

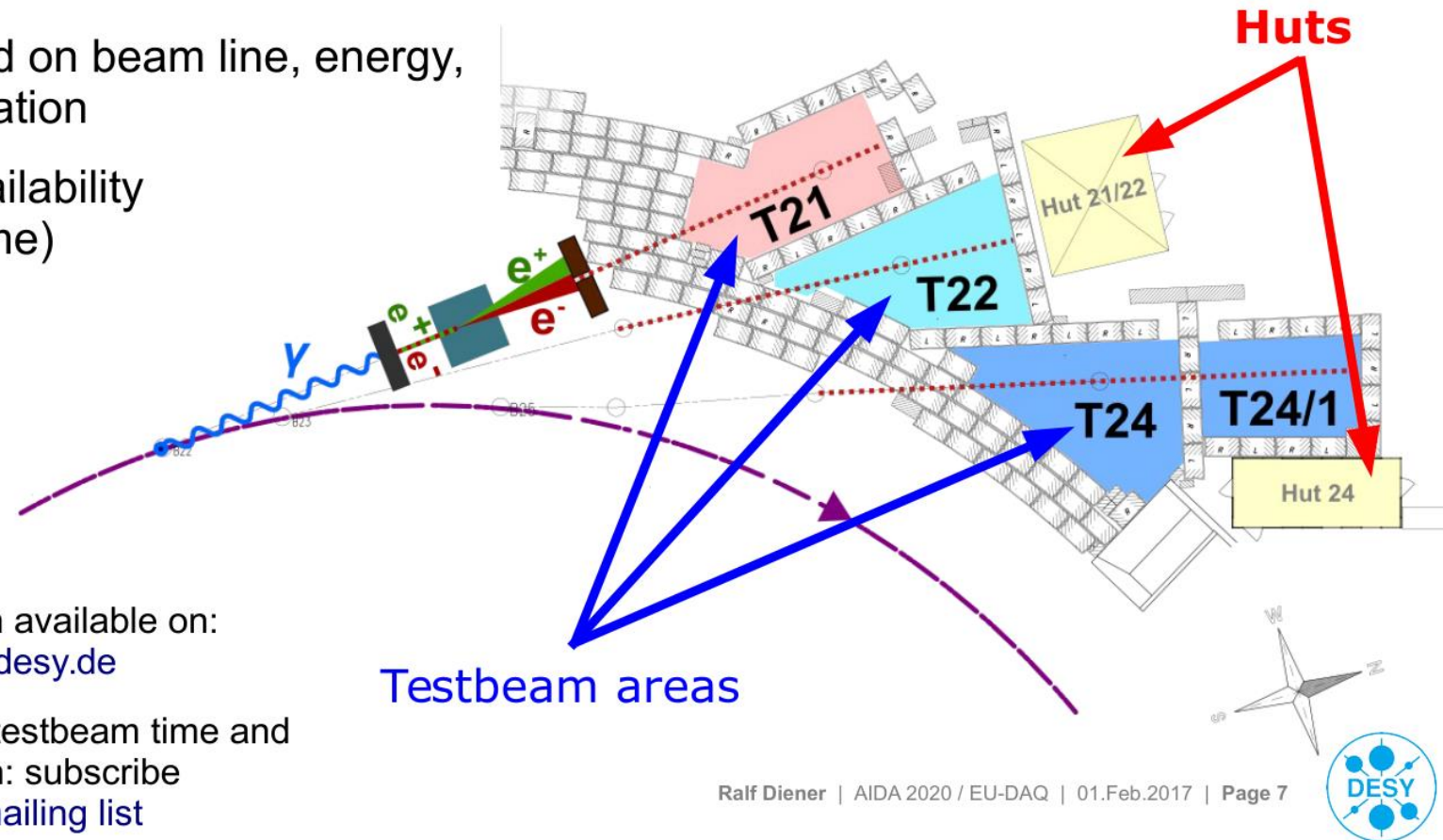


The EUDET telescopes: Status, Performance and Prospects

Lennart Huth for the Telescope Crew
BTTB8 Tbilisi, Jan 2020



- Facility fed by DESY II synchrotron
- Three thin, internal carbon fiber targets generate bremsstrahlung photons
- Conversion at target to e^+/e^- with energies up to 6 GeV
- Rates depend on beam line, energy, target, collimation
- Very high availability (~ 99 % uptime)
- Three individual beam lines, controlled by the user
 - Shutter, area interlock
 - Select particle momentum/collimation



- More information available on:
<http://testbeam.desy.de>
- Annual calls for testbeam time and other information: subscribe
[testbeam-info mailing list](#)

EUDET-type beam telescopes



- Mimosa26 based 6 layer telescopes
- Pixel Pitch of $18 \times 18 \mu\text{m}^2$
- Slow readout but excellent resolution
- Total size $2 \times 1 \text{cm}^2$
- Provided in all three DESY test beam areas
- Shipped with EUDAQ2 and AIDA-TLU support
- Workhorse for many different groups
 - Pixel/strip sensor studies
 - Calorimeter studies
 - Timing detectors
 - Electron tomography
 - Lorentz angle measurements
 -



Telescopes around the world



AIDA-2020 managed



Self managed



Carleton **SLAC**
UNIVERSITY

NATIONAL
ACCELERATOR
LABORATORY



EUDAQ – A Data Acquisition Software Framework for Common Beam Telescopes

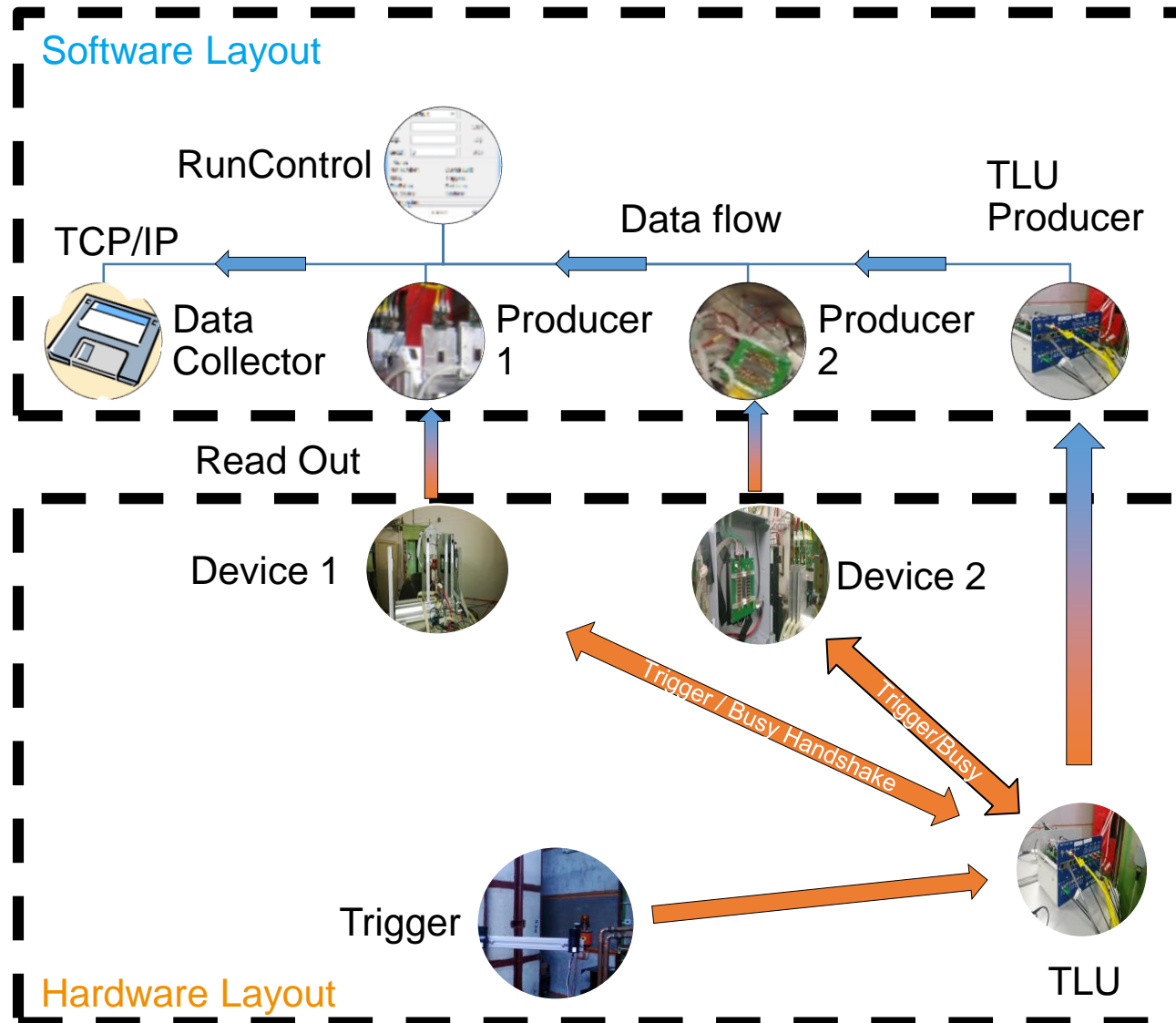
P. Ahlburg,^c S. Arfaoui,^{b,*} J.-H. Arling,^a H. Augustin,^d D. Barney,^b M. Benoit,^e T. Bisanz,^f E. Corrin,^{e,s} D. Cussans,^g D. Dannheim,^b J. Dreyling-Eschweiler,^{a,2} T. Eichhorn,^a A. Fiergolski,^{b,t} I.-M. Gregor,^a J. Grosse-Knetter,^f D. Haas,^{e,u} L. Huth,^d A. Irles,^{a,h} H. Jansen,^a J. Janssen,^c M. Keil,^b J. S. Keller,^{a,i} M. Kiehn,^{d,e} H. J. Kim,^b J. Kroll,^j K. Krüger,^a S. Kulis,^b J. Kvasnicka,^{a,j} J. Lange,^f Y. Liu,^a F. Lütticke,^c C. Marinas,^{c,q} P. Martinengo,^b A. Nurnberg,^p B. Paschen,^c H. Perrey,^{a,k} R. Peschke,^{a,l} D. Pitzl,^a D.-L. Pohl,^c A. Quadt,^f T. Quast,^{b,r} F. Reidt,^b E. Rossi,^a I. Rubinsky,^{a,v} A. Rummler,^b H. Schreeck,^f P. Schütze,^a B. Schwenker,^f S. Spannagel,^b M. Stanitzki,^a U. Stolzenberg,^f T. Suehara,^m M. Suljic,^b G. Troska,^{n,w} M. Varga-Kofarago,^o J. Weingarten,^{f,n} and P. Wieduwilt^f

EUDAQ2 – A Flexible Data Acquisition Software Framework for Common Test Beams

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- EUDAQ is the de facto standard meta Data Acquisition System for beam test telescopes
- Reliable cross platform DAQ System
- In use for well over a decade
- Under active development from a large community from all over the world
- Ease of user device (Device Under Test DUT) integration is one of the main focus points

Test Beam Readout

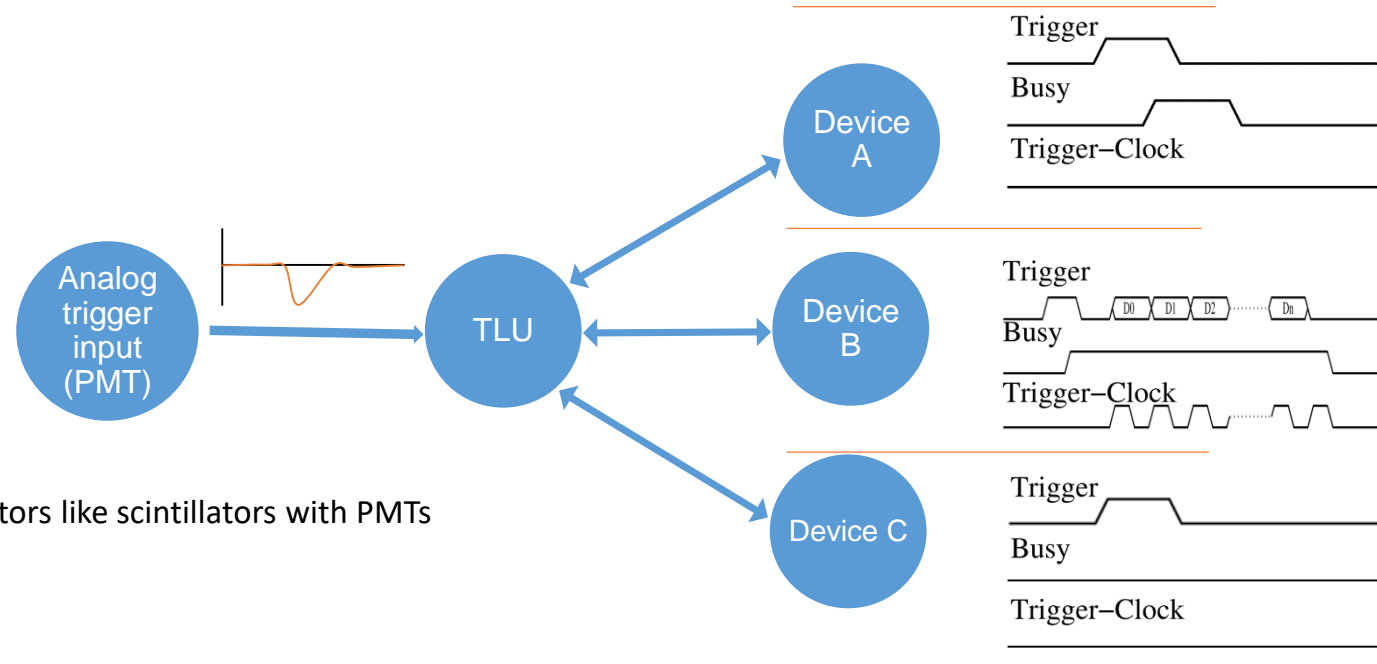


- Divided into Hardware and software layer
- Hardware
 - Trigger Logic Unit (TLU) is the central authority
 - The TLU receives analog trigger signal and distributes a digital trigger system to all devices in the setup
 - It uses a trigger busy handshake
- Software
 - Distributed DAQ system (EUDAQ)
 - Consists of completely independent parts / programs such as:
 - Run Control
 - Data Collector
 - Producers
 -

Trigger Logic Unit (TLU)



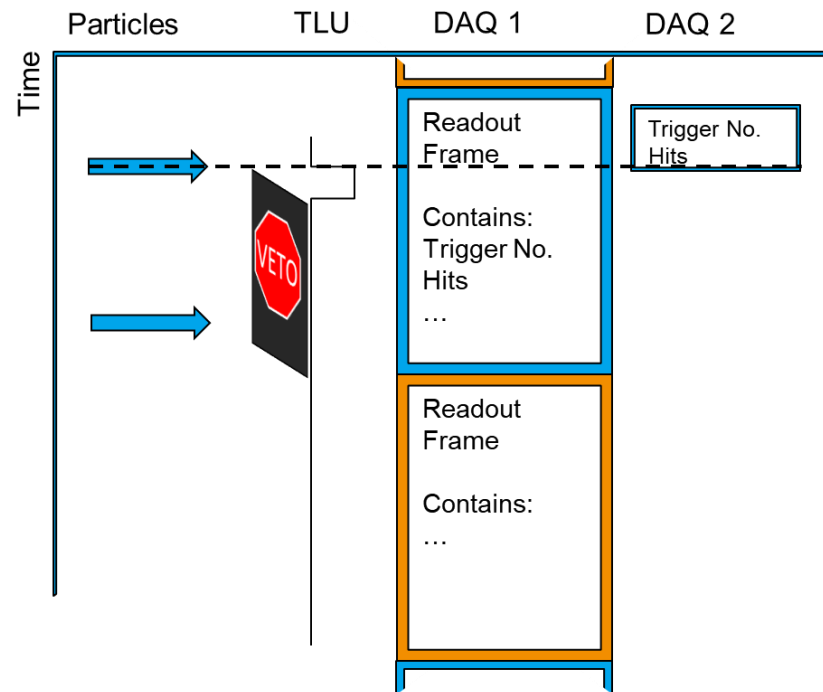
- Receives analog signals from fast particle detectors like scintillators with PMTs
- Converts the analog signal to a digital trigger
- Sends trigger to the devices
- Waits for the devices to finish their data taking
- Fully integrated into EDUAQ
- New Version of TLU (AIDA-TLU) is produced right now. If we want to have one we have to decide soon.



- Three types of handshakes
 - **Trigger/Busy Handshake:** Device sends a busy signal back. No new triggers can be issued during this time
 - **Trigger/Busy/Trigger-Data Handshake:** The TLU can send the TLU Trigger ID to the devices
 - **No handshake mode:** TLU just sends trigger without waiting for a response from the device

EUDAQ 1.x VS EUDAQ 2.x Readout Mode

EUDAQ 1.x

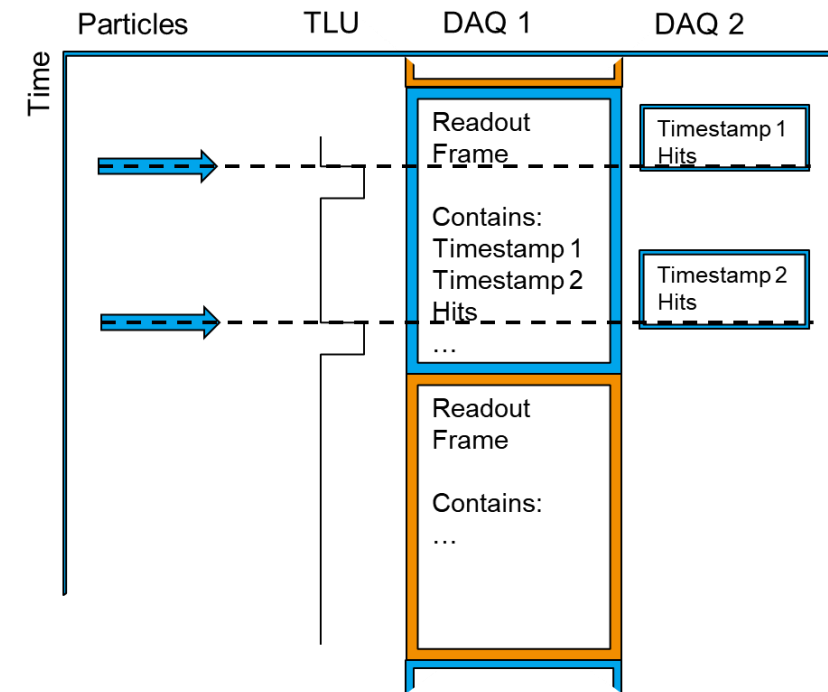


Marked for write to Disk

Not Marked

- > One trigger per read out frame
- > Prevents the issuing of triggers for the whole time of the read out
- > Slowest device limits the Event rate

EUDAQ 2.x

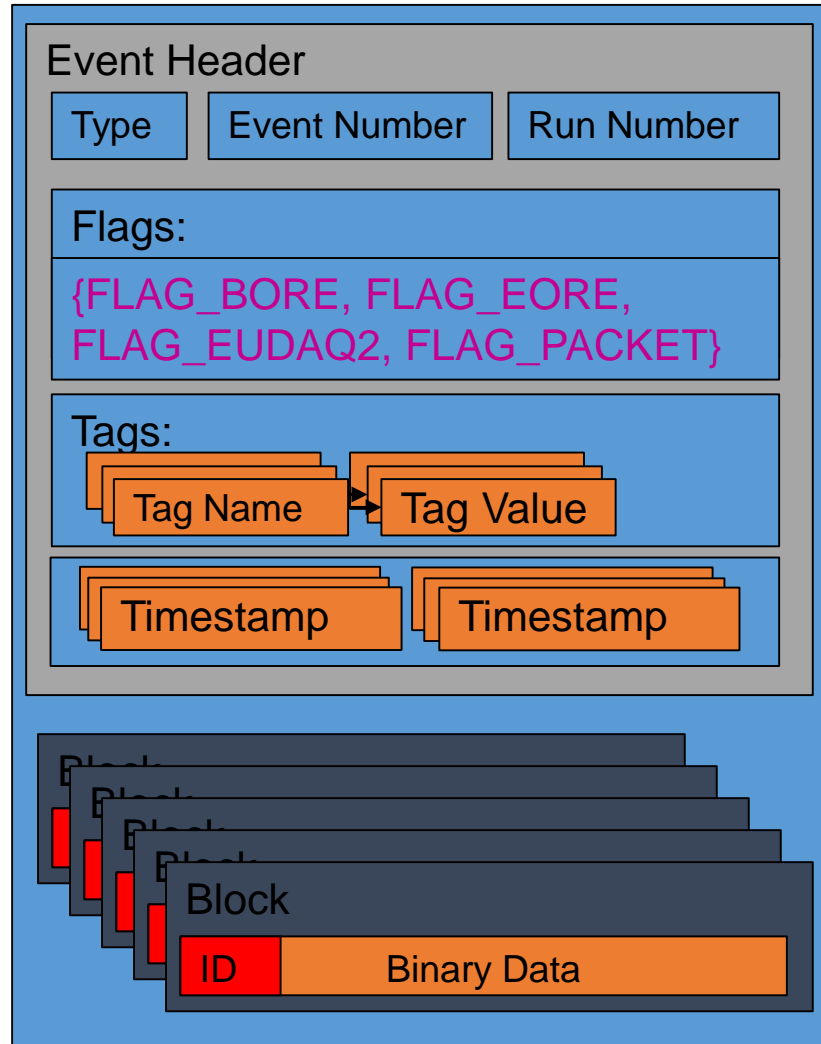


Marked for write to Disk

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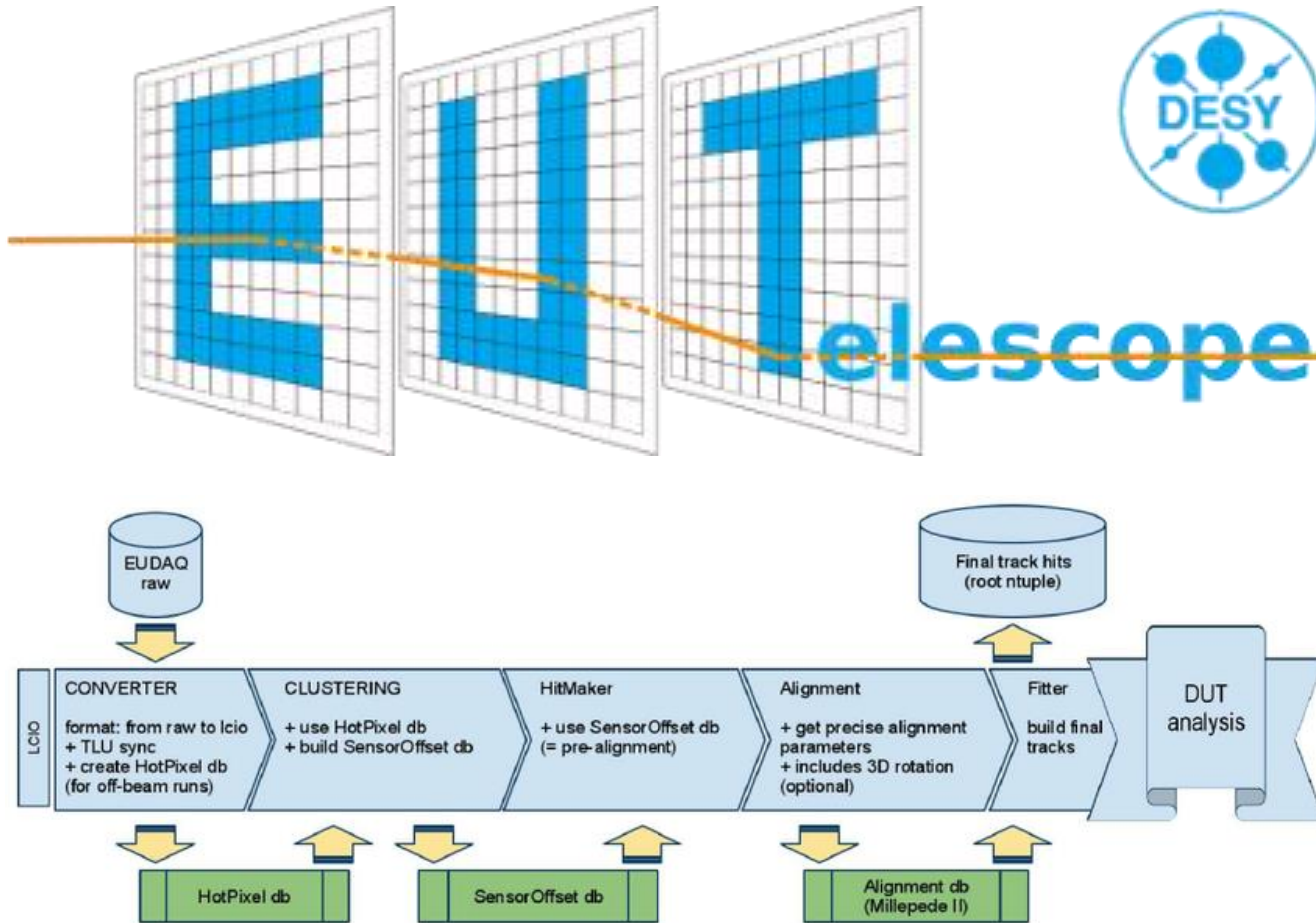
- > Each Device can run at its own speed
- > User can decide how to merge events
 - Event number Merging
 - Time stamp based merging

RAW Data Files




- Persistent Data Format
- Convertible to ROOT/LCIO
- Writing custom converter well documented
- Flexible
- No External Dependencies
-

EUTelescope



- EUTelescope is the analysis framework which is used for analyzing test beam data
- It is well integrated in the workflow
- Active development (many examples)
- Docker Images available
- It contains all the necessary tools for analyzing test beam data
 - Convert from EUDAQ format to its own LCIO format
 - Clustering: accumulating pixel responses to clusters
 - Hitmaker: converting Cluster information to 3d hits using geometry files
 - Alignment: Using Millepede II to improved Detector Geometry description
 - Track Reconstruction: uses varies algorithm such as General Broken Line Fitter (GBL)







Established Community with Annually Conferences (BTTB)



7th Beam Telescopes and Test Beams Workshop

14-18 January 2019
CERN
Europe/Zurich timezone

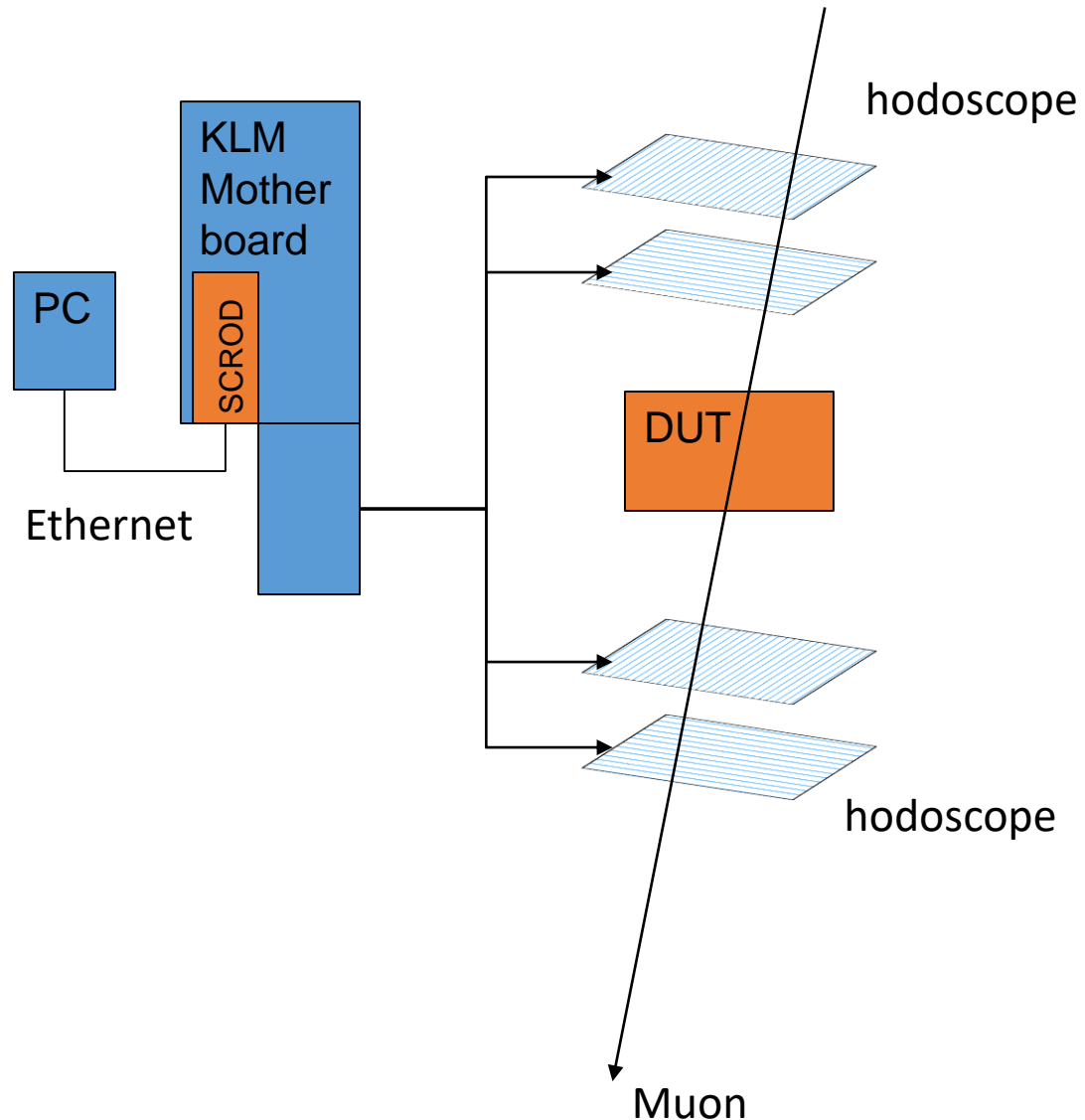
Search...

Overview	This workshop will cover a wide range of topics related to test beams for detector studies in tracking detectors, calorimetry and beyond. It aims at bringing together both experts and newcomers from various fields. There will be a combination of presentations by experienced users, results from recent test beam studies and tutorials to teach the software required to analyse the results. Please have a look at the last three events to get a more detailed impression of the workshop's content: BTTB6 in Zurich , BTTB5 in Barcelona in 2017 , BTTB4 in Orsay in 2016 or BTTB3 in Hamburg in 2015 .
Call for Abstracts	Abstract submission will open mid September.
Timetable	In order not to miss any announcements, please subscribe to the e-group 'BeamTelescopesandTestBeams-Announcements' at https://e-groups.cern.ch . In case you experience any problem during subscription, please contact bttb-ws@desy.de .
Contribution List	
Registration	
Participant List	
Financial support	
Vidyo Conference Room	
Venue and Travel information	
Accommodation	Starts 14 Jan 2019, 10:00 Ends 18 Jan 2019, 13:30 Europe/Zurich
Social program	 CERN 503/1-001 - Council Chamber Go to map
Wifi for Visitors	  1Booking form 7th Beam Telescopes 13.01.docx  1Booking form 7th Beam Telescopes 13.01.pdf  Locations_for_HandsOn-Tutorials.pdf
Contact	 Jan Dreyling-Eschweiler Hendrik Jansen Joern Lange Maria Robles Manzana
Poster	



- Many detector communities are represented
- Active development for all components of the EUDET Test Beam Framework
- All core components are openly Developed on GitHub

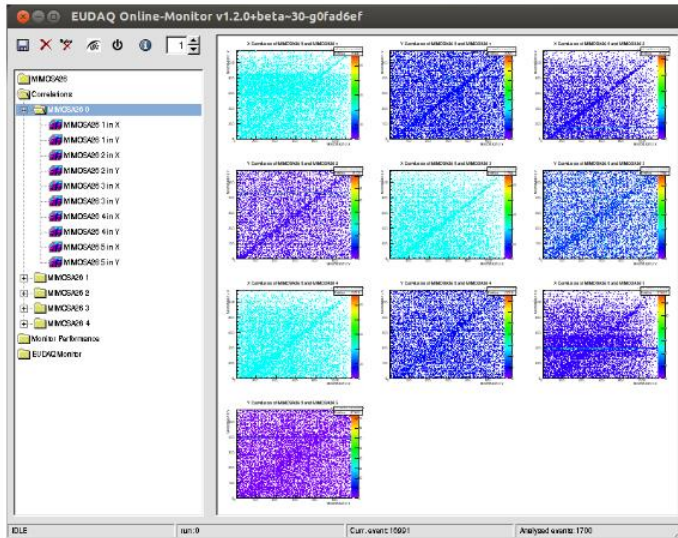
Hawaiian Muon Beam Line Setup (proposal)



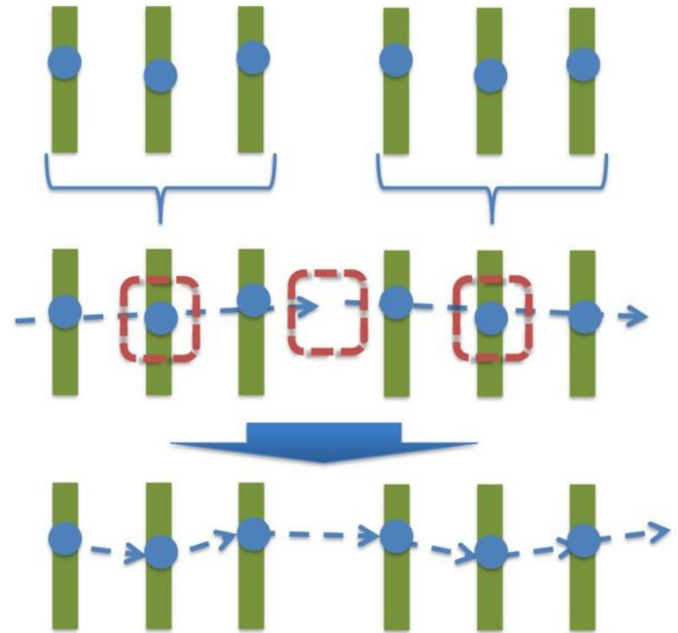
- Use KLM motherboard for the scintillator readout
- Use standalone Ethernet firmware for the SCROD
 - No FTSW
 - No PocketDAQ
 - No Copper
- Only Trigger Bit readout
- For the first version we should restrict ourselves to proven components
 - No new board design
 - No new chips
- **Let's get something working and then improve from there**

Milestones

Online Monitor



Track Reconstruction



- Readout Telescope
 - Ethernet Firmware
- Triggering System (TLU)
- DAQ Integration (EUDAQ)
- DQM Plots
(Correlation plot / Online Monitor)
- Track Fitting (EUTelescope)
 - Residual Plots → Pointing Resolution
- DUT Integration
 - Trigger Integration
 - DAQ Software Integration
 - DQM (Correlation plots etc.)
- Data Reconstruction
 - EUTelescope
- Data Analysis
 - EUTelescope/Root/BASF2/Python/Matlab