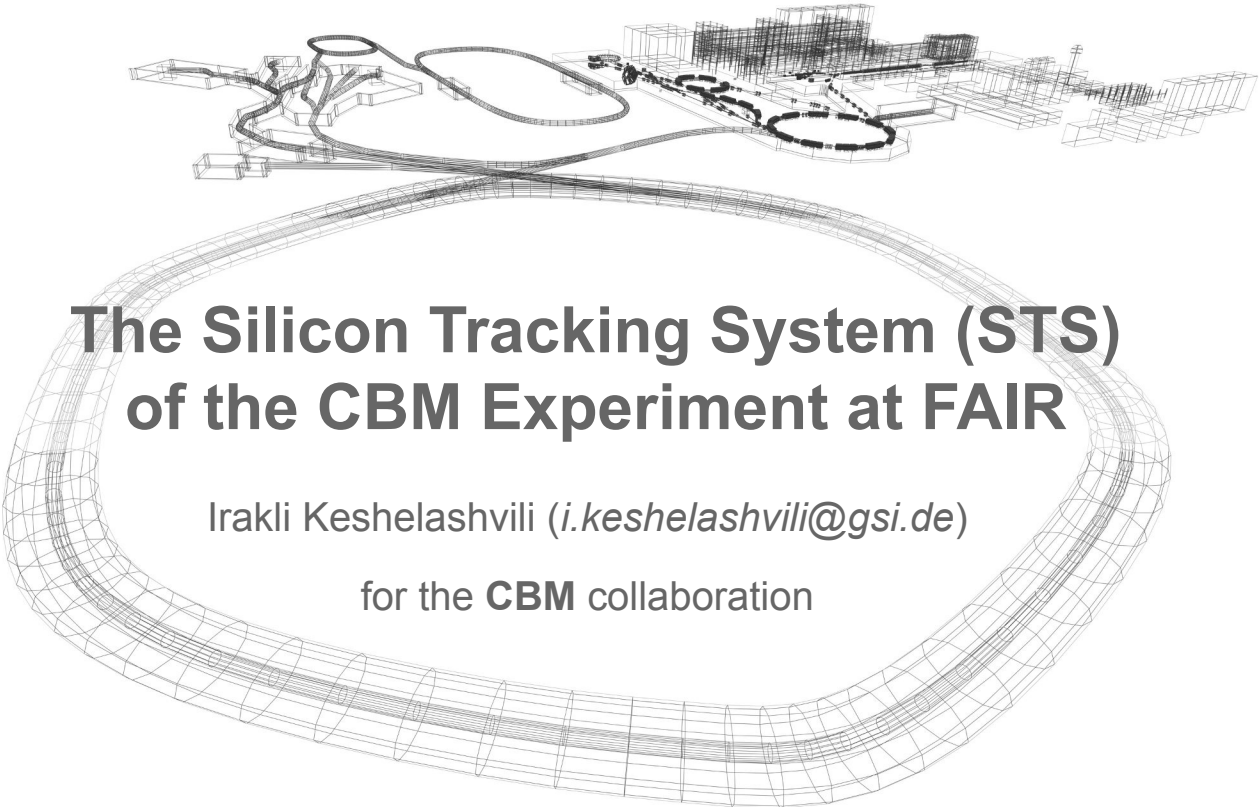


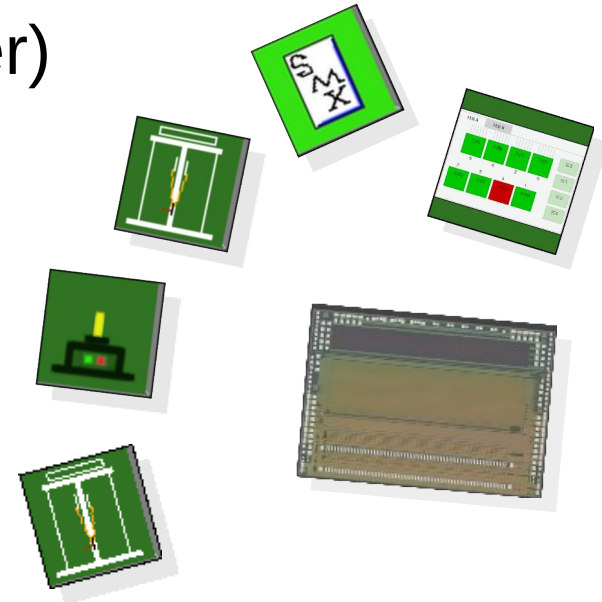
A 3D wireframe model of the CBM experiment setup. It shows a large, oval-shaped ring structure, likely the main detector, and a smaller, more complex structure at the top, possibly the target or beam line. The model is rendered in a light gray wireframe style.

The Silicon Tracking System (STS) of the CBM Experiment at FAIR

Irakli Keshelashvili (i.keshelashvili@gsi.de)

for the **CBM** collaboration

- **Introduction**
 - **FAIR** (**F**acility for **A**ntiproton and **I**on **R**esearch)
 - **CBM** (**C**ompressed **B**aryonic **M**atter)
 - **STS** (**S**ilicon **T**racking **S**ystem)
- **Q&A Test and Assembly Setup**
- **Summary**



Introduction

347. The FAIR/GSI facility - Status and future perspectives

Prof. Thomas Nilsson (GSI/FAIR)

26/09/2025, 09:00

Hadron Structure, Spectr...

Invited Presentation

Plenary Session

334. High Precision Measurements with Stored Highly Charged Radioactive Ions

Yury Litvinov (GSI Darmstadt)

22/09/2025, 11:00

Nuclear Structure, Spectr...

Invited Presentation

Plenary Session

288. Exploring the phase diagram with electromagnetic probes

Alberica Toia (Goethe Uni. Frankfurt & GSI)

23/09/2025, 14:50

Heavy Ion Collisions and...

Invited Presentation

Heavy Ion Collisions and...

Synthesis of chemical elements in the cosmos

Building blocks of life: Production of carbon and oxygen in stars

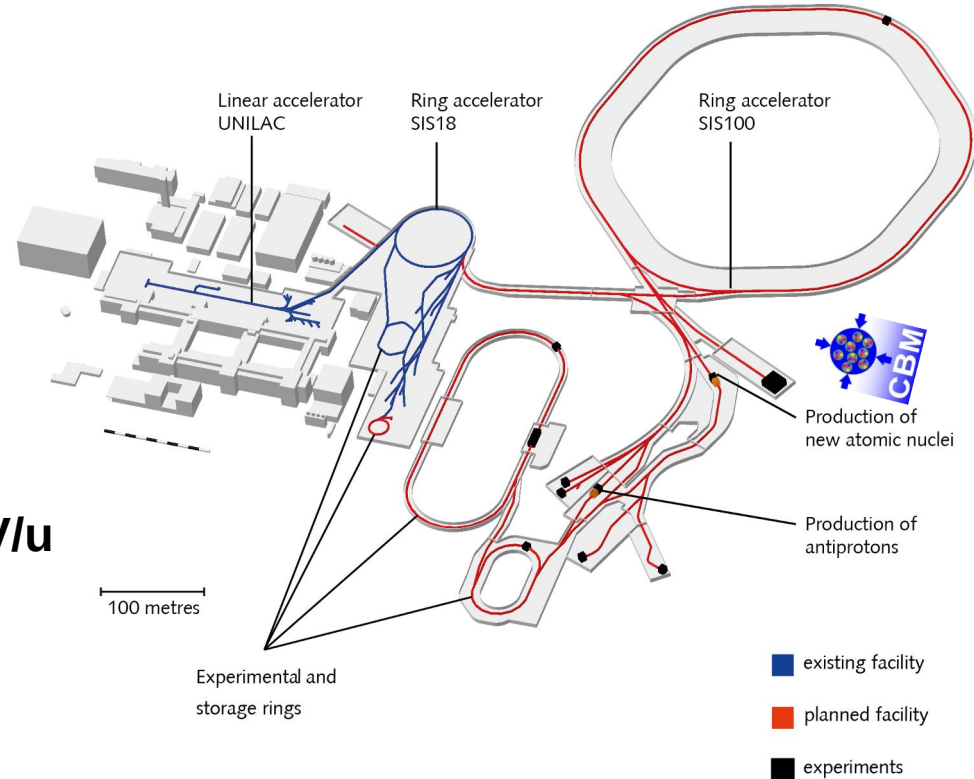
Neutron star mergers: equation of state, strong force, neutron rich nuclei

Matter in the interior of Earth and of large planets

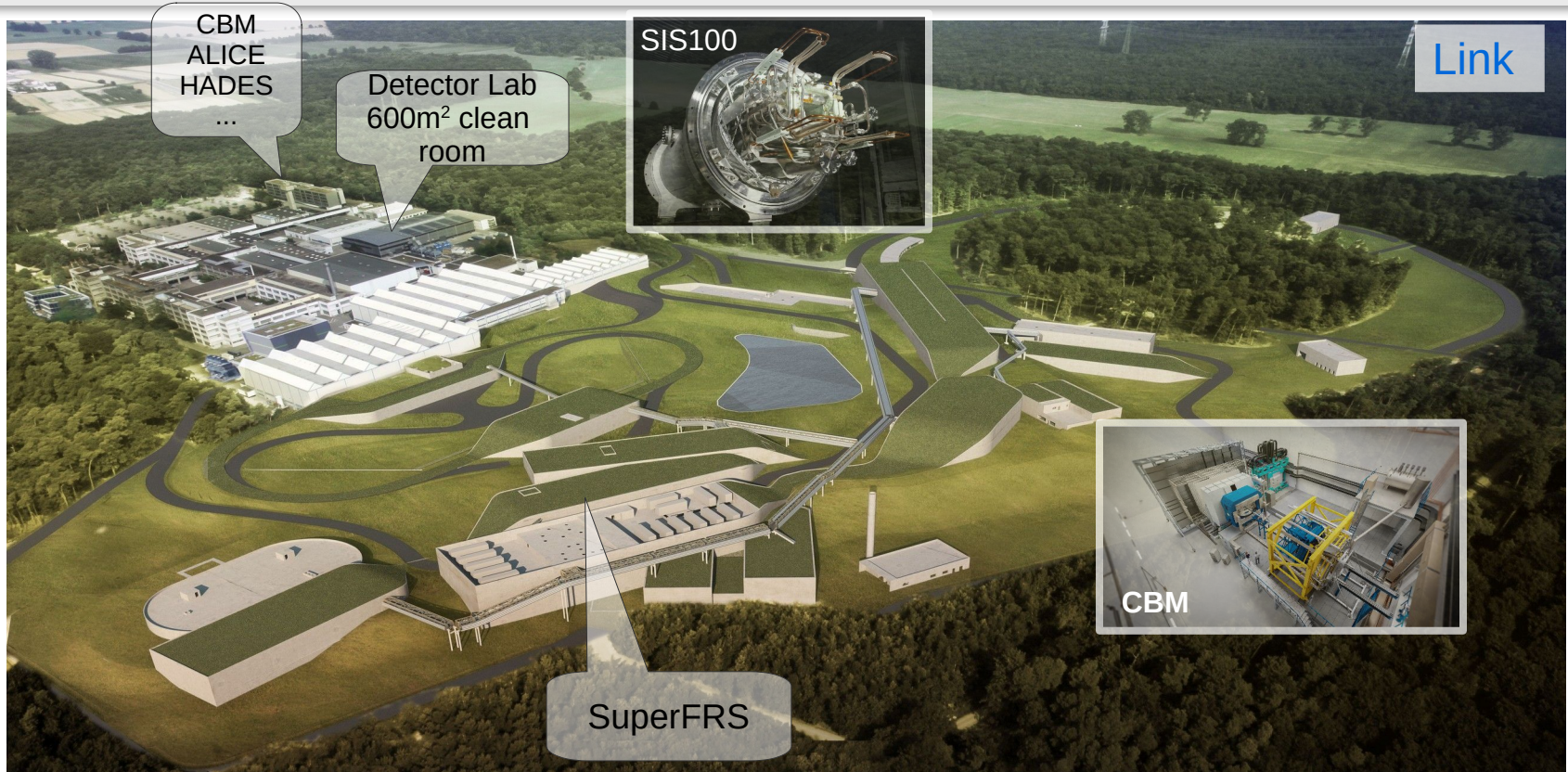
Facility for Antiproton and Ion Research

SIS100

- Circumference **1100m**
 - Underground 17m
 - Superconducting to -269°C
 - Superconducting superferric **1.9 T**
 - Fast-ramped up to 4 T/s
 - 4×10^{13} protons at **29 GeV**
 - 5×10^{11} Uranium (28+) ions at **2.7 GeV/u**
-
- **Investments 3.3 billion euros.**
 - **3000 researchers from 50 countries**



Facility for Antiproton and Ion Research



CBM (Compressed Baryonic Matter)



260. New timing Multi-Strip Multi-Gap Resistive Plate Chamber architecture with aging suppression for high counting rate experiments

👤 Mariana Petris (Horia Hulubei National Institute for R&D in Physics and Nuclear Engineering (IFIN-HH))

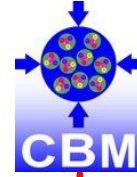
🕒 22/09/2025, 18:40

Accelerators and Instru...

Oral Presentation

Accelerators and Instru...

Silicon
Tracking
System



HADES

Homo
EUropaeus

- Fixed target
- $\int B_d \sim 1 \text{ Tm}$
- $\Delta p/p < 1.5\%$
- CR $\sim 10 \text{ MHz}$

CBM (Compressed Baryonic Matter)

288. Exploring the phase diagram with electromagnetic probes

Alberica Toia (Goethe Uni. Frankfurt & GSI)

23/09/2025, 14:50

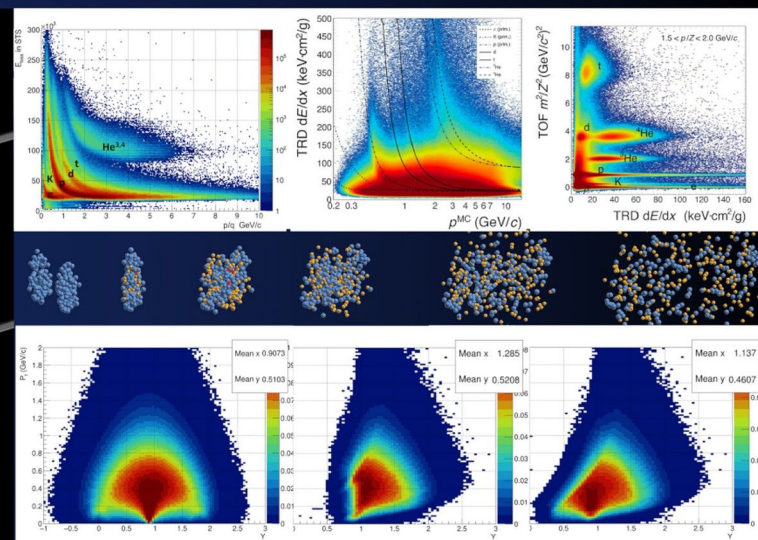
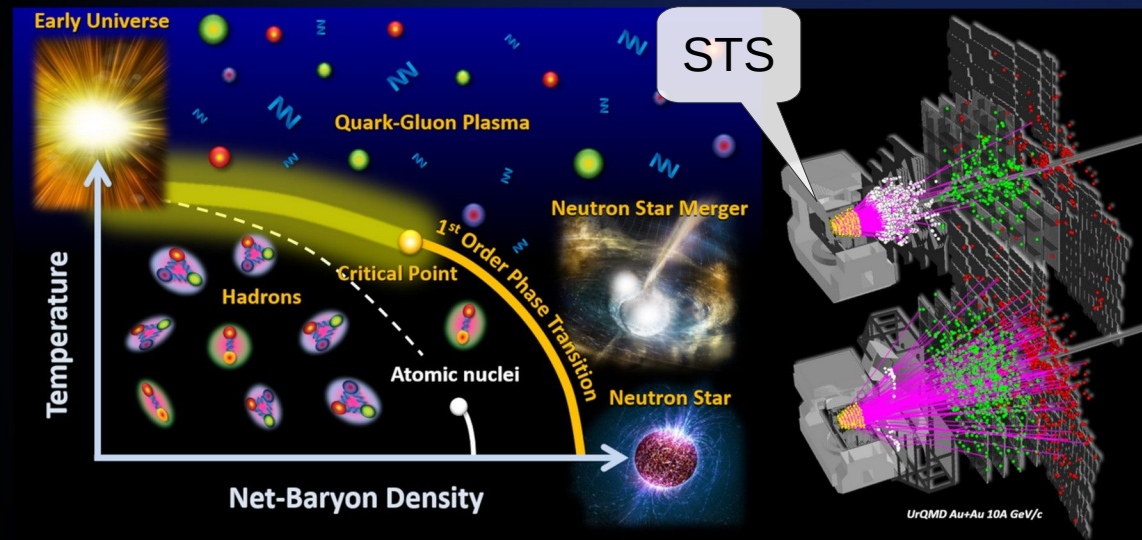
Heavy Ion Collisions and...

Invited Presentation

Heavy Ion Collisions and...

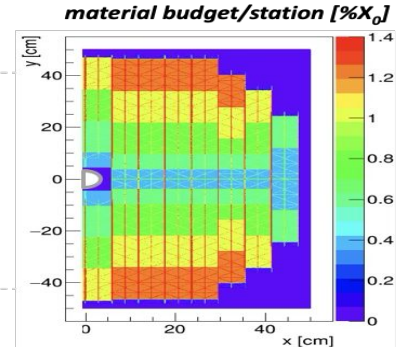
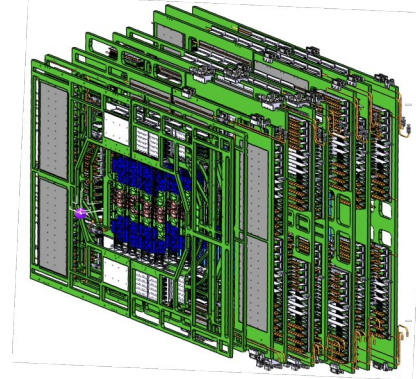
Au+Au 2-11 AGeV,

CBM aims at multi- ρ_0 matter ($\sim 3\text{--}6 \rho_0$) in the hottest, densest stage of the collision

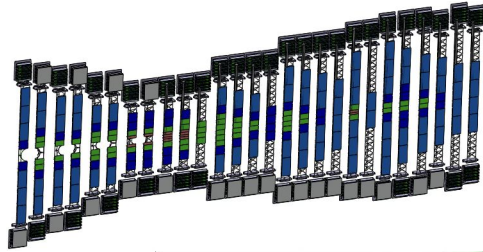


STS (Silicon Tracking System)

- In Total **1.8 Million** channels
- **Assembled to guarantee $< 1.5\%$ $\Delta p/p$**
- **876 (910)** silicon strip detector modules
- **106 Ladder** with up to 10 modules
- 2x(3+5) separate C-Frames / Stations
- 4 different sensor sizes (22; 42; 62; 124 x 62 mm)
- **2x1024 strips** per side; **58 um strip pitch**;
- Double-metallization on p side
- **Electronics outside acceptance**

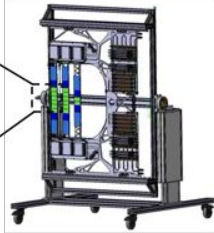
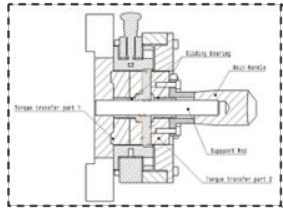


STS (Silicon Tracking System)



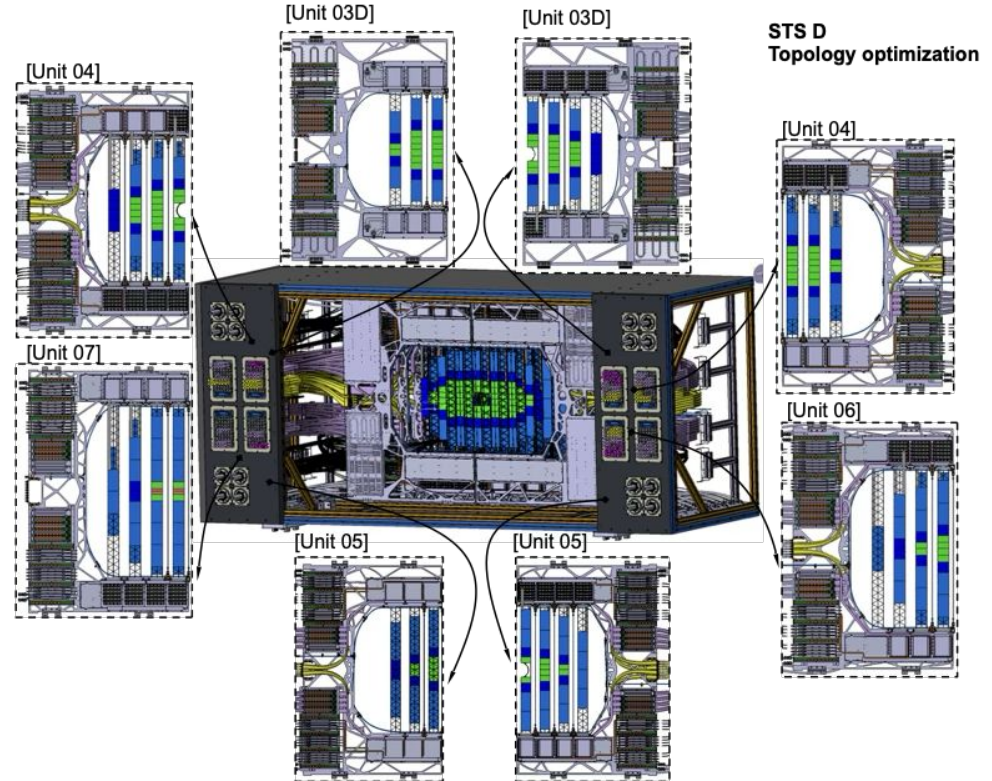
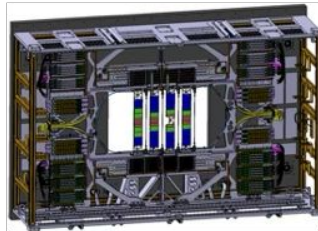
27 ladder variants

Central ladders with cut-out for beam pipe



- Joint redesign
- Increased stiffness and fixation point amount
- 3D Printed prototype
- Production soon

STS U
Topology optimization



STS D
Topology optimization

Ladders Top View

- 106 Ladder
- 2x(3+5) separate C-Frames / Stations

	FAIR GSI	Projects	DBase	QR Label	Admin	Help	Search
1st	0D	L0DR300010	L0DR100009	L0DL000150	L0DL200109		
	1U		L1UR201109	L1UR001151	L1UL101009	L1UL301010	
2nd	1D	L1DR400010	L1DR200009	L1DR000051	L1DL100109	L1DL300110	L1DL500111
	2U	L2UR501130	L2UR301129	L2UR101128	L2UL001052	L2UL201028	L2UL401029
3rd	2D	L2DR500014	L2DR300012	L2DR100012	L2DL000153	L2DL200112	L2DL400113
	3U	L3UR401113	L3UR201112	L3UR001154	L3UL101012	L3UL301012	L3UL501014
4th	3D	L3DR600015	L3DR400013	L3DR200012	L3DR000054	L3DL100112	L3DL300112
	4U	L4UR501133	L4UR301131	L4UR101131	L4UL001055	L4UL201031	L4UL401032
5th	4D	L4DR500018	L4DR300017	L4DR100016	L4DL000161	L4DL200116	L4DL400117
	5U	L5UR601119	L5UR401117	L5UR201116	L5UR001156	L5UL101016	L5UL301017
6th	5D	L5DR600019	L5DR400017	L5DR200016	L5DR000056	L5DL100116	L5DL300117
	6U	L6UR501137	L6UR301136	L6UR101135	L6UL001057	L6UL201035	L6UL401036
7th	6D	L6DR700021	L6DR500025	L6DR300020	L6DR100020	L6DL000158	L6DL200120
	7U	L7UR601126	L7UR401139	L7UR201139	L7UR001159	L7UL101039	L7UL301039
8th	7D	L7DR600024	L7DR400022	L7DR200022	L7DR000060	L7DL100122	L7DL300122
	8U	L8UR701126	L8UR501123	L8UR301122	L8UR101122	L8UL001060	L8UL201022
						L8UL401022	L8UL601024

Impressum

Data Privacy

Email: Irakli

Ladders Progress Overview

Ladder 8 to 10 modules



FAIR GSI

Projects DBase QR Label Admin Help Search

1st 0D L0DR300010 L0DR100009 L0DL000150 L0DL200109

1U L1UR201109 L1UR001151 L1UL100109 L1UL301010 L1DL500111

2nd 1D L1DL100109 L1DL300110 L1DL500111

2U L2UL001052 L2UL201028 L2UL401029 L2DL400113

3rd 2D L2DL000153 L2DL200112 L2DL400113

3U L3UR001154 L3UL101012 L3UL301012 L3UL501014

4th 3D L3DL000054 L3DL100112 L3DL300112 L3DL500114

4U L4UL001055 L4UL201031 L4UL401032 L4UL601034

5th 4D L4DL000161 L4DL200116 L4DL400117 L4DL600119

5U L5UL101016 L5UL301017 L5UL501018

6th 5D L5DL000056 L5DL100116 L5DL300117 L5DL500118

6U L6UL001057 L6UL201035 L6UL401036 L6UL601038

7th 6D L6DL000158 L6DL200120 L6DL400120 L6DL600127

7U L7UR601126 L7UR401139 L7UR201139 L7UR001159 L7UL101039 L7UL301039 L7UL501040 L7UL701041

8th 7D L7DR600024 L7DR400022 L7DR200022 L7DR000060 L7DL100122 L7DL300122 L7DL500123 L7DL700126

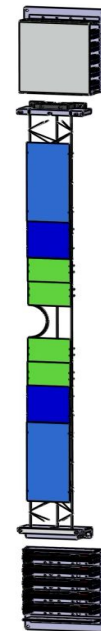
8U L8UR701126 L8UR501123 L8UR301122 L8UR101122 L8UL001060 L8UL201022 L8UL401022 L8UL601024

Module name Pos Y SN Set (A/B) ulink Stat...

Ladder: L2UL401029

Module name	Pos Y	SN	Set	(A/B)	ulink	Stat...
M2UL4T4010294B2	T4	0	4	B	2	0
M2UL4T3010293B2	T3	0	3	B	2	0
M2UL4T2010292B2	T2	0	2	B	2	0
M2UL4T1010291B2	T1	0	1	B	2	60
M2UL4T0010290B5	T0	0	0	B	5	60
M2UL4B0010290A5	B0	0	0	A	5	60
M2UL4B1010291A2	B1	0	1	A	2	60
M2UL4B2010292A2	B2	0	2	A	2	0
M2UL4B3010293A2	B3	0	3	A	2	0
M2UL4B4010294A2	B4	0	4	A	2	0

Impressum Data Privacy Email: Irakli

FAIR GmbH | GSI GmbH

Module Test Web Page



Projects

DBase

QR Label

Admin

Help

◀▶

[Link to ladder: L5UR201116](#)

Module versions: M5UR2T0011160A2 | [QR.pdf](#)

Tests:

✓

Thermal test

2025-04-23 09:00

Lady CollazoSanchez

Workflow: | [WF_2025_03_26_13_54_42.pdf](#) |

Module: M5UR2T0011160A2 [Site: KIT]

-- Last status: 2025-04-23 09:00 [Thermally Tested]

[Link to Sensor: 05102 \(Grade: A\) -- size: 62x42 mm](#)

History of statuses:

2025-04-23 09:00:00 < Lady CollazoSanchez > [Thermally Tested] GSI

2025-04-22 15:10:00 < Lady CollazoSanchez > [Tested in Hk.Hl.] GSI

2025-04-15 14:42:00 < Lady CollazoSanchez > [Test started in Hk.Hl.] GSI

2025-02-17 08:55:00 < > [Tested Ch CLRo.]

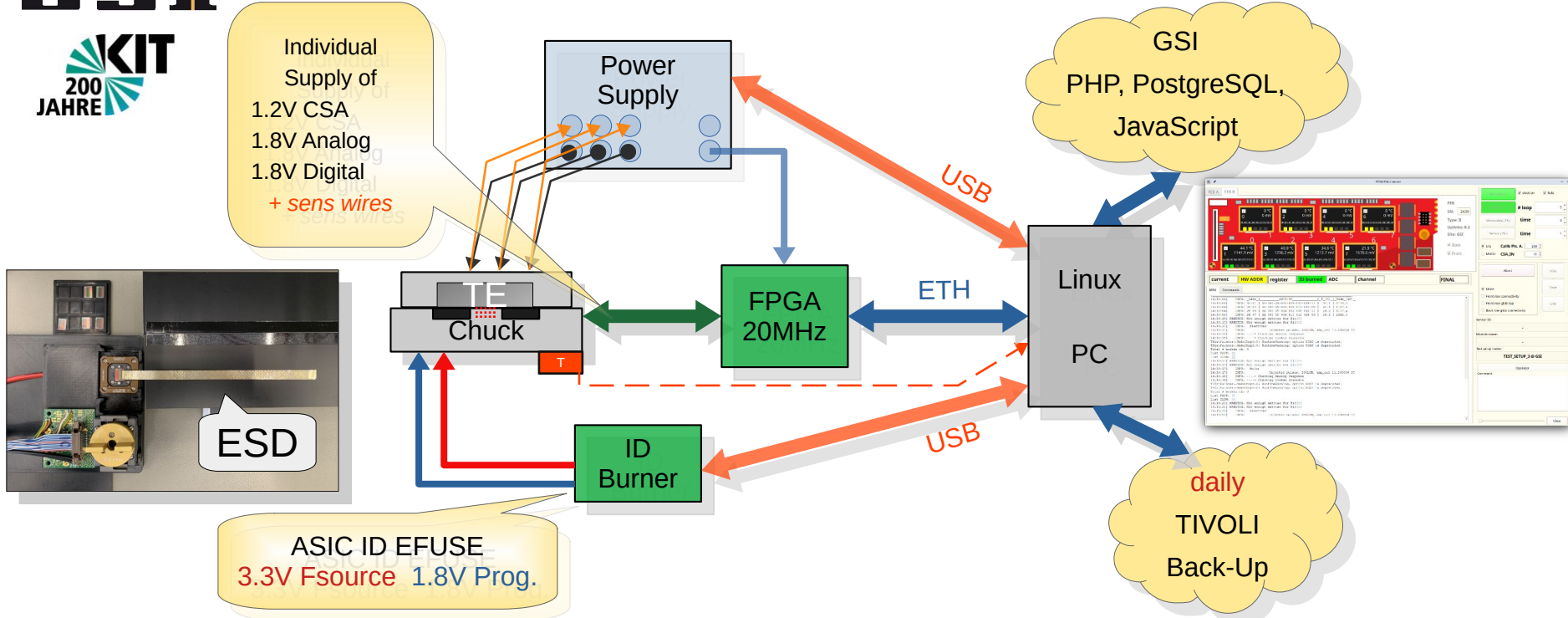
2023-11-11 10:00:00 < Irakli Keshelashvili > [Reserved] KIT

Impressum

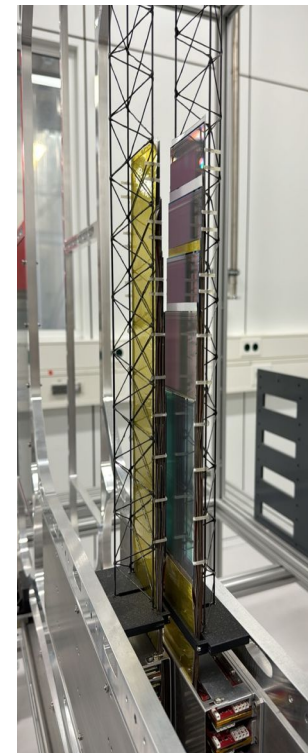
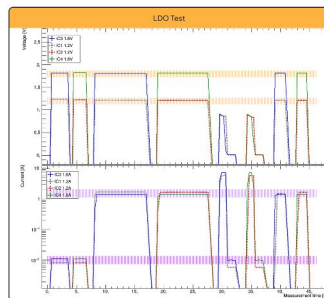
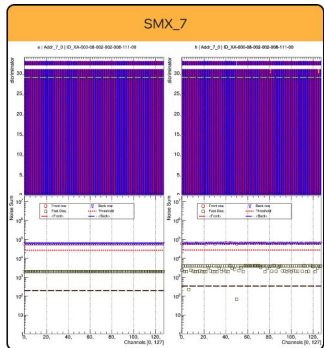
Data Privacy

Email: Iraki

How Test Setup Is Working?



Module Assembly Procedure



Test Software (5 x module/server)

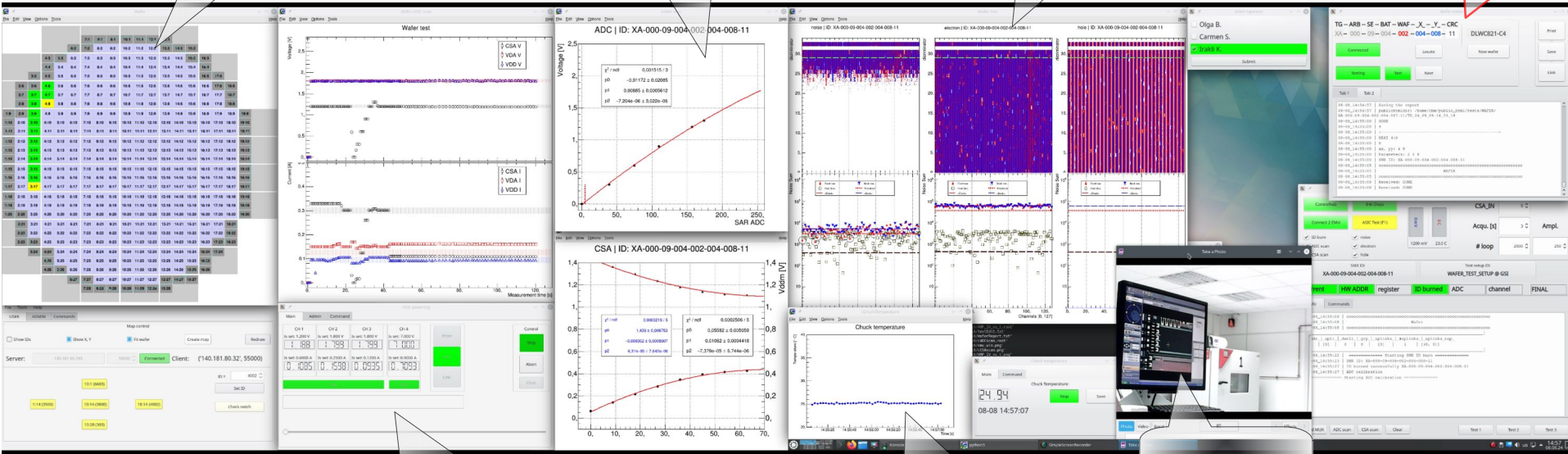


WAFER
Prober server

ADC calib.
CSA calib.

Channel test
Noise, Neg., Pos.,

MAIN
server



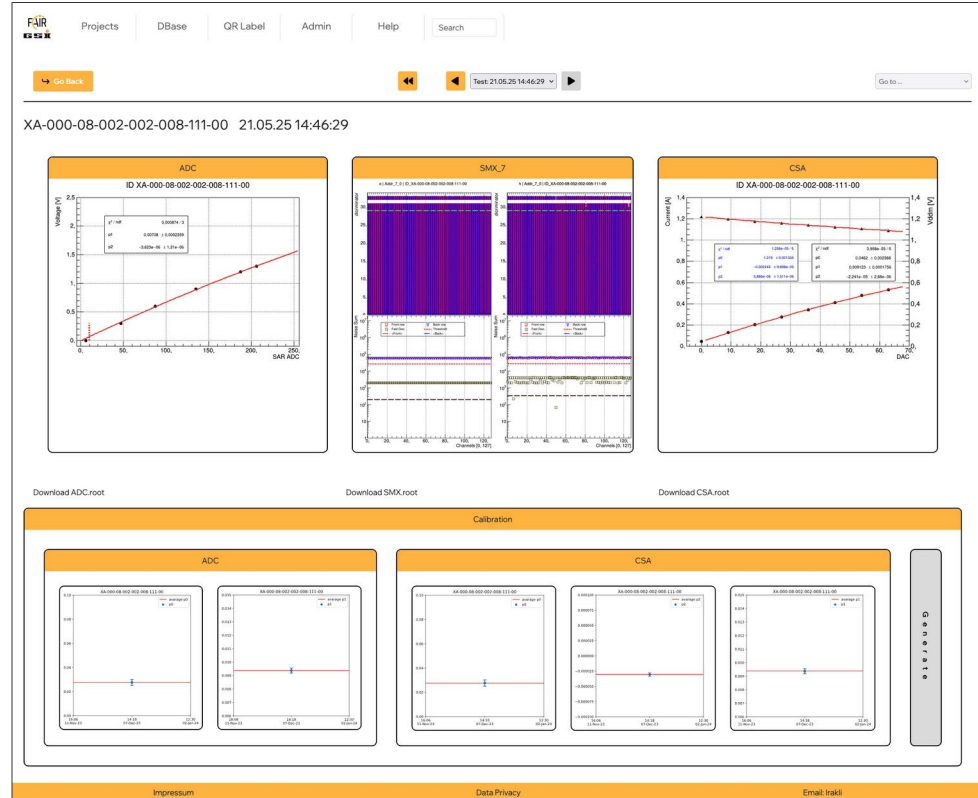
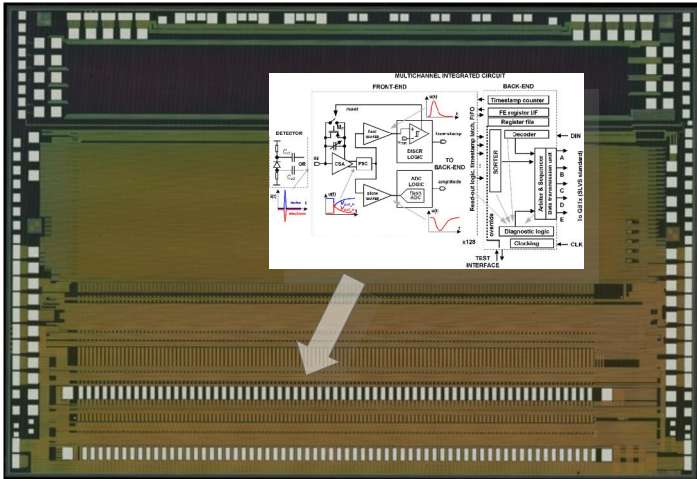
Power supply
server

WAFER/Chuck
Temperature

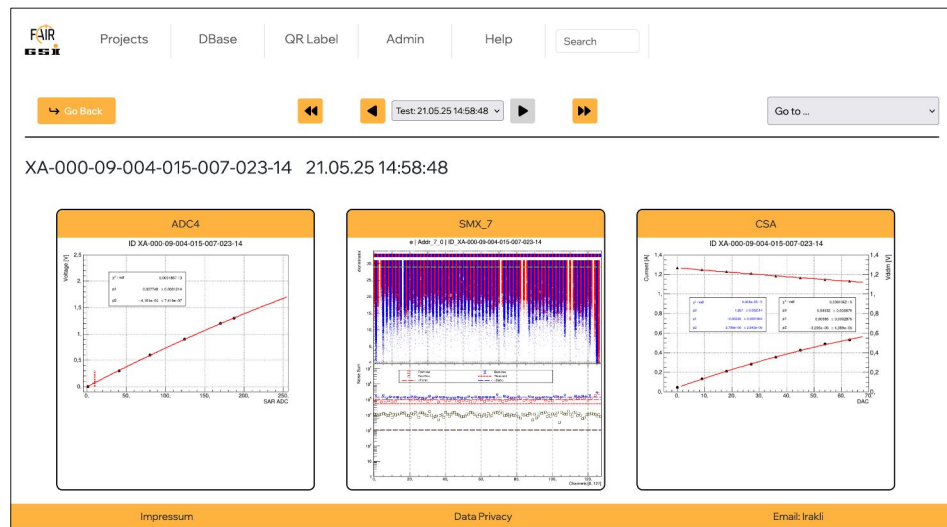
Test card

Test of XYTER 2.2 Readout ASIC

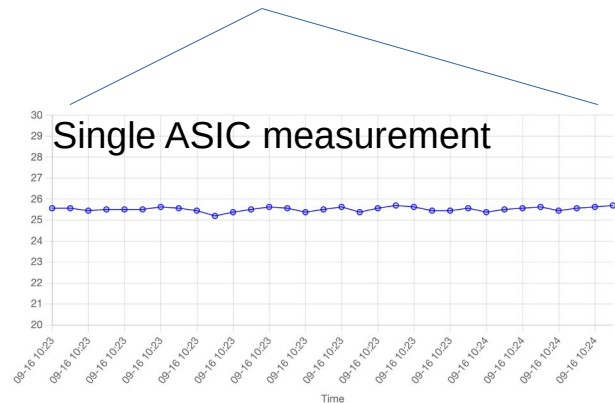
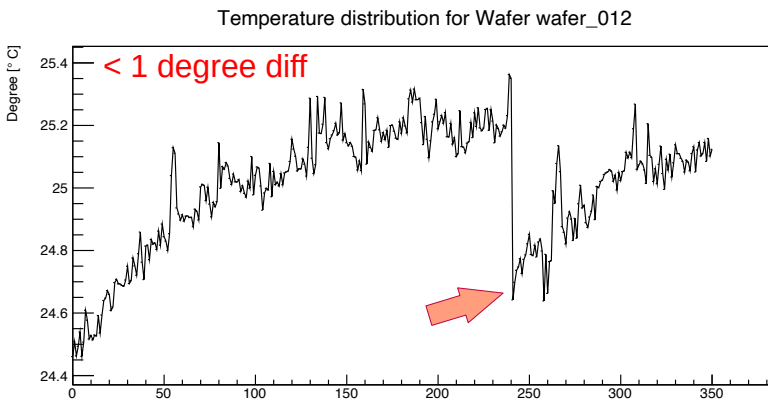
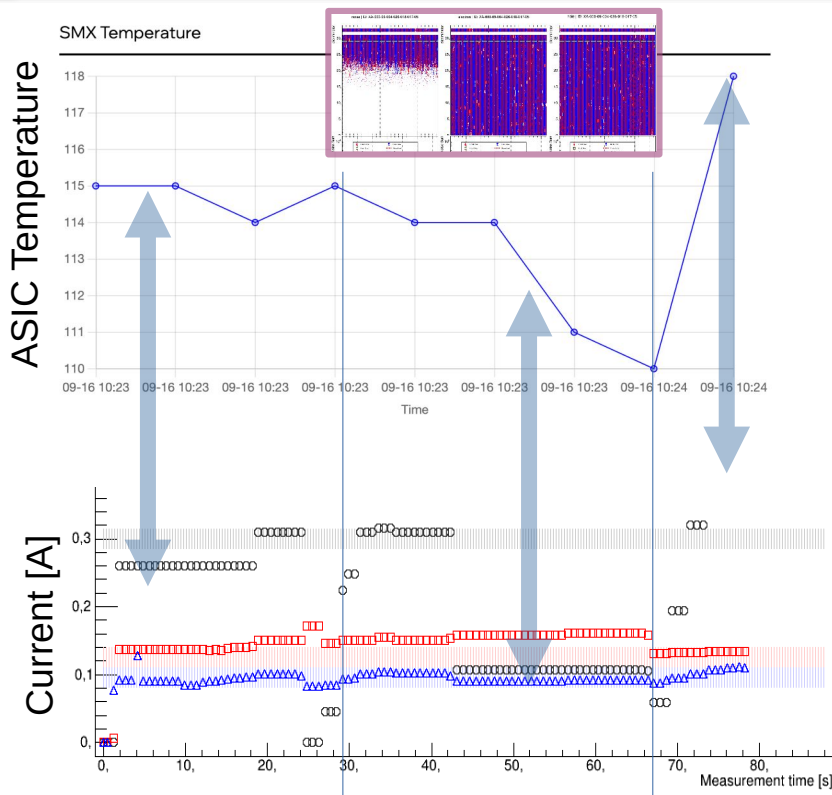
- **128** analog readout channels
- **5x320 Mbit/s** data transfer
- Analog+Digital circuit
- STS and MUCH
- 5 bit Amp, 14 bit Time res.



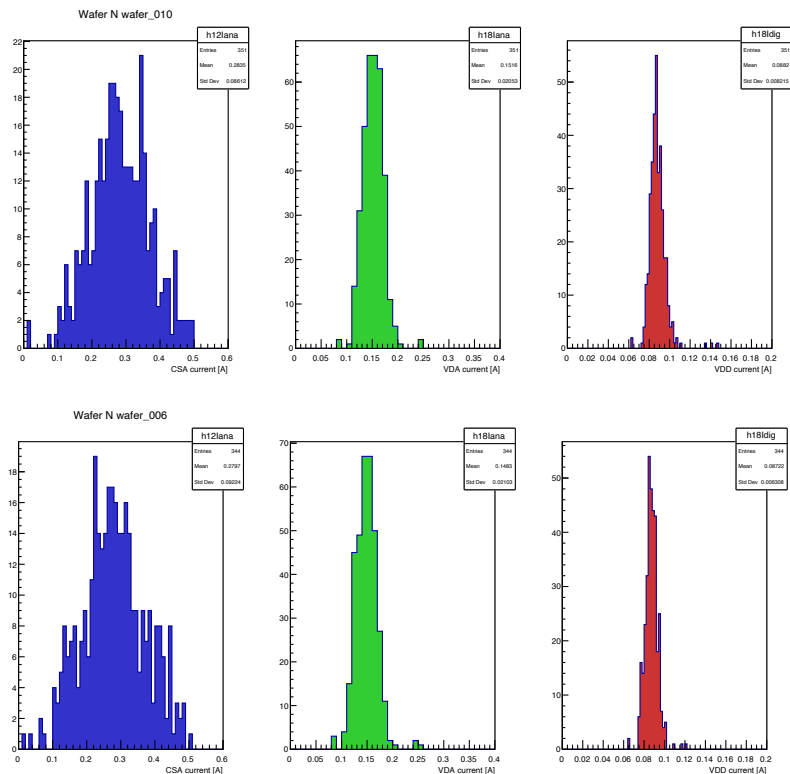
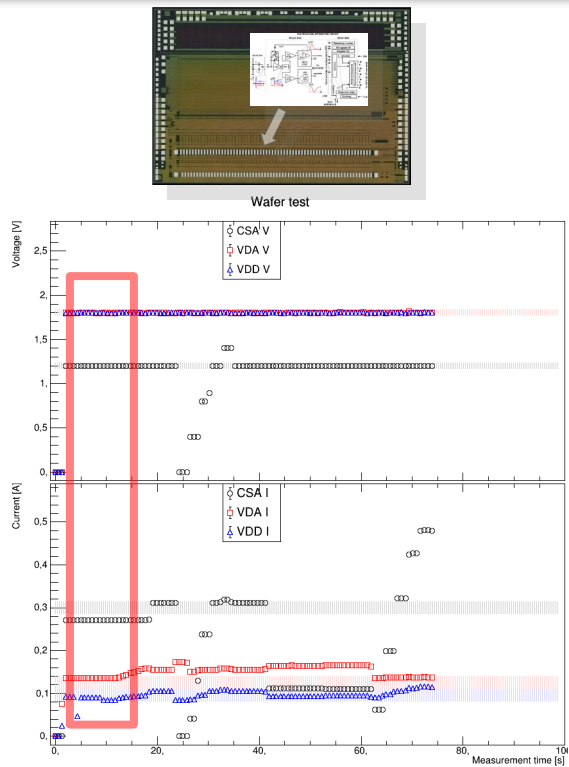
Wafer ASIC / Microcable Test Page



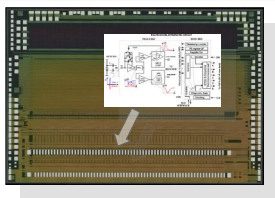
Chuck / Wafer / ASIC Temperature



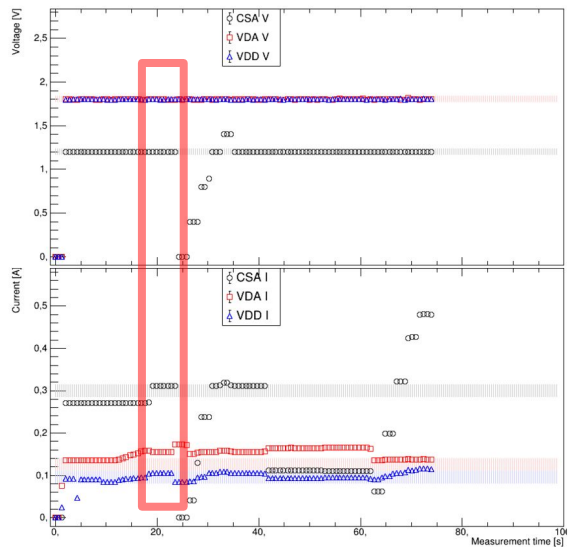
Current consumption **before** Init



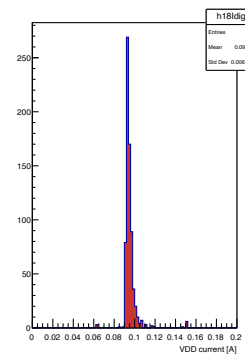
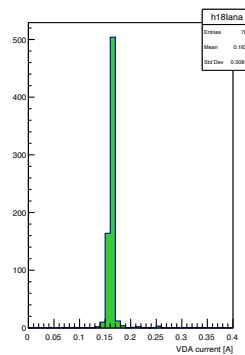
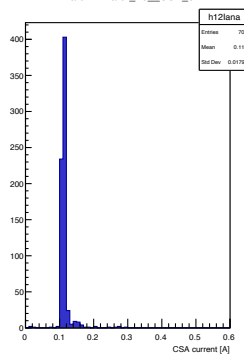
Current consumption after Init



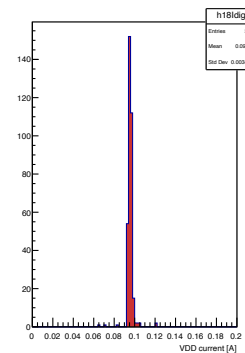
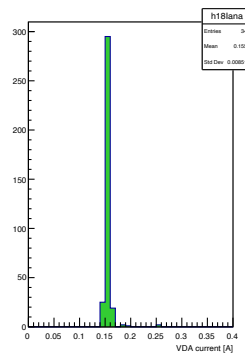
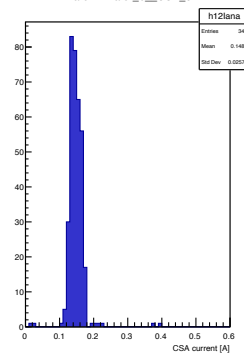
Wafer test



Wafer N wafer_10__CSA_5



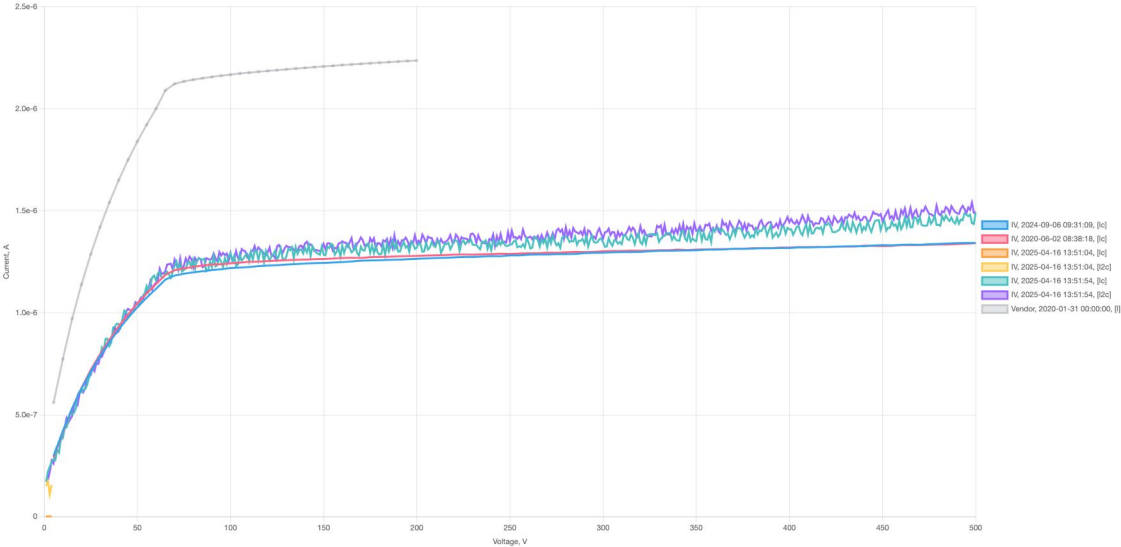
Wafer N wafer_6__CSA_5



Sensor Test Web Page



Sensor: 05102 (Grade: A)
Used: STS
Size: 62x42 mm | og: A | eg: A
Module: [M5UR2T0011160A2](#)



Front End Board Test Page



Projects

DBase

QR Label

Admin

Help

Search

Go Back

GSI

KIT

◀◀

◀

Test: 28.01.25 10:58:36

▶

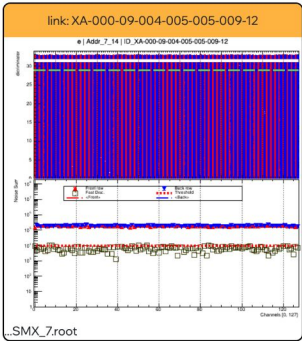
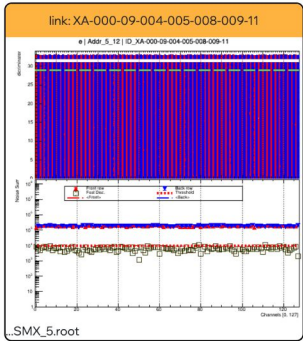
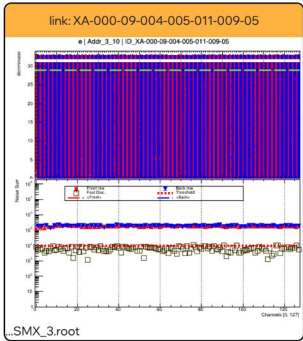
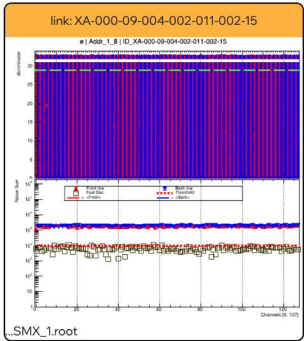
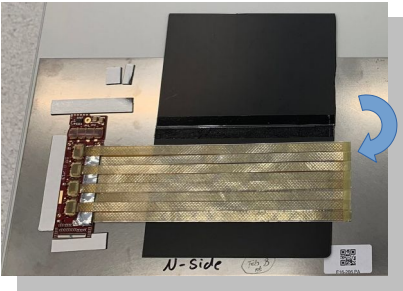
▶▶

LDO/GSI

LDO/KIT

FEB_3110 28.01.25 10:58:36

Ladder: L5UR201116 Module: M5UR2T0011160A2 Sensor: 05102



Impressum

Data Privacy

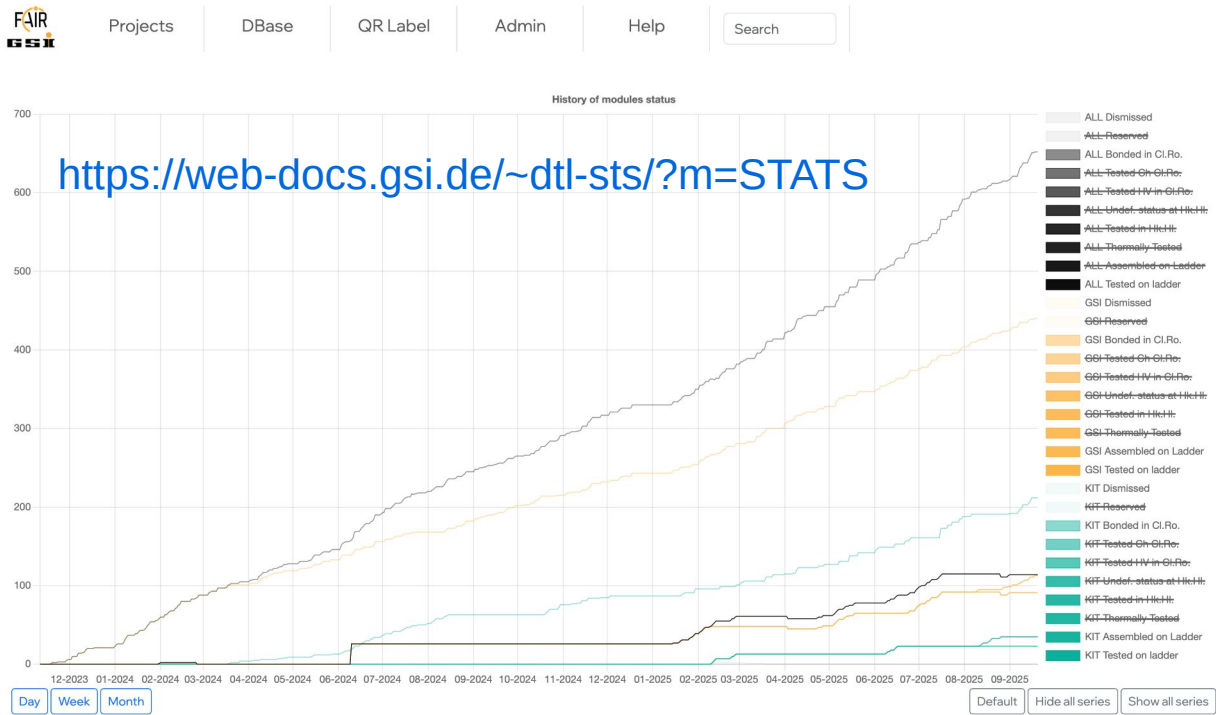
Email: Irakli

STS Assembly Monitoring



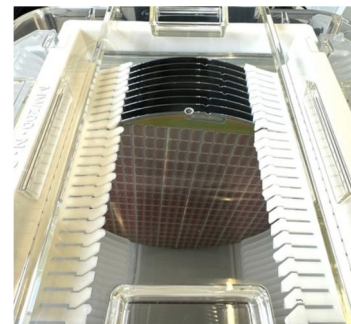
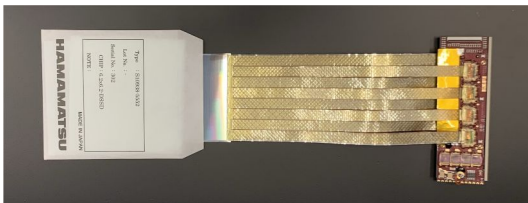
Module statuses - All (GSI, KIT)

Total		GSI		KIT		
#	%	#	%	#	%	
114	13	91	80	23	20	Tested on ladder
148	17	113	80	35	20	Assembled on Ladder
512	58	358	70	154	30	Tested in Hk.HI.
513	58	359	70	154	30	Undef. status at Hk.HI.
519	59	363	70	156	30	Test started in Hk.HI.
519	59	363	70	156	30	Tested HV in Cl.Ro.
656	74	447	70	209	30	Tested Ch Cl.Ro.
659	75	447	70	212	30	Bonded in Cl.Ro.
34	4	Rebuilt modules				
224	25	134	60	90	40	Reserved



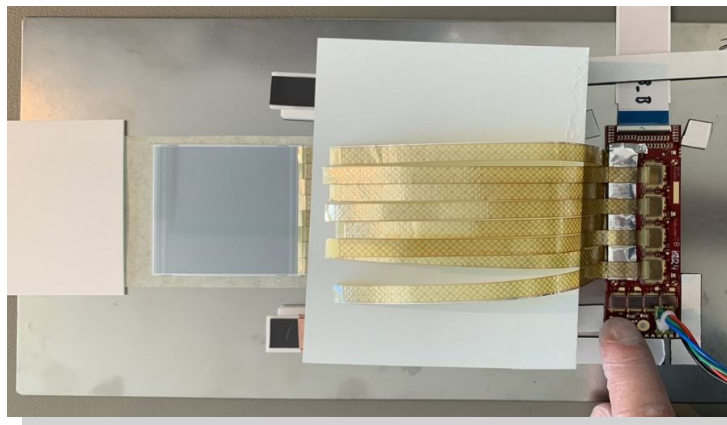
Summary

- **75%** of the modules are produced
- **13%** of the modules tested on the ladder
- 80 Wafers, each with 360 ASICs tested
- **Extremely successful Q&A procedure**
- Assembly teams at GSI and KIT
- Universal testing and storing software
- **Experimental success at miniCBM**

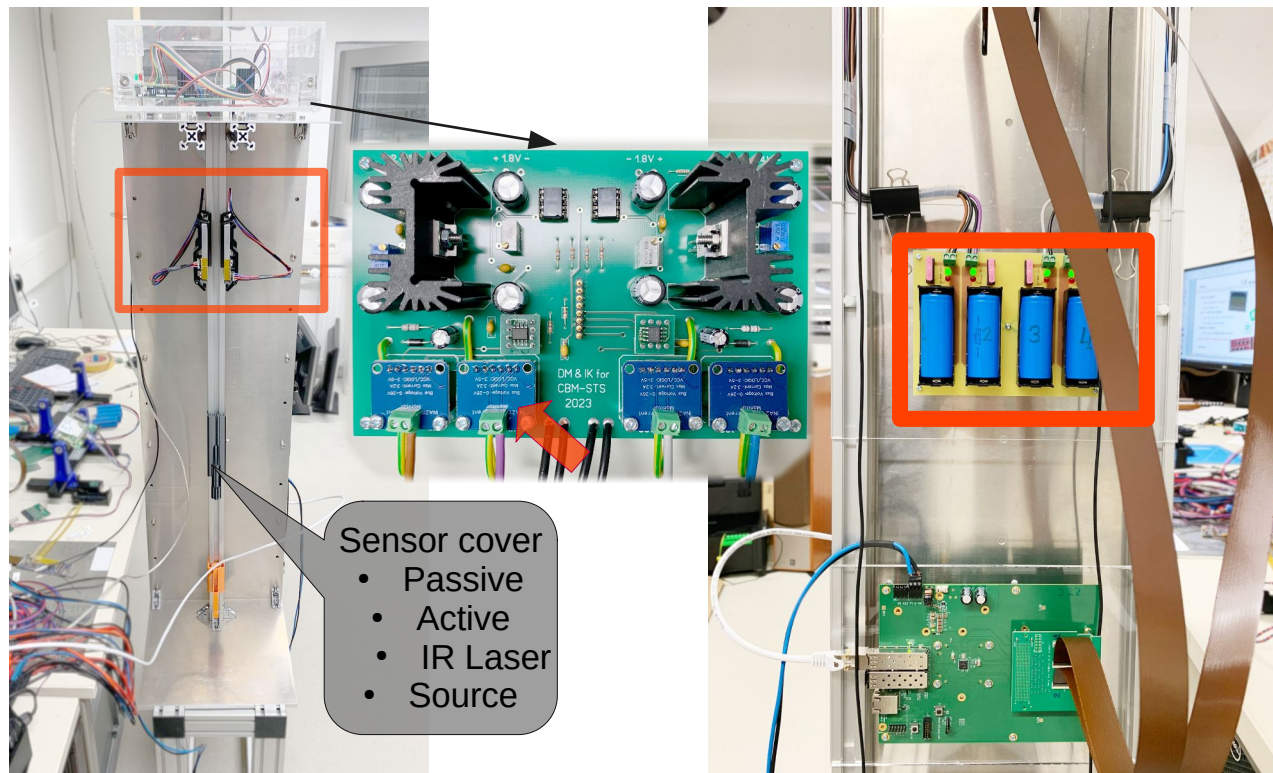


Total	GSI		KIT		
	#	%	#	%	
114	13	91	80	23	20 Tested on ladder
146	17	111	80	35	20 Assembled on Ladder
512	58	358	70	154	30 Tested in Hk.HI.
513	58	359	70	154	30 Undef. status at Hk.HI.
519	59	363	70	156	30 Test started in Hk.HI.
519	59	363	70	156	30 Tested HV in Cl.Ro.
655	74	451	70	204	30 Tested Ch Cl.Ro.
658	75	452	70	206	30 Bonded in Cl.Ro.

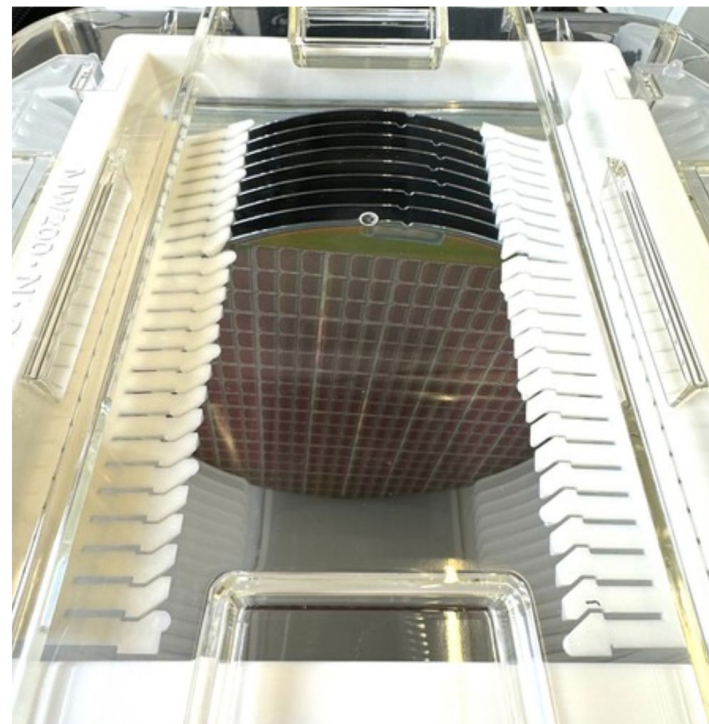
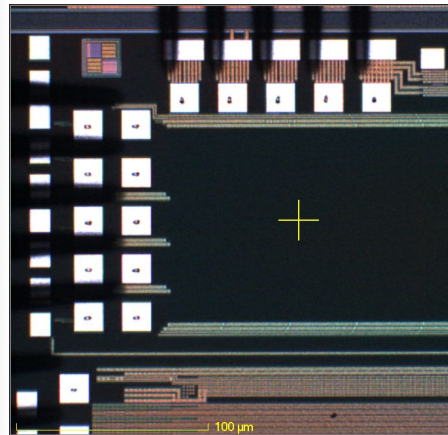
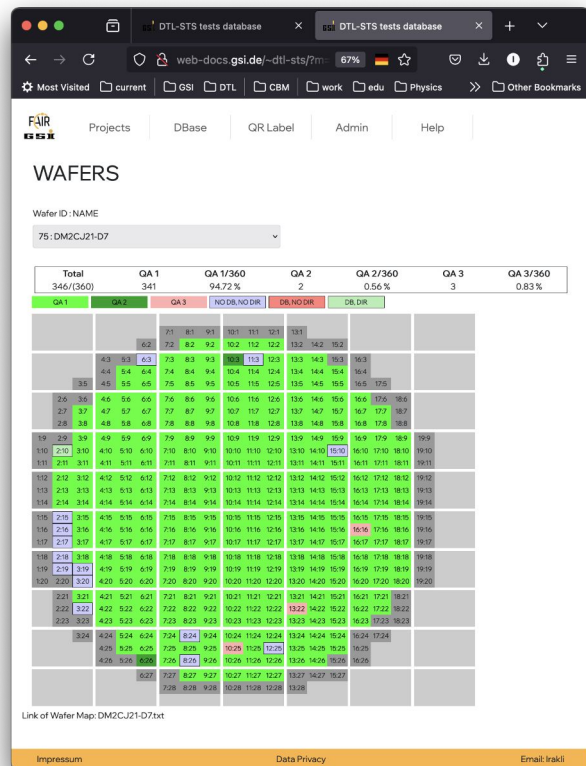
Sensor test



Module test setup



ASIC Wafer 80 x 360 chips



Wafer level ASIC test

