ATLAS experiment activities at KTH

Partikeldagarna, Stockholm, Nov 6-7, 2017

Christian Ohm, obo the KTH ATLAS group

Nov 7, 2017

Group overview

- ATLAS team at KTH part of Particle & Astroparticle Physics group
- Relatively small group:
  - Two faculty
  - Two Ph.D students
  - Two “in between”
- Hardware activities:
  - Now: High-Granularity Timing Detector for HL-LHC upgrade
  - Since Day 1: Liquid argon calorimeter pre-sampler
- Physics interests:
  - Higgs sector measurements
  - BSM searches (SUSY, dark matter, long-lived particles)

KTH main campus

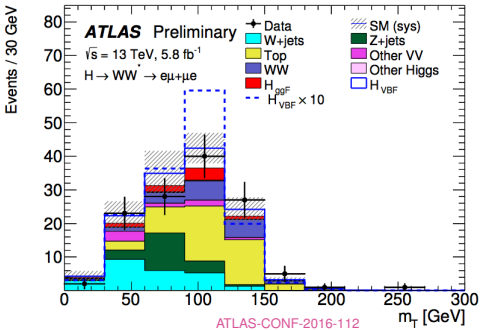
Find us at AlbaNova!

Edvin Sidebo – Ph.D. student, 2014–now

Past work:

- Studies of performance of neural network used for clustering in Pixel detector (https://cds.cern.ch/record/2116350)
- Minimum-bias analysis with early data (link)

Now back in Stockholm after a year at CERN.



ATLAS-CONF-2016-112

Current focus:

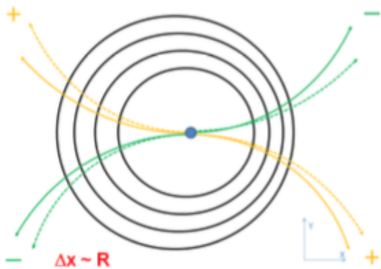
- $H \to WW$ measurements, focus on estimating backgrounds from fake leptons
- Planning to defend Ph.D. thesis in 2018

Giulia Tremearne Ripellino – Ph.D. student, 2015–now

Also back in Stockholm after a year at CERN.

Recent work related to tracking:

- Alignment studies of inner tracker using K_S^0
- Impact parameter resolution: extracted MC correction factors from data, for use in analyses



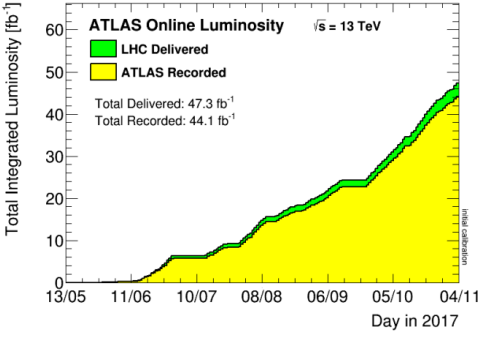
Current focus:

- SUSY search in $Z(\ell\ell) + E_{\mathrm{T}}^{\mathrm{miss}}$+jets final state (see talk yesterday)
  - Estimate of “flavor-symmetric” bg: $t\bar{t}, WW, Wt, Z \to \tau\tau$
- Writing up lic. thesis (plan to defend in Jan)

Alex Kastanas – Research Engineer, 2016–now

Responsible for infrastructure for online luminosity:

- All luminometers: LUCID, BCM, Tile, LAr, ...
- Online calibration for quick feedback, to LHC and trigger for monitoring and optimization
- Crucial during so-called van der Meer (vdM) scans for lumi calibration



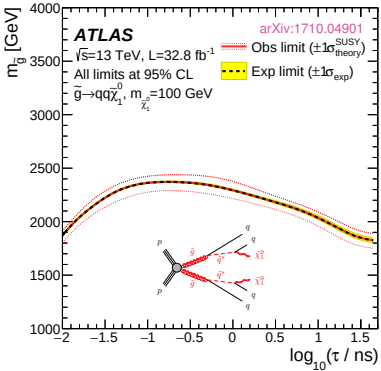
Other activities:

- Finished tracking convenership: *Clustering and Tracking In Dense Environments* (CTIDE) subgroup
- High-Granularity Timing Detector (more later)
  - Test beam data analysis, tracking
  - Luminosity!

Christian Ohm – Researcher, 2017–now

Recent work:

- Search for BSM in final state with $E_{\mathrm{T}}^{\mathrm{miss}}$ and displaced vertices (arXiv:1710.04901)
  - Exclusions for gluinos with τ between $\mathcal{O}(0.01)$–$\mathcal{O}(10)$, reaching up to $m_{\tilde{g}} = 2.37$ TeV
  - Extensive effort on public reinterpretation material!



Currently co-organizing:

- ATLAS Astroparticle Forum
- ATLAS SUSY searches with displaced vertices
- BSM group at Oskar Klein Centre

High-Granularity Timing Detector:

- Editor of Expression of Interest document ($\Rightarrow$ LHCC soon!)

Jonas Strandberg – Associate Professor, 2011–now

- Recently finished two-year term as *Data Preparation Coordinator* in ATLAS, requiring full-time presence at CERN

  $\Rightarrow$ Moved back a month ago - all here now!
- Convener of $H \to WW$ group in ATLAS
- Represents Sweden in IPPOG (see talk today)

Research interests:

- Exploration of Higgs sector: measurements of SM Higgs, searches for additional, heavier Higgs particles (as predicted e.g. by SUSY)
- Also involved in WW scattering initiative
- High-Granularity Timing Detector: initiator of luminometer usage

Bengt Lund Jensen – Professor, 1989–now

- ATLAS team leader and head of Particle & Astroparticle Physics division at KTH
- Long-term involvement in liquid argon calorimeter project: design and construction of pre-sampler , main h/w activity in the group until recently
- Main physics interest is Supersymmetry, search in $Z + E_{\mathrm{T}}^{\mathrm{miss}}$+jets with Giulia

Current focus on detector upgrade for HL-LHC:

- High-Granularity Timing Detector

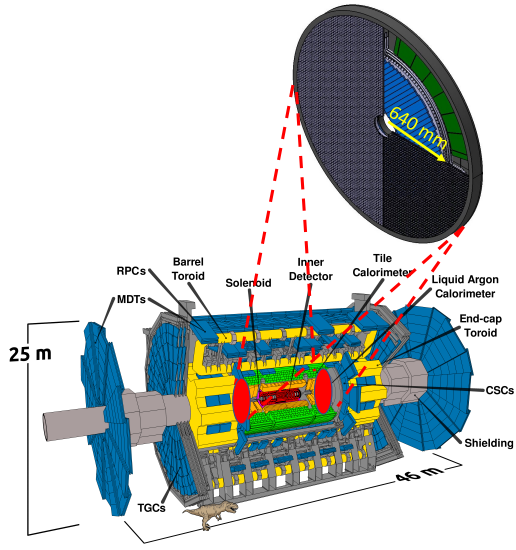
High-Granularity Timing Detector for HL-LHC

Proposed new ATLAS detector for HL-LHC (2025), to mitigate pileup

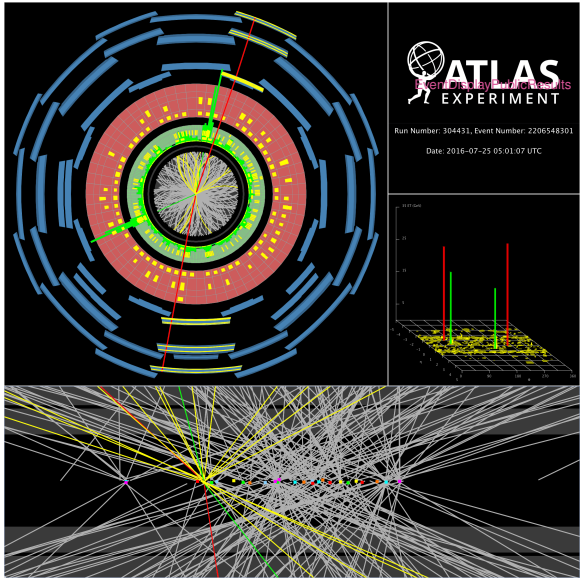
- Two endcap disks ($r = 640$ mm) at $z = \pm 3.5$ m from collision point, where MBTS detectors are now
- Si-based Low Gain Avalanche Detectors, giving $\sigma_t = 30$ ps/track

KTH activities:

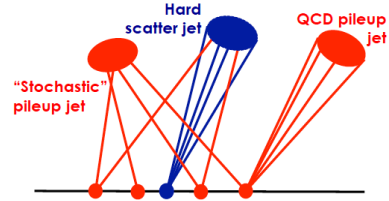
- Test beam measurements and data analysis
- HGTD as a luminometer
- Editorial work for Expression of Interest doc - plan to send to LHCC for review on Nov 20!



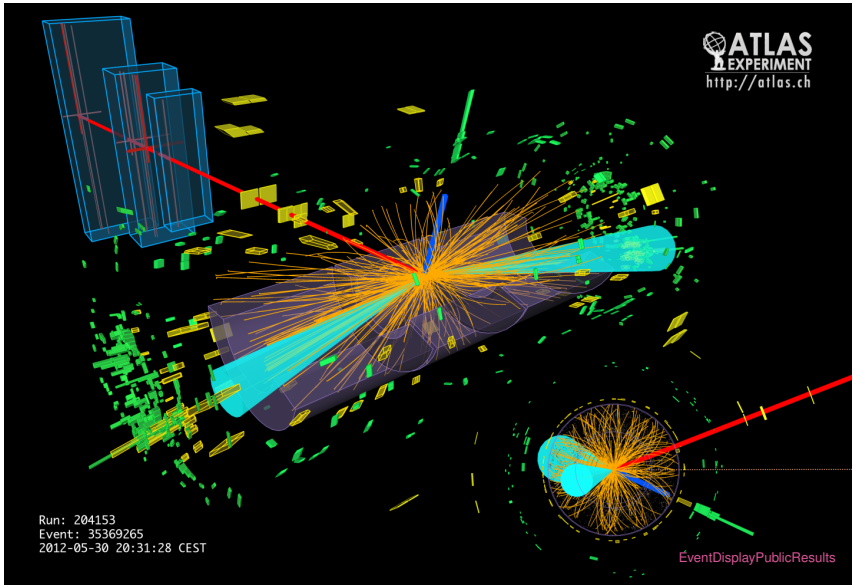
HGTD: the challenge of pileup



- Pileup vertices in $H \to ZZ \to e^+e^-\mu^+\mu^-$ candidate event
- Must associate particles produced in hard process to the same vertex
- Tracks from pileup can contaminate objects from hard scatter

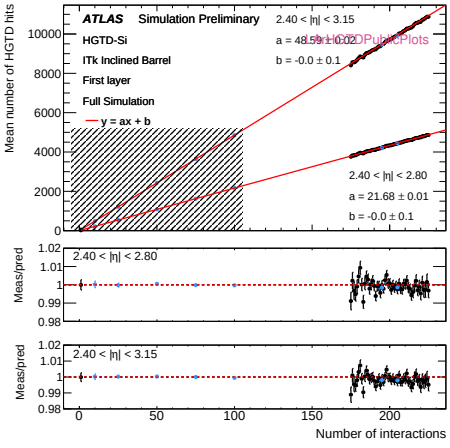


Forward jets in VBF production



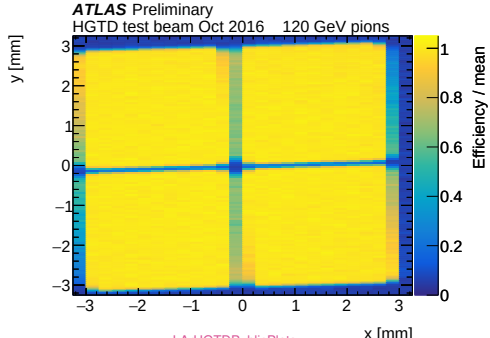
HGTD effort at KTH

Average n_{hits} linear function of number of simultaneous pp collisions $\Rightarrow$ can be used for **luminosity measurements**!



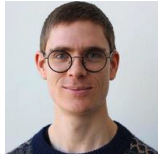
Test beam measurements of LGAD sensors ongoing!

- Participating in data taking at CERN
- Tracking and data analysis
- Example: efficiency for 2×2 array of $3\text{ mm} \times 3\text{ mm}$ sensors



Thanks!



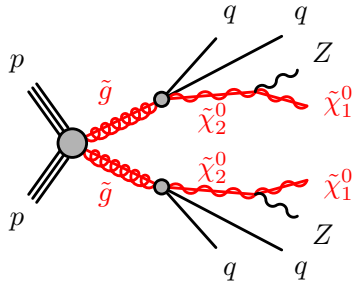



Back-up

Physics analysis activities: direct BSM searches

SUSY search in final states with $Z \to \ell^+\ell^- + E_{\mathrm{T}}^{\mathrm{miss}}$:

- Involved: Giulia, Bengt (+CO)

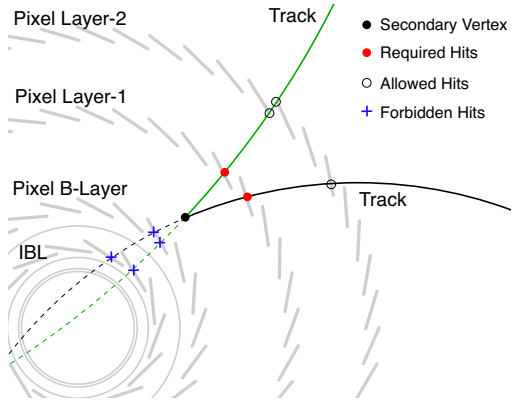


Summarizing/steering DM searches (CO):

- Presenting limits for comparison with non-collider searches
- Assessing coverage in parameter space, ensuring consistent model use

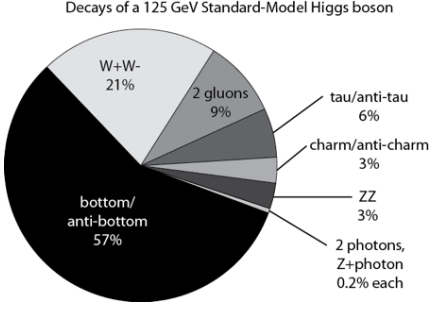
Searches for long-lived particles:

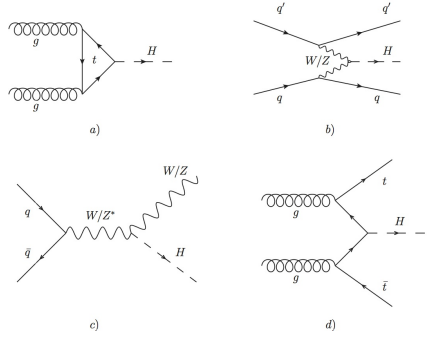
- Generic signature predicted by many BSM theories (SUSY)
- Displaced vertices, $\mathcal{O}$(1–100) mm:



Physics analysis activities: Exploring the Higgs sector

- The LHC only place where the Higgs sector can be measured! Production cross sections, branching ratios, couplings, mass, spin, CP structure, ...
- Involved: Jonas, Edvin (+Alex)
- Primarily working on $H \to WW$





Can give signs of BSM!

- Production and decay diagrams sensitive to BSM
- Additional Higgs bosons? E.g. 2HDM extensions predict five.