AIDA-2020-SLIDE-2019-023

AIDA-2020

Advanced European Infrastructures for Detectors at Accelerators

Presentation

Improvements of test beam infrastructure for high precision tracking

Dreyling-Eschweiler, Jan (DESY)

25 April 2018

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This work is part of AIDA-2020 Work Package **15: Upgrade of beam and irradiation test infrastructure**.

The electronic version of this AIDA-2020 Publication is available via the AIDA-2020 web site <http://aida2020.web.cern.ch> or on the CERN Document Server at the following URL: <http://cds.cern.ch/search?p=AIDA-2020-SLIDE-2019-023>

WP15.2 – Improvements of test beam infrastructure for high precision tracking

Jan Dreyling-Eschweiler (DESY) for the telescope and test beam team

AIDA-2020 Third Annual Meeting
WP15: Upgrade of beam and irradiation test infrastructure
Bologna, 25th April 2018

HELMHOLTZ RESEARCH FOR GRAND CHALLENGES

AIDA 2020

DESY TEST BEAM.

DESY.

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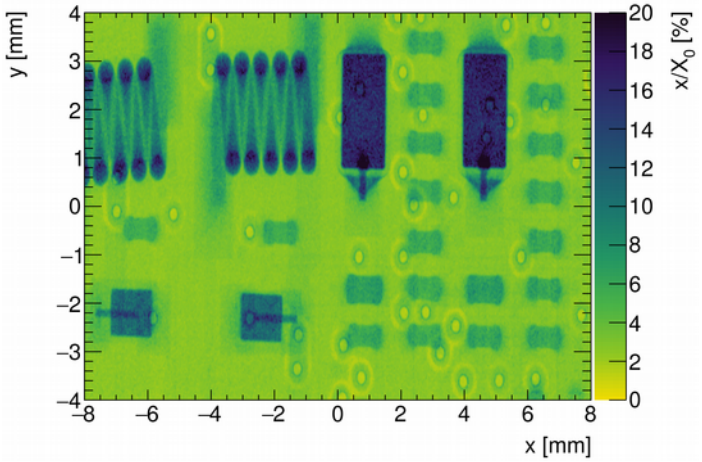
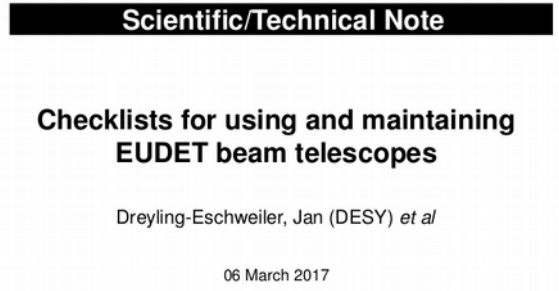
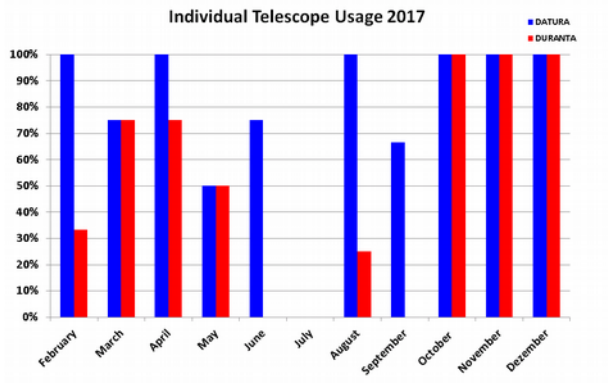






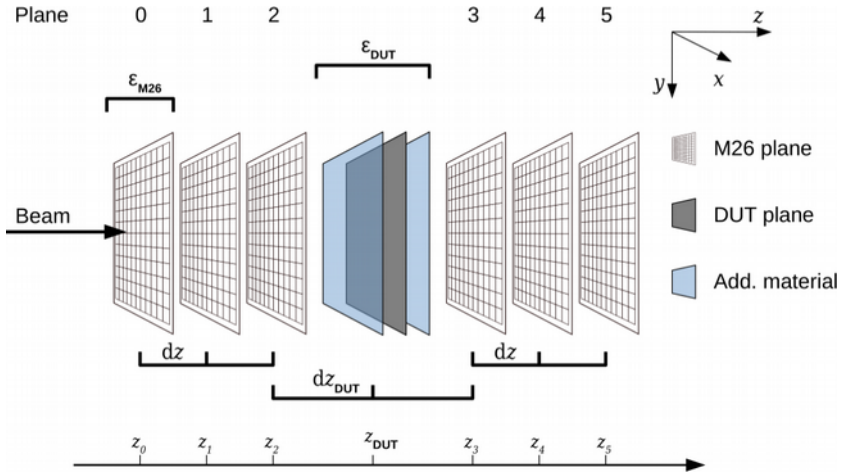
01 Introduction: Beam Telescopes

High precision reference tracker

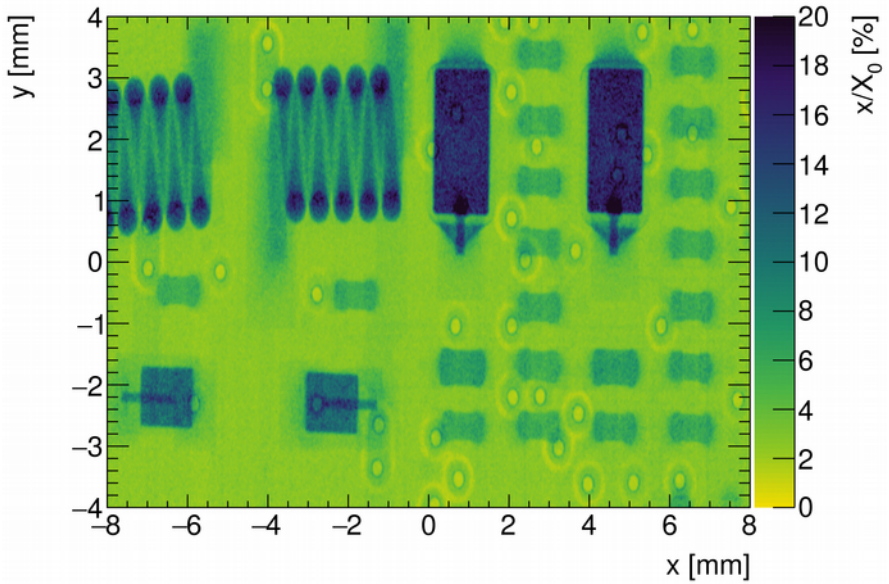
EUDET-type telescopes in a nutshell

- Mimosa26 based 6-plane telescope
  → **Device Under Test (DUT) in between** (or behind)
  → Response studies, efficiency, Lorentz angle, etc.

- Pointing resolution (> 1.8 µm) or
  angular resolution (> 0.03 mrad) @ 1-6 GeV/c
  → **Material Budget (X0) imaging**



H. Jansen et al https://doi.org/10.1140/epjti/s40485-016-0033-2



Electronic Board for ATLAS ITk strip upgrade (J.-H. Arling, C. David, M. Queitsch-Maitland)

References

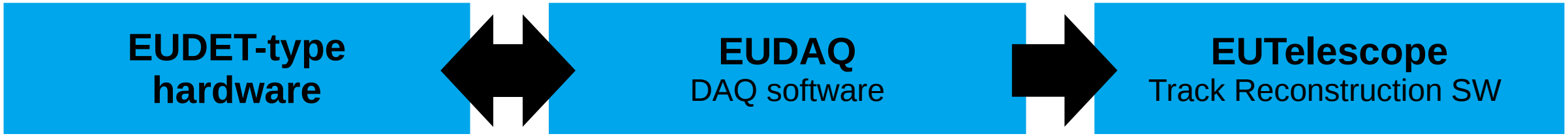
- **Portal & Manual & Description:** *telescopes.desy.de*
- **Performance & Reference Paper:** *H. Jansen et al https://doi.org/10.1140/epjti/s40485-016-0033-2*

01 Introduction: Common Beam Telescopes

A common tool used by many different users from various experiments

Today & User interfaces

- A workhorse for various (HEP) test beams: 7 copies at 5 different test beam facilities
- 3 pillars of EUDET-type telescope package: from data to results



- **Defined Interfaces**
  - DUT integration e.g. in µm-precise stages
  - TLU communication
- **Starting point:** *beam-telescopes.github.io*

Talk in WP5 by P. Baesso

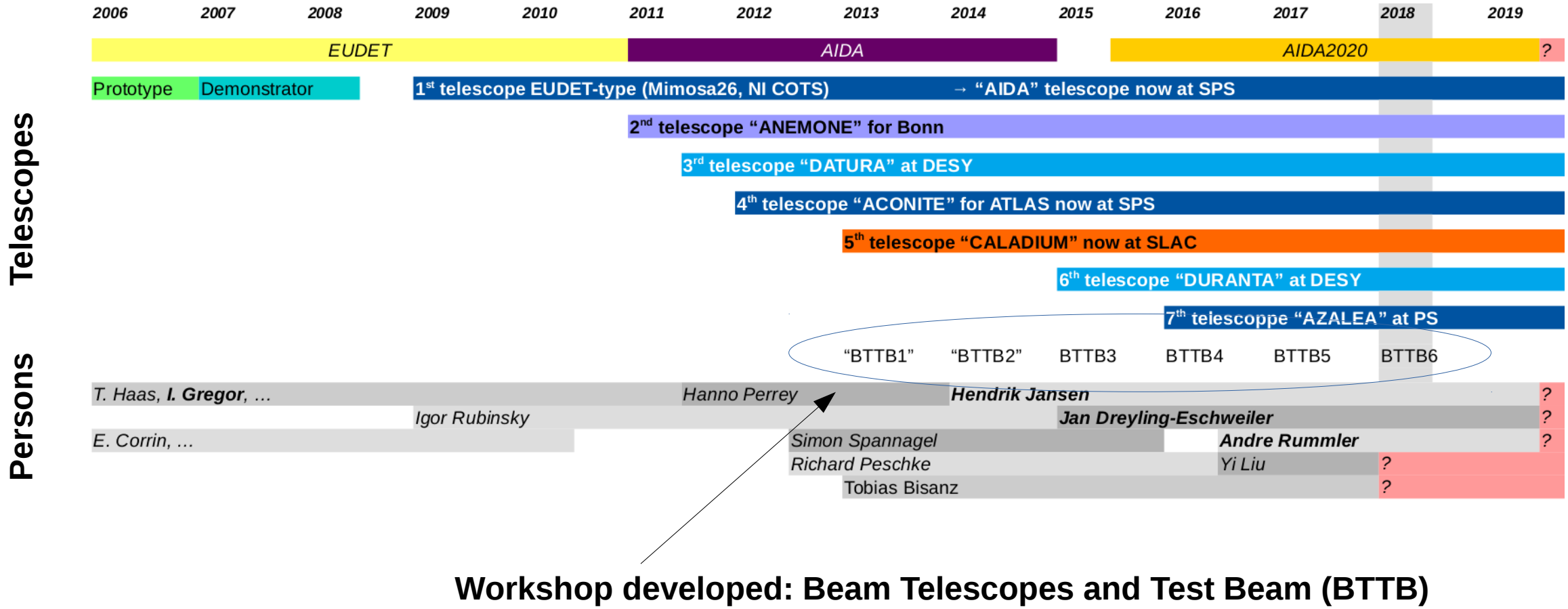
- **Defined Interfaces**
  - Producer for DUT-DAQ communication
  - Converter for data proc.
- **Starting point:** *eudaq.github.io*

Talk in WP5 by JDE

- **Interfaces**
  - To EUDAQ 1 events
  - DUT implementation
- **Starting point:** *eutelescope.github.io*

01 Evolution of EUDET-type Telescopes

History: European support, devices and manpower



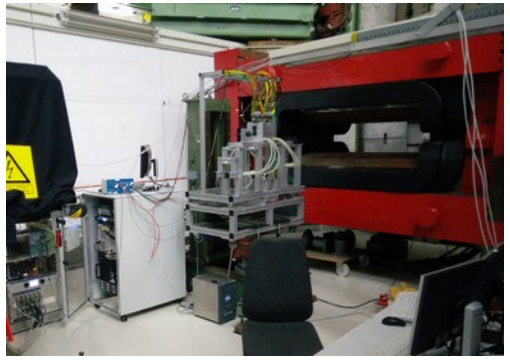
Workshop developed: Beam Telescopes and Test Beam (BTTB)

01 EUDET-type Telescopes Family today

Seven copies around the world at 5 different beam test beam facilities

Supported by AIDA2020 (WP15, WP5, WP10)

TB contact:
Ralf Diener, Norbert Meyners, Marcel Stanitzki
Telescope contact:
Hendrik Jansen, Jan Dreyling-Eschweiler



DATURA @ TB21

DURANTA *@ TB22*

SPS/PS contact:
Henric Wilkens
Telescope contact:
André Rummler

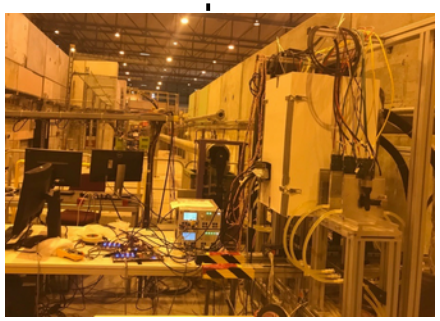
AIDA @ SPS, H6B

AZALEA @ PS, T10

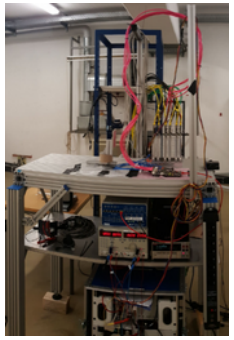
Mainly self-managed

CALADIUM @ SLAC in Stanford, USA

General Contact:
Carsten Hast



ACONITE @ SPS, H6A



ANEMONE @ BONN / ELSA

TB contact:
Daniel Elsner
Telescope contact:
David-Leon Pohl

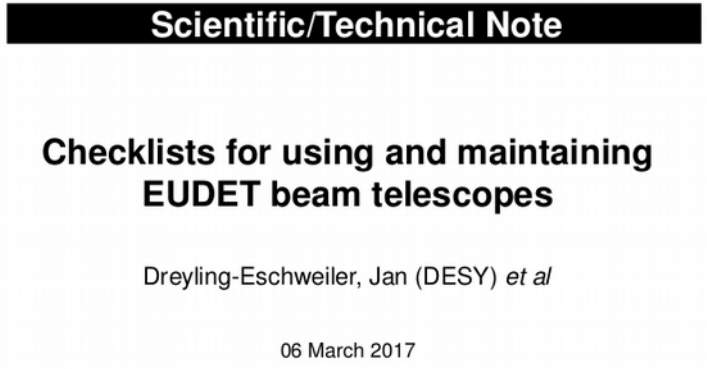
02 WP15.2 Status

Deliverables achieved

AIDA2020 – WP15.2 – Improvements of test beam infrastructure for high precision tracking

- AZALEA was installed at PS T10, CERN, in September 2016
- Milestone and Delivery achieved, Documentation updated

MS32	Pixel telescope hardware assembled	15	M18	31/10/2016	Achieved	Report
D15.1	CERN pixel beam telescope for the PS	WP15	M24	27/03/2017	Achieved	Report



Starting point of documentation

- *telescopes.desy.de*

02 Inputs and Cross Links

A DESY focus

AIDA2020 inputs

- FTE: 10% (05/15-06/16) and 40% (07/16-today)
- For AZALEA: 80k
- For 10x Mimosa spares: 30k

DESY inputs

- Support for R&D in the HEP department
- Usage/accessibility of DESYII test beam
- Usage of engineers/workshops at DESY

Support for DESY activities

→ Telescope coordination and telescope meeting:

- Local and extern user **support**: training and documentation, ...
- **Maintenance**: Mimosa26 characterisation, repair broken HW ...
- **Development**: EUDAQ2, hardware control, ...
- **Education**: school interns, summerstudents, PhD projects

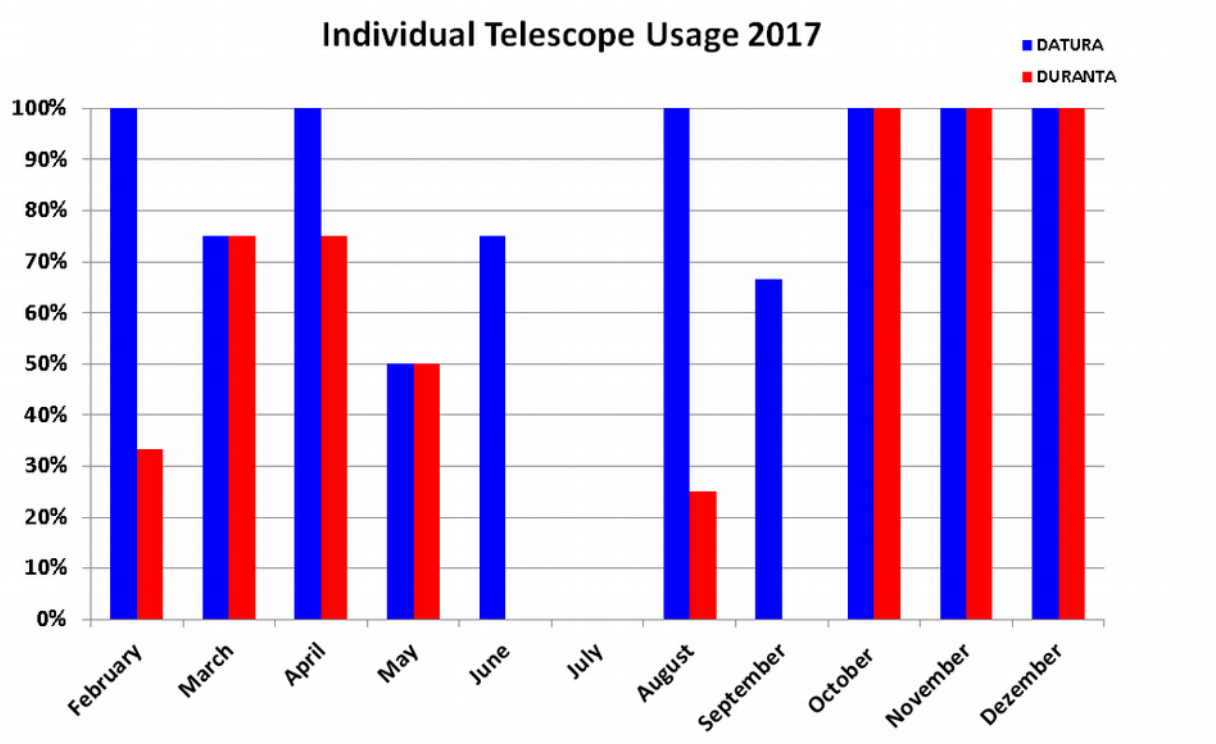
Cross links at DESY

- Strong exchange with test beam coordinators → understanding of **source and detector**
- Direct exchange with users → **facing needs**
- BTTB Coordination → **community hub**
- Exchange with linear coll. and calo. community (e.g. WP5 meetings / common DAQ) → **the full HEP picture**

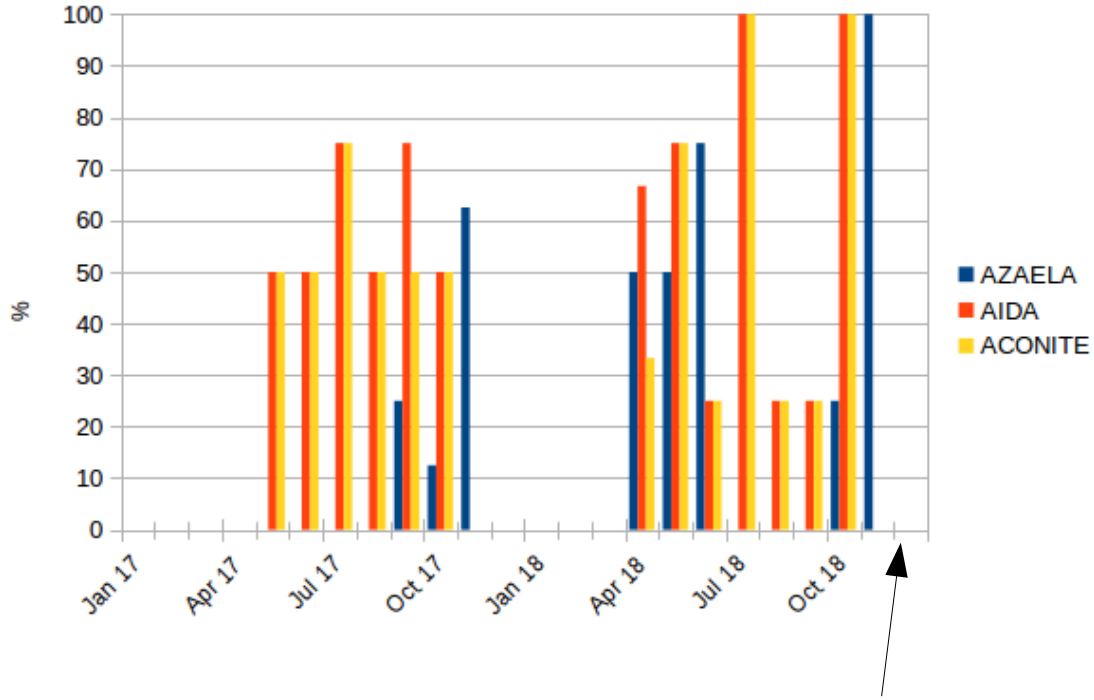
02 Telescope Usage

Usage & demand

DESY (two telescopes)



CERN (one telescope at PS, two at SPS)



LS2 shutdown from mid Nov. 2018

03 Reviews for the Future Steps

Learning from the past for the future

In 2017/18: Reviews of the last decade and future needs

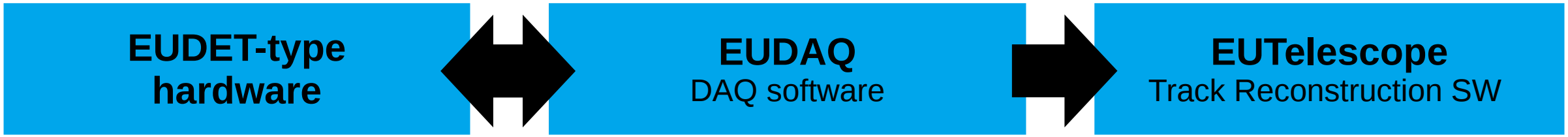
- Dedicated workshop “Future opportunities for Test Beams at DESY” → ***White paper***
  Hamburg, 5-6 October 2017, https://indico.desy.de/indico/event/17998/
- During the POF review appearance in MT and MU contributions
  Hamburg, 5-9 February 2018, https://indico.desy.de/indico/event/19128/
- Asking the community in the “Beam Telescope 2025” Forum at BTTB6 → ***White paper***
  Zurich, 16-19 January 2018, https://indico.desy.de/indico/event/18050/

Main results:

- ***“EUDET-type beam telescopes are a common tool (hardware, DAQ, reconstruction software) used by many different users from various experiments”***
- Continuous development (hardware and software) and support are needed
- Specific needs:
  1) **Better time resolution**
  2) **Test beam database**

03 Future: Increase Time Resolution

Coordinating common developments: Agreements from BTTB6



- Data taking and analysis upgrades with **EUDAQ2, AIDA TLU** and current Mimosa DAQ. DESY (Tom Daubney, Xiaocong Ai, Yi Liu, JDE) , Bristol (Paolo Baesso, David Cussans) and CERN (Maarten van Dijk, Andre Rummler)

Talk in WP5 by JDE

- The **TimePix3** is already integrated into EUDAQ1, an integration in EUDAQ2 is foreseen to be carried out. DESY (Anastasiia Velyka, Hendrik Jansen) and CLICdp (Simon Spannagel, Dominik Dannheim et al.)
- The **MMC3** as new MimosaDAQ will be integrated in EUDAQ2. U Bonn (Yannick Dieter, Tomasz Hemperek, Toko Hirono, Jens Janssen, David-Leon Pohl) and DESY (JDE)

- At DESY an effort started to use **DQM4HEP as Online Monitor** in EUDAQ2. (Remi Eti, Tom Coates, JDE, et. al.)

- DESY has started a project to figure out to improve the current **EUTelescope** framework. (Hendrik Jansen & JDE, Michaela Queitsch-Maitland, Paul Schütze, Jan-Hendrik Arling, James Robinson, …)
- Find out possible connection to WP3.

Telescope 2025

- A new common beam telescope should be designed and based on a new sensor and should cover all three pillars of HW, DAQ and Reco. DESY has started an effort to figure out common needs and possible technologies.

03 Draft for “Test Beam Database”

Copying the success story of the irradiation facility database

Talk by Blerina

Considerations:

- Technical part as for the irrads
- Manpower for coordination/reviewing contents
- Starting point: Table from Christoph Rembser (CERN)
- Add-ons: particle rate (peak and avg.), available tools, ...

Test beams* in the world, status September 2017

Laboratory	Number of beam lines	Particles	Energy range	Diagnostics etc.	Availability	Information, contacts & comments
CERN / PS (CH)	2	e, h, μ (sec.)	0.5 - 10 GeV/c	Threshold Cherencov, scintillators, MWPCs, delay wire chambers, scintillators, magnet, movable platform	9 months per year, continous except winter shutdown Duty cycle depends on PS / SPS / LHC operation mode and is typical * PS ~1-3% * SPS: 20-40% No PS and SPS test beams in 2019 and 2020	Contact beam time request and scheduling: Sps.Coordinator@cern.ch http://sps-schedule.web.cern.ch/sps-schedule/ contact beam lines: sba-physicists@cern.ch http://sba.web.cern.ch/sba/
CERN / SPS (CH)	4	p (prim.) e, h, μ (sec.) e, h (tert.) Pb ions (prim) other ion species (out of fragmented primary Pb ions)	400 GeV/c 10 - <400 GeV/c 10 - 200 GeV/c 20 - 400 GeV/c proton equivalent (z=1)	Delay wire chambers, filament scanners, XEMC calorimeters, Threshold & CEDAR, hodoscopes, magnet, movable platform		
CERN / CLEAR (CH)	1	e-	50-250 MeV/c		8 -9 months per year	Contact: CLEAR-Info@cern.ch https://clear.web.cern.ch
DAFNE BTF Frascati, (IT)	1	e+/e- both primaries and secondaries	25-750 MeV/c Rep Rate 50Hz 1-40 ns 1 to 10^{10} p/pulse	Calorimeter, silicon pixel, remote trolley, gas system, HV, trigger	depending on DAFNE schedule, from 25 to 35 weeks/year Not available in the first half of 2018	Contact: btf@lnf.infn.it, paolo.valente@lnf.infn.it info at: http://www.lnf.infn.it/acceleratori/btf http://www.lnf.infn.it/acceleratori/padme
DESY (D)	3	e+, e- (sec.) e- (prim., planned for 201X)	1 - 6 GeV/c 6.3 GeV/c	Trigger systems and beam telescopes, magnet (~1T)	10 months per year, Duty cycle ~ 50%	Contact: Testbeam-Coor@desy.de http:// testbeam.desy.de

04 Summary & Outlook

Summary

- EUDET, AIDA, AIDA2020 were and are booster for success story of common beam telescopes
- WP15.2 supported 7th telescope and maintenance
- DESY reviewed the last decade and asked the community for future needs
  - Better time resolution: Ongoing integrations and documentations
    → AIDA2020 extension would be helpful!
  - Test beam database
- **Link:** telescopes.desy.de

Outlook

- Continuing support & continuous integration
- Reference publications
- Long LHC shutdown 2019/2020
  → Moving one telescope from CERN to DESY
- Future Telescope 2025

Breaking News:
BTTB7 at CERN
in the week
14-18 January

Backup