Technical contributions of DESY apart from upgrade and CP

Jour fixe – June 23

C. Sander (on behalf of many)

HELMHOLTZ

DESY.

Semi-Conductor-Tracker

Semi-Conductor-Tracker

Activities at DESY

- SCT Calibration loop: Maintenance (DESY institutional commitment)
  - Identification and upload to DB of noisy strips (to be masked during bulk reconstruction)
  - Writing of DQ data (raw occupancy, efficiency, noise occupancy, byte stream errors) to conditions database
  - Transition to Run 3 was big effort (migration to Rel22); no issues in transition to 2023!
  - Ongoing improvements to increase performance and reliability
- Several SCT DAQ & DCS on call shifts
- Several other finished or dropped SCT related activities over the last years

People involved: Christian Sander (staff, 0.45 OTP), Evgeniya Cheremushkina (postdoc, 0.15 OTP + shifts)

By end of 2023: replacement for Evgeniya (Jakub expected to join); then covered until end of Run 3

Luminosity

Luminosity

Activities at DESY

- Run 2:
    - 13 TeV luminosity analysis (vdM analysis and track counting)
    - VdM analysis of 2017 5 TeV run
    - Run 2 legacy paper submitted to EPJC in December 2022
        - Setting new precision record of 0.83% uncertainty for full Run 2 dataset: 140.1 ± 1.2 fb^{-1} (https://arxiv.org/pdf/2212.09379.pdf)
- Run3:
    - 2022 dataset yields 31.4 ± 0.7 fb^{-1} (ATL-DAPR-PUB-2023); initial precision of 2.2%
    - Preliminary vdM analysis of 2022/2023 luminosity
    - Follow-up of new incoming vdM scans
    - Track counting Z-efficiency corrections
    - Pixel cluster counting studies
   - Responsibilities: Luminosity vdM and Calibration Transfer SG convener (Klaus)

People involved: Staff: Klaus Mönig, Claudia Seitz; Postdocs: Filippo Dattola, Oliver Majesky; PhD students: Cédrine Hügli, Thomas Mclachlan

ATLAS Forward Proton

AFP

Activities at DESY

- Intact forward scattered protons are key tool to identify photon-induced processes
- Measure them using AFP detectors: Tracking & Time-of-Flight detectors
- Provides powerful background rejection:
  - New kinematic information e.g. total missing momentum by combining AFP & central ATLAS
  - Time-of-flight information to match protons in AFP to ATLAS *z* position (distinguish from pile-up)
- Need to precisely identify and calibrate protons for use in physics analysis
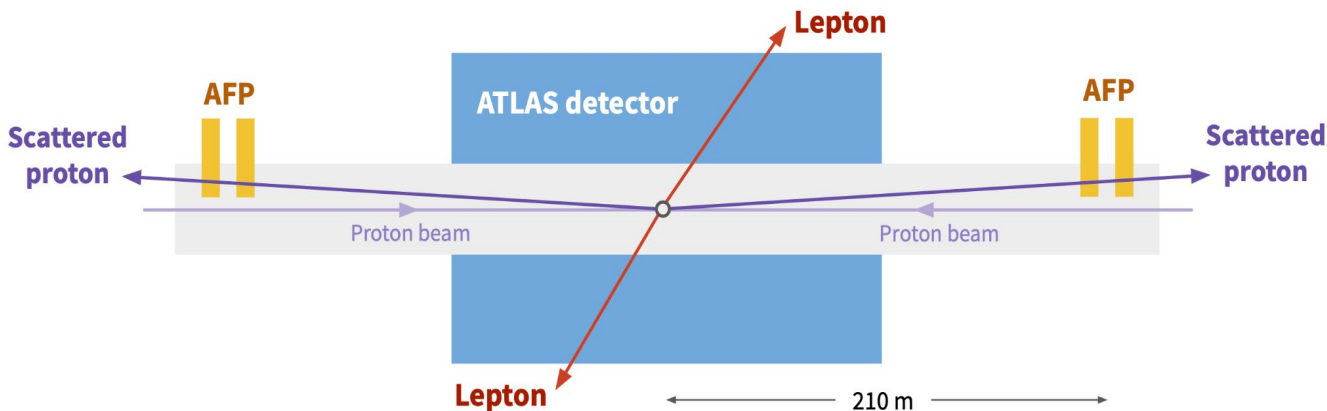
ATLAS Forward Proton (AFP) detectors relative to central ATLAS detector

AFP

Activities at DESY

- Coordination of Run 3 recommendations for forward protons

    - 2022 data already doubles existing dataset recorded with AFP

- Run 3 global alignment of AFP tracker planes:

    - Performing in-situ alignment using photon-induced di-muon events

    - Crucial to align detectors to use forward proton object in Run 3 data

- AFP offline monitoring

- AFP software and simulation

People involved:

- Staff: Lydia Beresford (YIG leader, LHC Forward Physics WG convener)

- Postdoc: Savannah Clawson (ARP (ATLAS Roman Pot) Combined Performances Coordinator); Clara Leitgeb

- PhD student: Weronika Stanek-Maslouska, Yusuf Cekmecelioglu

Monte Carlo / Pile-Up / Pheno

Monte Carlo

Activities at DESY

Generators software maintenance and development (institutional commitment)

- Successful switch to HepMC3 - object oriented, C++ package for event
  record encoding and manipulation

- Successful start of Run 3 EVGEN production (now ongoing)

- Preparations for retirement of software infrastructure used for older EVGEN production campaigns, and
  providing the same functionality with use of new releases and software infrastructure

- Creation of releases for running production and validation of MC generators

- Generator software fixes and improvements needed for running in new software configuration (compiler
 changes, athena modifications)

- User support

People involved: Ewelina Lobodzinska (staff)

Monte Carlo production coordination

Activities at DESY

- Cooperation with Physics Coordination, ATLAS Distributed Computing, Physics Validation, Distributed Data Management and other teams on MC production in the Central Production System

- Preparation of new MC campaigns

- Running large MC sample production for Run 3 campaigns

- Monitoring and optimising MC production resources usage

- Support for shifters running MC production for Run 2 campaigns

People involved: Ewelina Lobodzinska (staff, MC Production Coordinator)
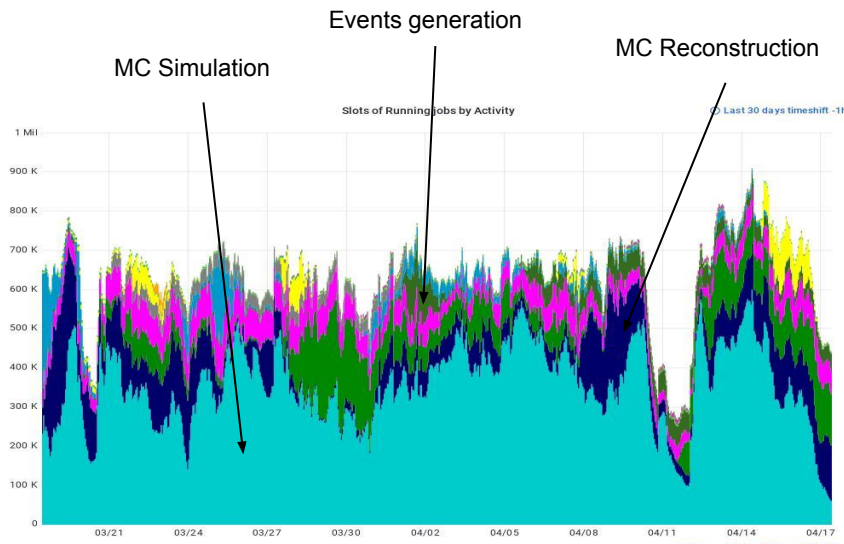
Pile-up / AI / Pheno

Activities at DESY

- Machine learning algorithm development

    - Diffusion networks to generate pile-up predictions for Run 3

- Organisation of Helmholz.ai Konferenz @ DESY

- Sherpa-fusing: Fusing fragments for several processes in one setup

    - E.g. combine ttbb and tt+jets multi-leg predictions

    - Merge samples by removing ttbb-like events from tt+jets multi-leg prediction

    - Fusing leads to consistent treatment covering full phase space

People involved:

- Staff: Judith Katzy

- Postdoc: Stephen Jiggins

- PhD: Lars Ferencz

Software, **C**omputing, **O**peration

SCO

Activities at DESY

- Members of DESY-ATLAS group hold key coordination positions, covering all aspects of ATLAS computing, resulting in a significant and visible presence

People involved and roles:

- James: Data Preparation Coordinator (Top level ATLAS coordinator position)

- David: ATLAS Distributed Computing coordination (until September), ATLAS Software & Computing Coordinator (from October, Top level)

- Federico: Data Re-processing Coordinator

- Nicholas Styles: Software Coordinator

- Priscilla: CRC (Computing Run Coordinator) shifts

- Johanna: Sys. Admin, further activities

Backup

Luminosity

Run 3 activities

Run 3 initial calibration PUB Note released

- 2022 dataset yields 31.4 ± 0.7 fb^{-1} (ATL-DAPR-PUB-2023)

- Initial precision of 2.2%

- Van der Meer (VdM) scan

  - Leading involvement in November 2022 vdM session

  - Quick turn-around on calibration including detailed systematic uncertainties

    - Provided luminosity measurement for Moriond 2023 analyses
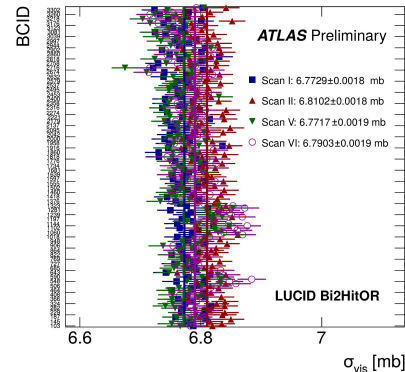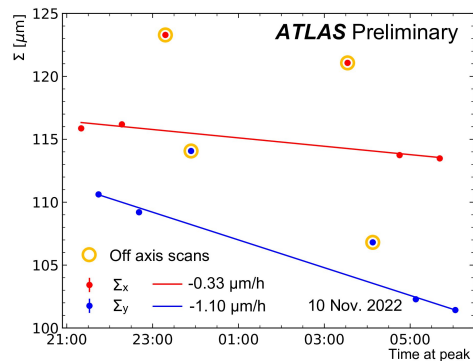
Data sample	2022
Uncertainty contributions [%]:	
Statistical uncertainty	0.01
Fit model	0.24
Background subtraction	0.06
FBCT bunch-by-bunch fractions	0.01
Ghost-charge and satellite bunches	0.17
DCCT calibration	0.20
Orbit-drift correction	0.06
Beam position jitter	<0.01
Non-factorisation effects	1.07
Beam–beam effects	0.35
Emittance damping correction	0.21
Length scale calibration	0.03
Inner detector length scale	0.24
Magnetic non-linearity	0.32
Bunch-by-bunch σ_{vis} consistency	0.50
Scan-to-scan reproducibility	0.27
Reference specific luminosity	0.43
Subtotal vdM calibration	1.45
Calibration transfer	1.50
Calibration anchoring	0.53
Long-term stability	0.41
Total uncertainty [%]	2.19

Luminosity

Run 2 activities

Run 2 legacy paper submitted to EPJC in December 2022

- Setting new precision record of 0.83% uncertainty for full Run 2 dataset: 140.1 ± 1.2 fb^{-1} (https://arxiv.org/pdf/2212.09379.pdf)

Main DESY contributions over the last years:

- Van der Meer (VdM) scan
  - Absolute calibration of main luminosity measurement in ATLAS
    - Re-analysis of all 13 TeV vdM sessions of Run2
- Track counting (TC) luminosity
  - Key ingredient for extrapolation of main luminosity measurements from vdM to physics regime
    - Optimization of track counting working points, monitoring of track selection stability using Z bosons, data reprocessing
    - Conveners of Inner Detector luminosity subgroup