ITK ATLAS FASE II

Preventivi 2022 sezione di Lecce

5-Luglio-2021

Gabriele Chiodini
ATLAS ITK Institute Rappresentative

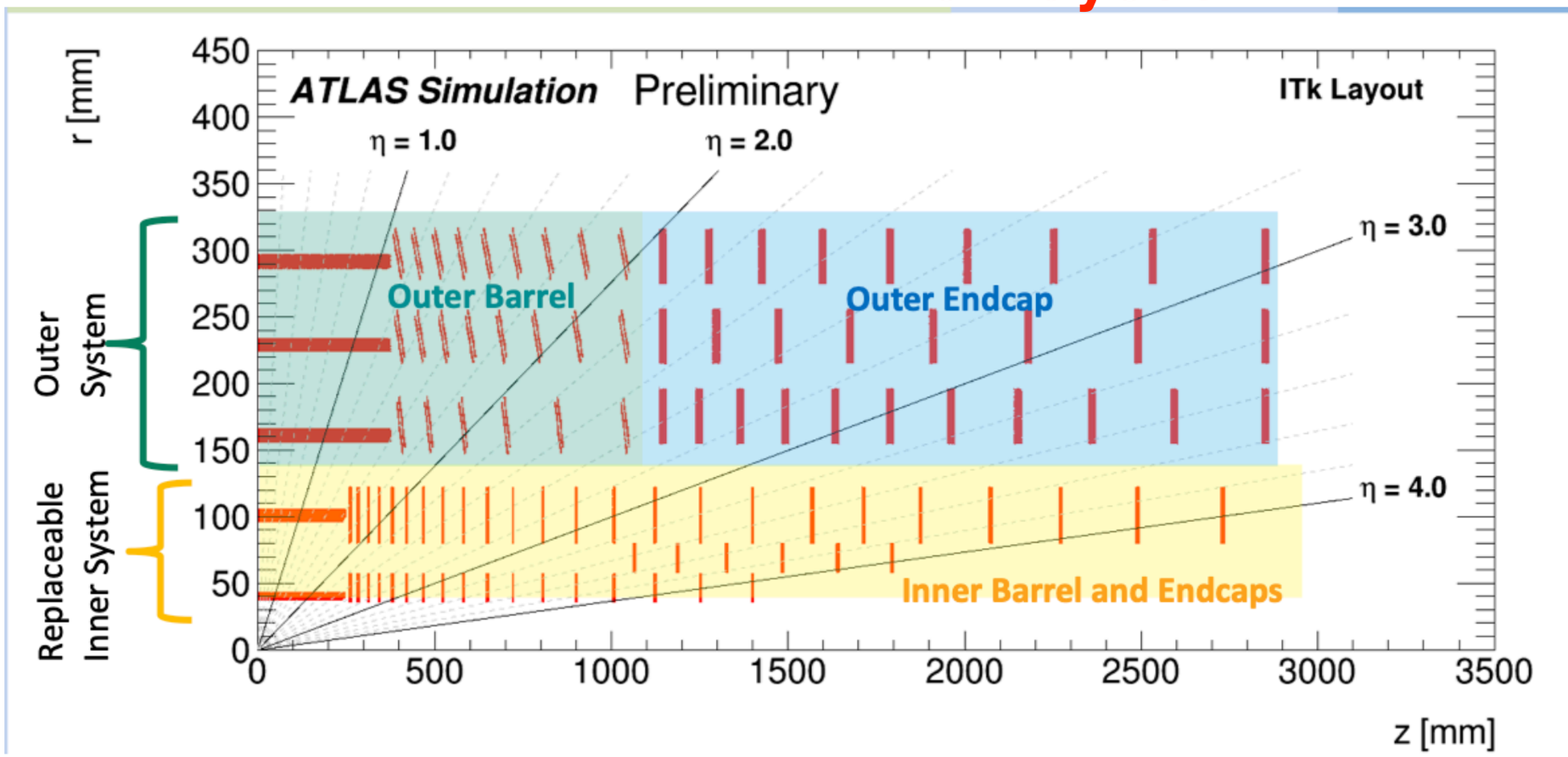
On behalf of ATLAS ITK Lecce group

R. Assiro, G. Chiodini, M.R. Coluccia, P. Creti, A. Innocente, A. Miccoli.
INFN Lecce
A. Palazzo, C. Pinto, E.J. Schioppa, S. Spagnolo
INFN Lecce and Università del Salento

INTRODUZIONE A ITK

ATLAS FASE 2 (2027) avrà un **intero tracker al Silicio** denominato ITK fatto di **Strip** e **Pixel** (installazione 2026)

ITK Pixel Layout



Current pixel system
~92M pixels
~2000 modules
~1.9m² active area

ITk Pixel System
~1.4G pixels
~9,400 modules
~13m² active area

ATLAS Italia dovrà costruire uno dei due **Outer Endcap** di pixel ibridi di Silicio (UK dovrà costruire l'altro)

Costruzione Pixel EndCap in ITALIA

Lecce costruirà e certificherà tra il 2023 e il 2024 metà degli half-ring (28 + spares) necessari a costruire l'endcap italiano: 28 half-ring + spare per un totale di 586 moduli + spares (quad-modules).

Working groups:

A) Test di ricezione dei moduli
B) QC degli half-ring

DAQ+DCS

COSTRUZIONE

C) Costruzione half-ring (Loading)
D) QC glue on silicon after irradiation

E) Half-ring handling frame
F) Half-ring storage box
G) Integrazione half-ring in half-shell

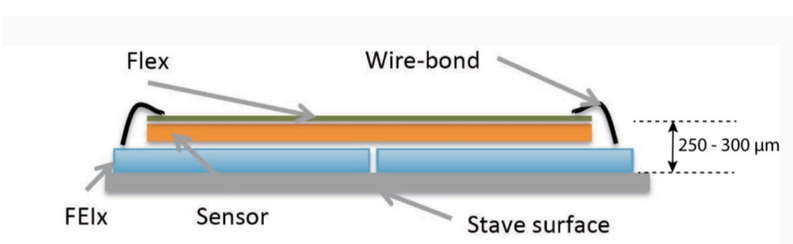
MECCANICA

H) FOS (E.J.Schioppa)

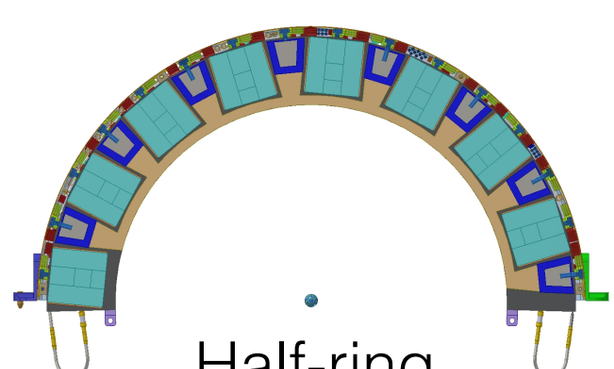
Ge, Le

Frascati

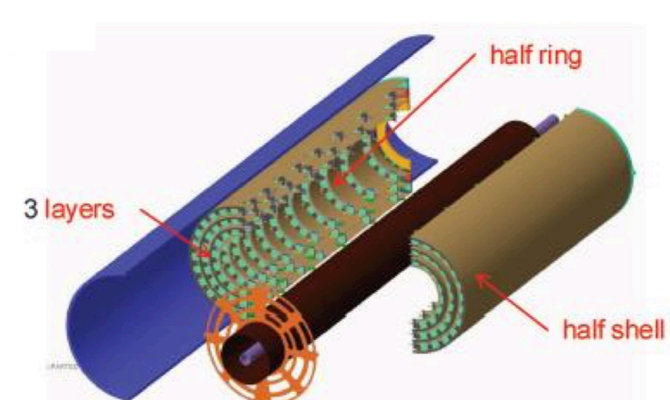
CERN



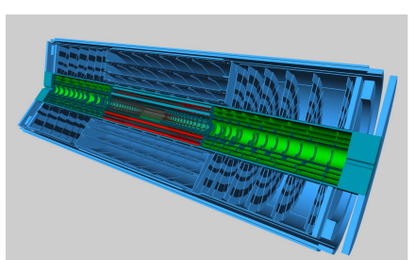
Quad-module



Half-ring



End-cap



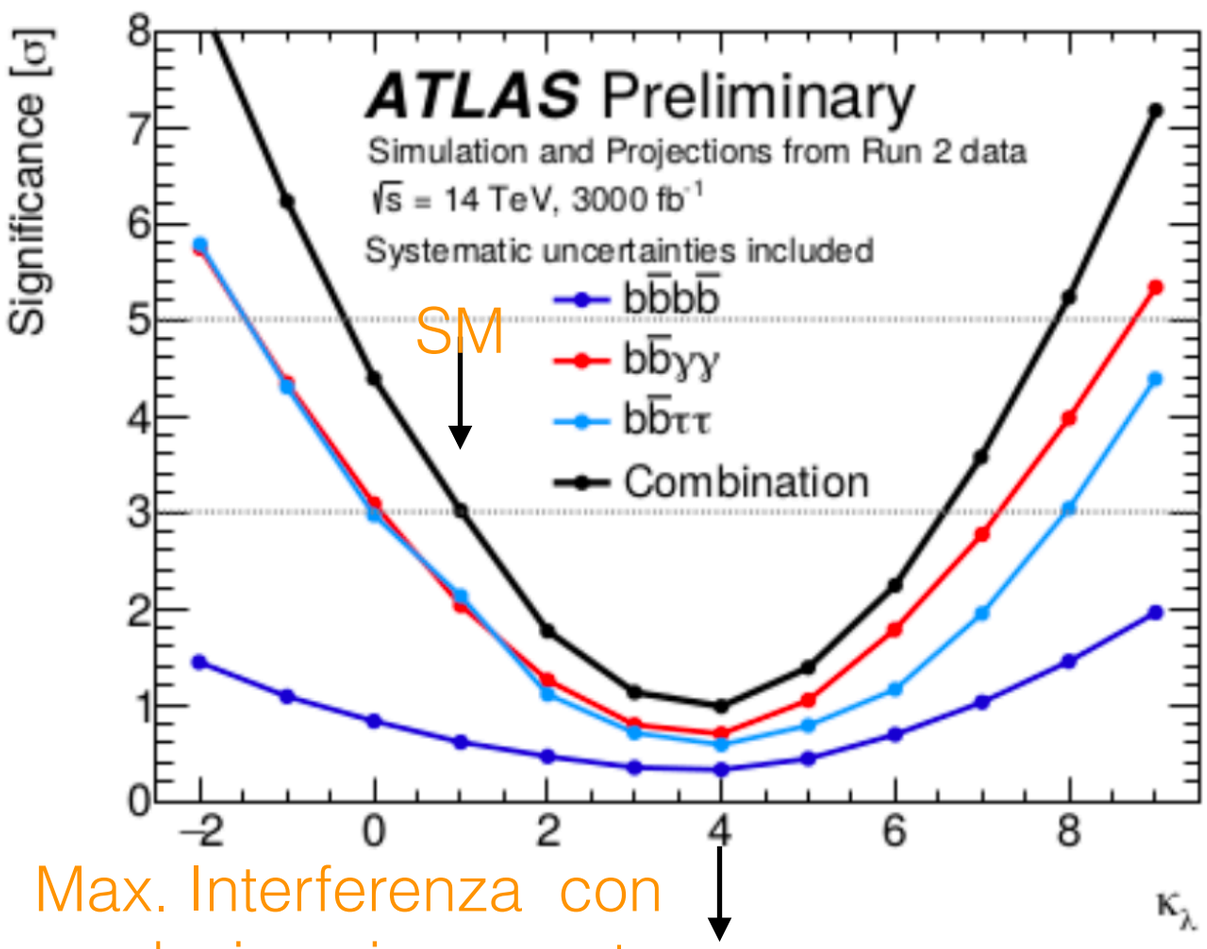
ITK

ITK and Higgs pair production

ALTARELLI, LP09

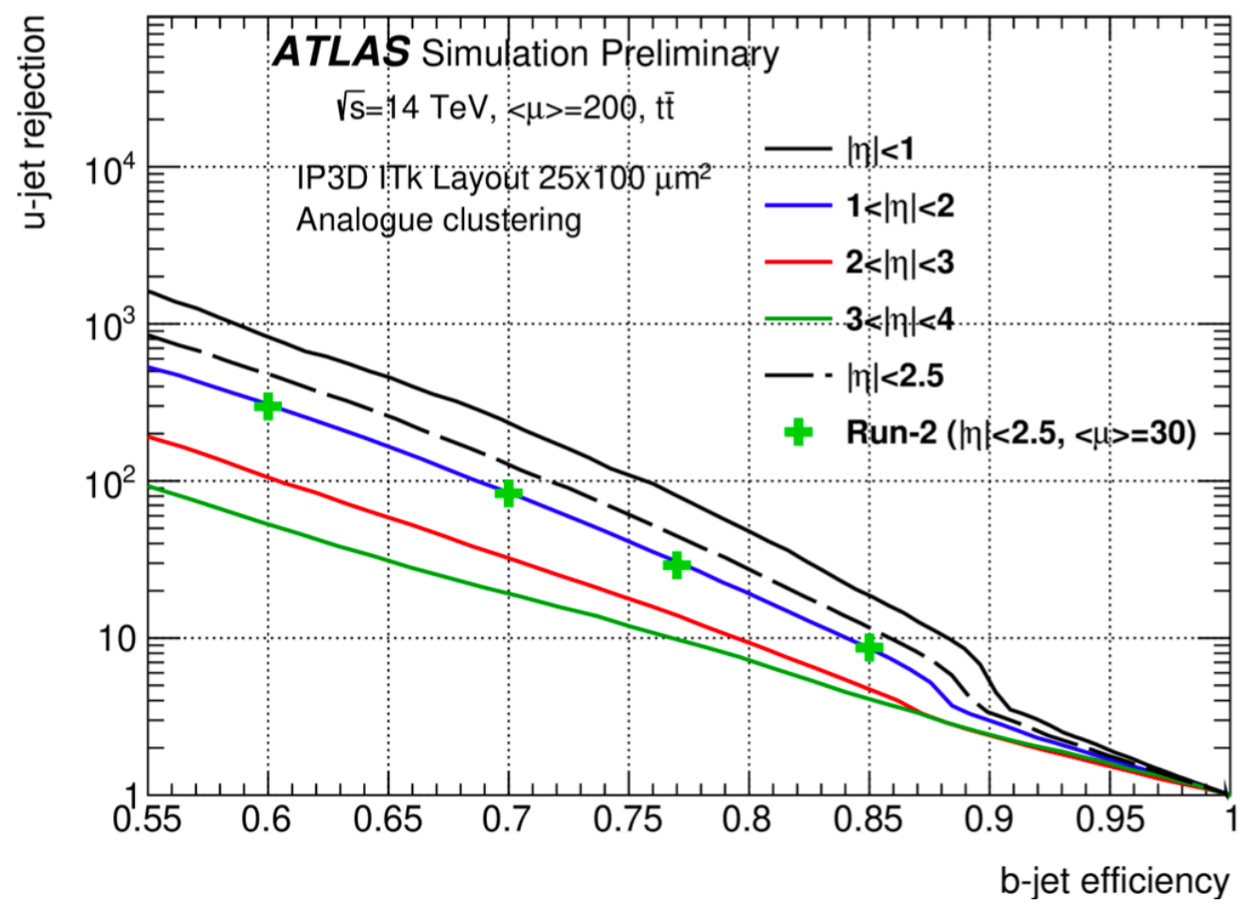
The main problems of the SM show up in the Higgs sector

$$V_{Higgs} = V_0 - \mu^2 \phi^\dagger \phi + \lambda \left(\phi^\dagger \phi\right)^2 + [\overline{\psi}_{Li} Y_{ij} \psi_{Rj} \phi + h.c.]$$



Max. Interferenza con produzione incoerente

HH reach of ATLAS at HL-LHC

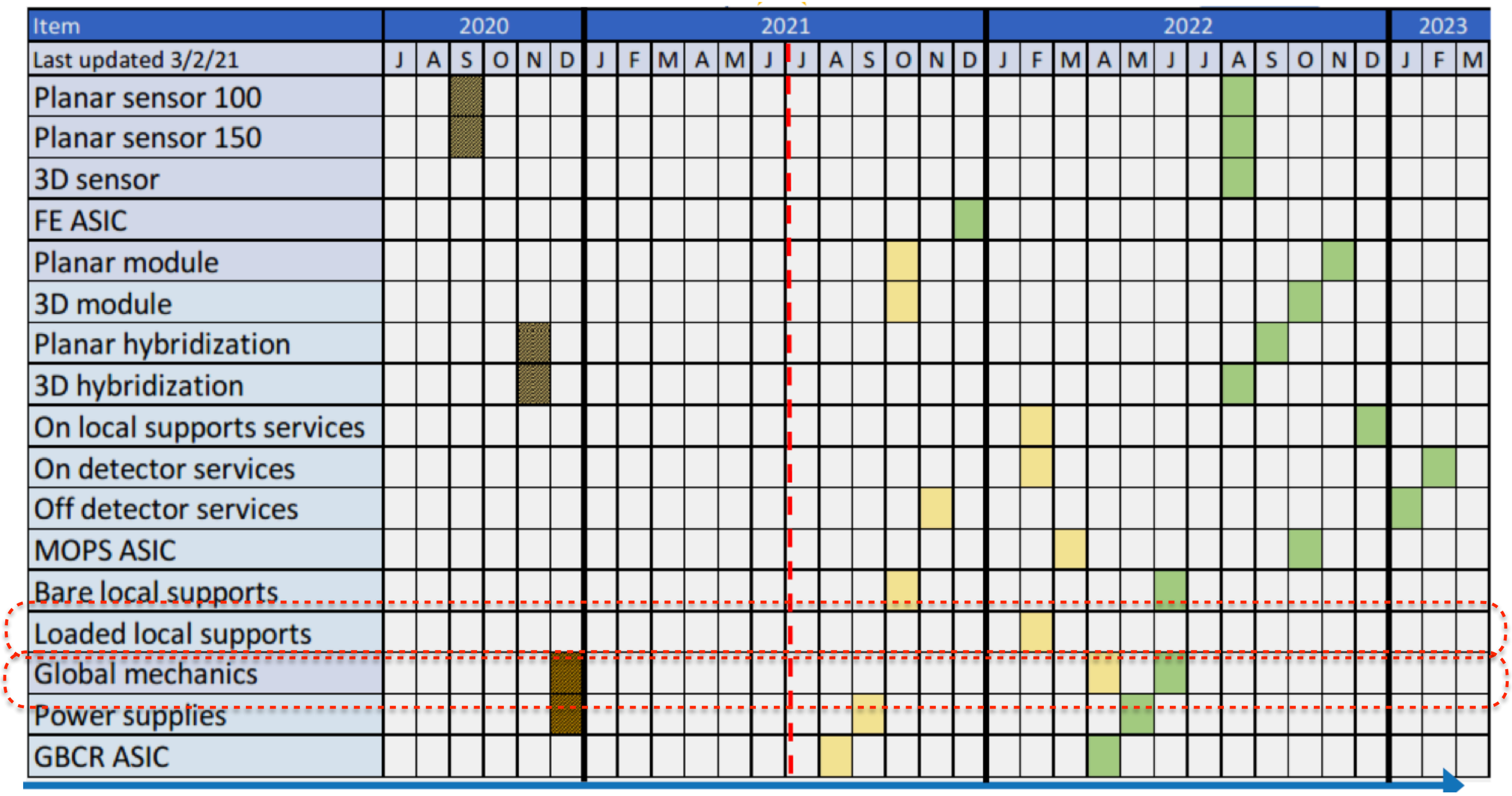


ATLAS b-tagging performance

SOME HIGHLIGHTS ABOUT ITK

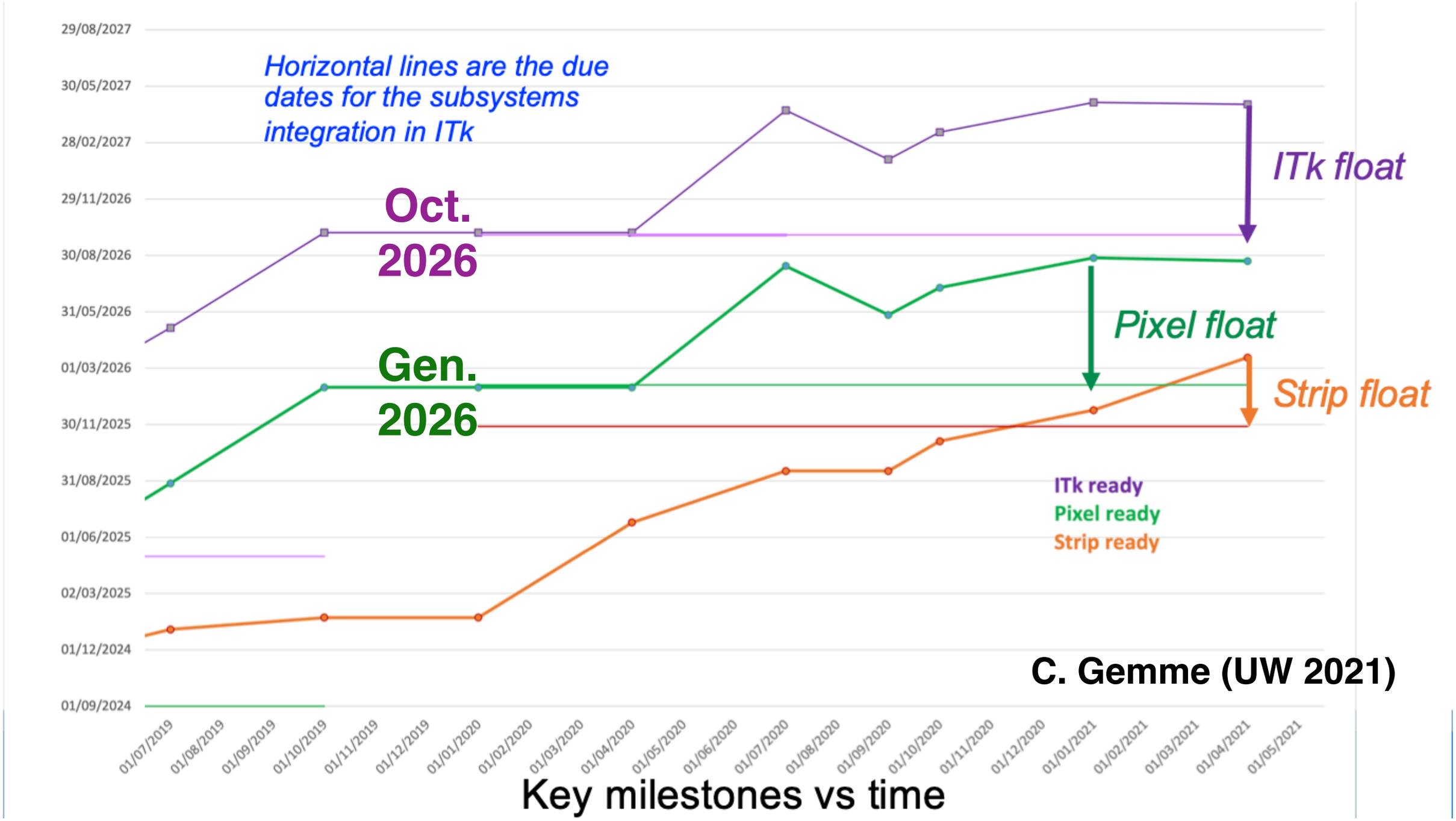
Verso la produzione

Preliminary Design Review — **Final Design Review** — **Production Readiness Review**



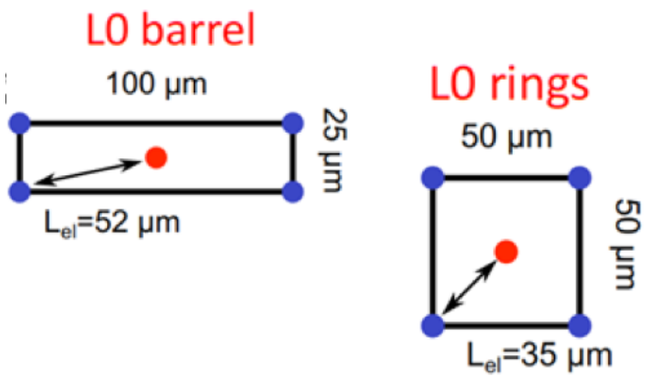
ITK schedule issue

Technical Coord schedule (Feb 2020) has ITk needed for installation in early October 2026 but ITk Ready date is early May 2027 (-7months).



SI HYBRID PIXEL

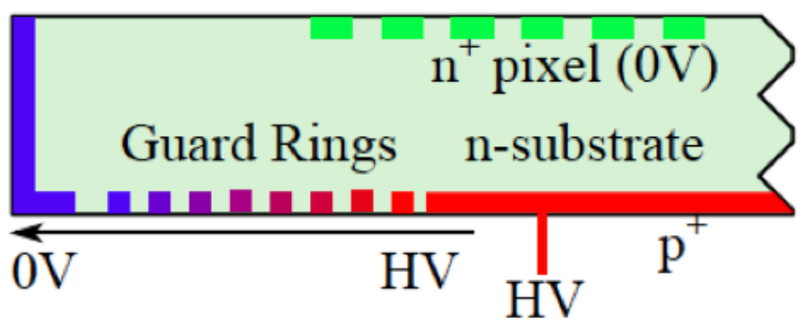
3D: 1.3×10^{16} n_{eq}/cm^2 for 2000 fb^{-1}



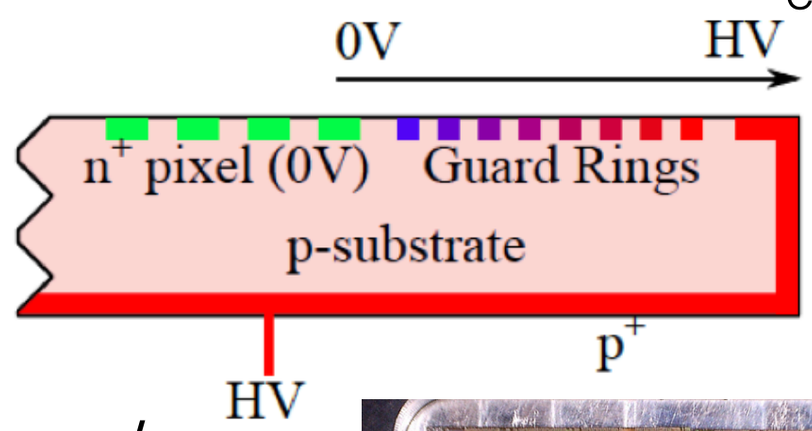
Spessore: 150 um + 100 um support wafer
Area: 2 cm x 2cm = 1 readout chip RD53

Planari tradizionali

Planari sottili: 4.5×10^{15} n_{eq}/cm^2 for 2000 fb^{-1}



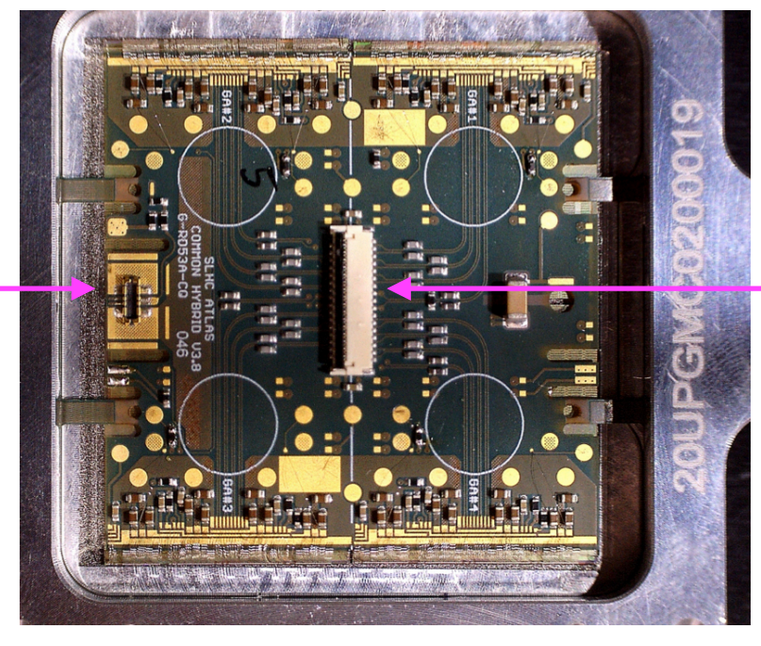
n^+/n



n^+/p

Thin: 100 um layer1
Thick 150 um layer 2-4

Power connector



Data connector

Quad-module:

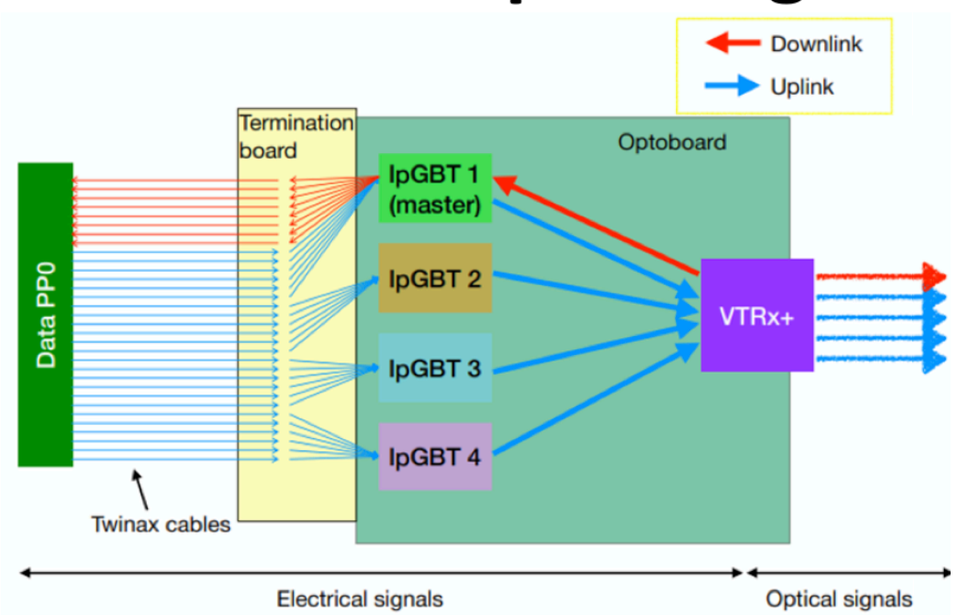
Area: 4 cm x 4cm = 4 readout chip RD53

HALF RING CHANNEL COUNTS

Outer Endcap

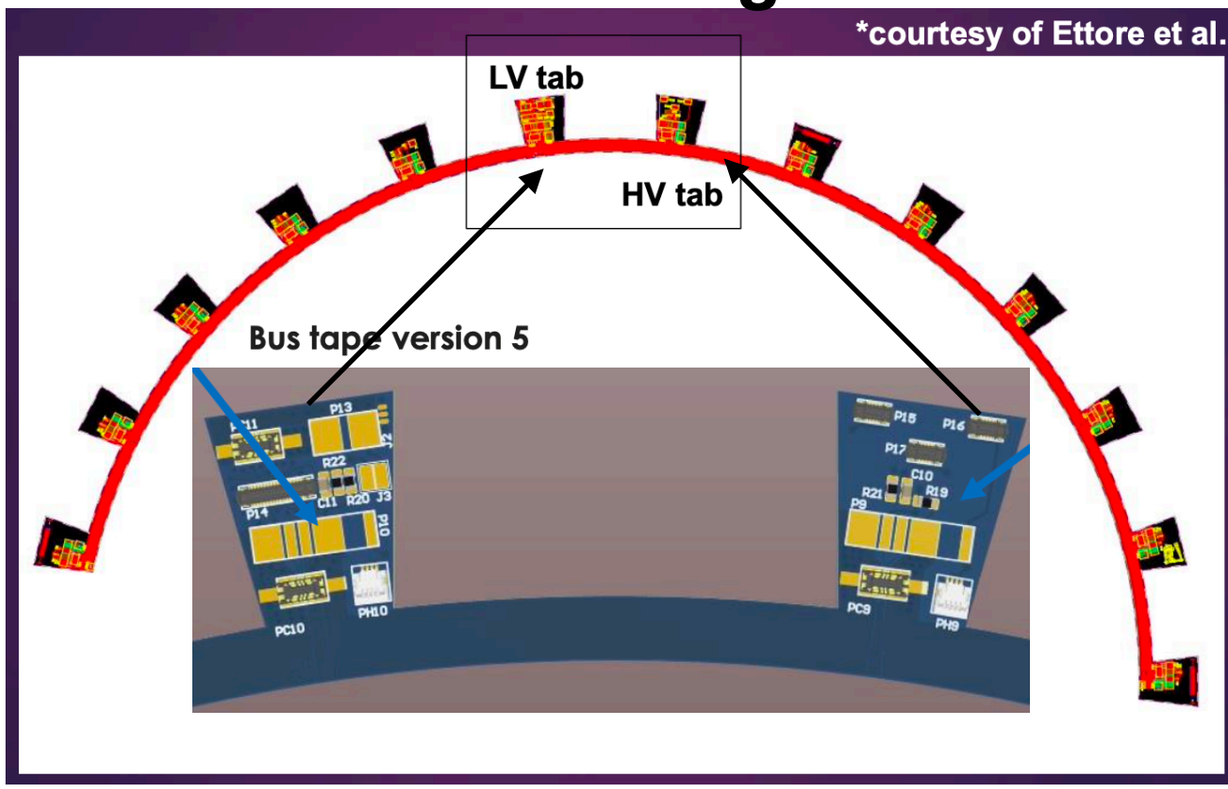
LLS type	modules	SP chains	HV channels	MOPS chips	Tiloc NTCs	electrical data uplink	electrical command downlinks	opto boards	power [W]
L2 R1-5	16	2	4	2	2	32	16	2	163
L2 R6-11	16	2	4	2	2	64	16	4	163
L3 R1-8	22	2	4	2	2	44	22	4	224
L4 R1-7	26	2	4	2	2	26	26	4	265
L4 R8-9	26	2	4	2	2	52	26	4	265

Electrical → optical signals → Felix



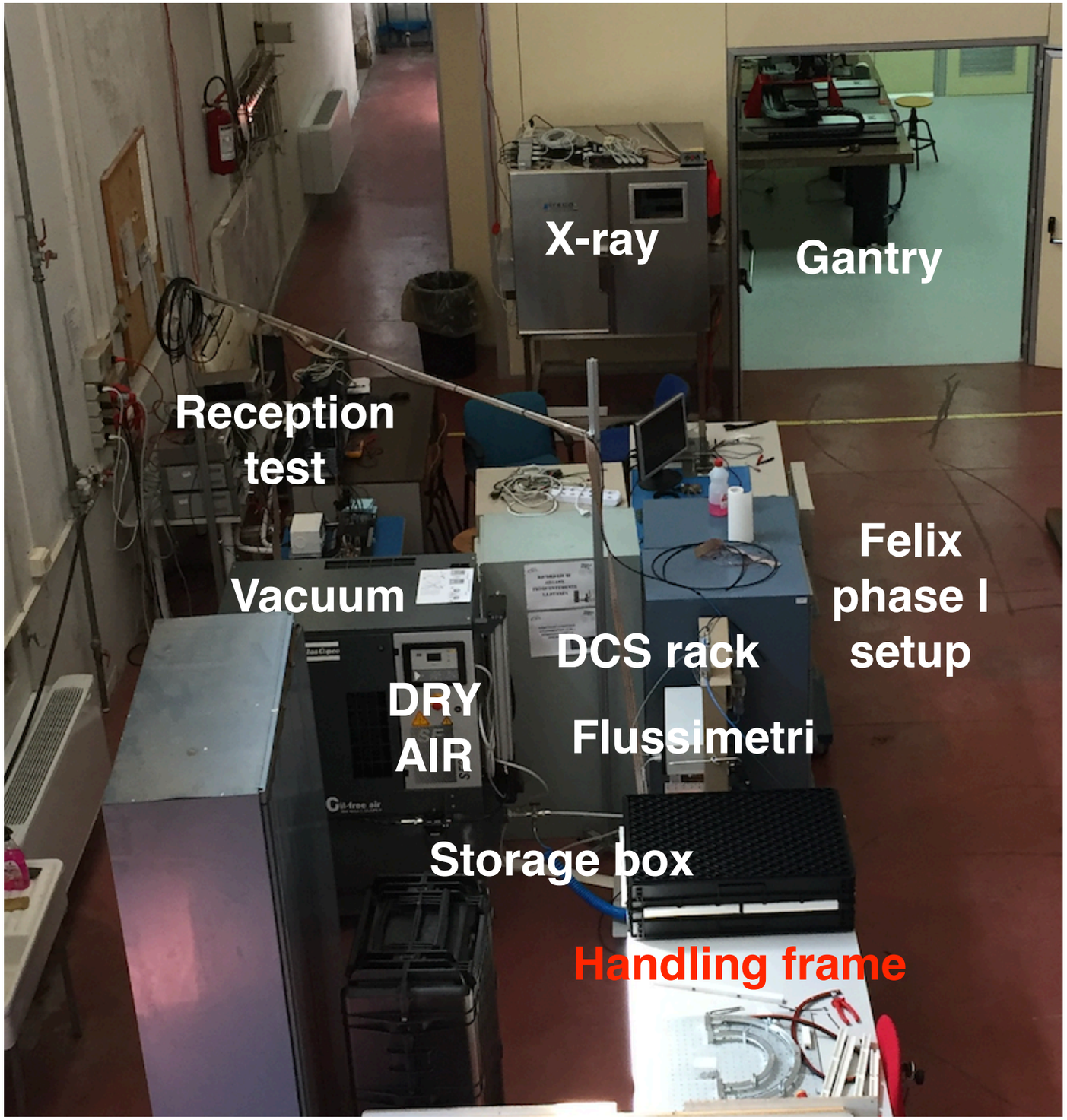
OPTO BOARD

Serial Powering / side



ITK LECCE ACTIVITY

ATLAS ITK INFRASTRUCTURE



Missing:

- MARTA: CO2 biphase cooling system
- Dry air cabinet
- …

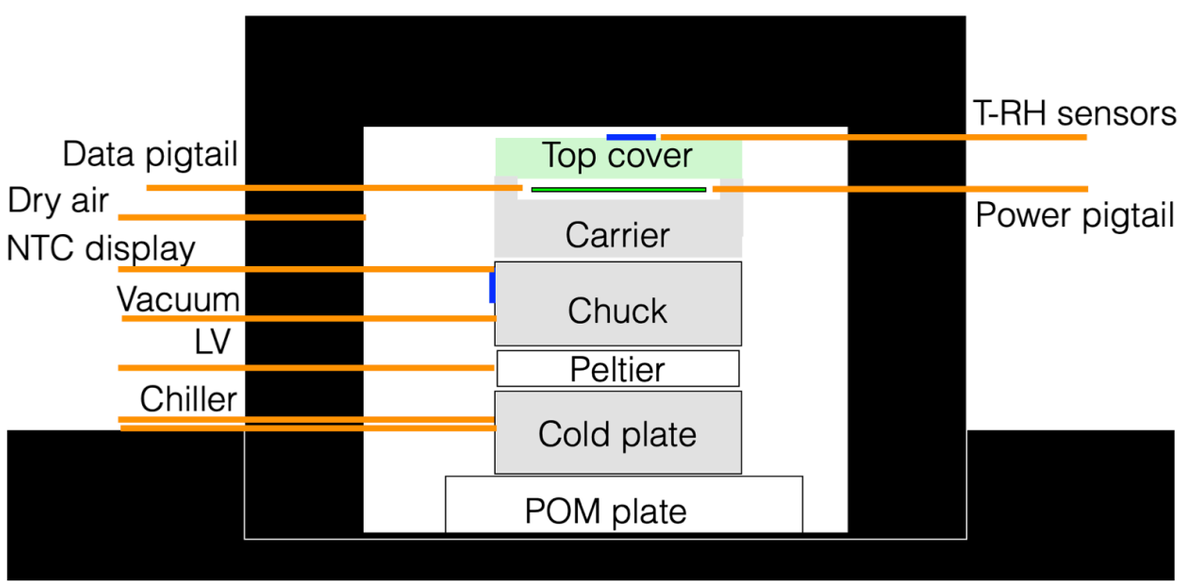
Passata qualificazione fase 1 come sito di ricezione e test dei quad-modules

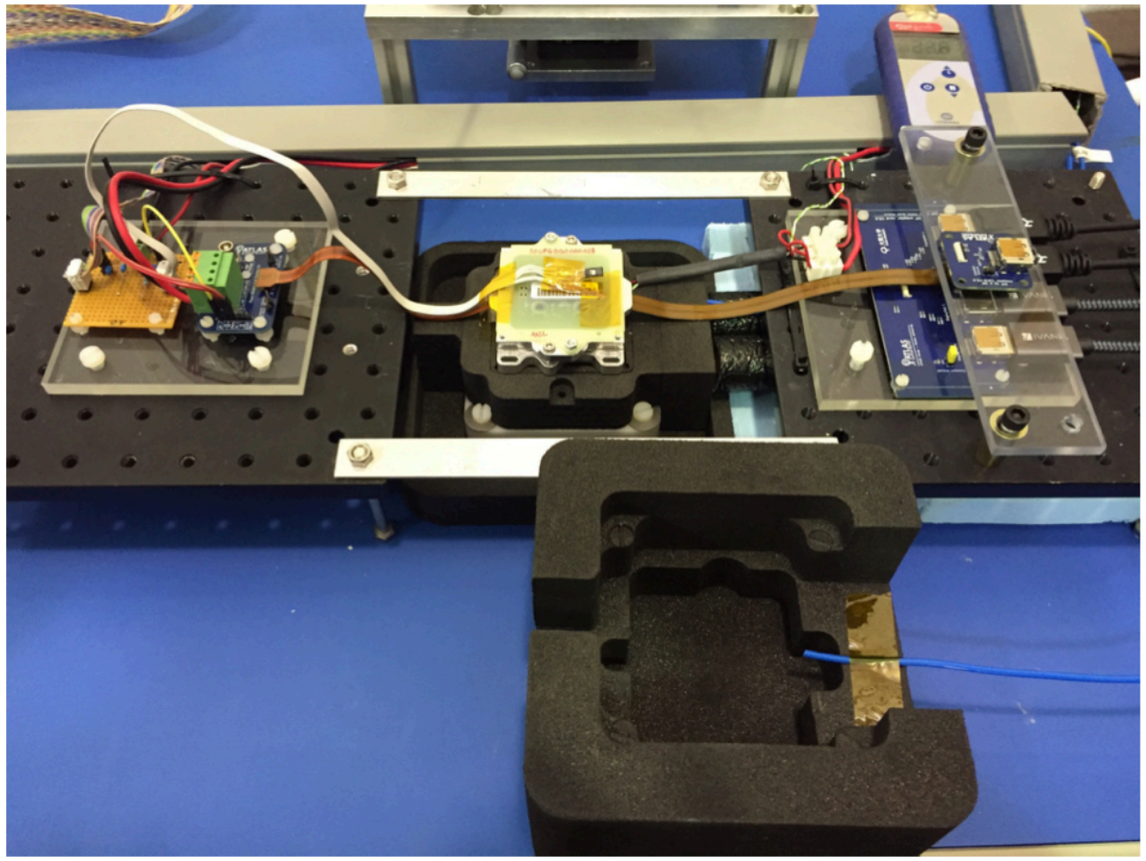
- DAQ: Felix Linux Server + YARR Software + YARR Firmware + Pileup Board (Bologna, equivalent to YARR board)+Ohio Card.
- DCS: Wincc software + glib opcserver (instrumentation) + elmb opcserver (enviromental sensors)
- DRY AIR: compressor/dryer + MKS + Flux controllers
- VACUUM
- WATER + PELTIER COOLING
- DATABASES: Local database (MONGO) and DCS database (INFLUX)

R. Assiro, G. Chiodini, M.R. Coluccia, M. Corradi, P. Creti, A. Innocente, A. Miccoli, A. Palazzo, C. Pinto, E. J. Schioppa, S. Spagnolo

MISSING: 1)INTERLOCK 2) FINAL GUI

Foam box and service layout sketch

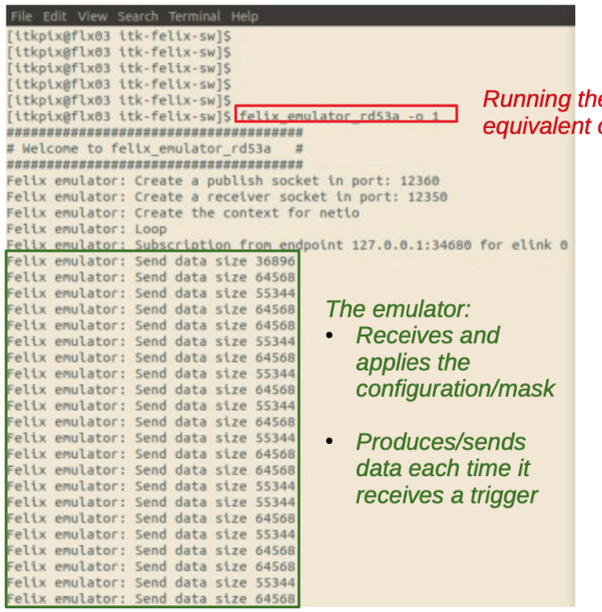




Certificazione di qualità half-ring

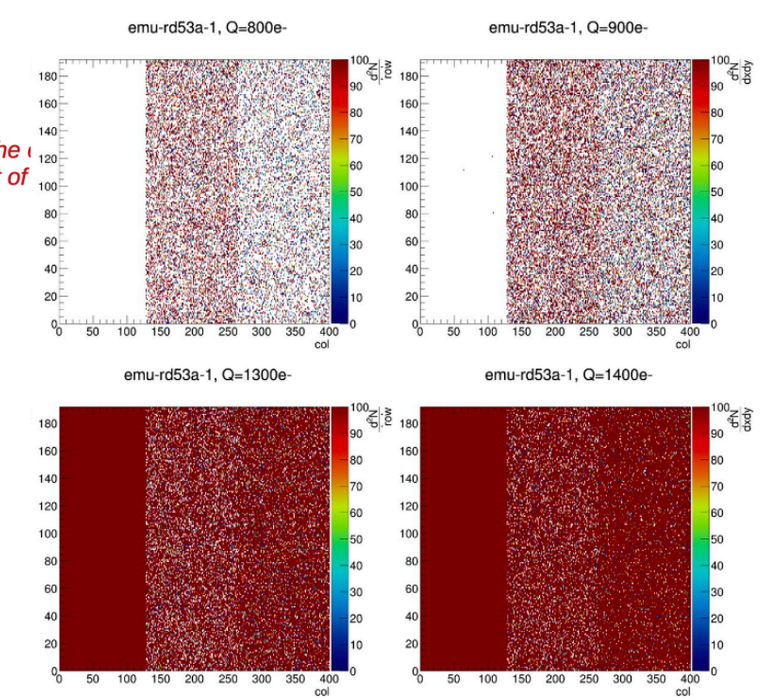
- Sistema di raffreddamento bifase a CO2 MARTA (300 W) acquistato ed in attesa di essere prodotto e consegnato dalla ditta polacca.
- DAQ HARDWARE: FELIX Phase I + VLDB+ + BOB Board
  NOT FINAL: replaced by OPTOBOARD when ready
- DAQ SOFTWARE: ITK DAQ Software
  (under development by
  A. Palazzo and E.J. Schioppa with CERN team)
  + ITK FELIX Phase I Firmware (under debugging)

Felix + quad-module emulator in ITK-DAQ SW



Running the equivalent of

The emulator:
- *Receives and applies the configuration/mask*
- *Produces/sends data each time it receives a trigger*



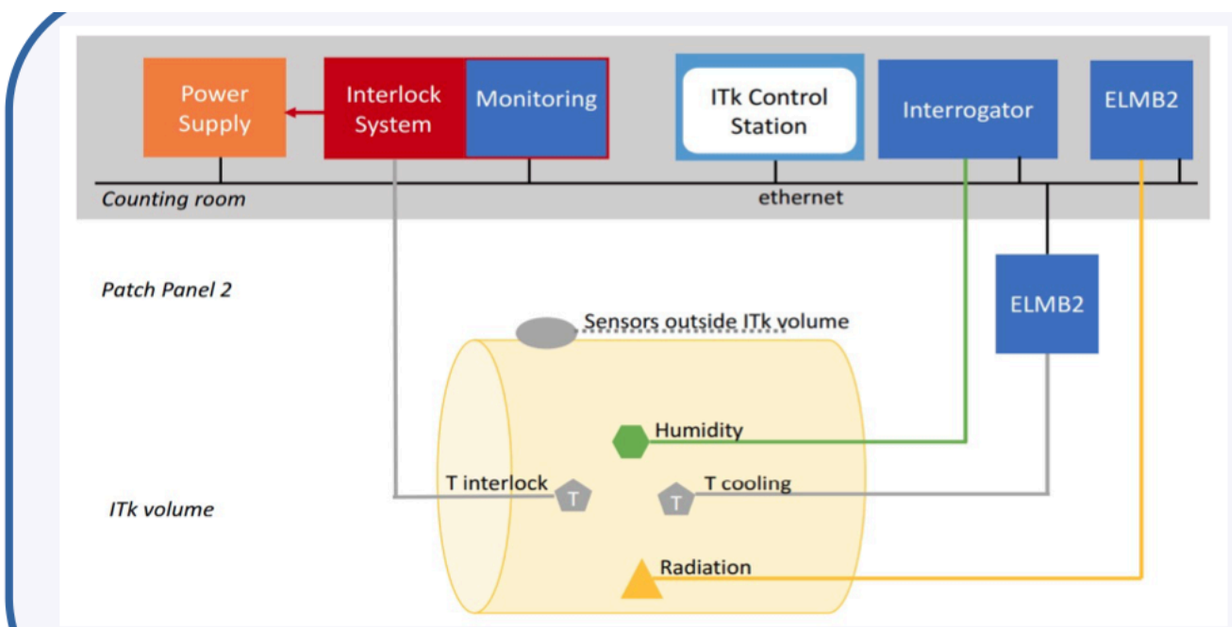
A. Palazzo ATLAS qualification task

UNIVERSITÀ DEL SALENTO

ATLAS EXPERIMENT

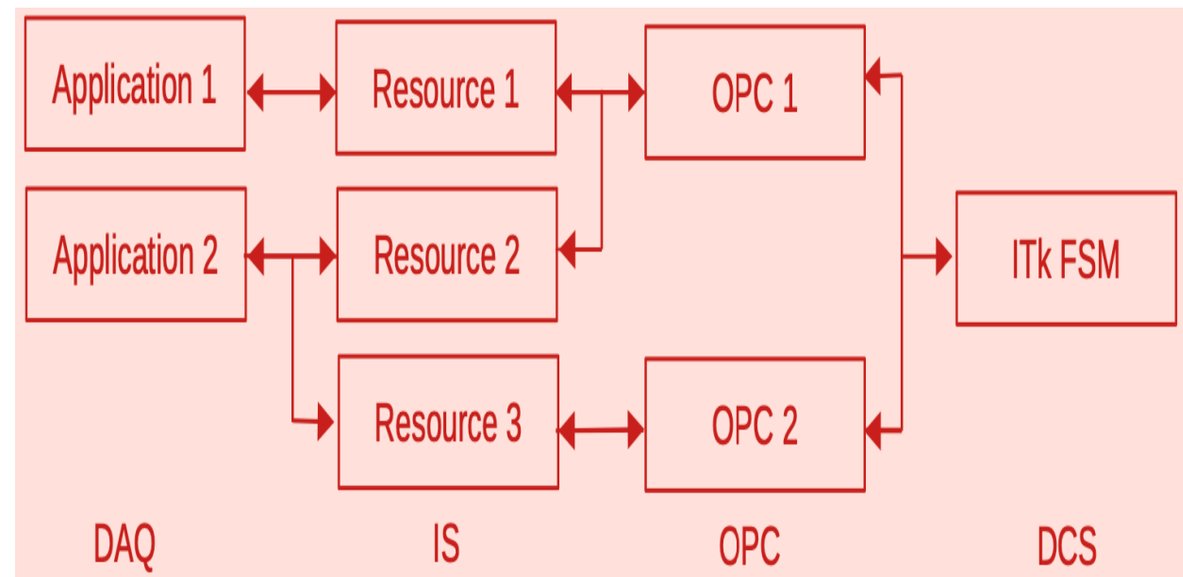
DEVELOPMENT OF DAQ TO DCS COMMUNICATION
IN THE ATLAS INNER TRACKER

Alessandra Palazzo
on behalf of the ATLAS ITk Collaboration



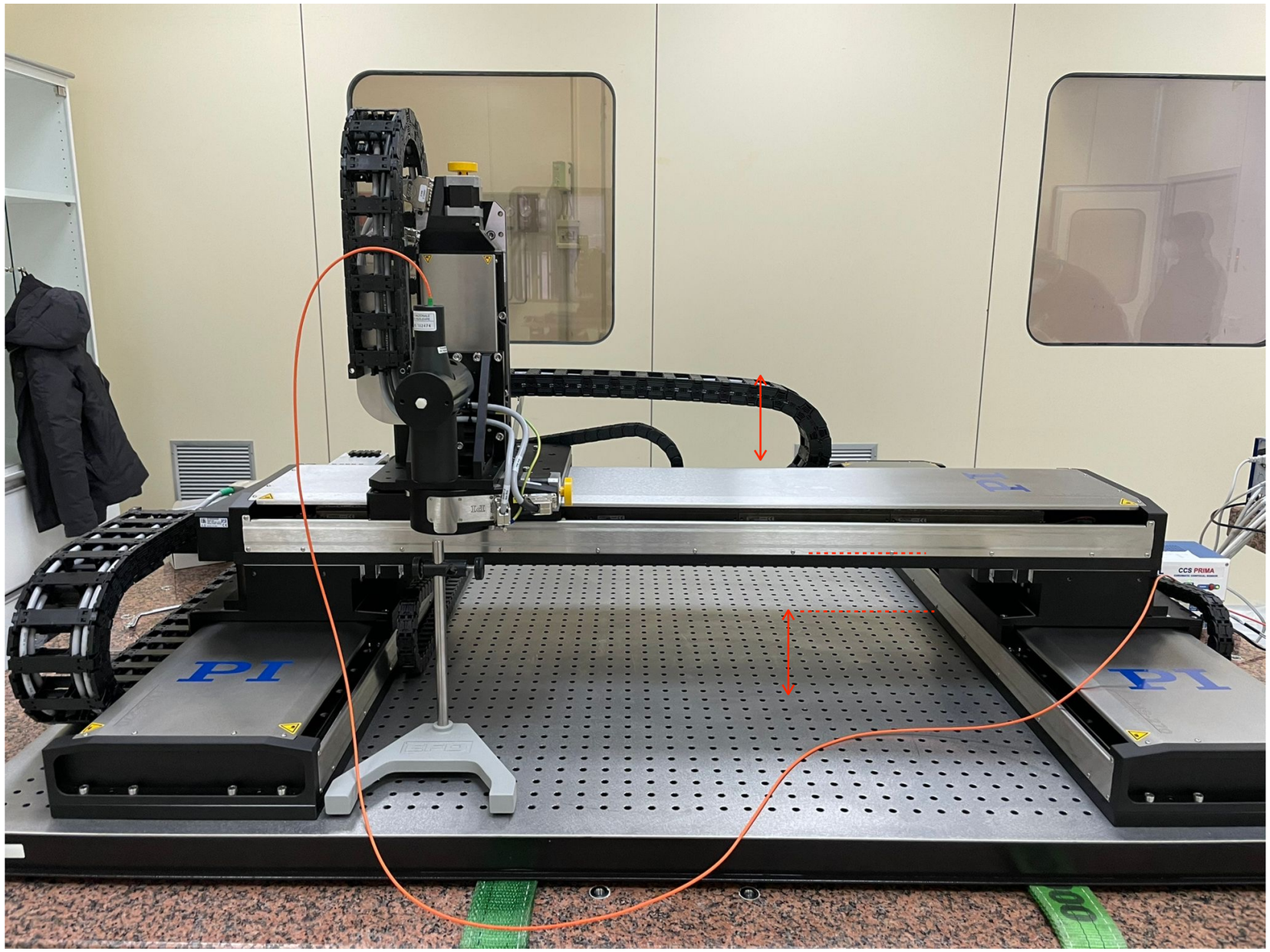
S. Kersten et al., "*The ITk Common monitoring and interlock system*", ICALEPS 2019

Development of ATLAS ITk DDC: Communication framework between DAQ and DCS



Lo stesso DDC verrà implementato anche nel sistema locale di certificazione di qualità degli half-ring.

Gantry in clean room (Feb 23, 2021)



- Gantry installed in clean room in Feb 23, 2021 (few days later also in Genova).
- Stress test failed after few weeks and I decide to send back Gantry to Germany.
- Lecce Gantry back from Germany last Friday.

Realizzati diverse tool di pick-up e metrologia mediate stamp 3D (**R. Assiro)**

Gantry commissioning (at least 4 months delay)

- **Gantry installed in clean room in Feb 23, 2021 (few days later also in Genova).**
- Calibration verification performed with microscope and z-profilometer.
- Stress test performed after few weeks in Lecce showed X-axis encoder errors. The same problem observed in Genova.
- PI could not understand the problems.
- **After few weeks I decide to send back Gantry to Germany. Impossible for Genova**.
- In the meantime the PI expert in Germany had a heart attach which delayed the debugging.
- PI experts in Germany found the problem on Lecce Gantry (weak encoder cables).
- One month to have the new encoder cables for Lecce and Genova.
- Lecce Gantry refurbished in Germany and Genova Gantry in situ from PI Italy expert.
- Full qualification in Germany and Genova took several weeks.
- **Lecce Gantry back from Germany last Friday.**

QC glue on Silicon after irradiation

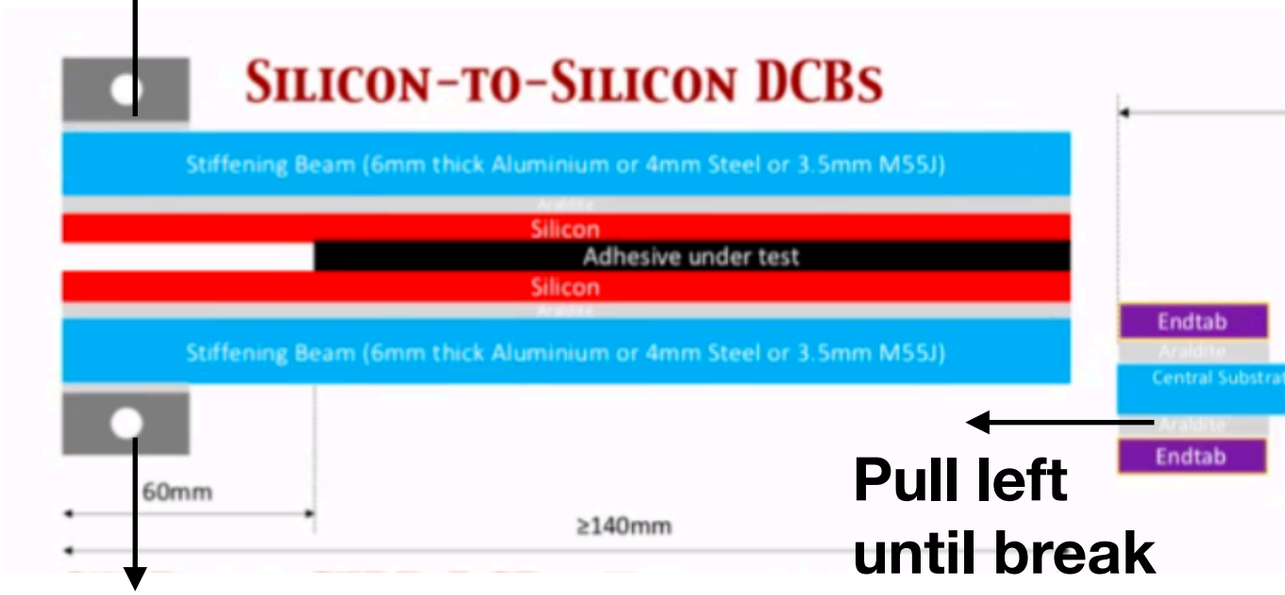
Chiodini,
M.R. Coluccia

DBC: Double Beam Cantilever

DLJ: Double Lap Joint

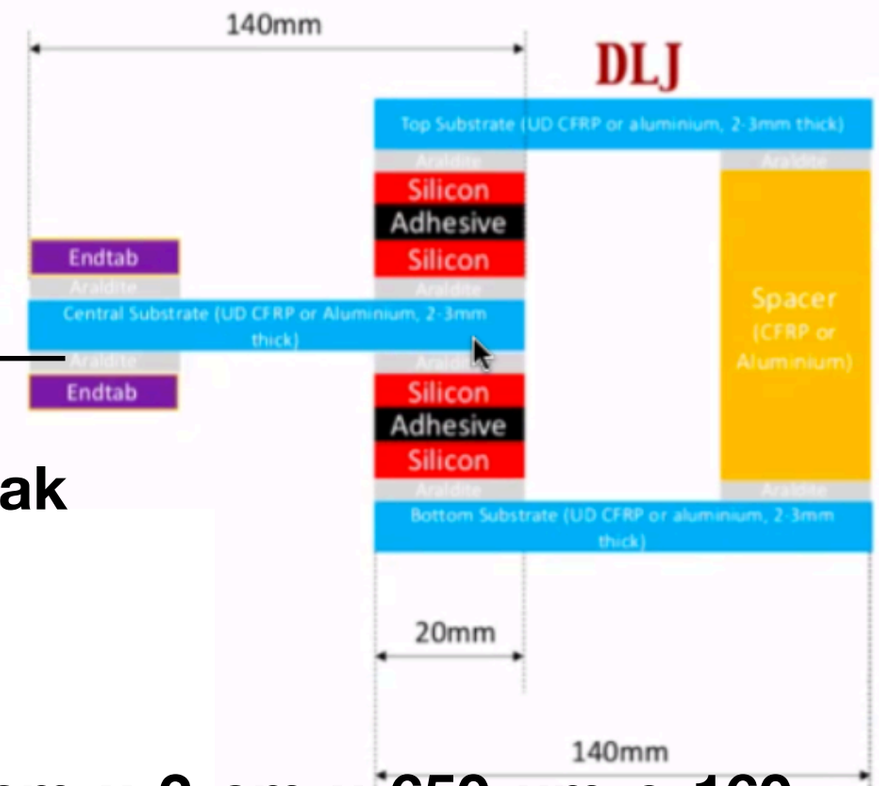
5 samples
X
4 glues
X
4 doses

Pull up



Pull down

Pull left until break

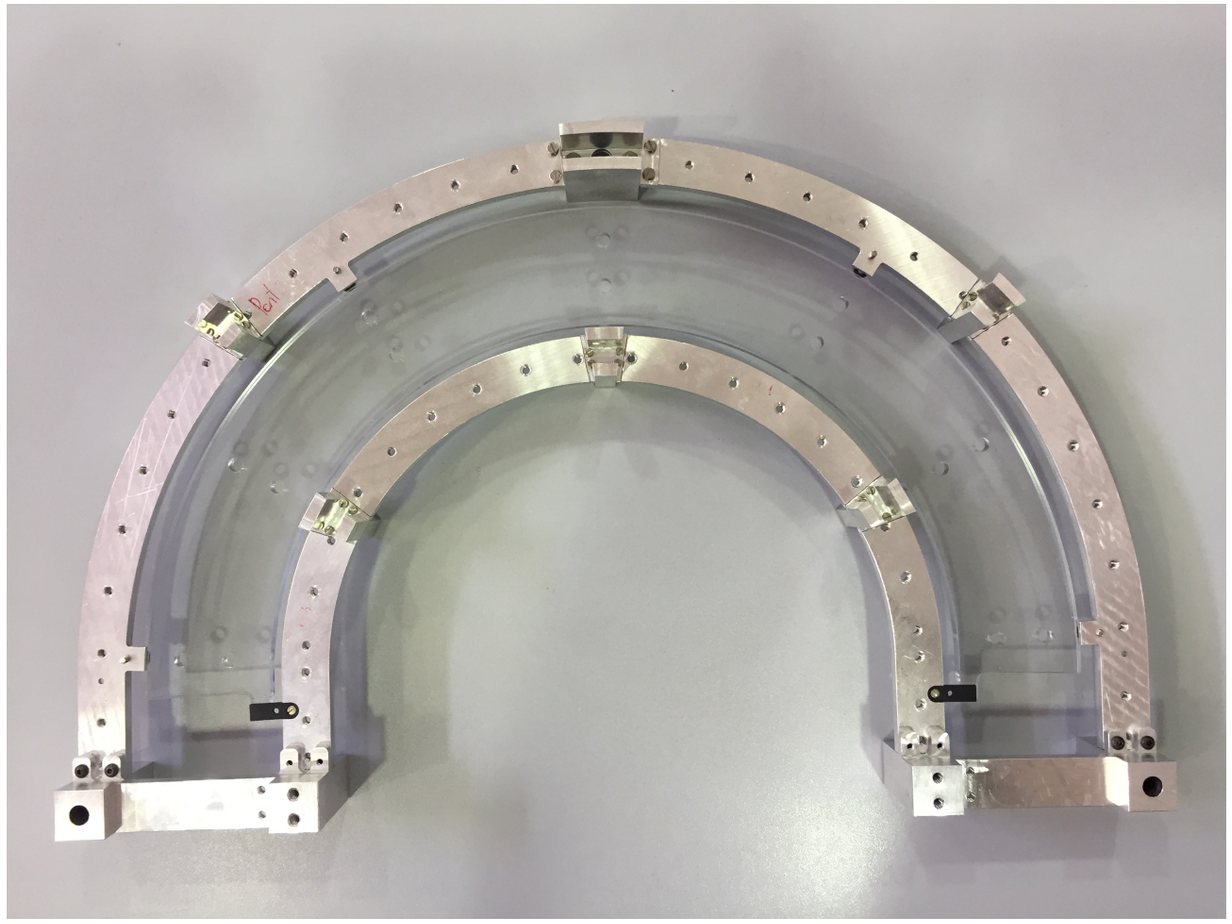


Spedite a Berkeley circa 320+spare silicon tiles 2 cm x 2 cm x 650 um e 160 + spare silicon tiles 2 cm x 13 cm x 650 um per realizzare 80 sandwich Si/colla/Si lunghi e 160 sandwich Si/colla/Si corti.
Identiche strutture saranno fatte rimpiazzando Silicio con Carbon Fiber per qualificare Glue on Carbon Fiber

Thanks to Prof.ssa Rinaldi and Prof. Maruccio to provide us the silicon clever machine.
Thanks to Dott. A. Della Torre to teach us how to use it.

Half ring handling frame

Il Gruppo ITK di Lecce è responsible Italiano della realizzazione degli handling frame



A. Miccoli

Three inner handling frame realised in Lecce and sent to Genova and RAL for loading site qualification.

There are 56 x 2 + 10% spare = 124 handling frame

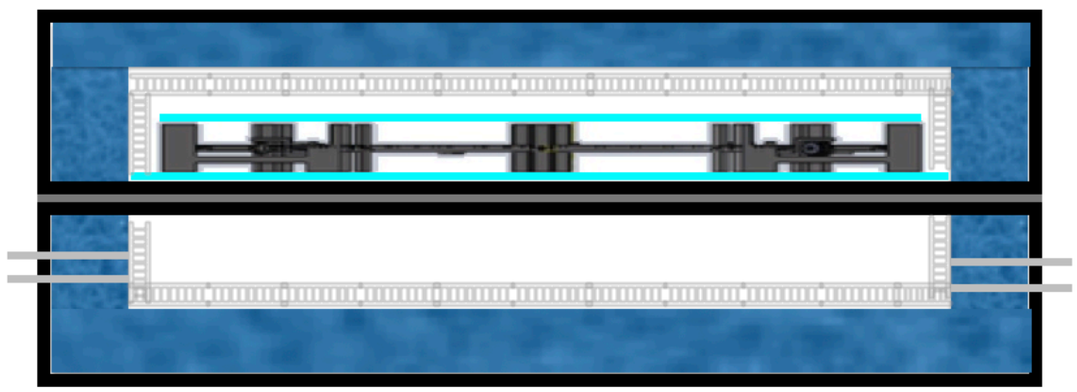
ITK Lecce would like to realise a large part of them: impact on mechanics and workshop numerical control machines.

Storage box for half-ring

Il Gruppo ITK di Lecce è responsible della realizzazione della box di storage per tutu ITK.

We propose to use the storage box for testing, transport and integration.

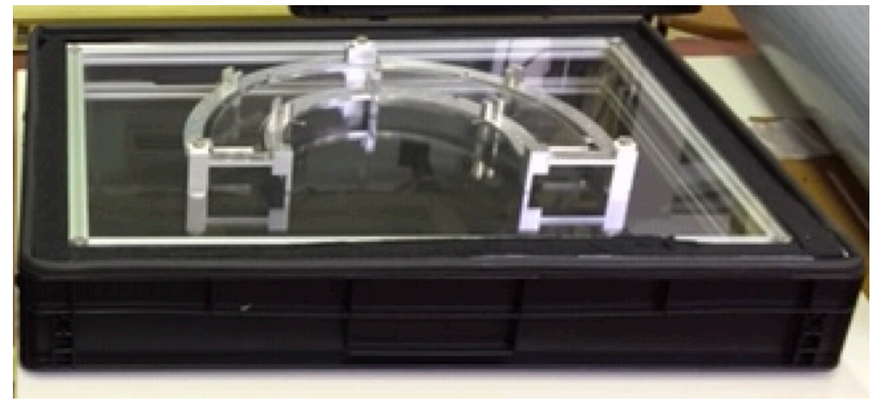
Top cover ESD box
Top foam
Bosh frame
Top cover ESD acrylic
Gasket



Outlets:
-dry air
-CO2

Gasket
Bosh frame
Bottom cover ESD acrylic
Bottom foam
Bottom cover ESD box

Inlets:
-dry air
-CO2



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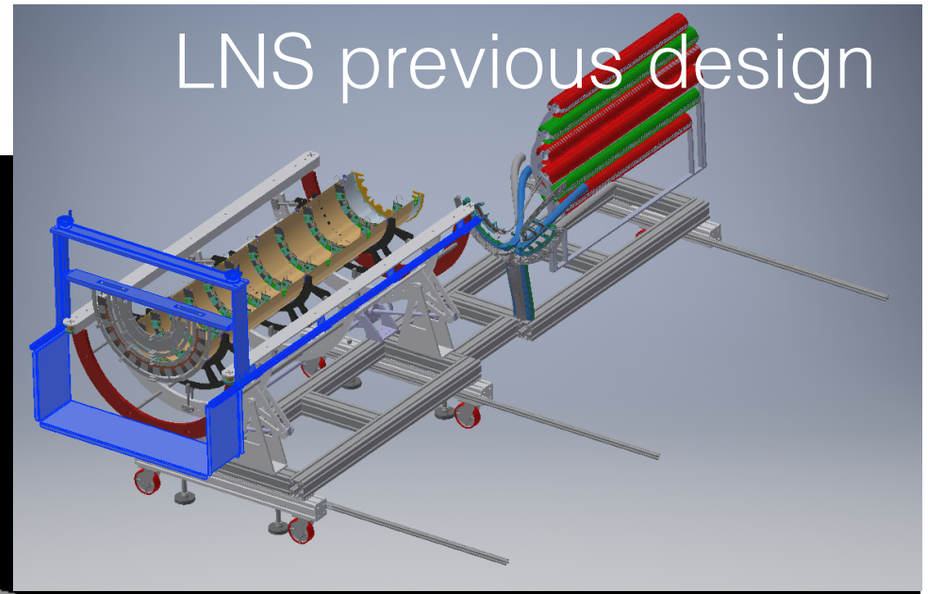
Ready full demonstrator with T/RH/3g usb dataloggers to be sent to Manchester

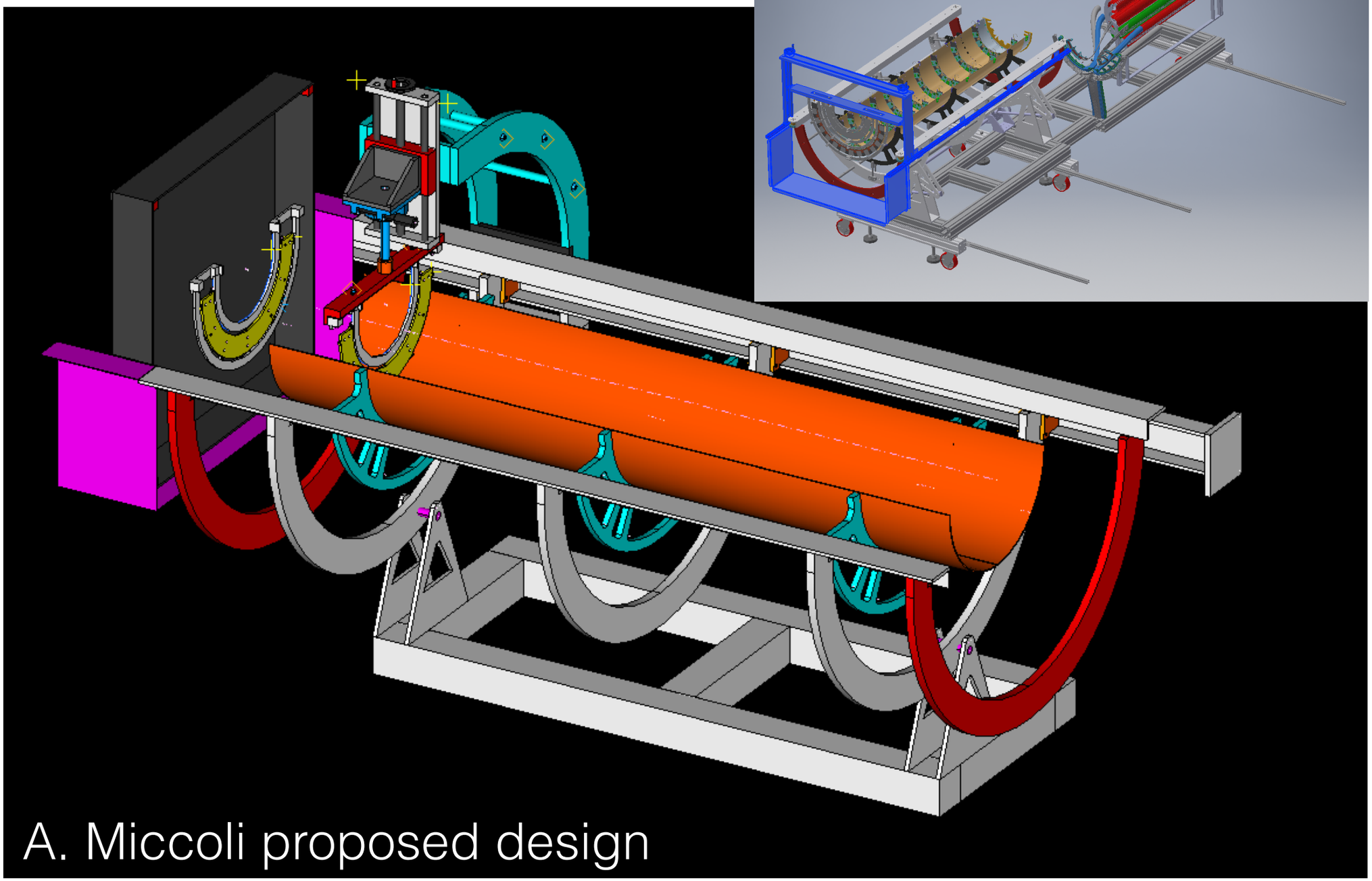
There are 56 x 2 + 10% spare = 124 storage box

ITK Lecce would like to realise a large part of them: impact on mechanics but not need workshop numerical control machines.

Half-ring integration in half-shell

Il Gruppo ITK di Lecce è responsible della realizzazione del tool di integration degli half-ring negli half-shell che avverrà a Frascati.





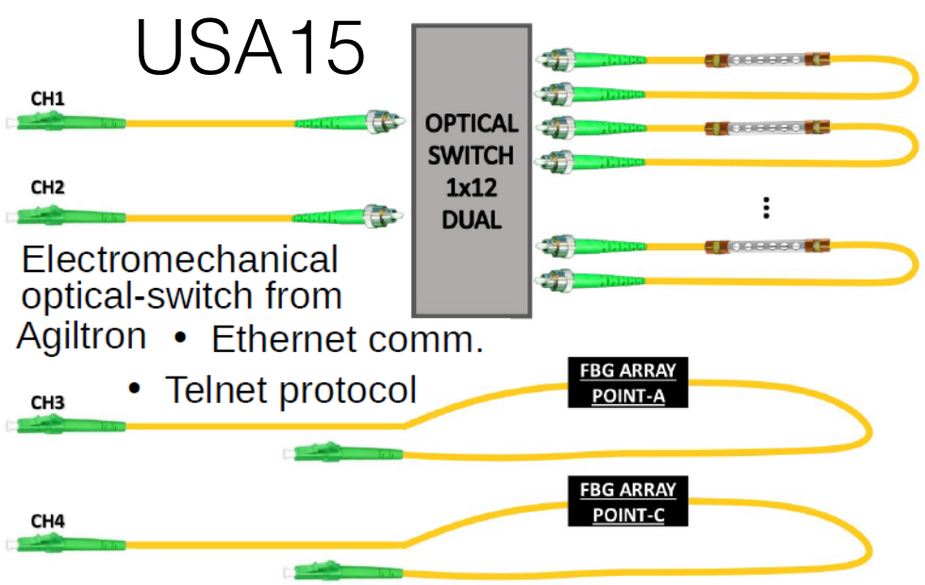
- From two linear lateral guides to one linear lateral guide.
- From crane to single arm
- From z motion to additional x and theta motion
- Basket for storage box

Fibre Optics Sensors (FOS)

Enrico Junior Schioppa è parte del gruppo CERN FOS che sviluppa sensori di umidità ultraresistenti alle radiazioni per experiment a HL-LHC.

FOS = reticolo ottico fabbricato in una fibra ottica con tecniche di laser writing
Bare: sensibili a T e Strain. Coated sensibli a RH.
FBG = Fibre Bragg Grating = grating period submicron (10% accuracy)
LPG = Long Period Grating = grating period from 100 μm to 1 mm (1% accuracy).

Hyperion interrogator from MicronOptics:
- 4 channels readout
- 1pm sensitivity
- Ethernet comm.
- C++ API



- FOS installate in ATLAS ID
- Presa Dati da Novembre 2020
- Integrazione in DCS ATLAS con opcserver e Final State Machine (FSM)
- 30 pagine di NIM sottomesso a Marzo.

Demonstrated the feasibility of sensors multiplexing using an external opto-mechanical unit.

ANAGRAFICA ATLAS ITK LECCE 2022

Attuale

SEZIONE	NOME COGNOME	TIPO	CONTRATTO	QUALIFICA	RICERCATORI		TECNOLOGI		TOT. PERS.	FTE	FTE / PERS.
LE	Chiodini Gabriele				x					70	
	Coluccia Maria Rita						x			20	
	Creti Pietro						x			40	
	Palazzo Alessandra				x					50	
	Schioppa Enrico Junior				x					50	
	Spagnolo Stefania				x					60 → 70	
LE					2.3 fte	4 pers.	0.6 fte	2 pers.	6	2.9	0.483

Proposta 2022: **3 FTE** in Anagrafica (solo RIC e TECN.)

		2018	2019	2020	2021	2022	2023	2024	2025	2026	TOT	Task
LE												
Gabriele Chiodini	RI-INFN	0.5	0.5	1.0	1.0	1.0	1.0	1.0	1.0	1.0	8.0	2.1.5
Stefania Spagnolo	PA	0.5	0.5	1.0	1.0	1.0	1.0	1.0	1.0	1.0	8.0	2.1.5
Pietro Creti	Te.go ele. INFN	0.2	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	4.2	2.1.5
Roberto Assiro	Tec ele. INFN	0.3	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	4.3	2.1.5
Alessandro Miccoli	Tec mec. INFN	0.1	0.3	0.5	0.5	0.5	0.5	0.5	0.5	0.5	3.9	2.1.5
Giuseppe Fiore	Tec mec. INFN	0.1	0.2	0.5	0.3	0.0	0.0	0.0	0.0	0.0	1.1	2.1.5
Angelo Innocente	Tec mec. INFN	0.1	0.2	0.5	0.2	0.0	0.0	0.0	0.0	0.0	1.0	2.1.5
DOE (nuova richiesta a carico INFN)	Ing mec.	0.0	0.0	0.0	0.2	0.5	0.5	0.5	0.5	0.5	2.7	2.1.5
DOE (nuova richiesta a carico INFN)	Pos Doc.	0.0	0.0	0.0	0.3	0.5	0.5	0.5	0.5	0.5	2.8	2.1.5
											36.0	

In linea con il Piano presentato ai REFEREE nel 2018

ASSEGNO DI RICERCA ATLAS ITK LECCE

Link: https://www1.unisalento.it/bandi-concorsi/-/bandi/view/65665820

Titolo: “Costruzione e certificazione dei rivelatori a pixel per l’upgrade di ATLAS per il run di alta luminosita’ di LHC”

Responsabile Scientifico: Prof.ssa Stefania Spagnolo

Scadenza: 19-07-2021

RICHIESTE 2022: INFRA e PRE-PROTO

- INFRASTRUTTURA 11000 euro
  - Microscopio per visual inspection quad-module. Richiesto dal QC di ricezione moduli pixel e di certificazione half-ring
    4500 euro
  - Machine Calibration Plate - 60 cm x 70 cm. Necessario per cross-check/ calibrazione periodica Gantry.
    5500 euro
  - Ricondizionamentro flussimetri da SF6 a Aria Secca. 1000 euro

- PRE-PROTOTIPO 5500 euro
  - Componentistica per finalizzazione prototipo struttura di integrazione Half-Ring su Half-Shell (responsabilità di Lecce)
    2000 euro
  - Materiale per camera pulita: copri piedi ESD, guanti ESD copritesta ESD, grembiuli ESD, contenitori ESD 1000 euro
  - Manutenzione annuale camera pulita classe 10000 2500 euro

NB: anticipabili al 2021

RICHIESTE 2022: CORE

- CORE 14500 euro
  - 240 quad-moduli dummy di Silicio 4.1 cm x 4.2cm tagliati da FBK (per LE e GE). 3500 euro
  - Versione finale head Gantry. 2000 euro
  - Componentistica per installazione sistema di Cooling a CO_2 MARTA. 1000 euro
  - Gas CO_2 per sistema di Cooling a CO_2 MARTA. 1000 euro
  - Mescolatore planetario e di degasing della colla. 5000 euro
  - Trasporti 2000.euro