Jonas Strandberg, KTH

LHC Experiments: Current Runs

KTH VETENSKAP OCH KONST

LUND UNIVERSITY

Stockholms universitet

UPPSALA UNIVERSITET

Organisation

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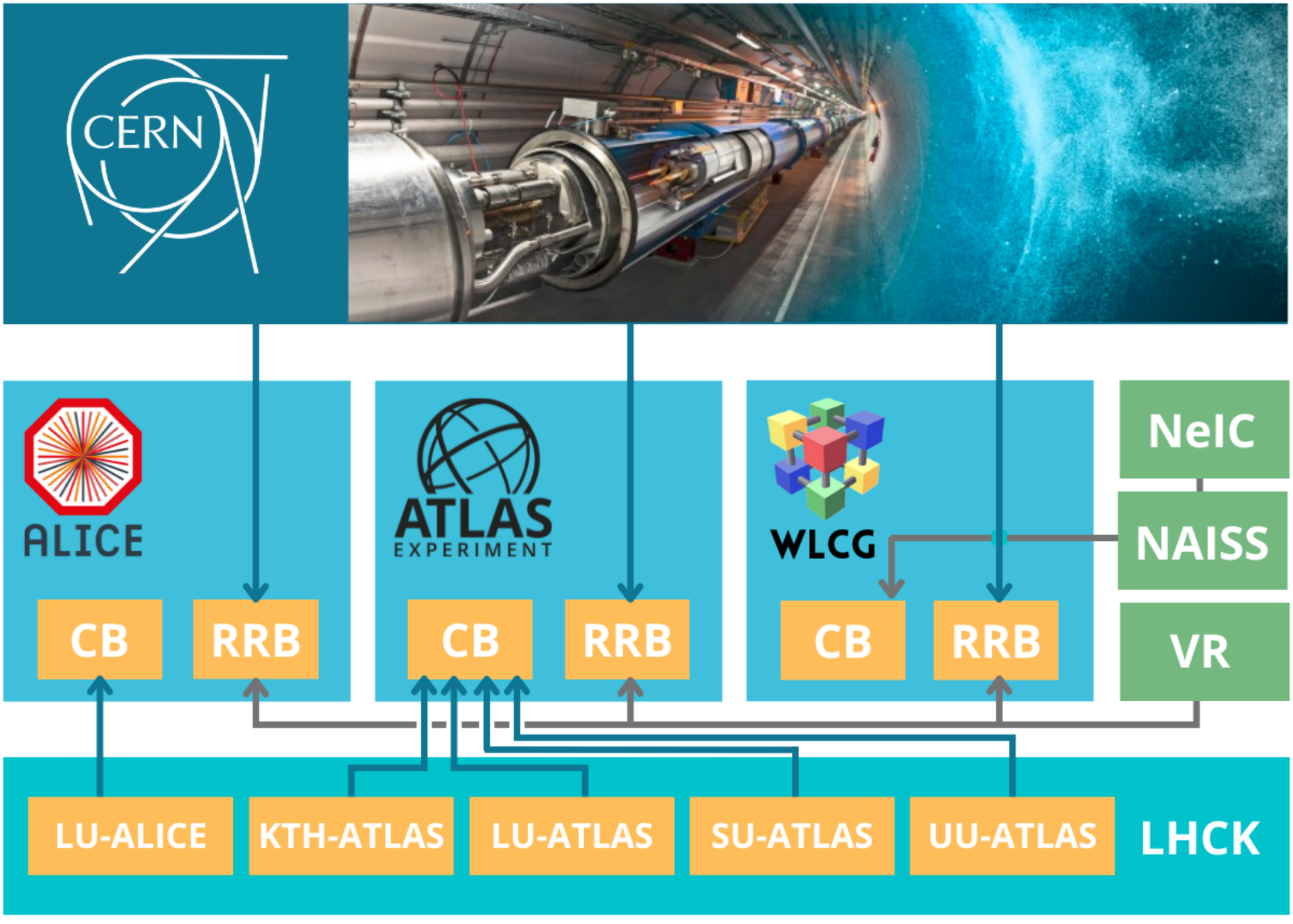


Organisation

Module 1:

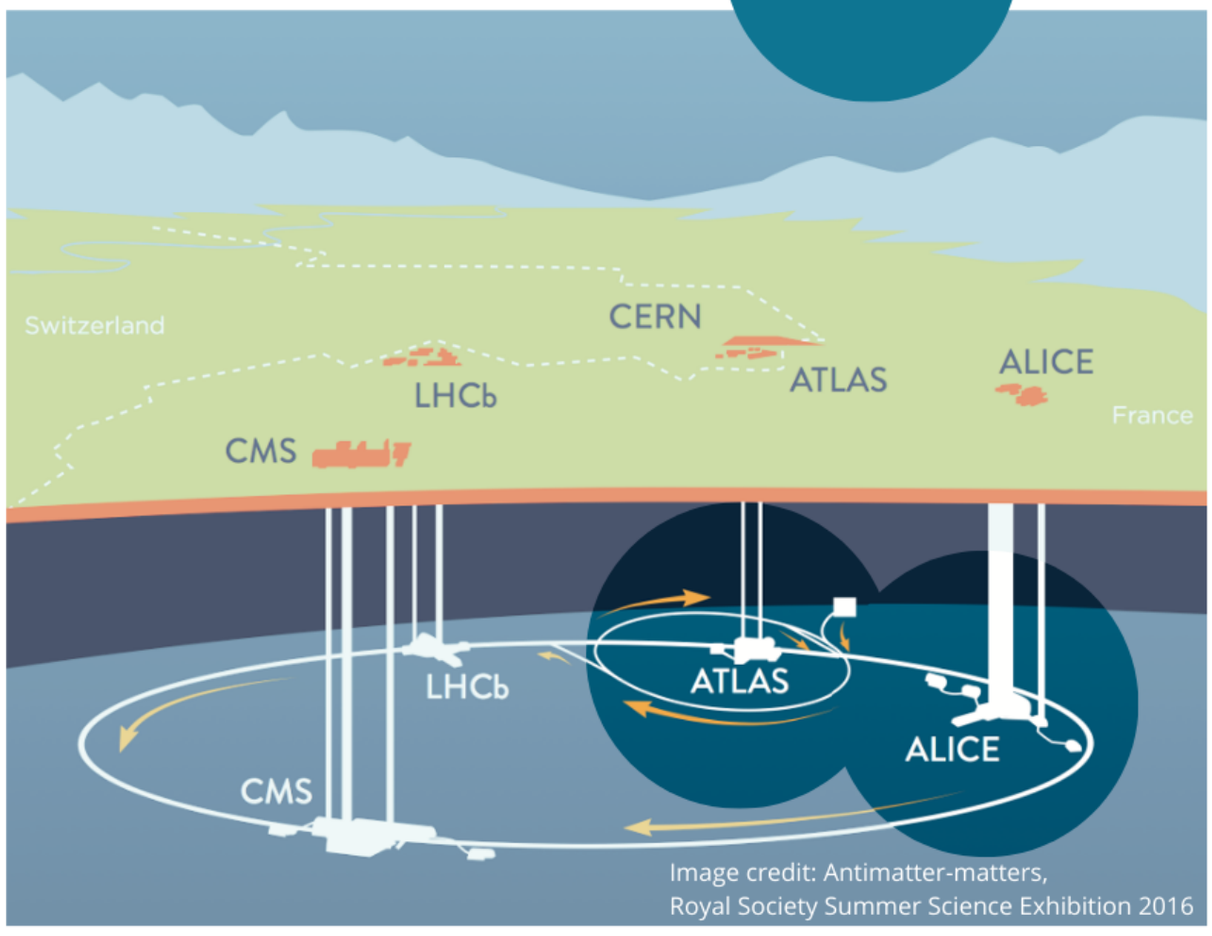
Coordination of the Swedish node for ALICE and ATLAS

KTH VETENSKAP OCH KONST · LUNDS UNIVERSITET · STOCKHOLMS UNIVERSITET · UPPSALA UNIVERSITET

Module 2:

M&O costs for ALICE and ATLAS

VR



LU

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NAISS

CERN

Module 3:

Operations of ALICE by the Swedish node

ALICE

Module 4:

Operations of ATLAS by the Swedish node

ATLAS EXPERIMENT

Module 5:

Operations of WLCG

Investment in CPUs

Investment in storage

Data transmission

WLCG

Module 6:

Swedish participation in CERN's summer student and technical student programmes

CERN

Size of the Community

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- The latest census of M&O members done by LHCK at the beginning of the year. The number of participants in ALICE and ATLAS were:

	Active senior authors	Ph.D. students and qualifiers	Total
Lund ALICE	6	4	10
Lund	7	4	11
Sthlm KTH	5	2	7
Sthlm U	11	5	16
Uppsala	9	3	12
Total	38	18	56

- In addition, there are members which do not count against the M&O:
  - Approximately 20-25 active master students at any given time.
  - Most emeriti professors, who are still members of experiments.
  - Some technicians and engineers, but few compared to prominent universities internationally.
- Total size of community 2019-2024: **58 - 62 - 69 - 60 - 63 - 56.**

Operations Tasks

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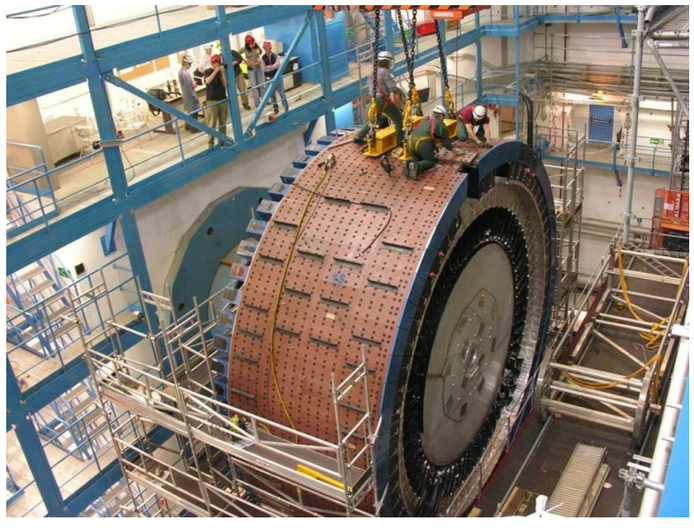
- The Swedish requirements on detector operation and service work are:
  - 13.5 FTE of expert work and 530 8-hour shifts for ATLAS (approximately corresponding to 16 FTE in total) per year.
  - 1.5 FTE of expert work and 50 8-hour shifts for ALICE (approximately corresponding to 1.8 FTE in total) per year.
  - Travel costs funded, but only approximately 1 FTE of the salary costs.

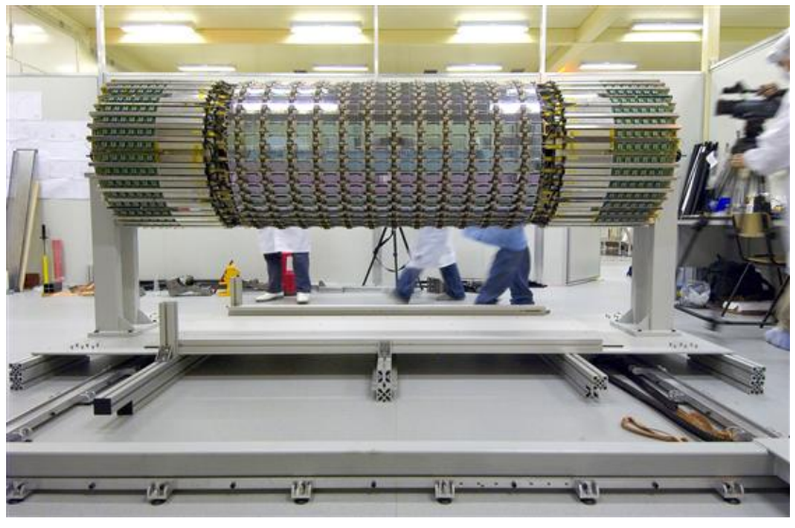
≈ 30% work load on all members

ATLAS Tile Calorimeter



- Shifts, Data Quality, Operations Coordination, Noise Description

ATLAS SCT Tracker



- Shifts, Code Development, Hardware Maintenance

Operations Tasks

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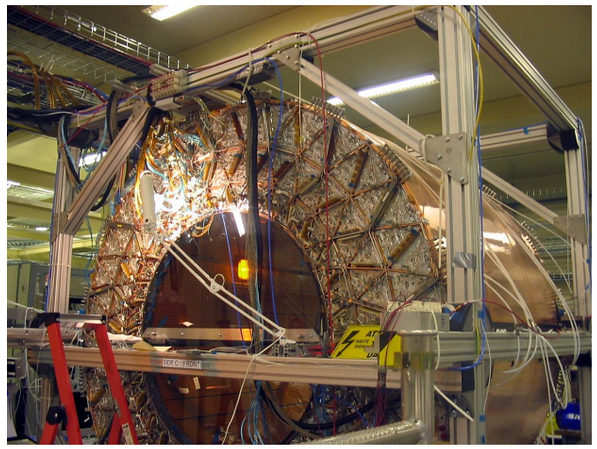
ATLAS Trigger

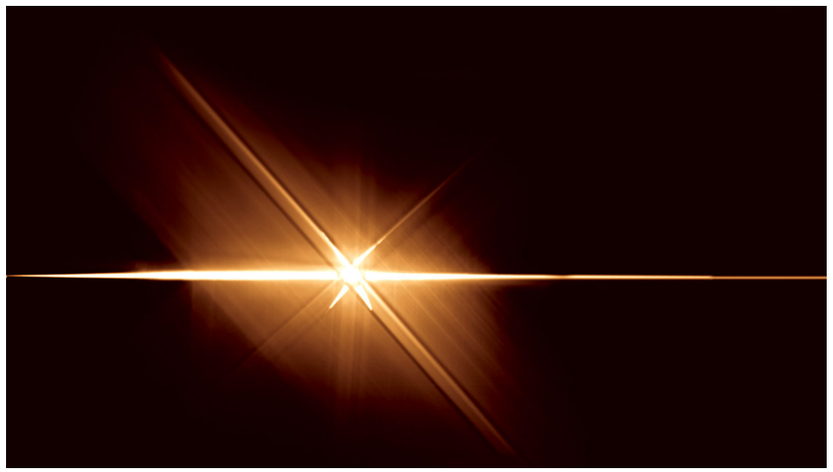
- Shifts, Coordination, L1 Calo, Tau Triggers, Jet Triggers

ATLAS TRT Detector



- Shifts, Calibration, Offline Performance & Optimisation

ATLAS Luminosity Measurement



- Online Software, Coordination, Expert Shifts, LUCID, Offline Measurements, Operation Coordination

Operations Tasks

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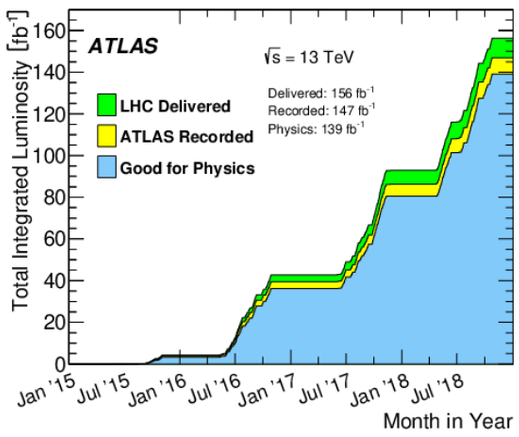
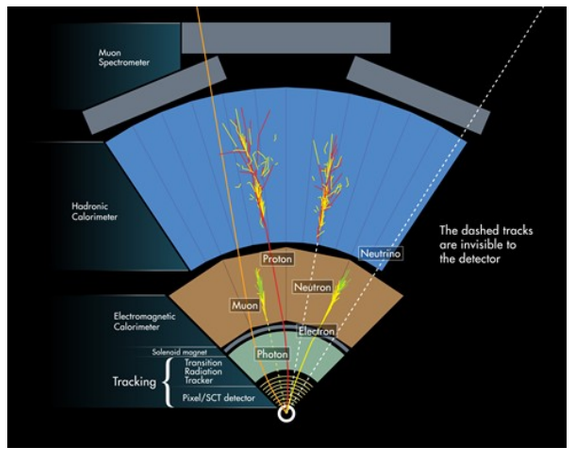
ATLAS Data Quality



- Shifts, Coordination, Infrastructure, On-Call

ATLAS Object ID

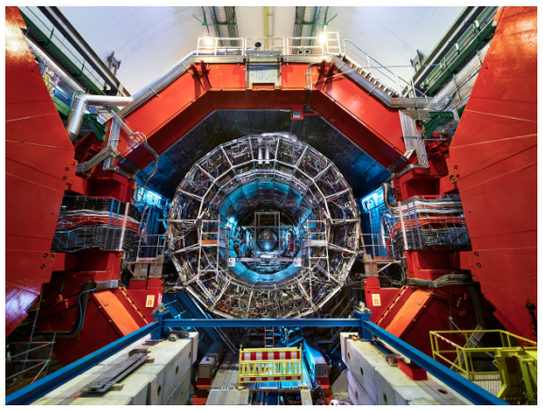


- Tracking, b-tagging, Egamma, Jet/MET, Tau

ATLAS Software&Computing

- On-Call, Release Building, Prompt Reconstruction, Common Analysis Software

ALICE TPC



- On-Call, Hardware Maintenance, Shifts, Phase-I Upgrades

ALICE Analysis and Leadership Roles

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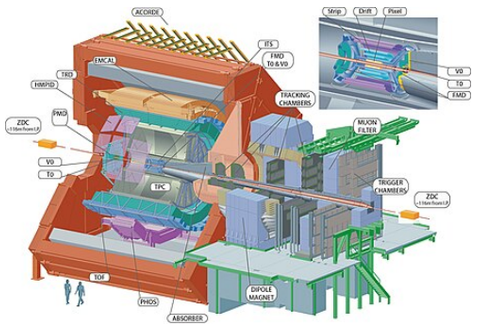
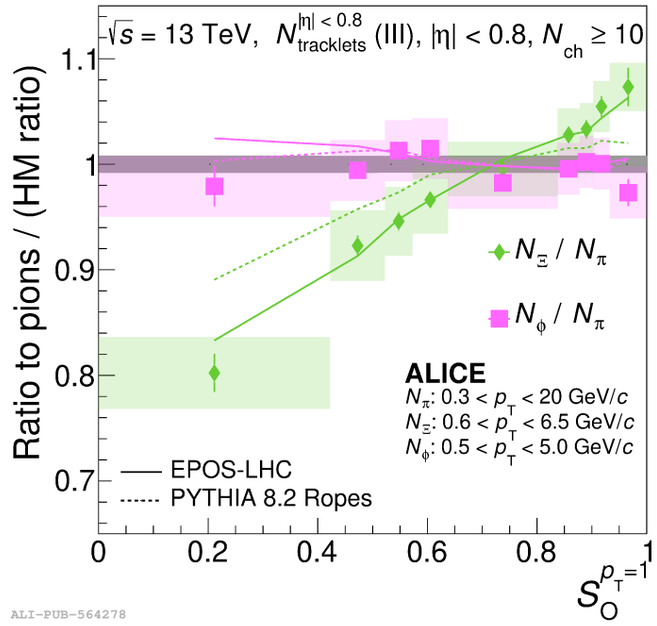
- Lund University is the only Swedish member institute in the ALICE collaboration.
- Strong interplay with the particle physics theorists in Lund.
  - Wallenberg-funded CLASH project jointly between experiment and theory.

Selected Leadership Roles

- Elected Management Board member, 2021-2023.
- Physics Working Group convener for Correlations and Flow 2018-2020, MC and MinBias 2018-2021.
- Physics Analysis Group convener for Underlying Event 2017-2020, 2022-2024, Event-by-Event 2022-2024, Flow 2021-2023.
- Conference Committee, 2016-2018, 2017-2018.



Physics Analysis Examples



- Strangeness and baryon production mechanisms.
- Light-flavor particle production as a function of transverse spherocity.
- Production of pions, kaons, and protons as a function of the relative transverse activity classifier.
- The upgrade of the ALICE TPC with GEMs and continuous readout.
- Enhanced production of multi-strange hadrons in high-multiplicity proton–proton collisions.

Physics Analysis in ATLAS

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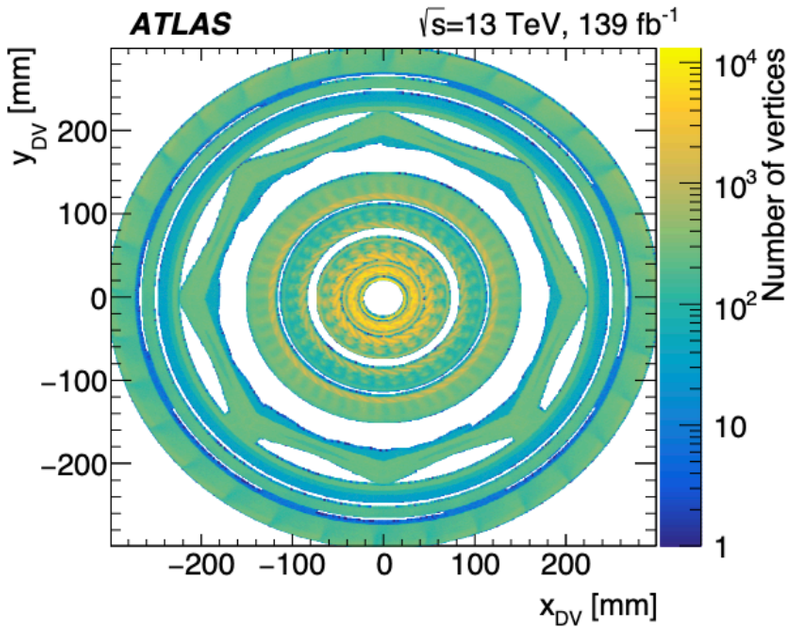
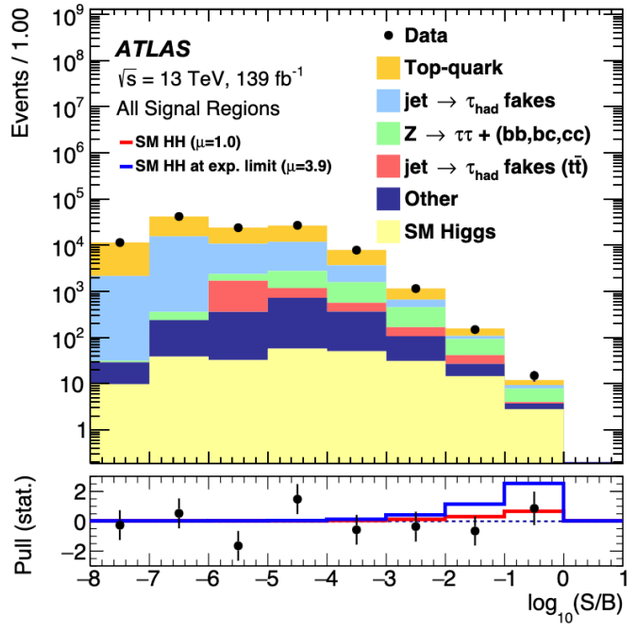
Exotic and Long-lived Particles



- Searches for Heavy neutrinos and Heavy leptons; Displaced vertex and muon or jet; Charged Higgs bosons.
- Active in searches for Displaced vertex + MET; Seesaw models; Vector-like quarks; Dark mesons to top and bottom quarks.

6 3 2 1

Di-Higgs and Two Scalar Particles



- HH→bbττ; HH→bbγγ; HH combination; HH→4b; SH→bbγγ
- Active in HH→bbττ; HH→bbγγ; HH combination; ttHH; SH→bbγγ

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Physics Analysis in ATLAS

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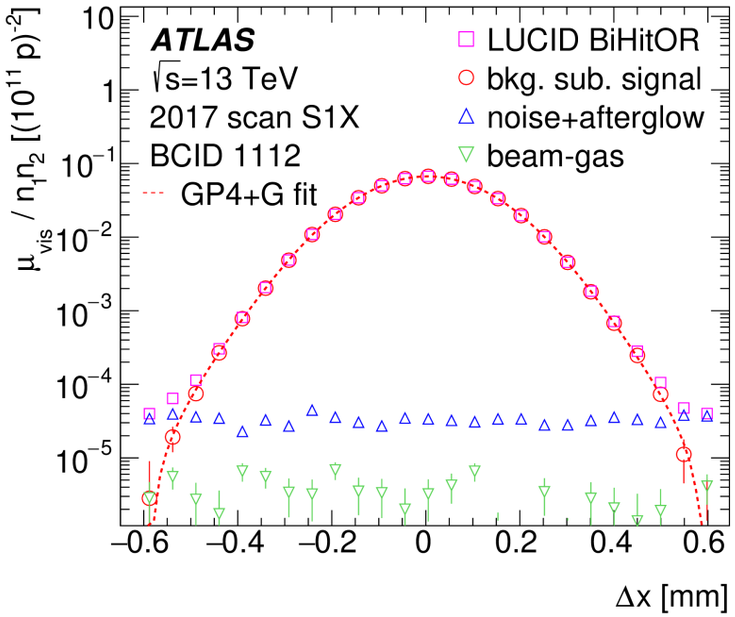
Performance Papers



- Run 2 papers for Data Quality; Luminosity; Trigger; Jet Energy Scale; Soft b-tagging; SCT; Egamma; Muon.
- Active in Prompt Processing; EM shower shapes; Jet Energy Scale from E/p deconvolution.

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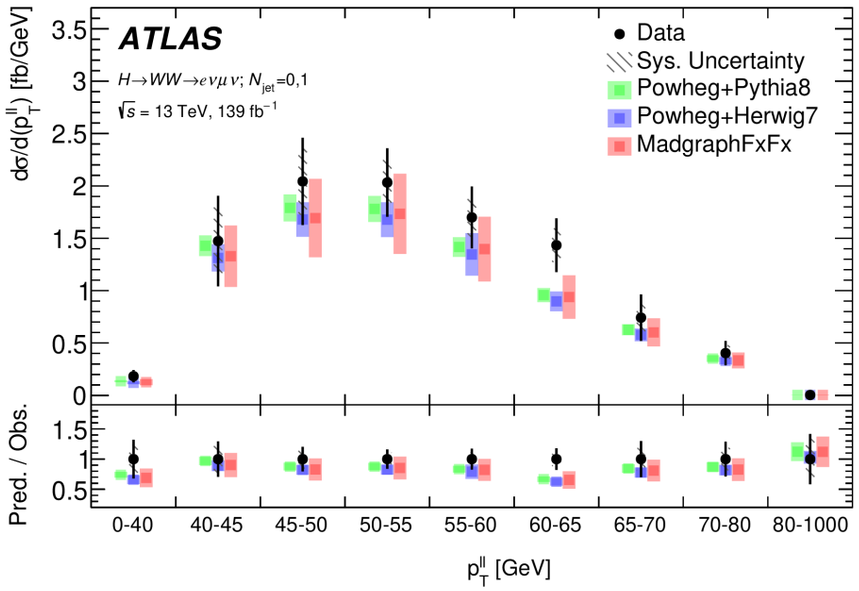
Single Higgs Boson



- H→WW gluon-fusion and vector boson fusion, spin and CP with EFT, VH production, differential cross section; H→ZZ mass measurement.
- Active in H→WW high mass search, off-shell analysis, simplified template cross section.

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Physics Analysis in ATLAS

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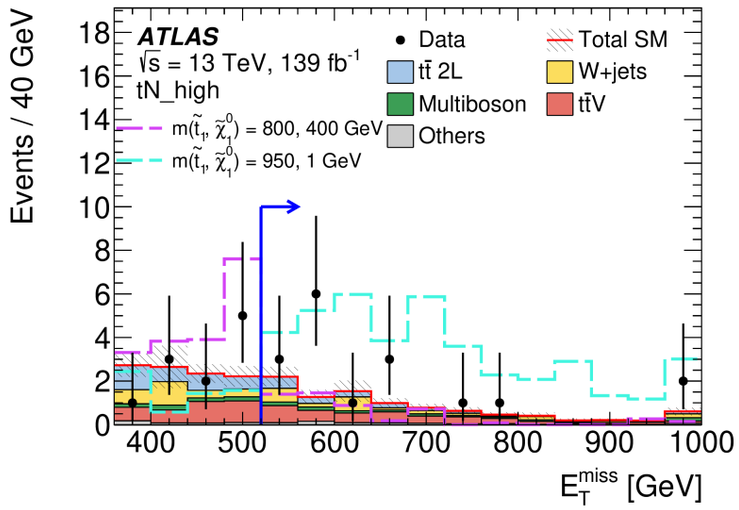
Supersymmetry



- Top quark pairs plus MET; Third-generation tt one-lepton; EWK pMSSM summary; Strong SUSY 0-lepton.
- Active in SUSY grand pMSSM scan; Third generation pMSSM summary; stop pair and tt+DM.

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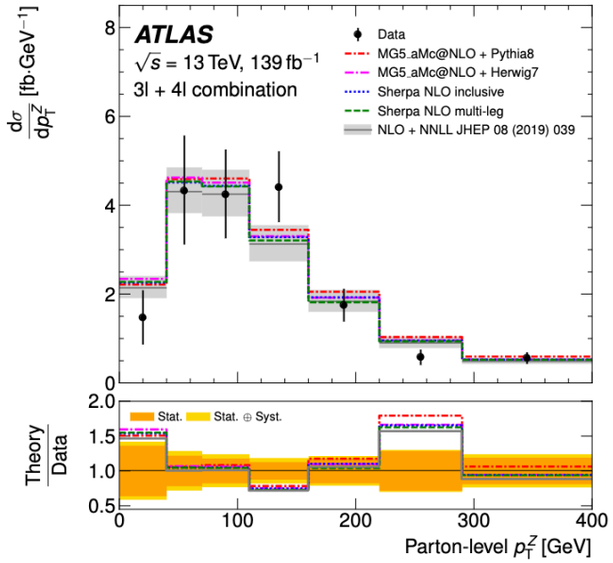
Top Quark and Z boson



- Measurements of tt+W; tt+Z; Looking for FCNC decays t→qZ.
- Active in Electron-muon universality in top decays; Search for ttW+jets; Top Yukawa coupling from the ttbar cross section; Z(→ll)γ cross section.

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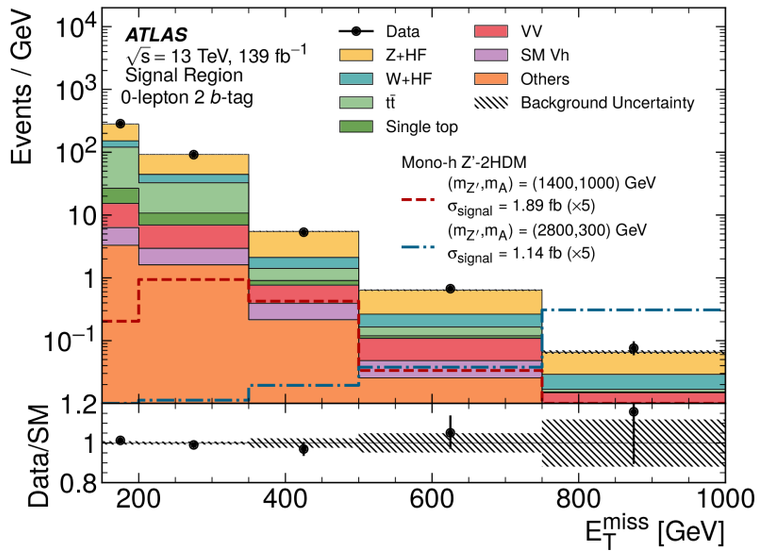
Dark Matter



- MET+jets; Multijets Y→XX→jjjj; Higgs invisible BR combination; DM in mono-Higgs.
- Active in Anomaly detection with pileup; Trigger-level dijet search; Dijet angular analysis.

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ATLAS Leadership Roles

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- Despite the relatively small size of the community, Swedish physicists have had many leadership roles. A selection of (non-upgrade) roles since 2016 are:
- Institute Board Chair:
  - SCT 2016-2018.
  - Inner Detector 2017-2018.
  - HGTD 2020-2022.
- Data Quality Convener:
  - 2021-2023.
  - 2024-now.
- Convener Higgs & Diboson Searches, 2021-2023.
- Upgrade Physics Convener 2019-2021.
- Online Luminosity Convener, 2022-2024.
- Luminosity ID/Tracking Convener:
  - 2018-2020
  - 2021-2023
  - 2022-2024
  - 2023-now.
- International Computing Board, 2019-now.
- Convener BSM Higgs group, 2016-2017.
- LHC Dark Matter WG Convener, 2018-2019.
- Data Preparation Coordinator 2016-2017.
- Higgs to WW Convener 2017-2019.
- ATLAS Luminosity Oversight Group Chair, 2021-now.
- Trigger Coordinator 2024-now.
- Trigger Operations and Monitoring Coordinator 2020-2023.
- Jet/MET Convener, 2016-2018.
- Prompt Reconstruction Coordinator:
  - 2019-2020.
  - 2022-2023.
- Outreach Coordinator, 2021-2023.
- Astroparticle Forum Convener, 2017-2018.
- Trigger Menu and Signature Performance Coordinator 2023-2024.
- LUCID Project Leader, 2011-now.
- SC Advisory Board (chair), 2016-2018.

LHCb Activities

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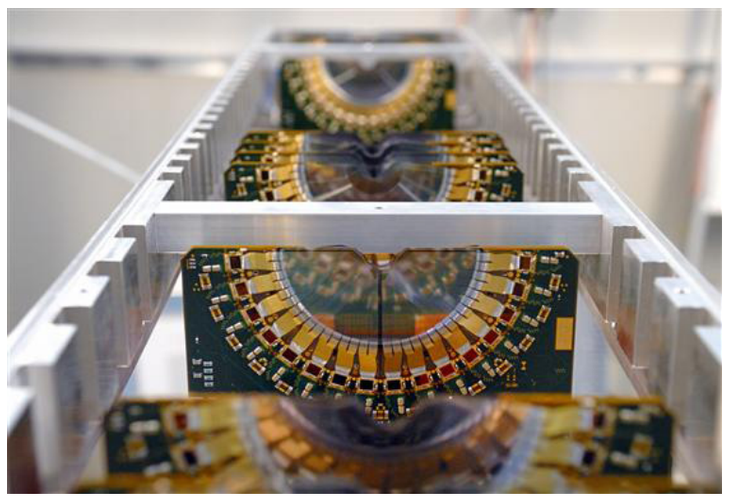
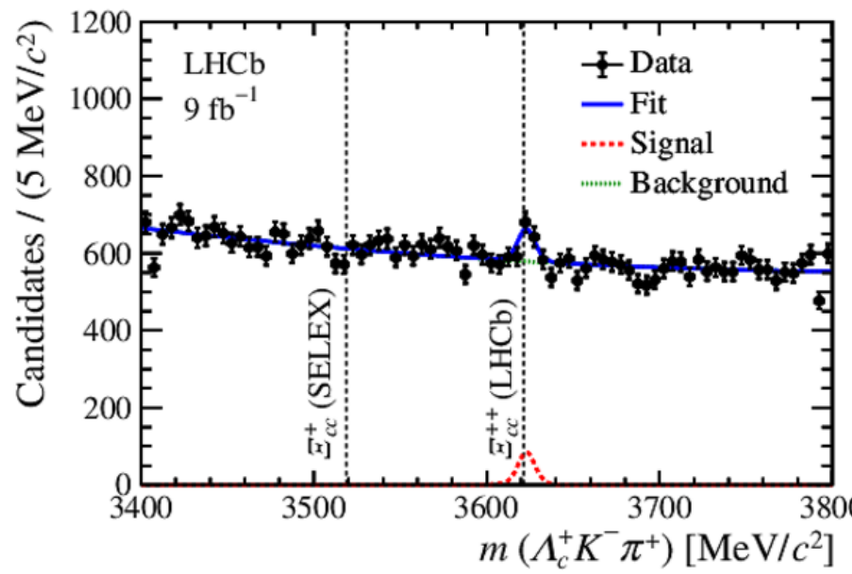
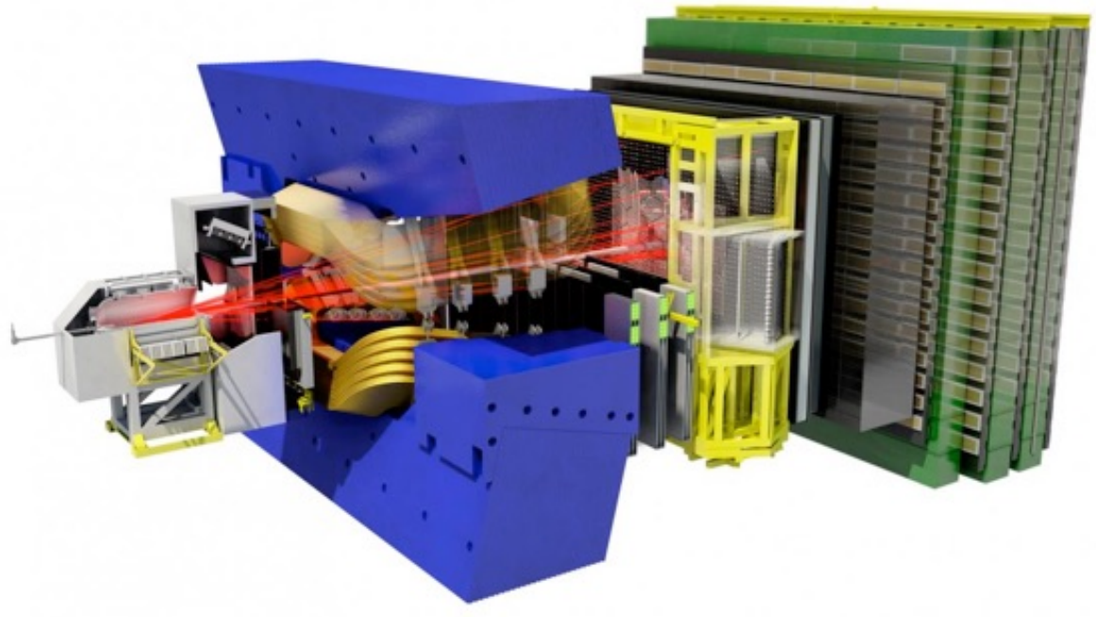
- The members of LHCb that are now active at Uppsala contributed to the VELO detector.
- Current service tasks include:
  - VELO piquet expert on-call.
  - Shifts in the Control Room.
  - Work on sample reduction methods (skimming) and the trigger.
- Analysis contributions to:
  - Time dependent CP violation in charmless b decays.
  - Search for doubly charmed baryon Ξ_{cc}^{+}.
- Active in analyses of:
  - CP violation in charm baryon decays.
  - Lifetime measurements of charmed baryons.

- Selected leadership roles:
  - Publications committee member.
  - LHCb upgrade 2 cost scrutiny.







Community Support

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- CERN infrastructure, the detectors, and the physics goals of the LHC experiments are:
  - Very long-term in nature, spanning decades.
  - Team-work oriented in nature.
- The lack of group level support makes it hard to have long-term commitment to operations of the experiments.
  - Work load falls on shoulders of faculty and their PhD students and postdocs who are hired on short-term individual grants.
  - Difficult to accomplish team building in the university groups, with a combination of faculty and other permanent members with complementing skill sets.
  - Perhaps the lack of a long-term funding perspective is also seen in the relative lack of important precision physics analyses at the Swedish universities.
- With the additional intense work load to carry out the phase-II upgrades of the experiments and limited staff support for that, the community is stretched extremely thin between operations, upgrade, and physics analysis.
- The experience of working in a team and organizing work in a collaboration are skills that are also very valuable at the home universities.
  - Faculty is frequently asked to also take on university leadership roles, further adding to the work load burden.

Summary and Conclusions

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- Despite the modest size of the Swedish community, there are high-impact contributions to both analyses and leadership roles:
  - Leading roles in the most sensitive di-Higgs and di-Scalar particle channels in ATLAS.
  - Leading roles in searches for new particles, including long-lived exotic particles and DM.
  - ALICE measurements resulting in Nature paper on multi-strange hadrons.

- The operation and maintenance of the experiments are person-power critical, with a need to transfer knowledge to a new generation of physicists.
- There are many advantages to being a physicist in Sweden:
  - We have support from the funding agencies for our infrastructure.
  - We have decent (good) salaries - both a blessing and a curse.
  - There are strong social benefits and strong support for the work-and-family balance.
  - All this results in us being able to attract world-leading physicists to Sweden.
- Our funding system is however not well-suited to support a team-oriented community doing research on a time-scale of decades.
  - Increased funding, at a long-term, group-based level, is one of the most important goals to work towards for the Swedish high-energy physics community!

Backup