ATLAS activities in Lund

an overview

OXANA SMIRNOVA, PARTIKELDAGARNA 2017, NOVEMBER 2017, STOCKHOLM

Overview

- Dedicated talks by LU ATLAS at Partikeldagarna:
  - “Search for doubly-charged Higgs boson production in multi-lepton final states with ATLAS” – by *Katja Mankinen and Else Lytken*
  - “A search for pair-produced resonances in four-jet final states with ATLAS” – by *Eva Brottmann Hansen*

- In this overview talk:
  - Jet triggers and jet performance
  - Dijet analysis
  - DM searches with jets
  - Mono-H searches
  - Leptoquark searches
  - Inner Tracker upgrade
  - Luminosity measurements
  - ATLAS TRT
  - Computing

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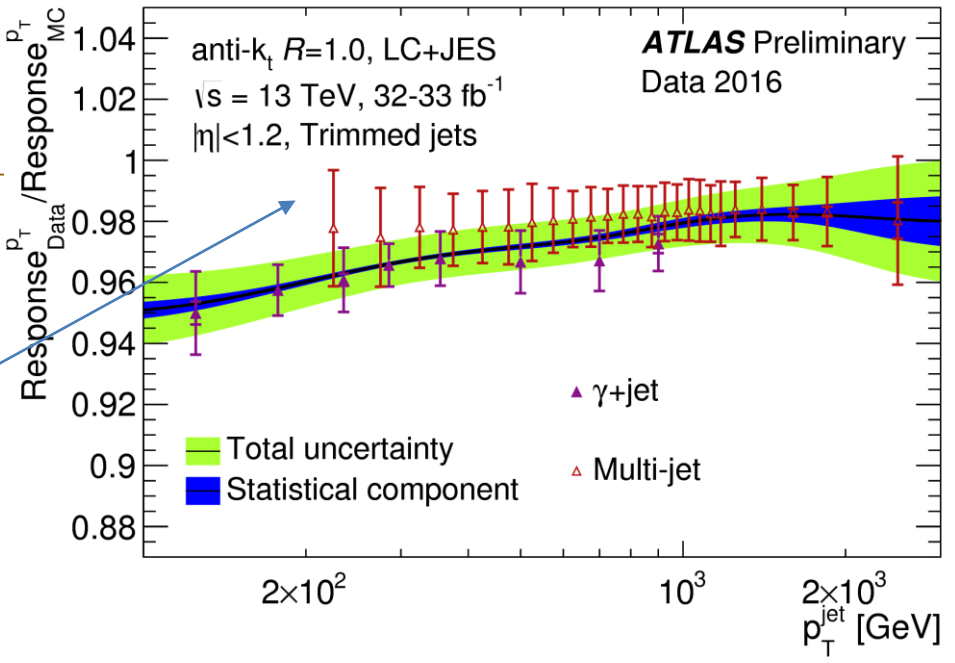
Jet triggers and jet performance

- *Will Kalderon* is the ATLAS jet trigger co-convenor
- *Eva Hansen* is responsible for combinining calibration techniques for large-R jets
- Among the improvements for 2017 data:
  - implementation of calibration based on jet properties improving jet resolution
    - » full trigger efficiency reached earlier
  - triggers on jet mass
    - » Useful for searches and measurements using jet substructure



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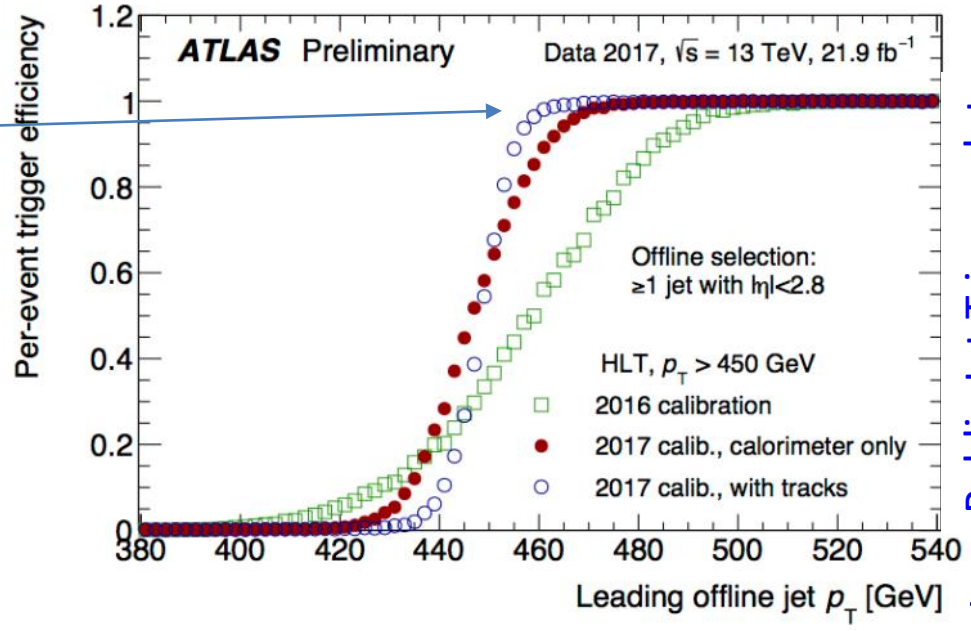

Public Jet Trigger plot

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Angular Dijet Analysis

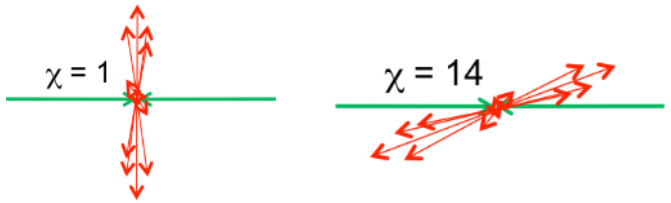
(Trine Poulsen, Torsten Åkesson)

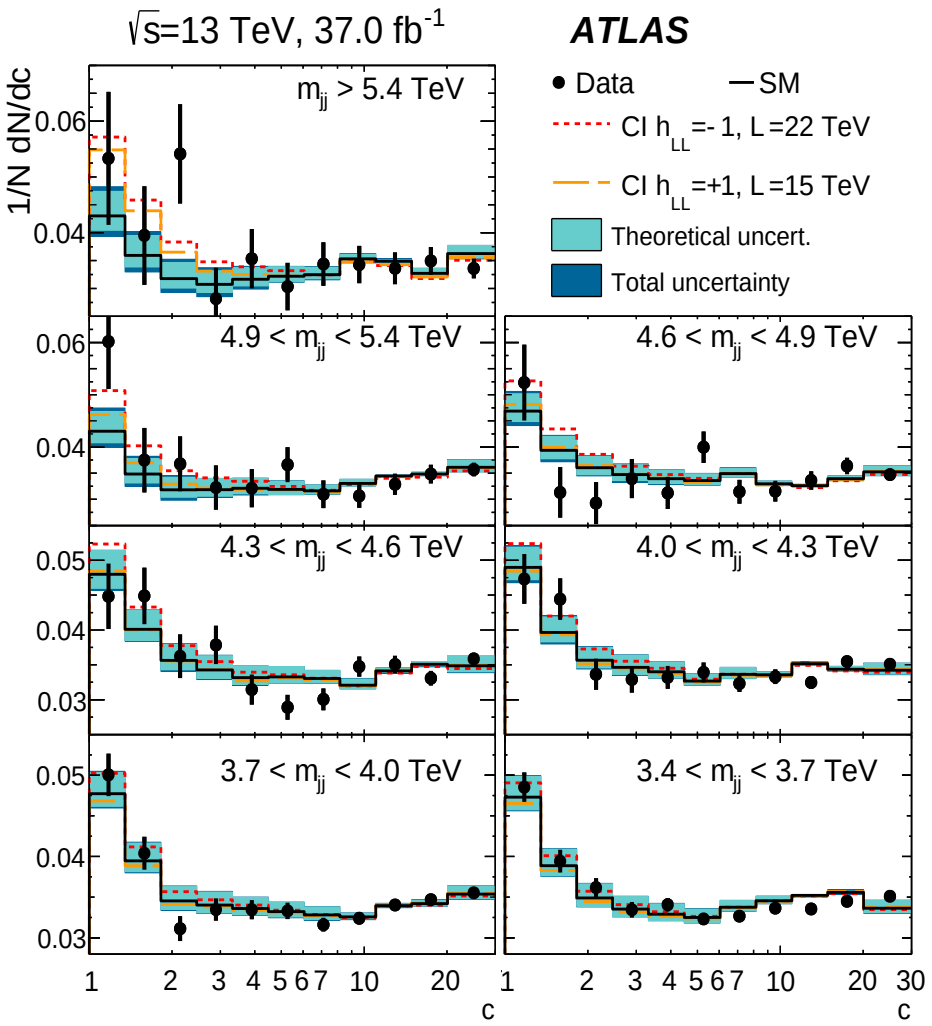
The analysis is a search for physics beyond the Standard Model including potential effects from a Dark Matter mediator

The **angular distribution** of the dijets is given by $\chi = e^{|2y^*|}$ and is divided into **different m_{jj}-bins**.

The **data** is compared to **PYTHIA simulation** which is corrected with NLO EW κ-factors as well as NLO QCD k-factors.

The **systematic uncertainties** include JES, PDF, tune and scale uncertainty, which are shown as a band around the simulated distribution.





dx.doi.org/10.1103

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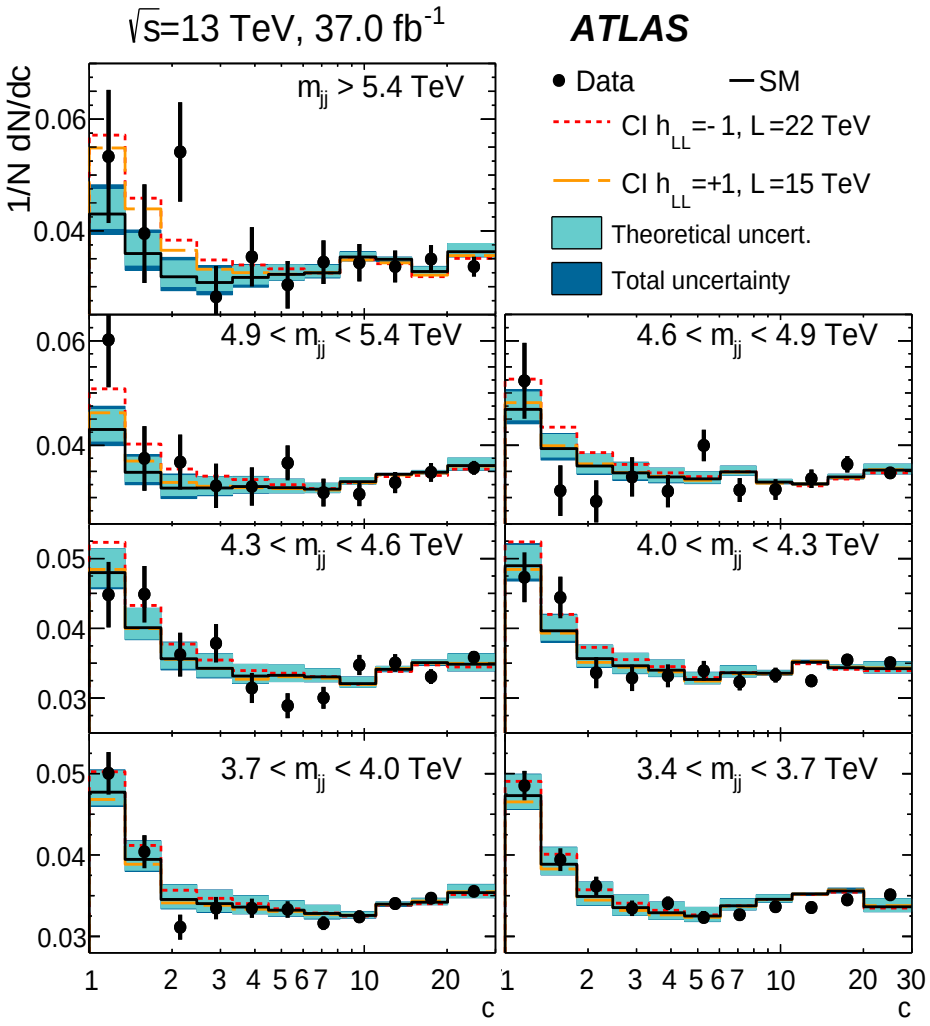
Angular Dijet Analysis

As the integrated luminosity increases we will be more **limited by** the **systematic** uncertainties. Therefore, we need to develop a **new method** to reduce the uncertainties.

The neighbouring ***m_{jj}*-bins** have very **similar** systematic uncertainties.

The uncertainties are reduced by **taking the ratio** between each m_{jj}-bin with the one below.

This is a **data-driven cancellation** of systematic uncertainties.



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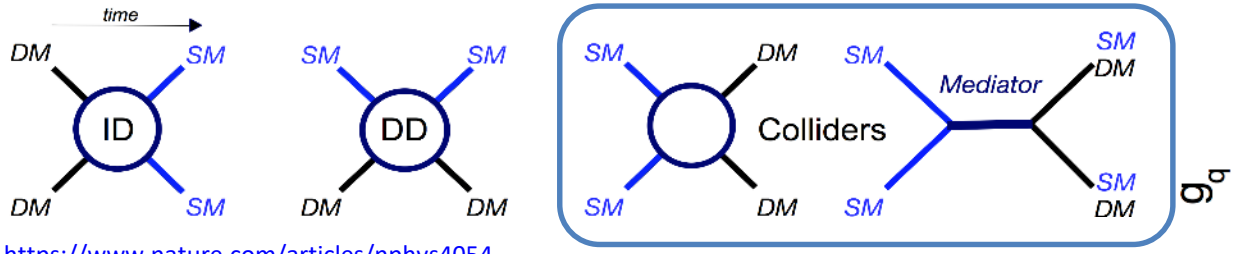
Dark matter searches with jets

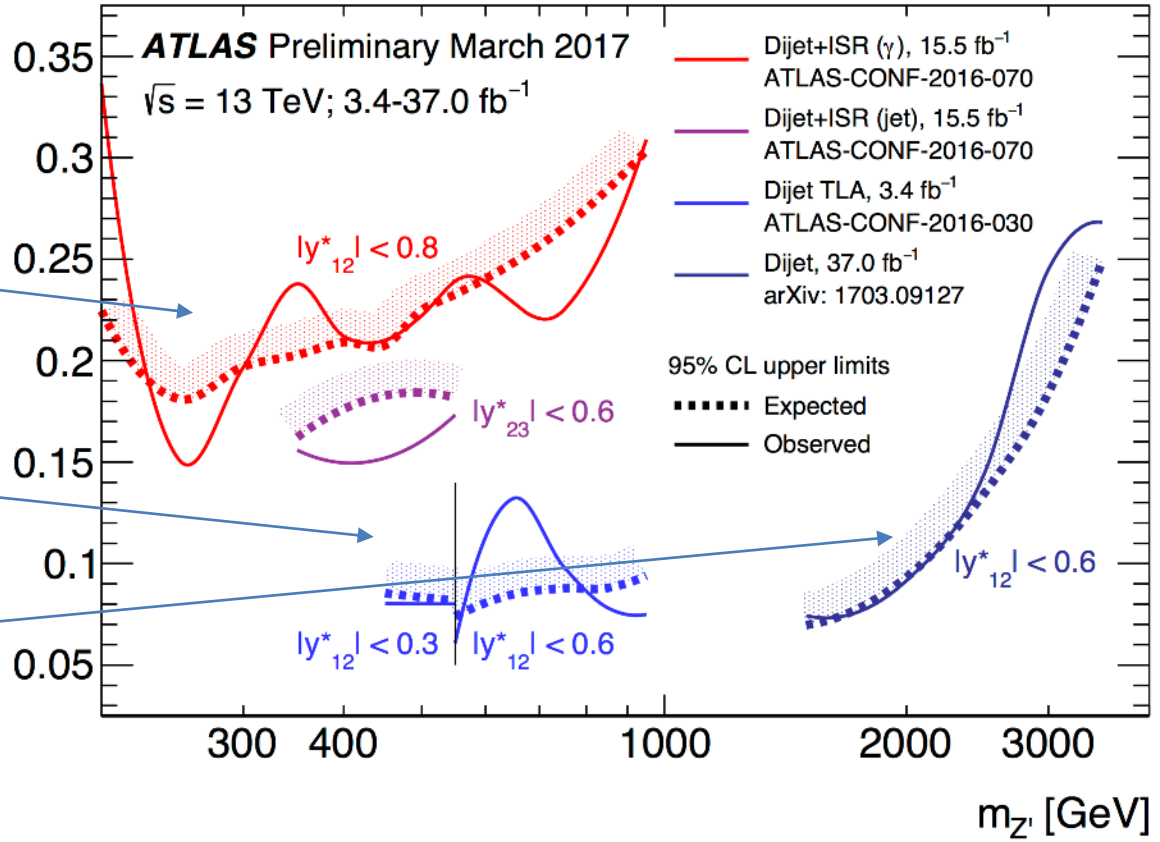
Searches for Dark Matter mediators decaying into jets:



https://www.nature.com/articles/nphys4054

- Ongoing analyses (*Eric Corrigan, Caterina Doglioni, Will Kalderon*) :
  - Dijet+ISR (ISR = photon, jet)
    - » Look for dijet resonances recoiling against hard radiation -> reach lower masses
  - Trigger-Level Analysis
    - » Look for dijet resonances using events at the trigger level, with smaller event size -> collect much more statistics
  - Dijet high-mass and angular analysis (previous slides)
    - » Will be reinterpreted in terms of heavy DM mediators

Summary of mediator -> dijet searches from Spring2017



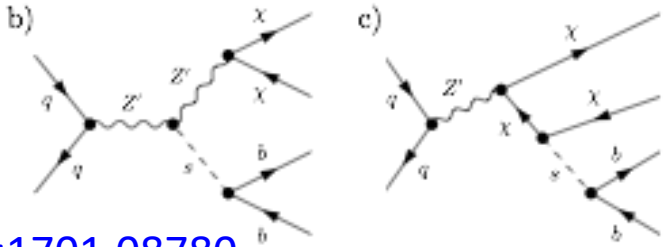
ATLAS Summary Plot

Caterina Doglioni is one of the LHC DM WG organizers, editor of whitepaper documents on arXiv

Mono-H searches

(Ruth Pöttgen, Eleni Skorda)

- new activity in DM programme in Lund: Higgs + E_T^{miss} search ("mono-H")
- studying new signal model: Dark Higgs



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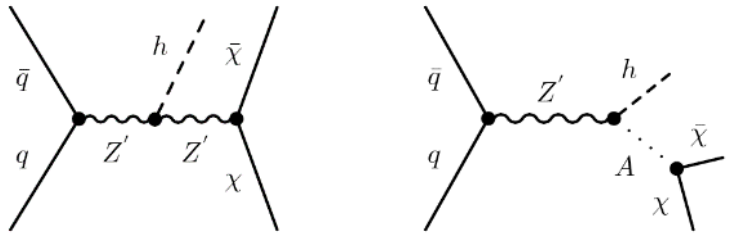
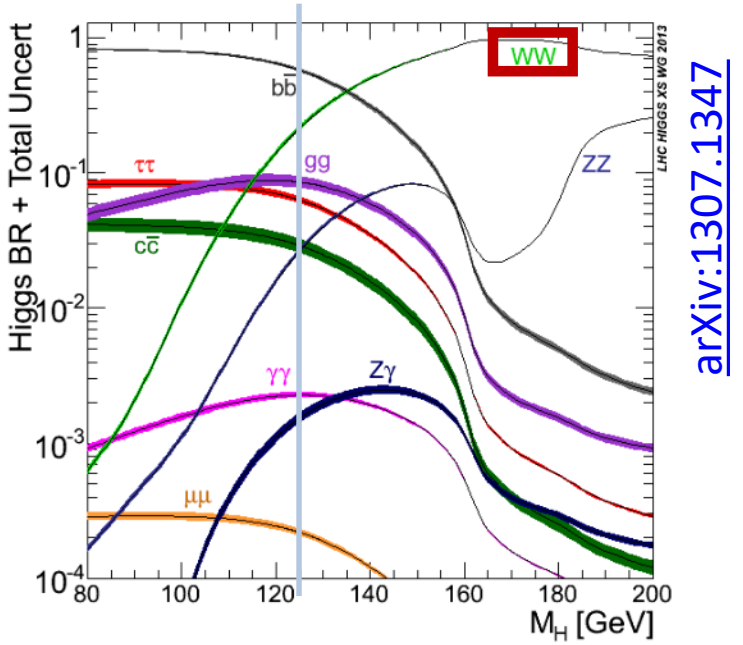


arXiv:1507.00966



arXiv:1307.1347

- in particular with 2017 data: H(→bb)+E_T^{miss} (largest BR for 125 GeV Higgs)
- future plans: H(→WW)+E_t^{miss}
  - 2nd largest BR @ 125 GeV
  - dominant for larger Dark Higgs masses

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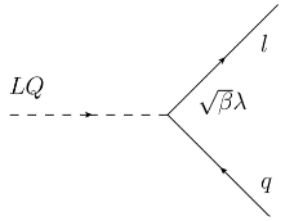
Leptoquarks searches

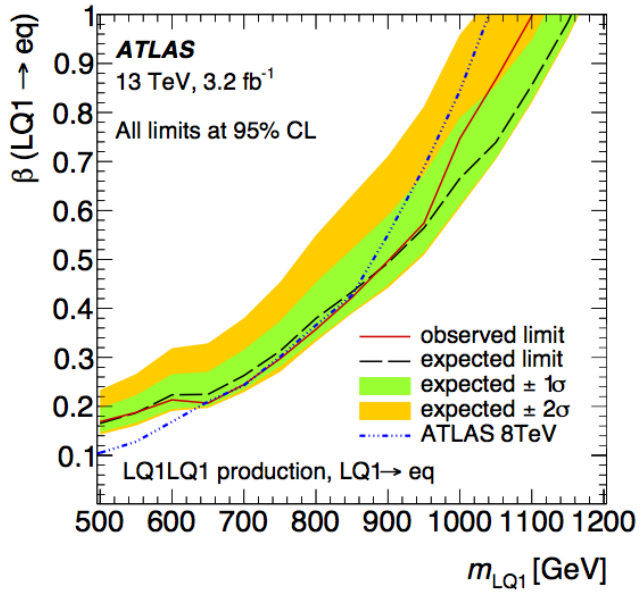
(by Ruth Pöttgen)

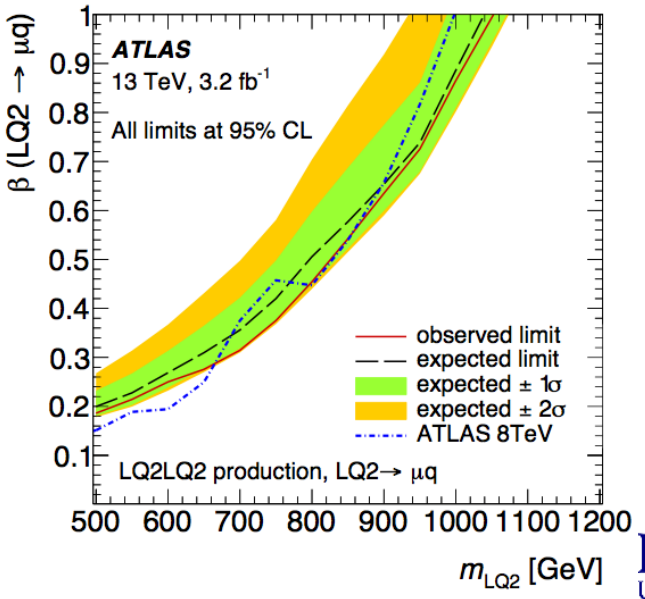
- Leptoquarks (LQ) part of many BSM theories, explain symmetry between lepton and quark sector in the Standard Model
- Increased interest in recent years due to anomalies observed at B-factories/LHCb
- In Lund: ATLAS search for pair production of 1st and 2nd generation LQs final states: *lljj*, *lvjj* (*l*=*μ*,*e*)



β: branching ratio for decay into charged lepton and quark

Plots from the latest public result:
http://iopscience.iop.org/article/10.1088/1367-2630/18/9/093016





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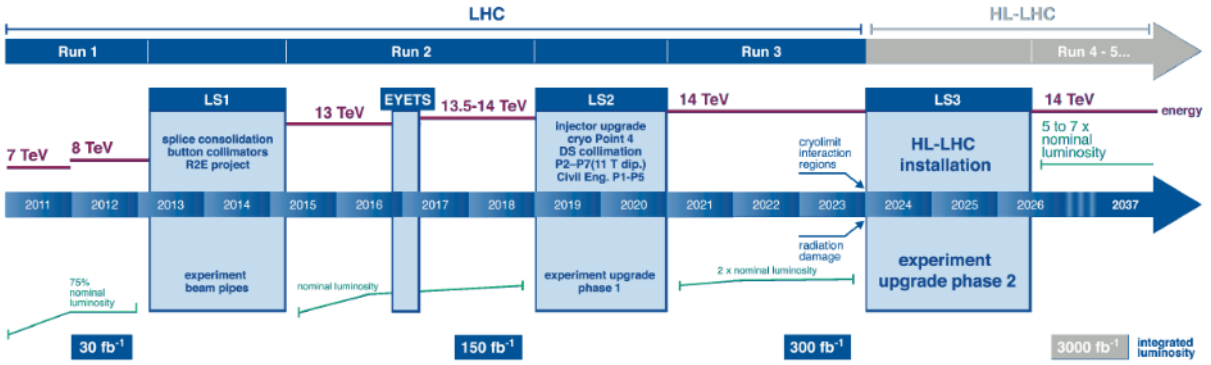
Upgrade of the ATLAS Inner Tracker

(Lund ATLAS group contribution)

- A substantial part of the upgrade work concerning the ATLAS inner tracking detector is planned as a collaboration between Copenhagen, Lund and Uppsala
- The new Inner Tracking Detector (ITk) will start recording data in 2026
- It will have 165 m^2 silicon strip detectors split into 18’000 modules, for a total of 60 million read-out channels
- Copenhagen, Lund and Uppsala will build 1’000 of those modules
- The module construction starts at the end of 2018/beginning 2019



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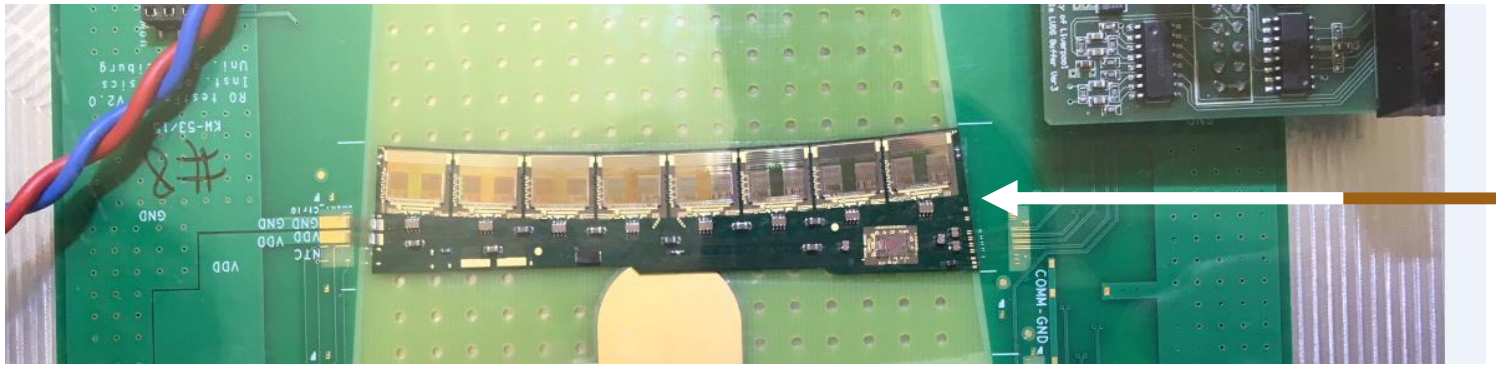
Lund contribution to this effort

- WP 3.1 – Detailed testing, trimming, burn-in of hybrid circuit boards (designed in Lund, see photograph below)
- WP 6.2 - Detailed testing, trimming, long-term testing, thermal cycling. Insertion of data into database ~90h/module (done on many modules in parallel in a climate chamber). Some rare repairs
- WP 6.3 – Metrology of full module after thermal cycling (if needed)
- WP 6.4 – Storage of modules and transport in batches of tested modules to macro assembly locations. N_2 storage. Final check of database and traveller sheet.

A cleanroom is needed for WP 3.1 and WP 6.2, using the same climate chamber, as well as 6.3. WP 6.4 is also facilitated if the storage of the modules is inside a cleanroom.



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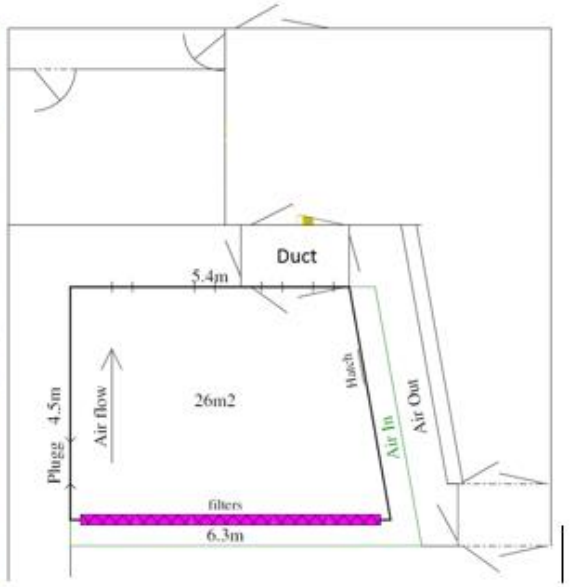
Preparation of a clean room for the work

- Next year we refurbish and equip an 26 m^2 ISO-7 cleanroom for this task
- The Science Faculty has supplied a grant to cover all equipment needed for this upgrade effort



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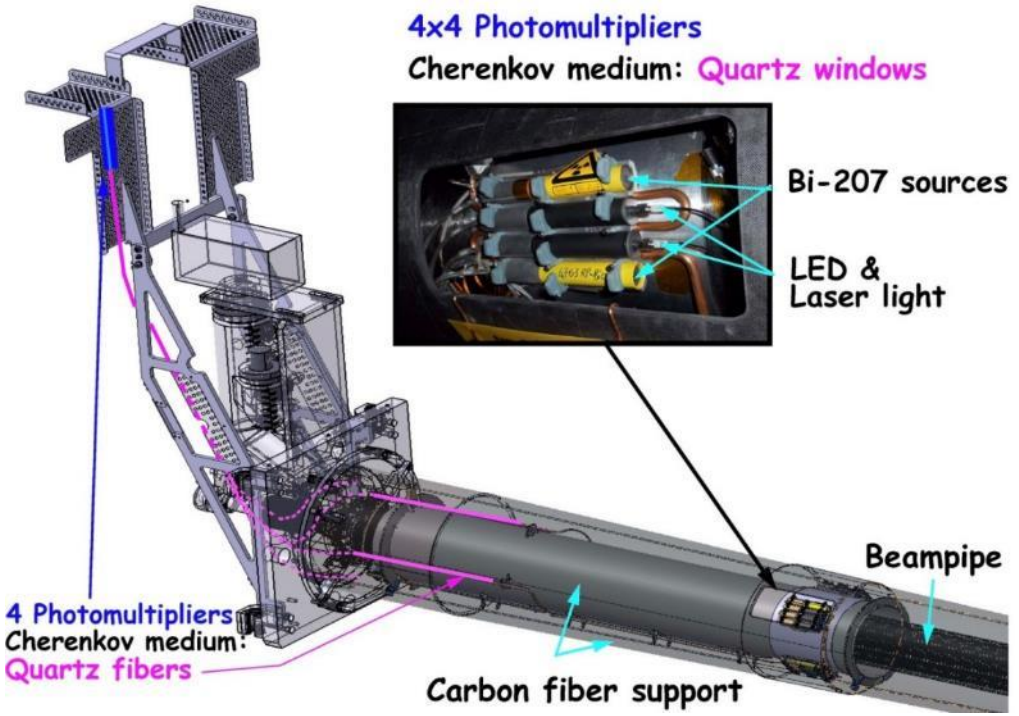
Luminosity measurements in ATLAS

(by Vincent Hedberg)

The ATLAS luminosity measurement is used in almost all physics analysis. The Lund group is participating in and coordinating the luminosity analysis. The group has also had a leading role in designing and constructing the LUCID luminometers together with groups from Bologna and Alberta.

LUCID-2 uses the quartz windows in photomultipliers and bundles of optical quartz fibers as Cerenkov medium.



Bi-207 sources that give monoenergetic electrons above the Cherenkov threshold provide an accurate monitoring of the photomultiplier gain stability.

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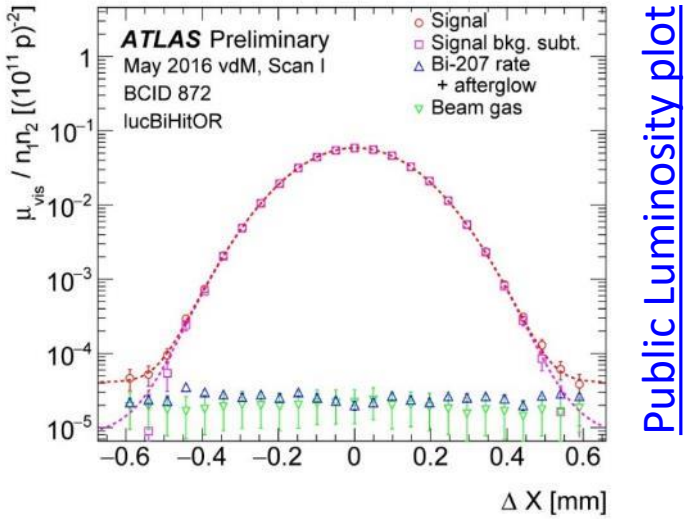
Luminosity measurements in ATLAS

The detector is calibrated in so-called van der Meer scans in which the beams are swept passed each other and the detector rates are measured.

The width and peak value in these scans provided a calibration with an error of 1.6% in 2015.

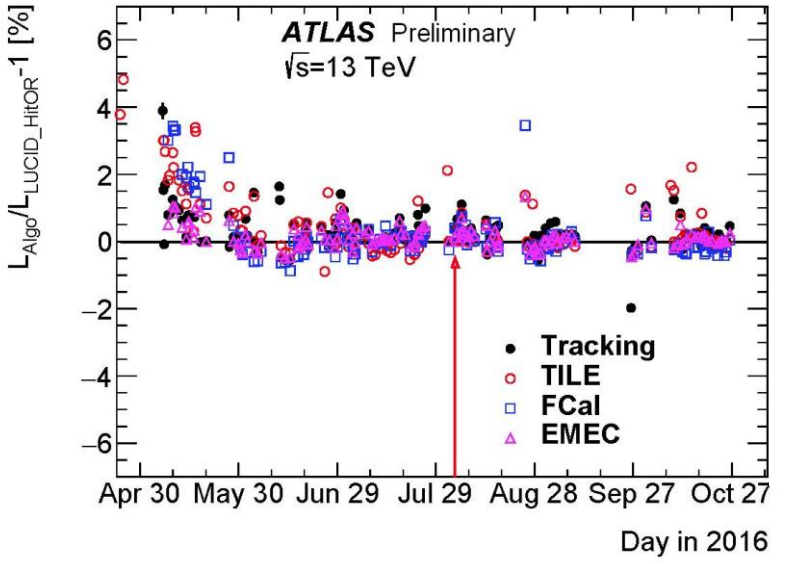


Public Luminosity plot

Comparison of the LUCID luminosity measurement with that of the luminosity from the hadronic Tile calorimeter, the electromagnetic liquid argon calorimeter the forward calorimeter and track counting by the inner detector.

Each point shows the measurement in one ATLAS run.

The total luminosity error was estimated to be 2.1% in 2015 and 2.2% in 2016.



Public Luminosity plot

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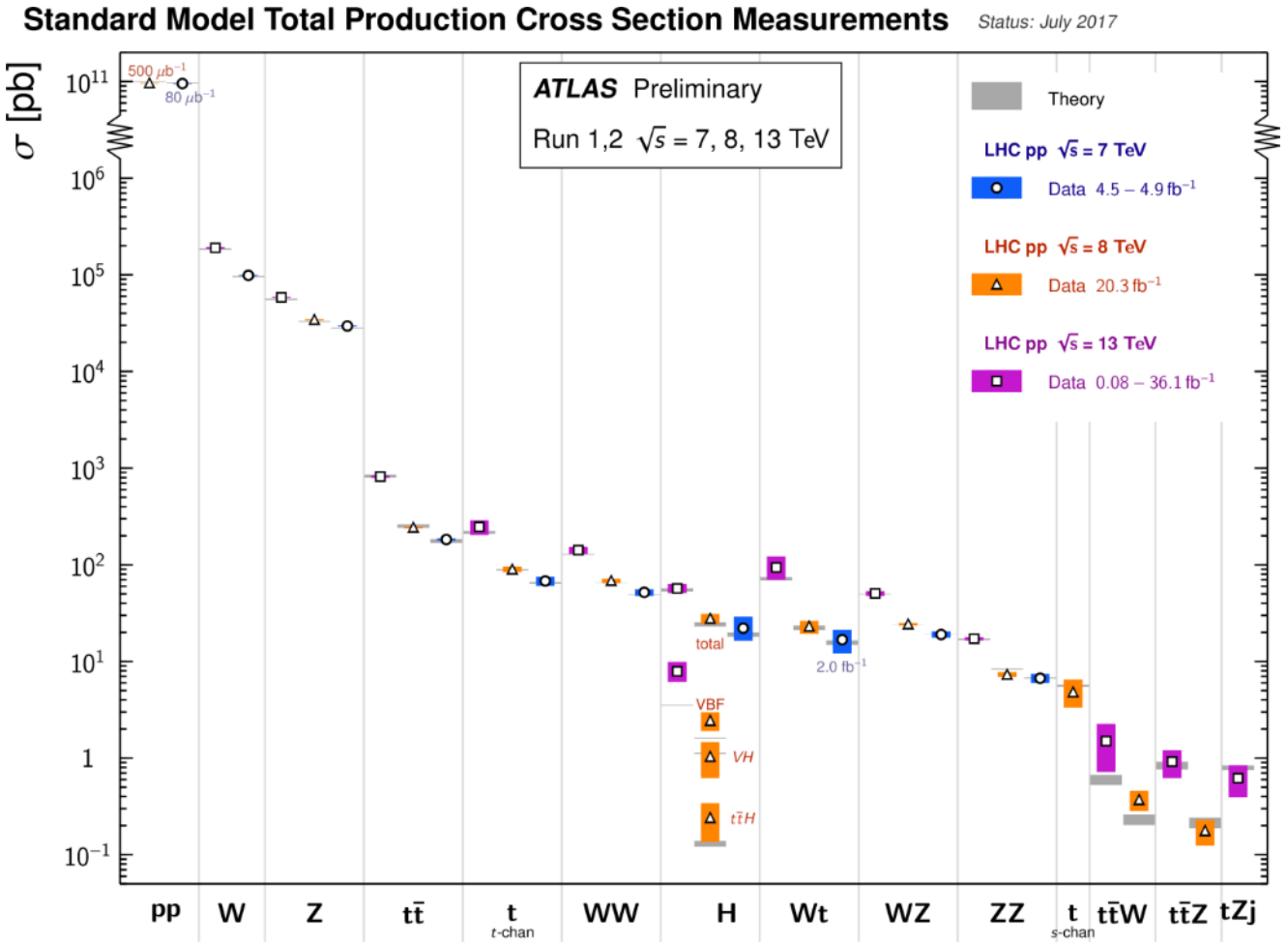
Luminosity measurements in ATLAS

The luminosity measurement is a crucial part of the cross section measurements in ATLAS.



Public Summary SM Plot

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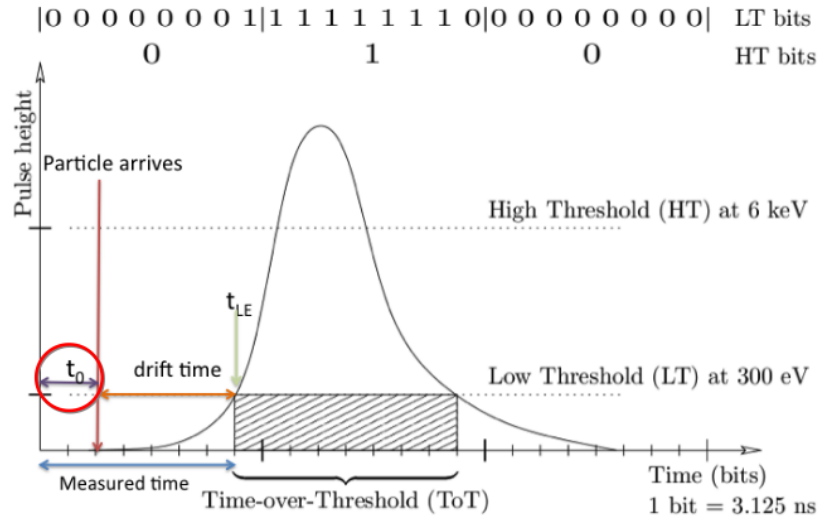
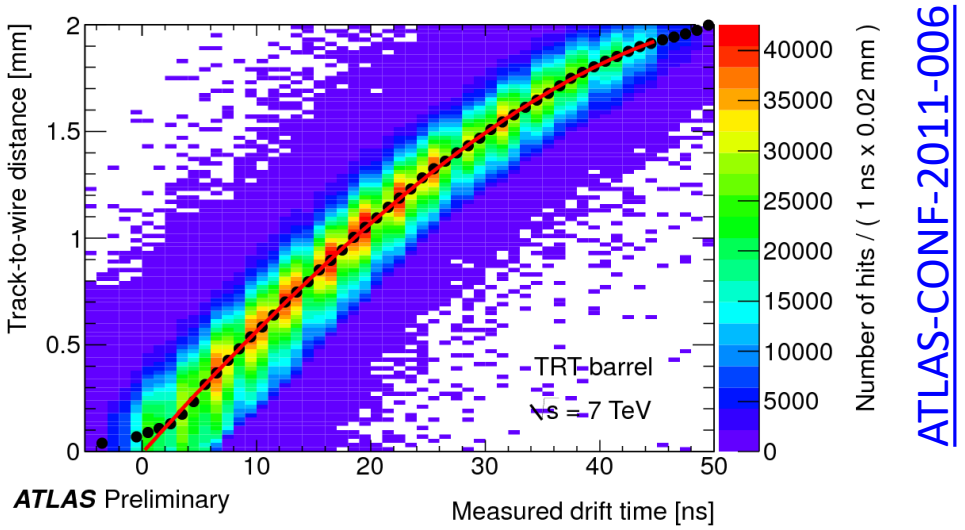
ATLAS TRT

- t0 and r-t calibration for different TRT gas geometries: *Katja Mankinen*
- t0 and r-t calibrations for different occupancies and pile-up conditions: *Eleni Skorda*
- Lund ATLAS group has been and is actively taking (expert) data quality offline shifts (*Katja Mankinen, Ruth Pöttgen, Else Lytken*)





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ATLAS Computing

- A number of activities, mostly in distributed computing:
  - Tier1 operations, infrastructure: *Oxana Smirnova* (also Computing Speakers Commitee, and represents Sweden in ATLAS International Computing Board
  - ATLAS information system (AGIS), storage info schema: *Balázs Kónya*
  - Profiling and optimisation of computing workflows: *Caterina Marcon*
  - Lund Tier3 operations, information system: *Florido Paganelli*
- Active cooperation with LUNARC – LU's computing centre
  - Hosting computing and storage resources for Tier2 (VR/RFI grant) and Tier3 (LU Science Faculty grant)

AURORA cluster at LUNARC hosting Tier2 and Tier3 nodes

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Conclusion

- Lund ATLAS group activities expand into new areas
- See Eva’s and Katja’s talks for more details

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