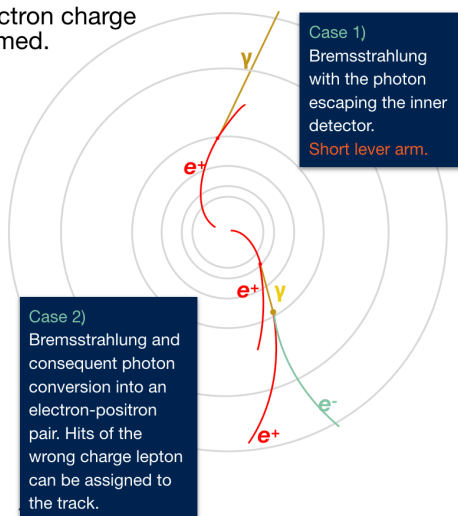
[EXOT-2016-07]

18

Electron charge misidentification

- **In type III seesaw analysis the same-sign charge final state is a distinct signature.**
- Calibration and validation of electron charge misid. modeling in MC is performed.

At typical energies ($p_T < 1$ TeV) charge misID is caused predominantly by bremsstrahlung.

The probability is about 1% at the Z peak.

Case 1) Bremsstrahlung with the photon escaping the inner detector. Short lever arm.

Case 2) Bremsstrahlung and consequent photon conversion into an electron-positron pair. Hits of the wrong charge lepton can be assigned to the track.

ATLAS Preliminary
$\sqrt{s}$=13 TeV, 79.8 fb^{-1}

- - - - Expected 95% CL
Expected limit ± 1σ
Expected limit ± 2σ
—— Observed 95% CL
—— Type-III seesaw

95% CL upper limit on cross-section [pb]

m(N,L$^\pm$) [GeV]

Highest responsibilities since LHC startup

Collaboration Board
(Chair: M. Klein
Deputy: A. Nisati)

ATLAS Plenary Meeting

Resources Review Board

CB Chair Advisory Group

Spokesperson
(K. Jakobs
Deputies: A. Hoecker, M. Vincter)

ATLAS Organization March 2019
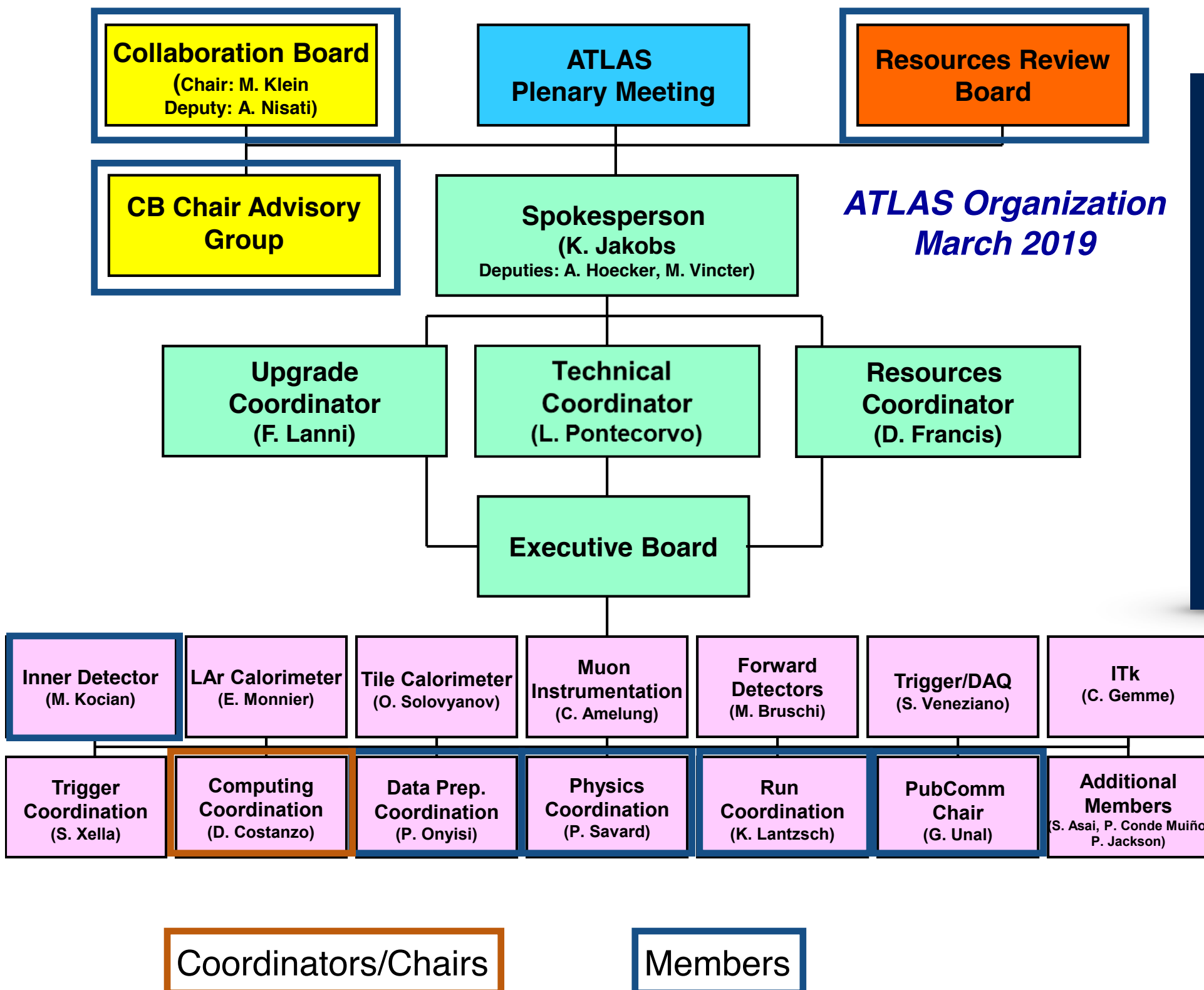
- **CB Chair Advisory Board member**
- **Computing Coordinator**
- **ADC Coordinator**
- **Run Manager**
- **Pub. Comm. member**
- **MC Prod. manager**
- **MC Phys. Group convener**
- **SCT IB Chair**
- **ADC Operation Coordinator**
- **DCC group convener**
- **ADC WFMS Coordinator**
- **Computing Speakers Committee chair**

Upgrade Coordinator
(F. Lanni)

Technical Coordinator
(L. Pontecorvo)

Resources Coordinator
(D. Francis)

Executive Board

Inner Detector
(M. Kocian)

LAr Calorimeter
(E. Monnier)

Tile Calorimeter
(O. Solovyanov)

Muon Instrumentation
(C. Amelung)

Forward Detectors
(M. Bruschi)

Trigger/DAQ
(S. Veneziano)

ITk
(C. Gemme)

Trigger Coordination
(S. Xella)

Computing Coordination
(D. Costanzo)

Data Prep. Coordination
(P. Onyisi)

Physics Coordination
(P. Savard)

Run Coordination
(K. Lantzsch)

PubComm Chair
(G. Unal)

Additional Members
(S. Asai, P. Conde Muiño, P. Jackson)

Coordinators/Chairs

Members

Summary

- **The Slovenian ATLAS group aims to fully participate in all ATLAS activities…**
  - … as much as it can, given its size. We have to rely on quality rather than quantity.
  - **We are are often limited to individual involvement in diverse activities, meaning that long-term commitments to projects are difficult.**
    - We try to maintain our hardware activities and collaboration with industry.
- **We fulfil all membership obligations and sometimes (e.g. in Computing) even exceed them.**
  - We are of course also fully engaged in the ATLAS physics exploitation, in particular in new physics searches.
    - **Again, we rely on our students to compete with often larger teams… but we are lucky to get very good students!**