WP6.3 Valiation and testing of common productions

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Outline

- Recall of milestones and deliverables.
- Update on test beam preparation

Activity Recall and Related Milestones and Deliverables

Task 6.3. Validation of common 3D and LGAD sensor productions

- Characterisation of the **3D** sensors in terms of **timing, radiation hardness, efficiency and uniformity** via measurements in the laboratory and beam tests

- Characterisation of small pitch **LGAD** and inverse LGAD sensors (iLGADs) from the common production in terms of **timing and efficiency** via measurements in the laboratory and beam tests

- Feedback to the foundries for further process optimisation of 3D and LGAD sensors

MS & D #	Name	Due date (in months)
M23	Preliminary characterisation of 3D and LGAD prototypes.	23
D6.2	Final validation of timing performance of common productions	46

Final draft under review

Milestone 23

RD50, TREDI,PIXEL,IWORD,…. conferences but were coming from the AIDAINNOVA groups.

Grant Agreement No: 101004761
AIDAinnova
Advancement and Innovation for Detectors at Accelerators
Horizon 2020 Research Infrastructures project AIDAINNOVA

MILESTONE REPORT

PRELIMINARY CHARACTERISATION OF 3D AND LGAD PROTOTYPES. TEST SET-UP READY IN THE LABORATORIES

MILESTONE: MS23

Document identifier:	AIDAinnova-MS23
Due date of milestone:	End of Month 23 (Mars 2023)
Report release date:	dd/10/2023
Work package:	WP6: [Hybrid pixels sensors for 4D Tracking and Interconnection Technologies]
Lead beneficiary:	[Short name of participant e.g. OEAW]
Document status:	Draft

Executive summary

Novel 3D sensors and LGADs of various types were characterized at the partners in the project. As a dedicated AIDAINNOVA sensor production within WP6 was not completed yet, sensors of similar design from other productions were tested.

The results show a good progress in the direction of achieving LGAD design with efficient inter-pad region thus allowing operation of small pitch LGAD pixel detectors. Several designs were produced and tested, most intensively RSD-DC LGADs, RSD-AC-LGADs, TI-LGAD and ILGADs. Radiation hardness of LGAD detectors has also been significantly improved with introduction of carbon in gain layer.

Timing performance of both Trench-3D and Column3D sensors was studied with prototypes produced by TimeSpot and RD50 collaborations. Both designs have demonstrated excellent radiations hardness at equivalent fluences in excess of 10^{16} cm^{-2} *showing no degradation of timing performance.*

The readiness of testing setups in the labs have been demonstrated. At the same time preparations for AIDAINNOVA WP6 test beam activities have started.

Test beam preparation

Details For Activity "AIDAINNOVA_WP6"

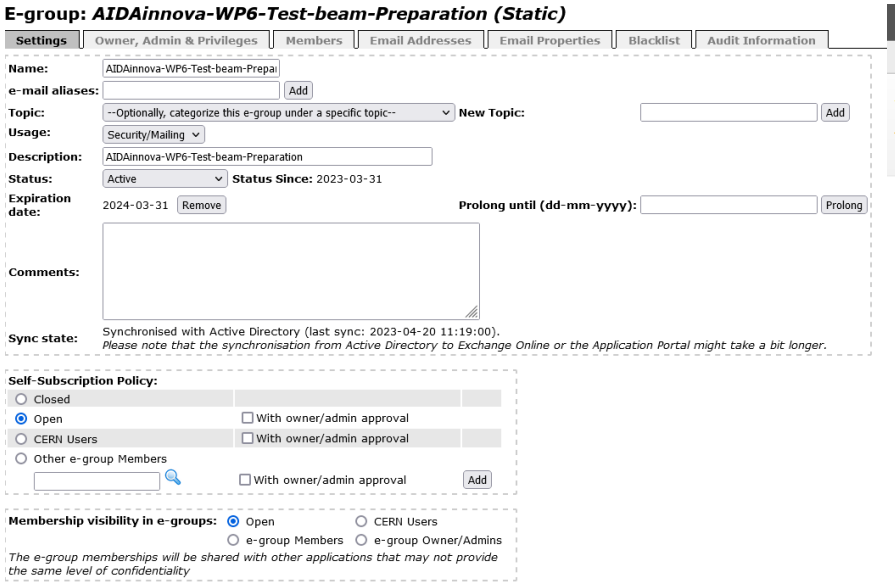
Short Name	AIDAINNOVA_WP6
Name	Hybrid sensors for 4D tracking
Status	Accepted
Responsible committee	LHC Experiments Committee (LHCC)
Envisaged activity end date	2023
Details for the target date	18/5 - 2/6 (immediately after ATLAS- HGTD for using the telescope or before CMS-ETL) 27/7 - 10/8 (immediately after ATLAS-HGTD for using the telescope or before CMS-ETL) 15/9 - 28/9 (immediately after HGTD for using the telescope or before CMS-ETL)

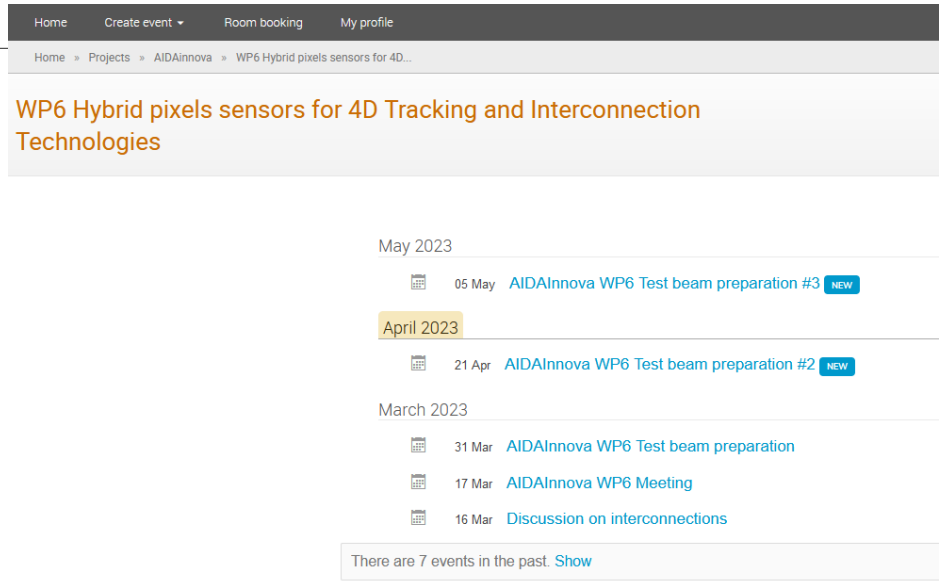
Beam Requests | Runs | Funding

Runs

Id	Name	Status	Location	Periode	Begin Date	Duration [days]	End Date	Role
129	AIDAInnova_4D	Scheduled	SPS[NA] / H6 / PPE156 / h (AIDA)	Protons 2023	2023-06-14	14.0	2023-06-28	Coordinator
175	AIDAInnova_4D	Scheduled	SPS[NA] / H6 / PPE156 / h (AIDA)	Protons 2023	2023-08-30	7.0	2023-09-06	Coordinator

Test beam preparation (2)





https://tinyurl.com/yfydfdfw

https://indico.cern.ch/category/13504/

Test beam preparation list

DEVICES:

- TI-LGADs from UZH - more than 60 devices (small pad devices - compatible with CAEN was checked by UZH)
- AC LGADs from CNM - all large pad devices (**CAEN digitizer**)
- LGADs from CNM/FBK - (CMS/ATLAS design - compatible with CAEN digitizer)

MECHANICS - Need to check the kind of sensor carrier PCB holder suitable for the cooling box. Cold box has 8 slots with positioners (holders are for UCSC boards), but should be possible to mount UZH boards as well **(need to do a suitable holder)**

DAQ - the default plan is to use CAEN DRS based digitizer that will allow more readout channels

- Confirmed the readiness of the producer for EUDAQv2. Futher integration testing is needed to complete the debuging of the code.
- 32 channel version (2x16) should be no problem if 16 ch. works.
- Oscilloscopes would be the back-up and used for the sensors where 5GS/s turns out not to be enough (small capacitance, fast collection e.g. small cell 3D devices). Two 4 Ch - are needed to readout 6 channels - each should have their own time reference.

- **TRIGGER** - The CAEN digitizer should issue a trigger veto while the digitization/transfer of the date is completed. It seems that this can be internally handled by the CAEN digitizer.

- **COOLING** - cold box which is currently in CERN lab, chiller allows operation at -20C

- THANK YOU!

Existing (in-progress) testing set-ups

Green – available; red – not available; yellow –in progress; white – no information

See back up slides for more details

Group	CV & IV	TCT or pico laser	TPA-TCT or femto	Sr90	X-ray	Wedge bonding
CERN						
CSIC – CNM						
CSIC – IFCA						
FBK						
IFAE						(flip-chip)
INFN-CA						
INFN-Tn						
INFN - To						
JSI						
NWO-I/Nikhef						
ZURICH						

Activity Recall and Related Milestones and Deliverables (2)

- Connections of WP 6.3 with other WP:
  - … DMAPS and Hybrid sensors developed in WP5 and WP6 will be integrated in telescope planes in **WP 3**(**Test beam and DAQ infrastructure**)
  - Support the evaluation of newly developed sensors (Low-Gain Avalanche Detectors (LGAD) and High-Voltage CMOS (HVCMOS) devices) developed in WP5 and WP6 in **WP4: Upgrade of Irradiation and Characterisation Facilities**
- Connections with RD50 projects on 3D, AC-LGAD and ILGADs.