

# AIDA

Advanced European Infrastructures  
for Detectors at Accelerators

## WP9.3 “Precise Pixel Detectors”

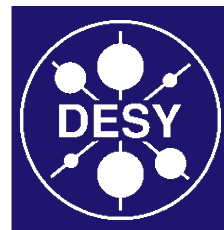
Igor Rubinskiy



Overview and deliverables

Timeline to commission the AIDA telescope

- PS & SPS schedule, AIDA WP 9.3.1 time slots
- readiness of subtasks





# Reminder of the objectives WP9.3

## Objectives

- Development of a versatile beam telescope able to characterize detector prototypes, satisfying the demanding requirements in terms of cooling infrastructure, read-out speed and precision
- Development of an off-beam infrastructure for the evaluation of thermo-mechanical properties of Vertex Detector prototypes

Deliverable 9.4 months 37  
Milestone with design 13

## Task 9.3.1 Telescope

- This task builds on the telescope **infrastructure** developed as part of the EUDET.
- A versatile and modular pixel telescope is to be built using state-of-the-art pixel devices (**Timepix, ATLAS FE-I4 and Mimosa**) to meet the requirements of a broad user community. **The telescope must provide a precise set of reference measurements and must be capable of LHC-speed response and time-stamping.**
- CO2 cooling plant
- Common analysis tools (EU Telescope *at el.*)
- DCS system

Deliverable 9.1 months 33  
done!

## Task 9.3.2 Thermo-mechanical infrastructure

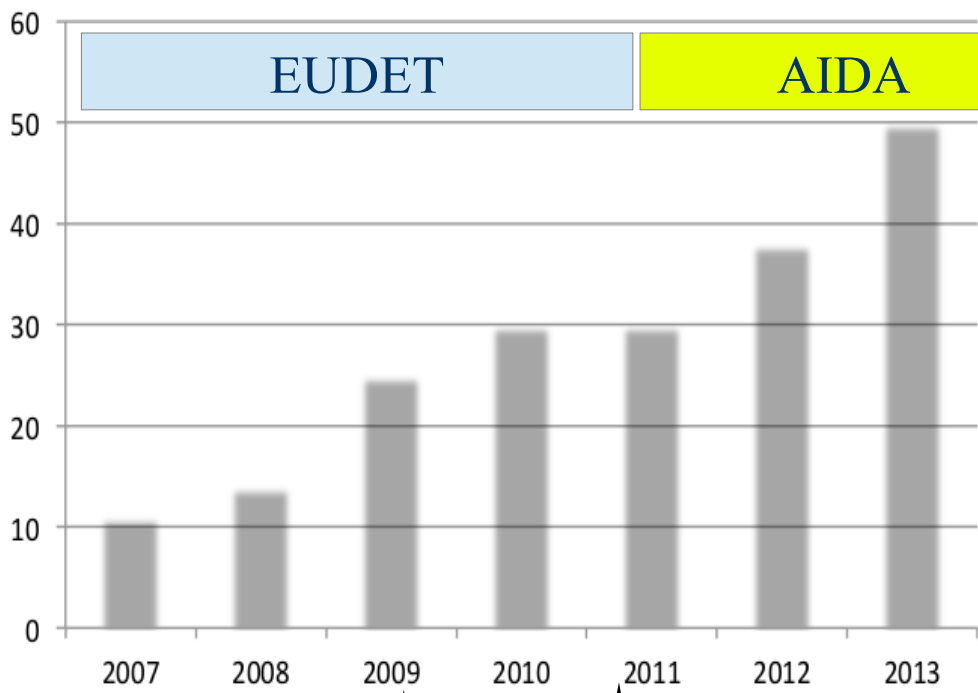
- Development of an infrastructure that allows to evaluate the thermo-mechanical performance of fully integrated detector prototypes under a realistic power load.





# from EUDET into AIDA

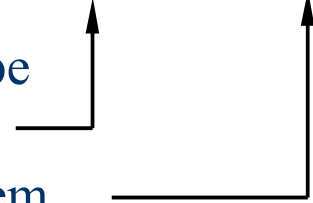
Number of weeks per year when a EUDET telescope ( $\geq 1$ ) was requested .



- Within AIDA:
- maintain and improve EUDET telescope as highly valuable resource
  - vital R&D infrastructure
  - overall 5 copies exist

The EUDET telescope

- Mimosa26 sensors
- the NI readout system



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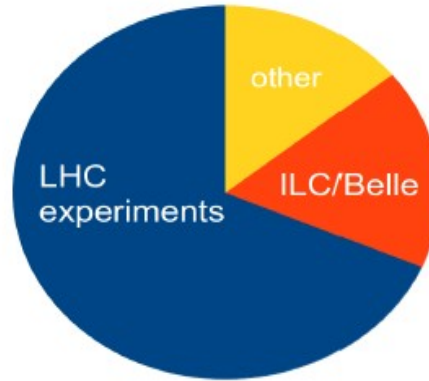
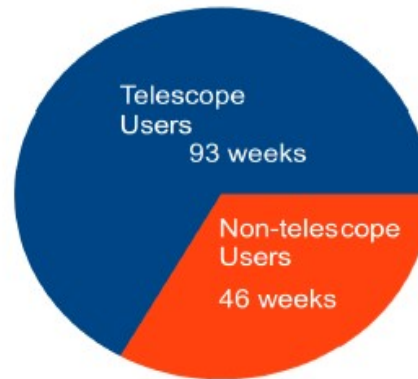




# EUDET telescopes in 2013 at DESY



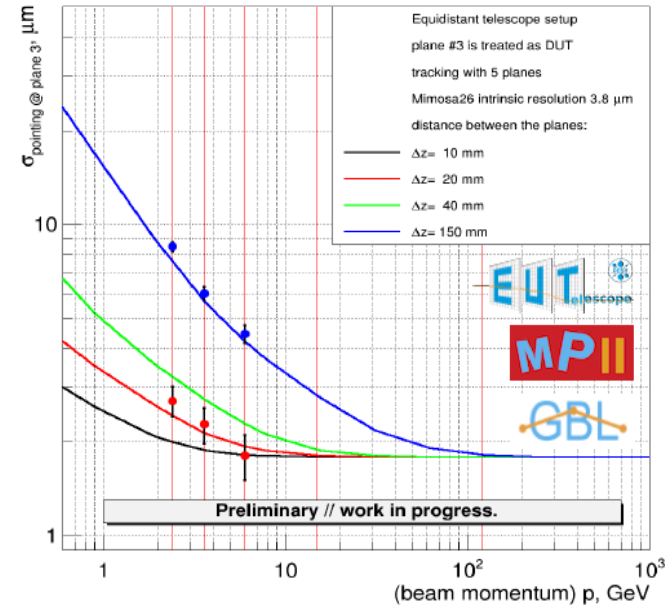
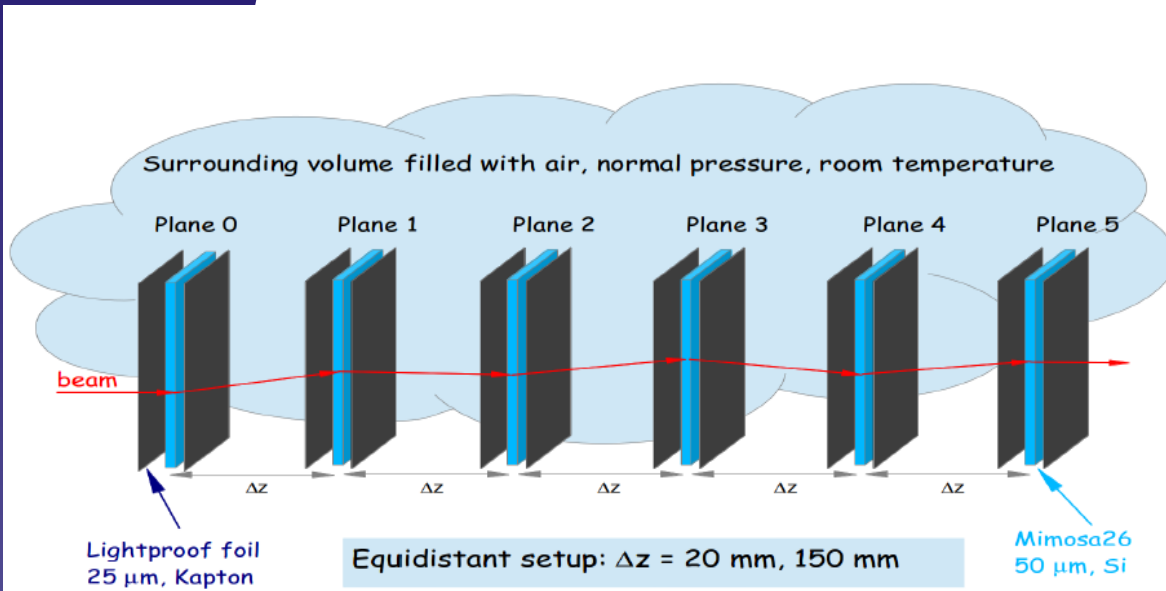
Top-bottom view on the EUDET telescope sensor fixtures with a DUT box mounted in between. (Photo by CLICpix group at DESY testbeam)



- in January 2013 - March 2014
  - 49 Calendar weeks
  - 123 User weeks in total
  - 7100 Testbeam hours
  - 400 Users in total
- DESY-II primary beam at 6.3 GeV
  - high availability time (>99%)
  - secondary  $e^+ / e^-$  at 1-6 GeV
  - rates 0.1-10 kHz
- beamtests in 1 Tesla magnet
  - new telescope mechanics
  - new DUT cooling system
  - over 20 weeks in B-field



# Tracking knowledge consolidated



The interplay between the sensor resolution, multiple scattering, distance between telescope planes well understood.

Track pointing resolution at plane 3 (treated as DUT)

Very good understanding of the contributions of multiple scattering, planes positioning, beam energy, and their impact on alignment and tracking.

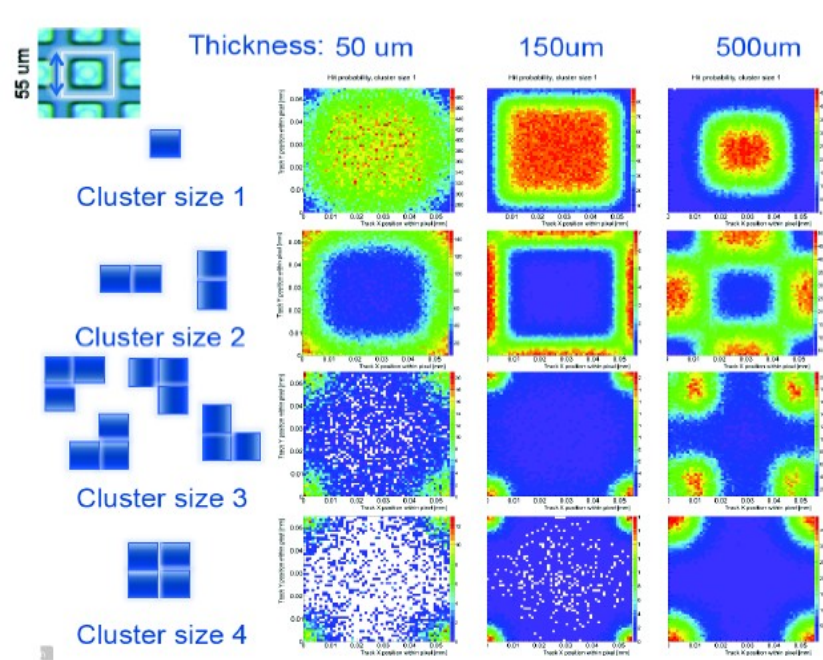
A lot of maintenance&development work ongoing on the software side.





# Timepix, precision studies, simulation

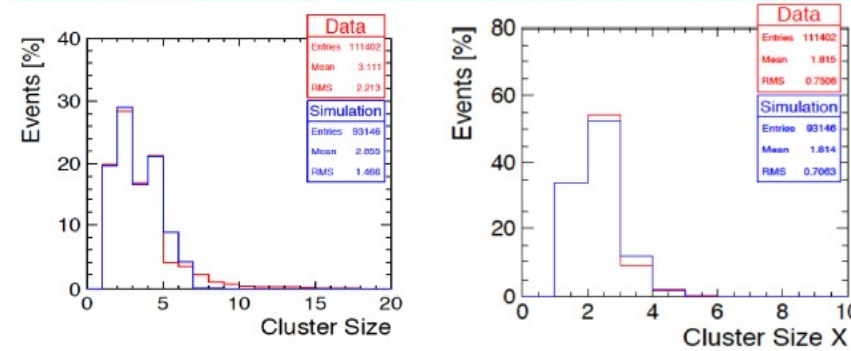
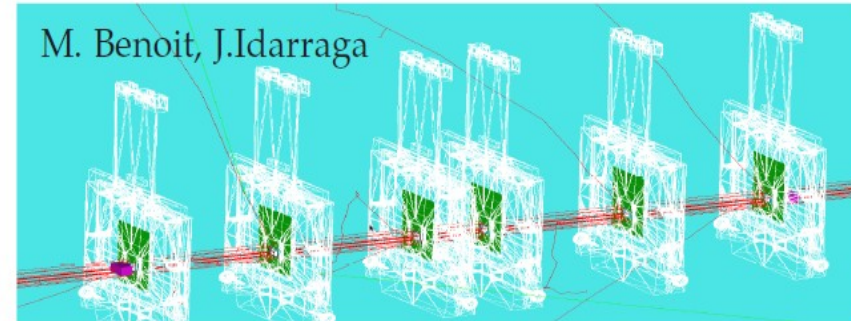
Timepix fully integrated with EUDAQ, TLU, EUTelescope //by CLICpix group



Timepix detector charge sharing study. DESY 5.6 GeV positrons. (M. Benoit, CERN)

**High res.** charge sharing map done at DESY beam 5.6 GeV.

Genat4 simulation for DUTs in TB



Geant4 ALLPIX detector toolkit. <https://twiki.cern.ch/twiki/bin/view/Main/AllPix>

DUT response **simulation** tools available.

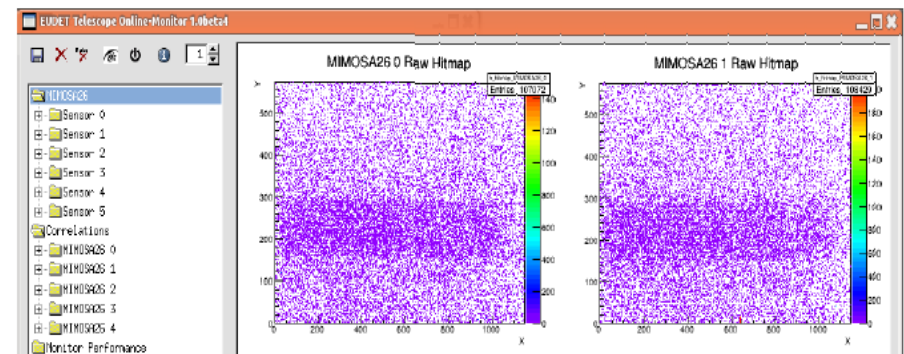
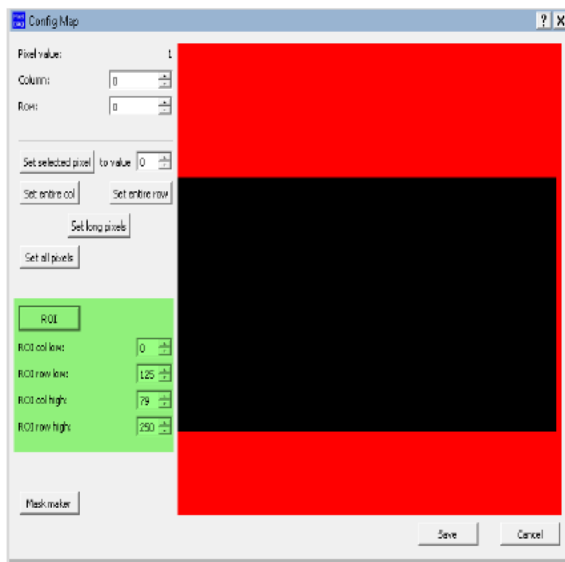




# FEI4 as trigger plane

As an LHC-type device with fast readout can provide track timing information.

The FEI4 planes provide  $14 \mu\text{m} \times 70 \mu\text{m}$  space resolution and 25 ns time resolution.  
The EUDET TLU track timing precision  $\sigma \sim 3 \text{ ns}$ . The design value of the AIDA TLU is 0.8 ns.



The FEI4 modules provide a self-trigger signal according to a retunable pixel mask, which is vital for prototypes of few  $\text{mm}^2$ . Left-hand plot: implementing a trigger pixel mask, and the Mimosa sensors hitmap in testbeam on the right.

Single FEI4 plane as trigger plane installed at DESY TB.

Time-stamping of tracks requires more work on the firmware/software

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# Testbeam schedule CERN PS & SPS 2014

- Defines intermediate milestones for the AIDA telescope
- Commissioning in the fall 2014
  - Final report end of 2014.

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# PS user schedule for 2014

schedule issue date: 12-Mar-2014

Version: 0.0

		Jul					Aug					Sep					Oct					Nov					Dec				
Week		27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52				
Machine		Move to SPS																													
T8 - Irrad	EA Setup 5	EA-Irrad 153																													
T9	EA Setup 5	ALICE TOF 4	DAMPE 4	LHC-b 13	ATLAS NSW 7	Clic pix 7	CMS ECAL 13	Insulab 7	Students 7	ALICE FOCAL 14	Clic pix 7	DAMPE 14	Calice (ahcal) 14	FCAL 7	RE21 (CBM) 14	Calice (ahcal) 12	LHC-b 7														
T10	EA Setup 5	ALICE ITS 7	ALICE FIT 7	ALICE VOA 7	CMS RPC 7	ALICE ITS 7	ALICE TOF/MRPC 7	NA58 (RICH) 21	ALICE ITS 7	ALICE PHOS 7	ATLAS NSW 7	ALICE FIT 7	NA58 (ECAL) 10	ALICE ITS 7	ALICE TOF/MRPC 14	ALICE HMPID 7	ALICE PHOS 7	ALICE TPC 7	ALICE TOF/MRPC 10												
T11 Cloud	EA Setup 5											CLOUD 77																			
TT2A	nTOF Setup 5	nTOF 153																													

For further information contact the PS/SPS-Coordinator. Email: Sps.Coordinator@cern.ch, Tel: +41 76 487 3845

Two days with ~7 GeV proton beam to test new EUDAQ 2.0 + AIDA mini-TLU, Mimosa26 telescope with IPHC readout, FEI4 arm with 1+ planes

Can start installing, last pre-beam tests

Goal of the TB: test of TLU-EUDAQ2 high duty cycle triggering with distinct timestamping per DAQ system





# SPS user schedule for 2014

schedule issue date: 12-Mar-2014

Version: 0.0

		Oct					Nov					Dec		
Week		40	41	42	43	44	45	46	47	48	49	50	51	52
Machine														
T2 - H2	NA Setup 4	CMS Si/GE 7	CMS Upgrade 1 7	CMS Upgrade 2 7	NA61 (SHINE) 42									
T2 - H4	NA Setup 4	LHCf 10	CMS EE aging 6	CMS ECAL R&D 14	DAMPE 7	photag/ice-rad 7	RD51 5	GIF++ setup 2	RD51 12					
T4 - H6A	NA Setup 4	RD42 7	ATLAS 14		CERF 7	BELLE 7	ATLAS ALFA/AFP 7	Monopix 7				CERF 7		
T4 - H6B	NA Setup 4	ALICE ITS 7	RD50 7	Arachnid 7	CERF 7	BELLE 7	Clc pix 7	ALICE ITS 7	ALICE FOCAL 7	CERF 7				
T4 - H8	NA Setup 4	TOTEM 7	LHC-b Tracker 12	LHC-b PID 10	ATLAS MDT 7	Calice (Sdhal) 7	LHC-b 6	RD52 (DREAM) 7	TOTEM 7					
T4 - K12	NA Setup 4	NA62 63												
T6 - M2	NA Setup 4	NA58 (COMPASS) 63												

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Parasitic installation at H6B

Setting up

Final TB:

SALAT arm (3 4xMimosa28) and FEI4 quad plane (1+) with already tested/improved AIDA mini-TLU, EUDAQ 2.0

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# Final AIDA telescope design

Final AIDA telescope:

WP 9.3.1: Milestone with design (M37)

- key modification is EUDAQ 2.0 + AIDA-TLU
  - equal rights between DAQ systems integrated in the telescope
  - DAQ systems write own datastreams with timestamping/TLU numbering
    - not allowed to block other DAQ system
    - exception: buffer overflow, not able to process data any more
  - to be tested in lab in April/May, testbeam in July CERN PS
- SALAT arm consisting of 3 SALAT planes
  - SALAT plane = 4 Mimosas28 (4x 2x2 cm<sup>2</sup>) [already beamtested]
- FEI4 quad planes for triggering and timestamping [to be ready by July TB]
  - final beam test in November 2014
- CO2 cooling as general infrastructure
- DCS as generic HV and Climate monitoring system

WP 9.3.2 Thermo-mechanical test setup – complete! Deliverable Report draft.

