

Swedish involvement in
**detector operation, data quality and physics
object performance of the ATLAS detector**

Partikeldagarna 2019, Linköping

Laura Pereira Sánchez
on behalf of ATLAS Sweden



**Stockholm
University**



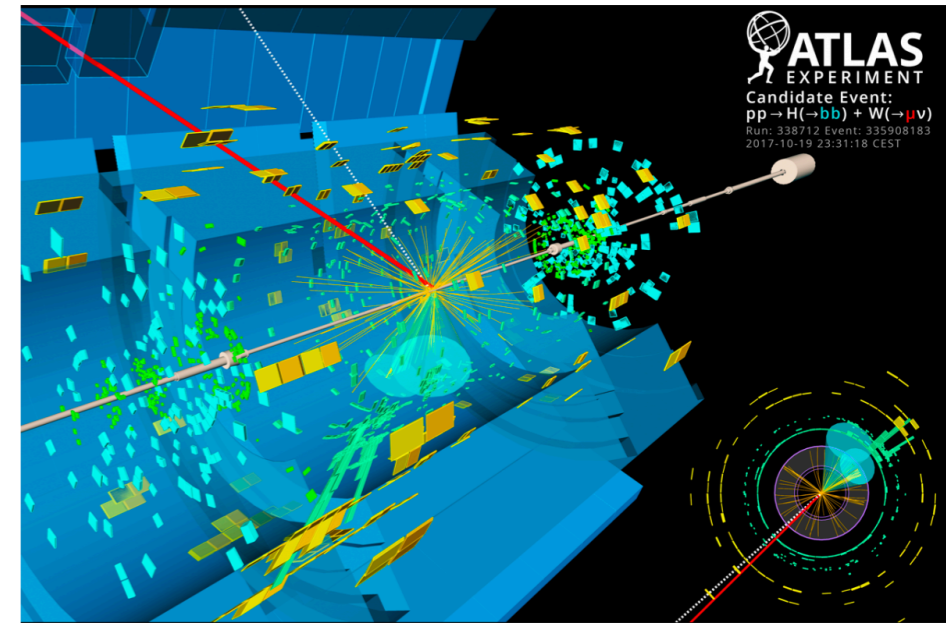
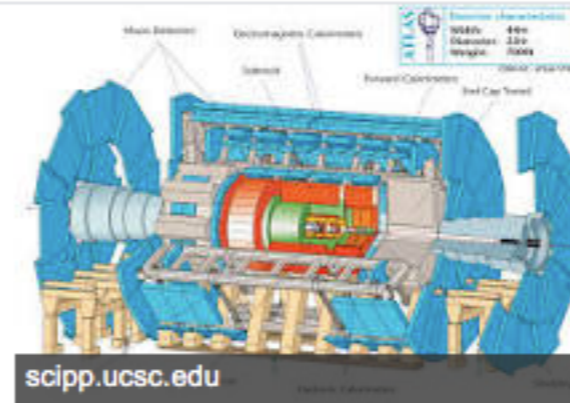
ATLAS experiment



atlas experiment

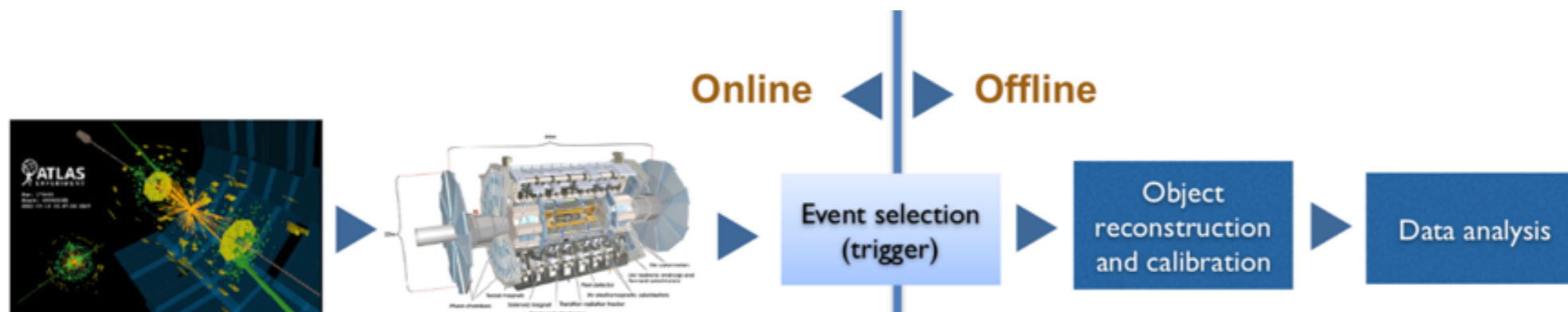


The **ATLAS experiment** is one of four large **experiments** at the Large Hadron Collider (LHC) facility at CERN, and one of two general-purpose detectors designed to explore a wide range of questions about the fundamental constituents of matter and the forces of nature. 7 dic. 2017



The ATLAS experiment - Department of Physics - Fysikum
<https://www.fysik.su.se> › english › instrumentation-physics › research-projects

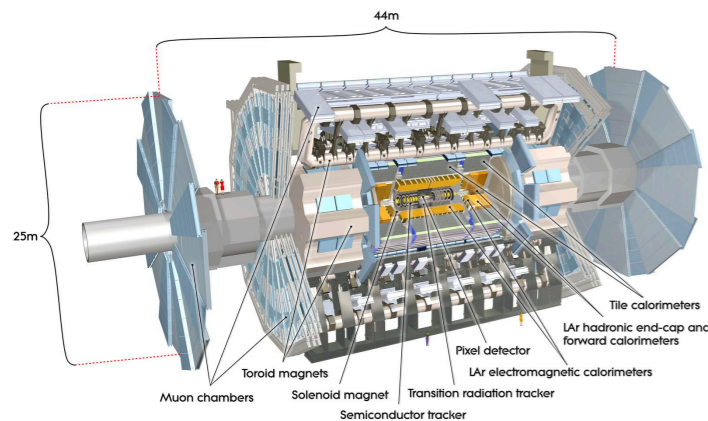
This talk will focus on all the “behind the scenes” work which is required to be able to do the physics analysis you will hear about in the following talks.



ATLAS in Sweden



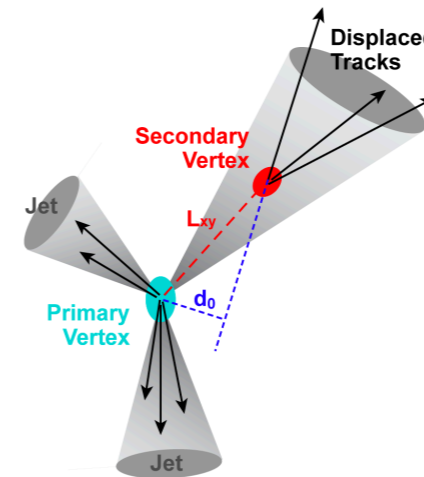
Everyone contributes to detector operation, data quality and object performance in some way



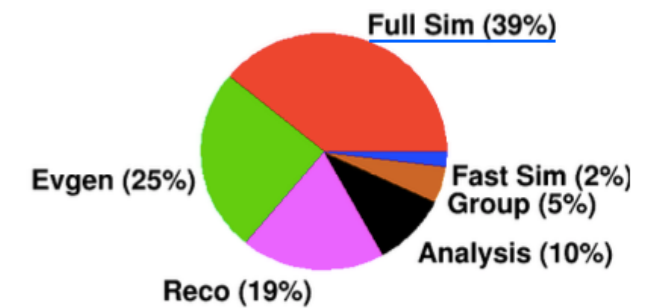
Detector calibration



Trigger



Object reconstruction

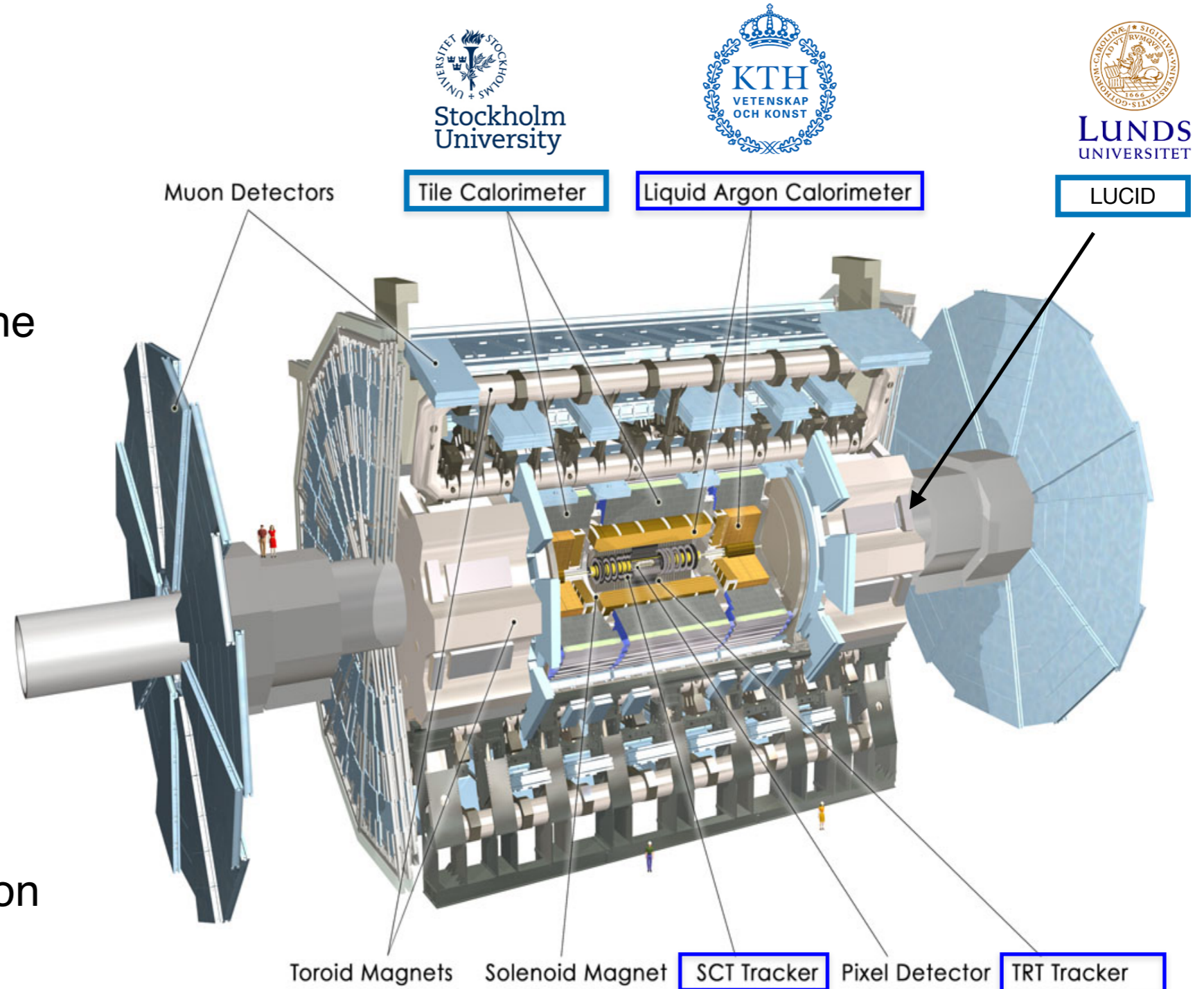


Wall clock time fraction for grid and HPC jobs
July 2015 - July 2016

Computing & data preparation

Detector design, construction & operation

- ATLAS comprises about 3000 scientific authors from 183 institutions around the world, representing 38 countries from all the world's populated continents.
- Sweden has had an important contribution in the detector. I will focus on detector calibration.



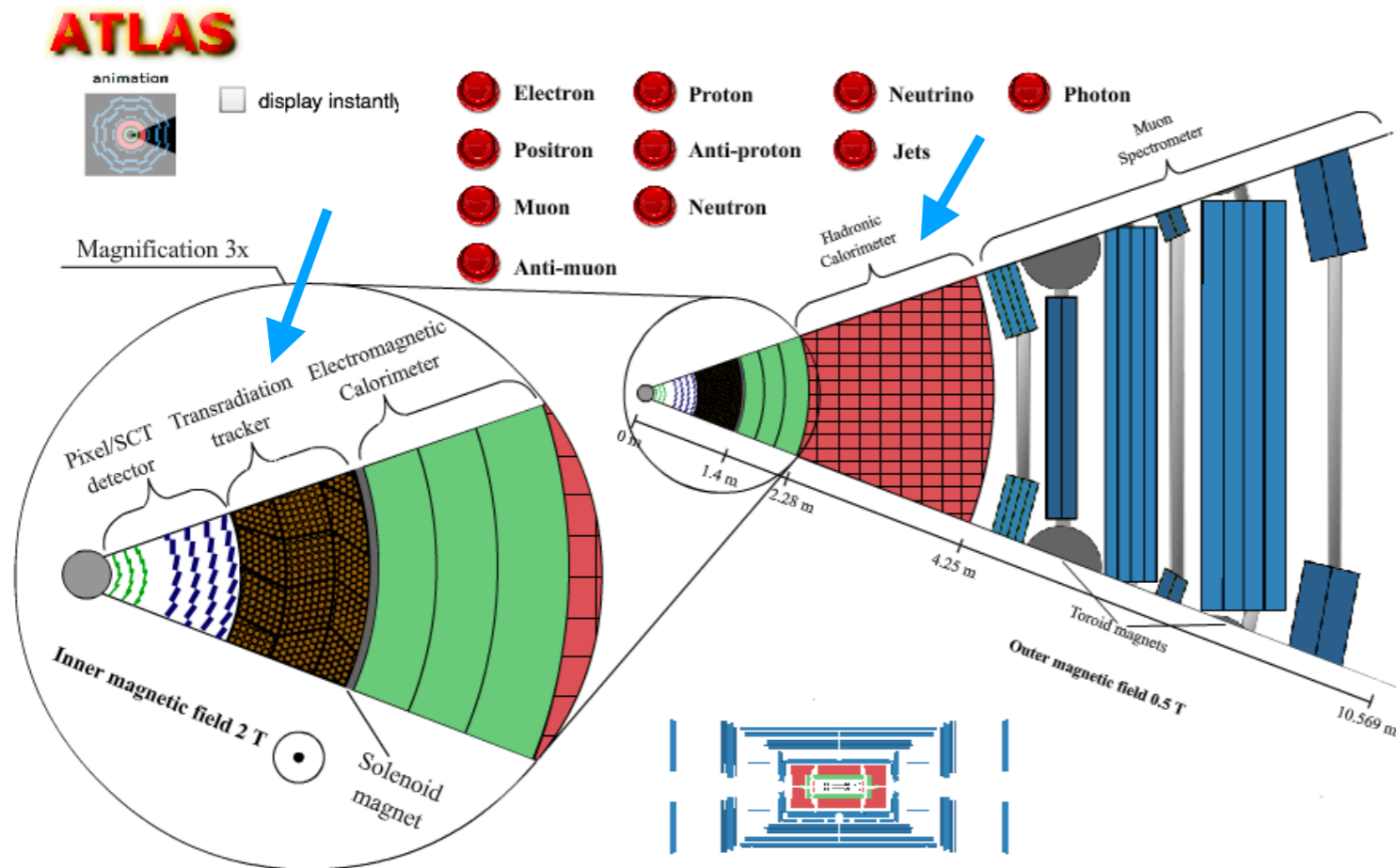
Detector Calibration

ATLAS Sweden works in

- Inner detector: Transition Radiation Tracker (TRT)
- Hadronic Calorimeter: Tile Cal



Visit at the ATLAS cavern during CERN open days

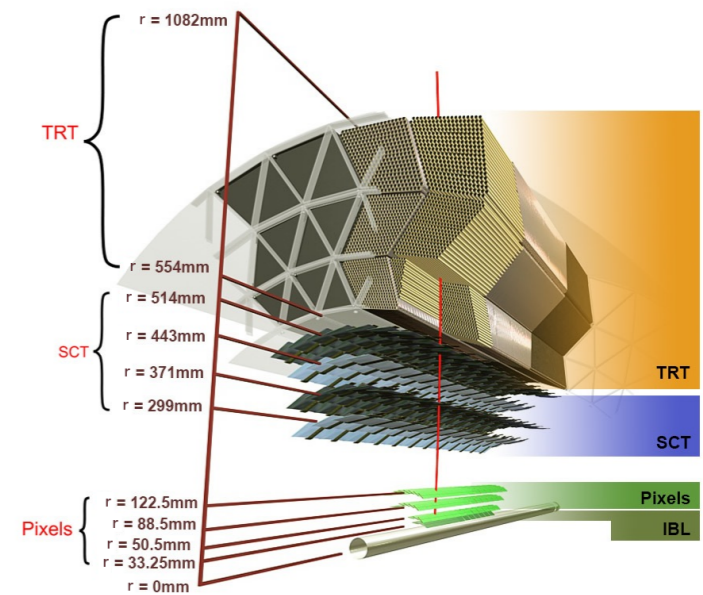


Created by T. Herrmann, O. Jeřábek, K. Jende, M. Kobel

Detectors need to be calibrated comparing data and simulation to ensure good physics results!

TRT

- Outer tracker with important contributions to electron identification.
- Calibration necessary to achieve the highest position resolution and the best momentum reconstruction.
- Very few data affected by “bad calibration” in Run 2, less than 1(2)% for 2016(2017).



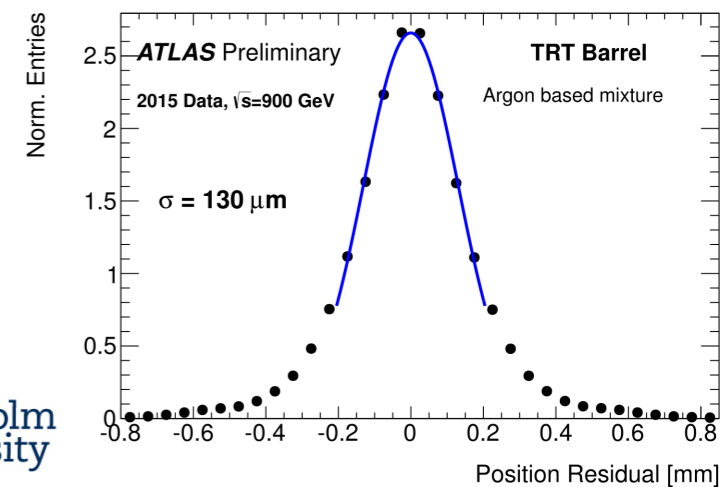
Katja Mankinen, Ruth Pöttgen, Eleni Skorda, Nathan Simpson, Else Lytken

Tile Cal

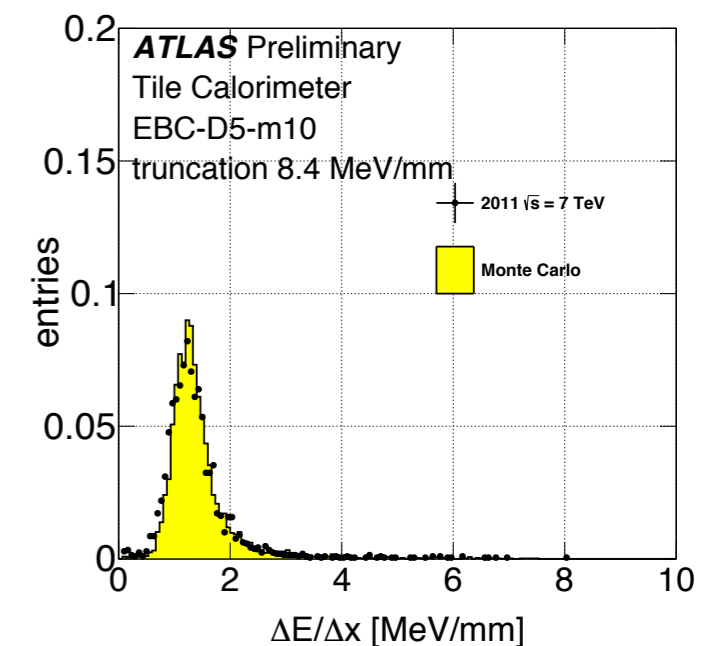


- Measure energy and momentum of hadrons. Important for missing momentum and jet reconstruction.
- Cell-by-cell energy calibration using energy deposited by muons produced in $W \rightarrow \mu \nu$ collisions.
- Electronic Noise calibrations and updates to the Conditions Database to have the correct energy reconstruction.

Stefio Yosse Andreato, Filip Backman, Christophe Clément & David Milstead



[ATLAS public plot link](#)



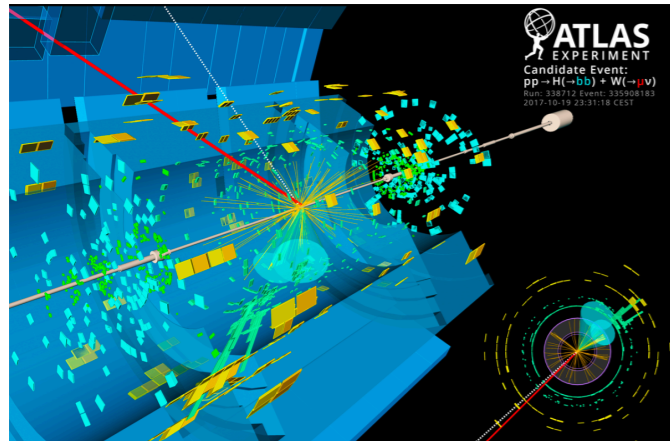
[ATLAS public plot link](#)

Trigger

40 million events (~ 1 billion pp collisions) per second

~75.000 ev/s after L1 trigger

~2000 ev/s after HLT trigger



Most interesting events need to be selected



ATLAS Sweden works in

- L1 Calo trigger
- Jet trigger

L1 Calo trigger

- Monitoring & calibration of L1 Calo trigger by comparing trigger and tile cal events during data taking period.

- Firmware

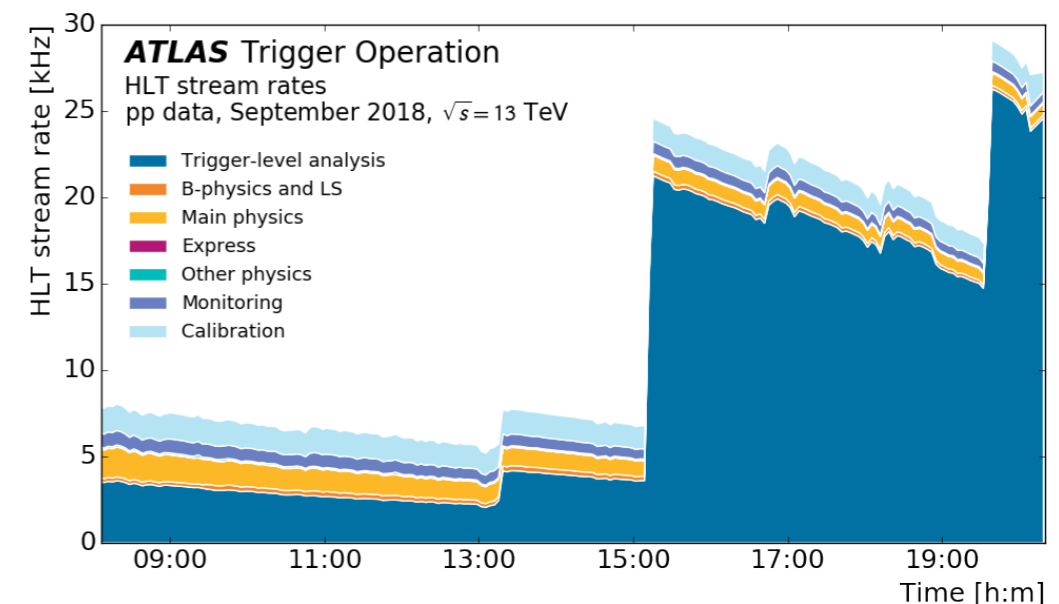
Sten Hellman, Nabila Shaikh & Sam Silverstein



Jet Trigger

Use energy deposits in the calorimeters to select events with jets.

- Lund group is responsible for jet trigger operations 2017-2019 and software special event recording.
- Deployed new technique for recording more events in less storage space. Planned future studies on ML for further data compression.
- Operation of new trigger board for Run 3 (gFEX)

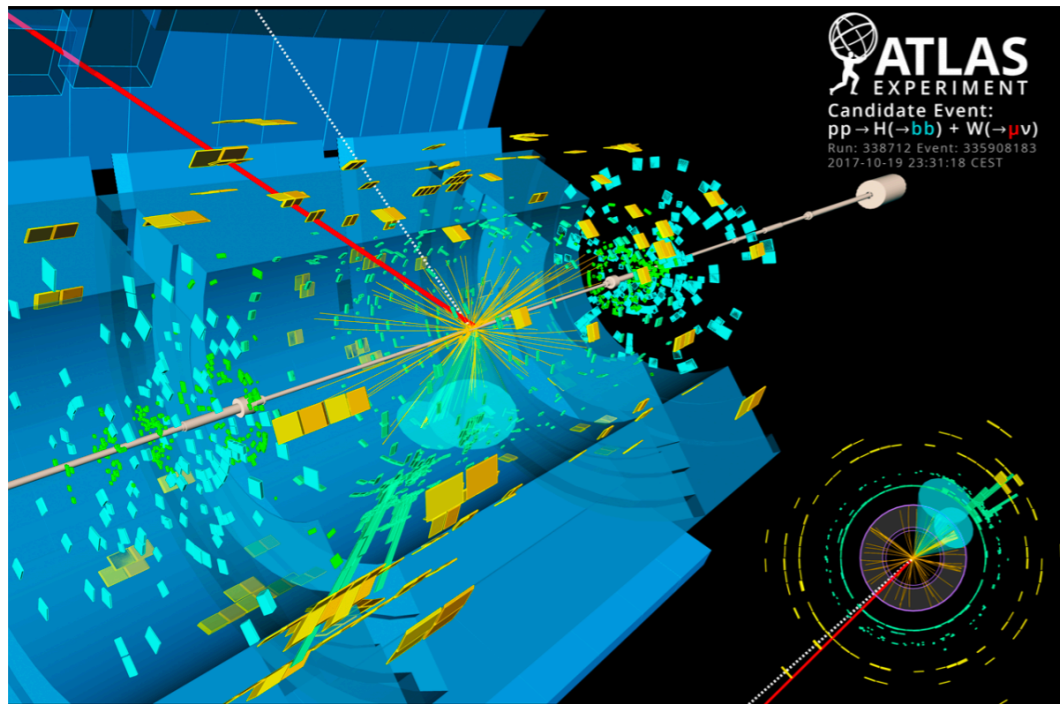


[ATLAS public plot link](#)

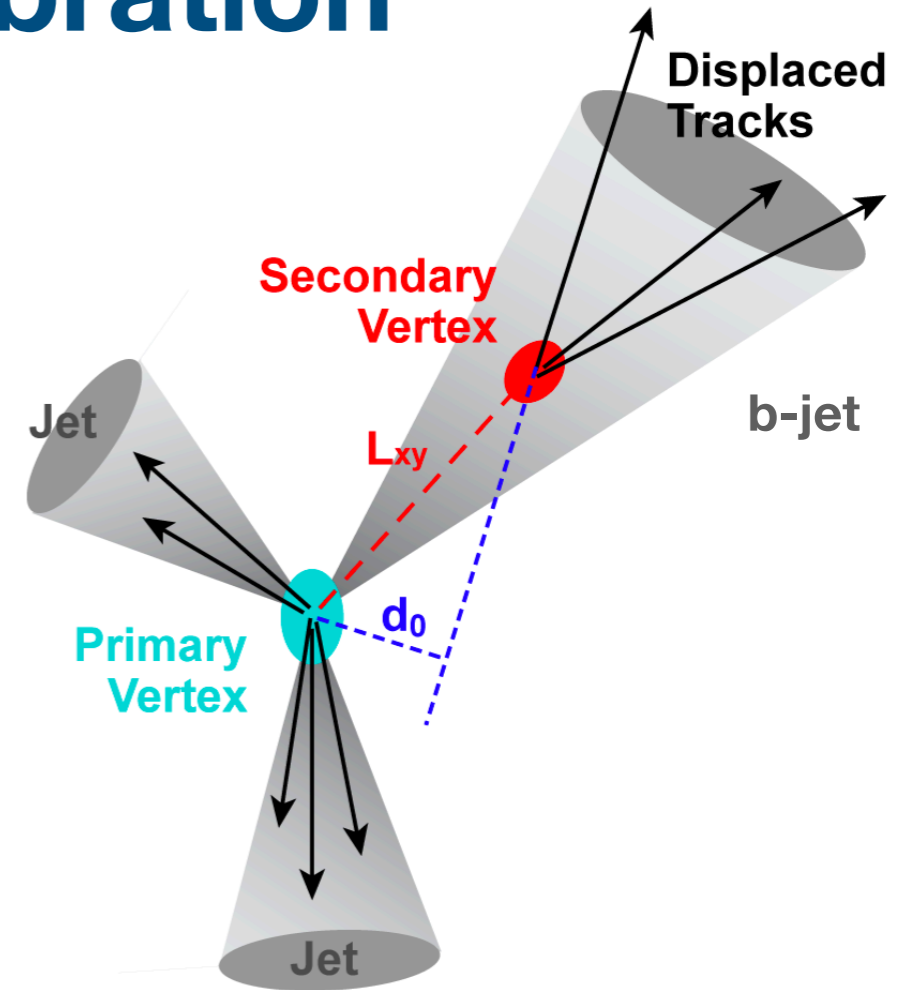
Will Calderon, Eva Hansen, Jannik Gensen & Caterina Doglioni



Object reconstruction & calibration



Tracks and energy deposits in the detector



Objects used in physics analysis

ATLAS Sweden works in

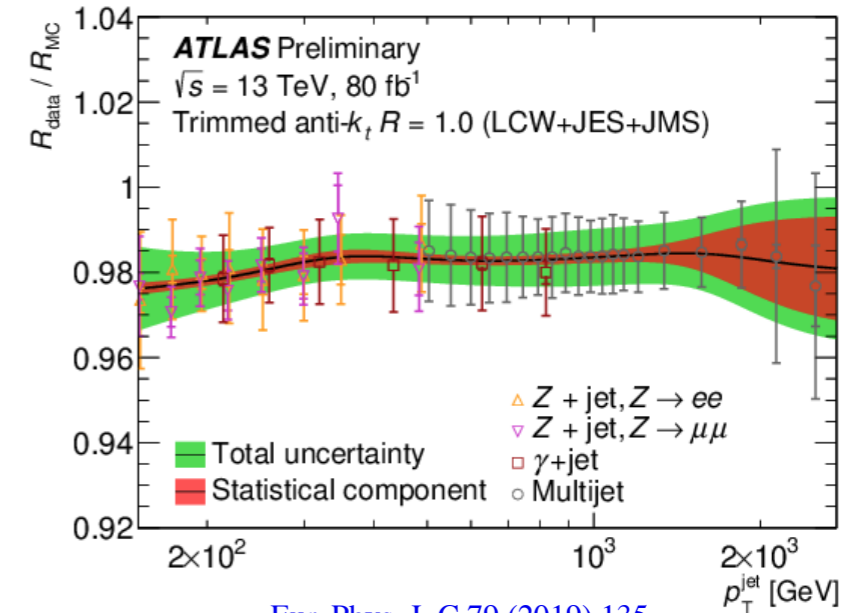
- Jet Performance
- B-tagged jets
- Fake taus estimation

jets, jets jets

Jet performance



- New jets definitions (PFlow) result in huge tagging performance gain.
- Residual “in-situ” calibration has been added to the calibration chain to reduce the large-radius Jet Energy Scale uncertainty.



[Eur. Phys. J. C 79 \(2019\) 135](#)

Eva Hansen, Michael Nelson & Christophe Clément

Fake taus estimation

Taus are the only leptons heavy enough to decay hadronically producing jets.

- A task force mandate for fake tau estimation was created early 2018, coordinated by Arnaud Ferrari to unify the fake-tau estimation.
- Measurement of fake factors & estimation of systematic uncertainties.

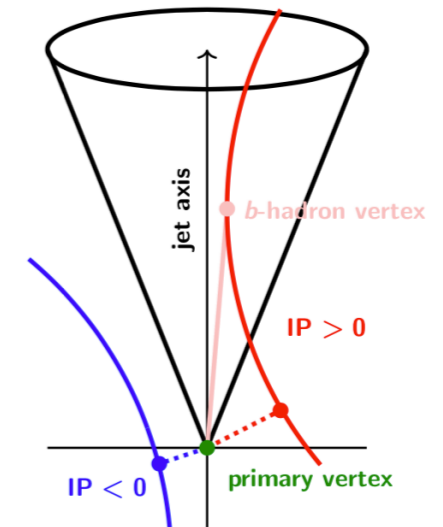
Myrto Asimakopoulou, Petar Bokan, Katja Mankinen, Arnaud Ferrari & Else Lytken



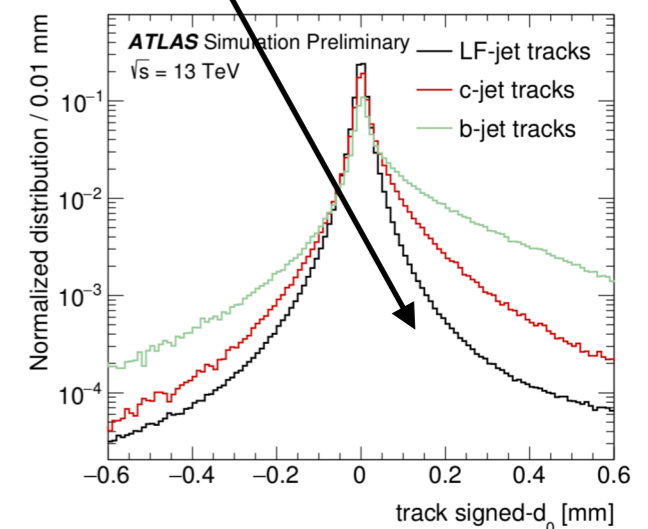
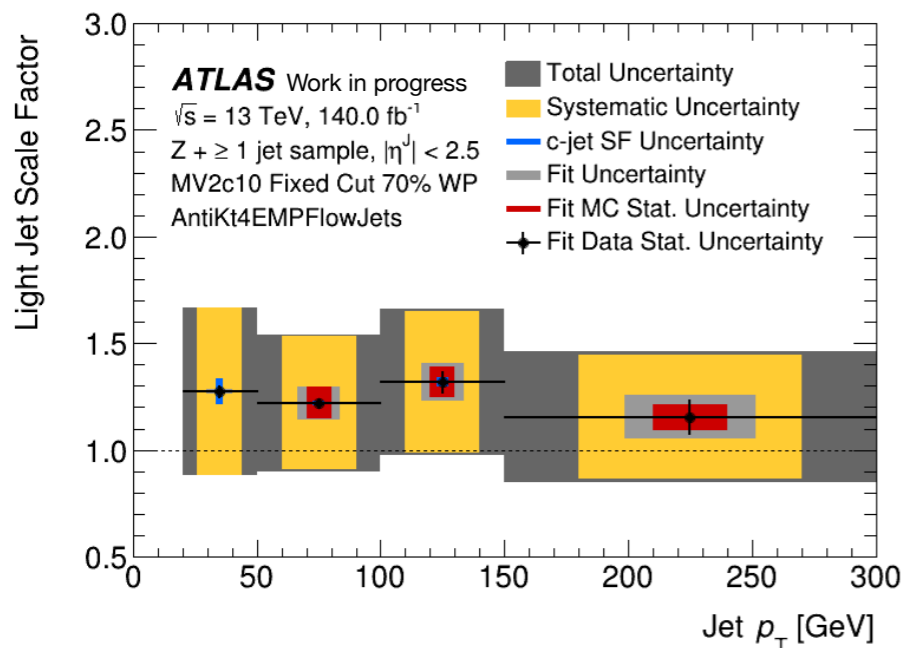
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B-tagging

- Developing a trackless b-tagging algorithm to improve b-tagging performance in high- p_T jets. The relative number of hits difference between two layers of the pixel detector is used to identify jets coming from a b-hadron.
- Mis-tag rate calibration: fraction of light jets identified by b-tagging algorithms as produced by b-jets.



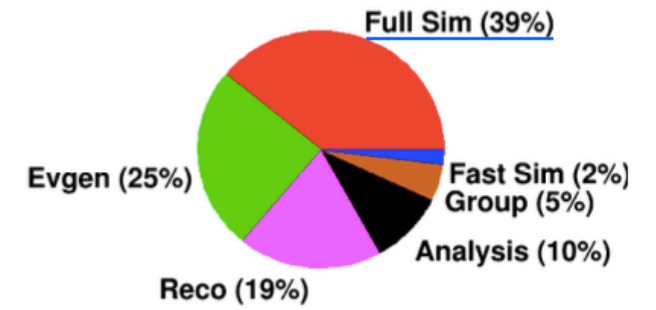
- Light flavour jets are mis-tagged mainly due to resolution of reconstructed track trajectories and impact parameters (IP), resulting in symmetric signed IP distributions.
- Tagging algorithms which use negative IPs and lifetimes as input are used to obtain a tagged sample enriched in light jets and calibrate the mis-tag rate.



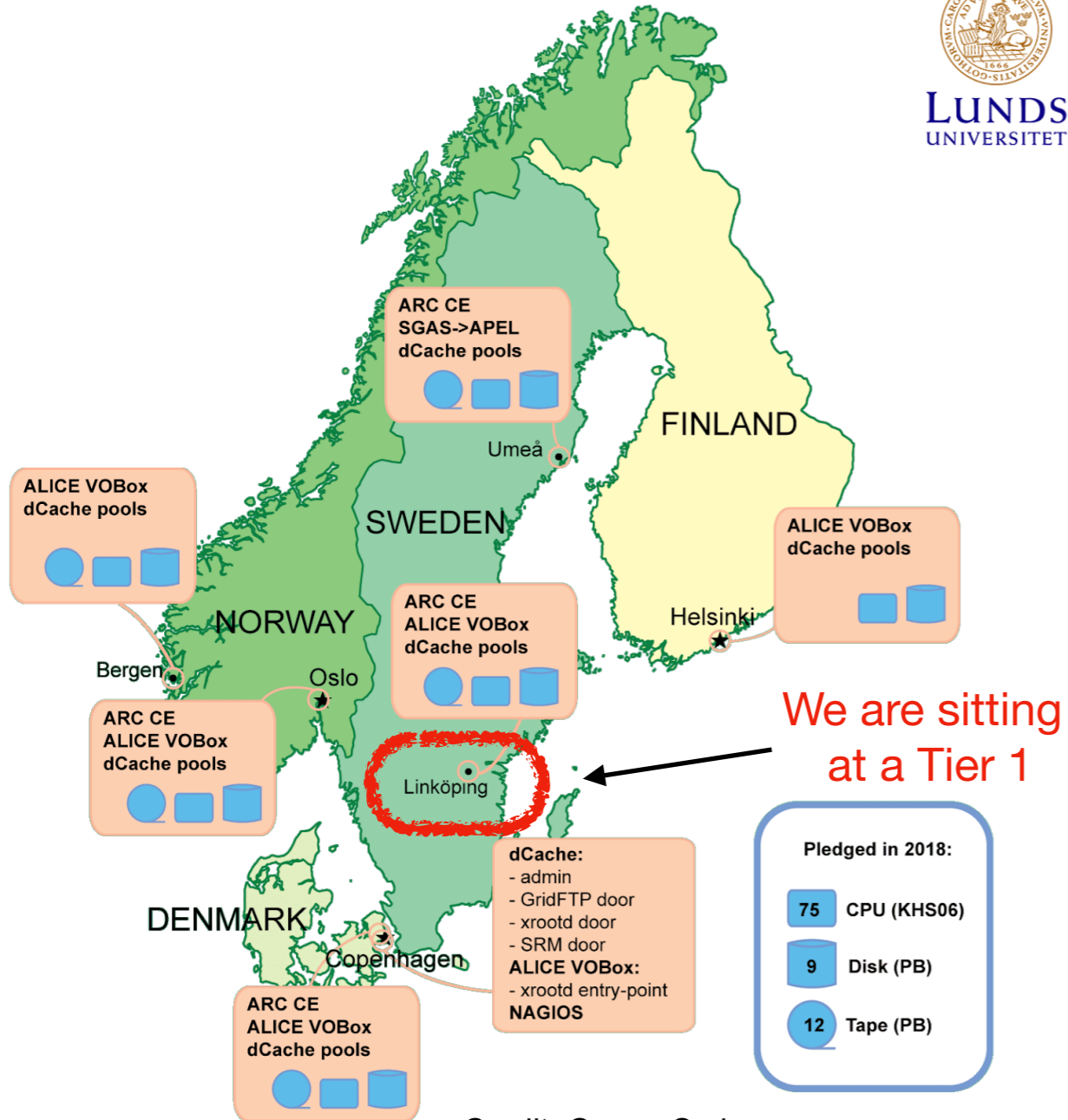
[ATLAS-CONF-2018-006](#)

Computing

Monte Carlo simulations take up a large fraction of computing resources.



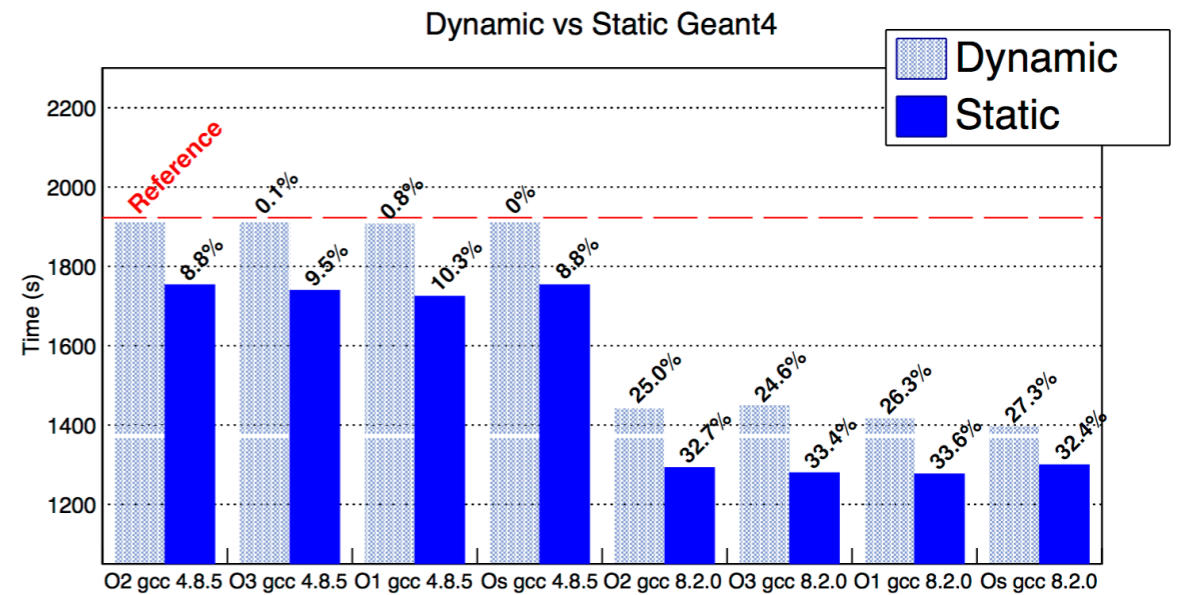
Wall clock time fraction for grid and HPC jobs
July 2015 - July 2016



Credit: Oxana Smirnova

Optimisation of the workload is needed to reduce computational costs.

- The Geant4 framework can be built using either dynamic or static libraries. Performed studies on the simulation execution time.



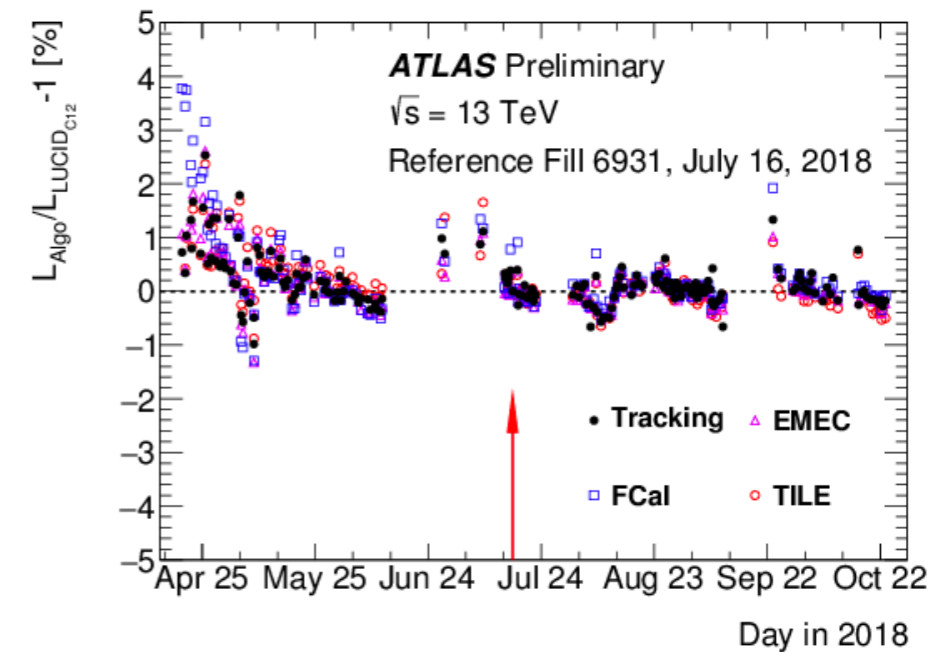
Credit: Caterina Marcon

Einar Elen, Caterina Marcon, Oxana Smirnova, Balazs Konya

Luminosity

An accurate luminosity measurement is crucial for all analysis.

- KTH+SU: Measure luminosity in Run 2 (& future Run 3) using track counting.
- LU: Work in the Lucid-2 detector and its upgrade. Main online and offline luminosity detector in Run 2.
- KTH: Works in the role as a luminosity detector of the new timing detector HGTD being devised for HL-LHC.



[ATLAS public plot link](#)

*Prim Pasuwan, Giulia Ripelino, Rabia Shaheen, Alex Kastanas,
 Vincent Hedberg & Jonas Strandberg & Sara Strandberg*



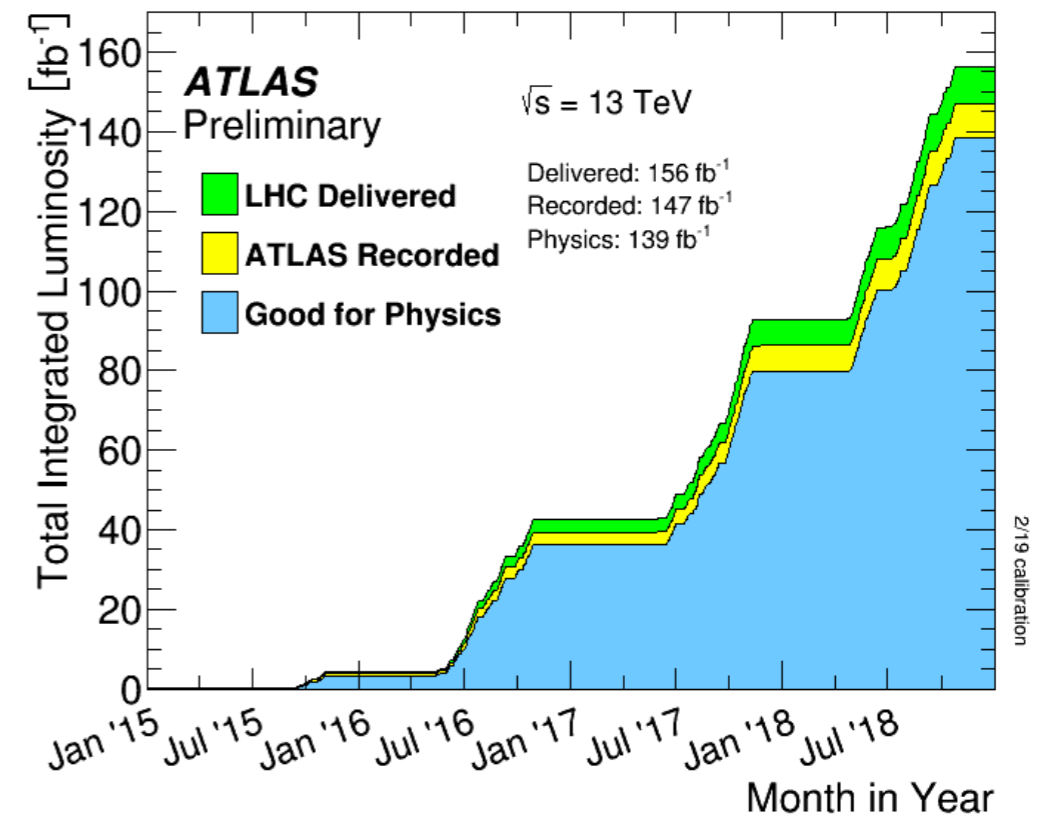
Data Quality

Data quality (DQ) is crucial for all analyses we do. The DQ work is about checking data immediately (as it comes in/online, or the day after/offline) and fix problems as they arise, assuring we have excellent data quality.

We have several important positions in Sweden:

- B-tagging DQ co-coordinator (Sara)
- Trigger DQ monitoring and tools contact (Elin)
- Tau trigger DQ contact (Myrto)
- L1 Topo DQ monitoring (Jörgen)
- Tile Cal DQ leader (Christophe, David, Sam over the years)

95.6% of data is good for physics in full run 2 (97.5% in 2018)



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Myrto Asimakopoulou, Elin Bergeaas Kuutmann, Christophe Clement, David Milstead, Sam Silverstein, Jörgen Sjölin & Sara Strandberg

Summary

- A lot of “behind the scenes” work is needed to be able to do the physics analysis you will hear about today.
- Everyone in the ATLAS collaboration needs to contribute to these tasks.
- Our ATLAS groups at Sweden do some crucial work for the collaboration in:
 - Detector operation:
 - LAr cal
 - LUCID
 - SCT
 - TRT
 - Tile Cal
 - Trigger
 - jet
 - L1 calo
 - Object reconstruction:
 - jet performance,
 - b-tagging,
 - fake taus estimation)
 - Computing
 - Data preparation
 - Luminosity
 - Data quality

Thanks for your attention!

