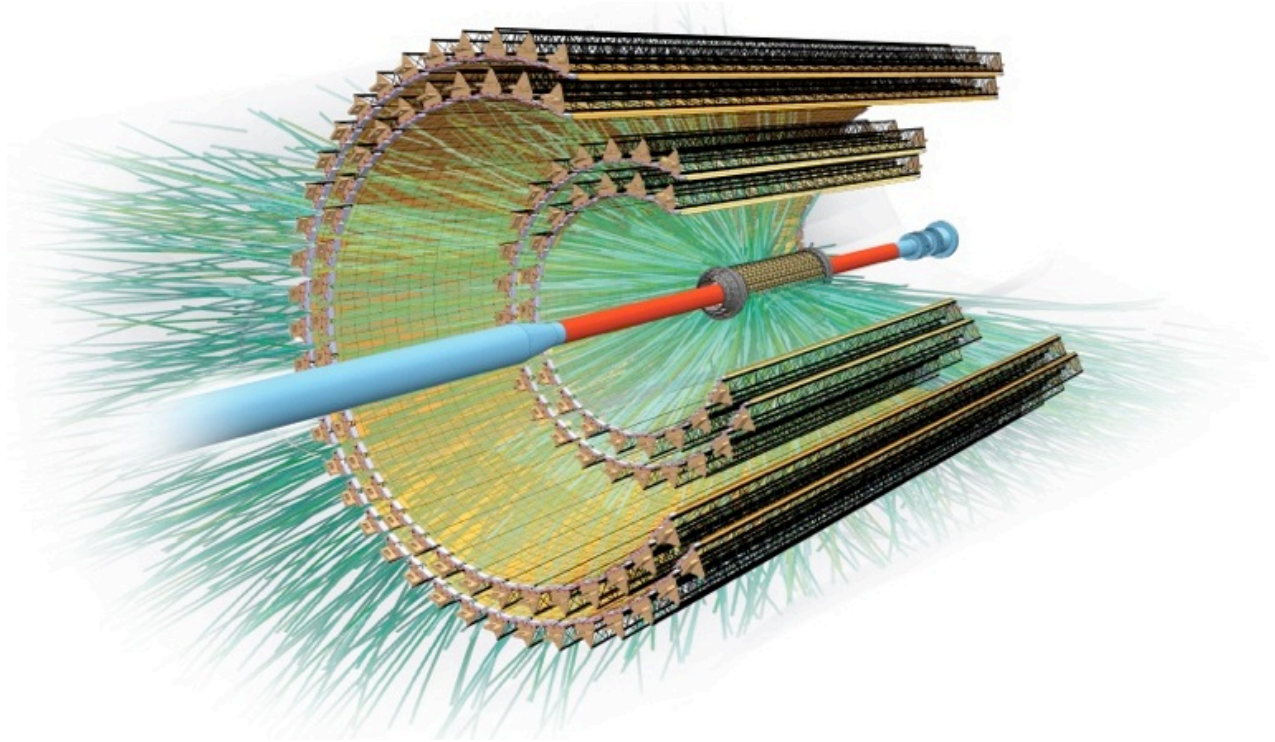
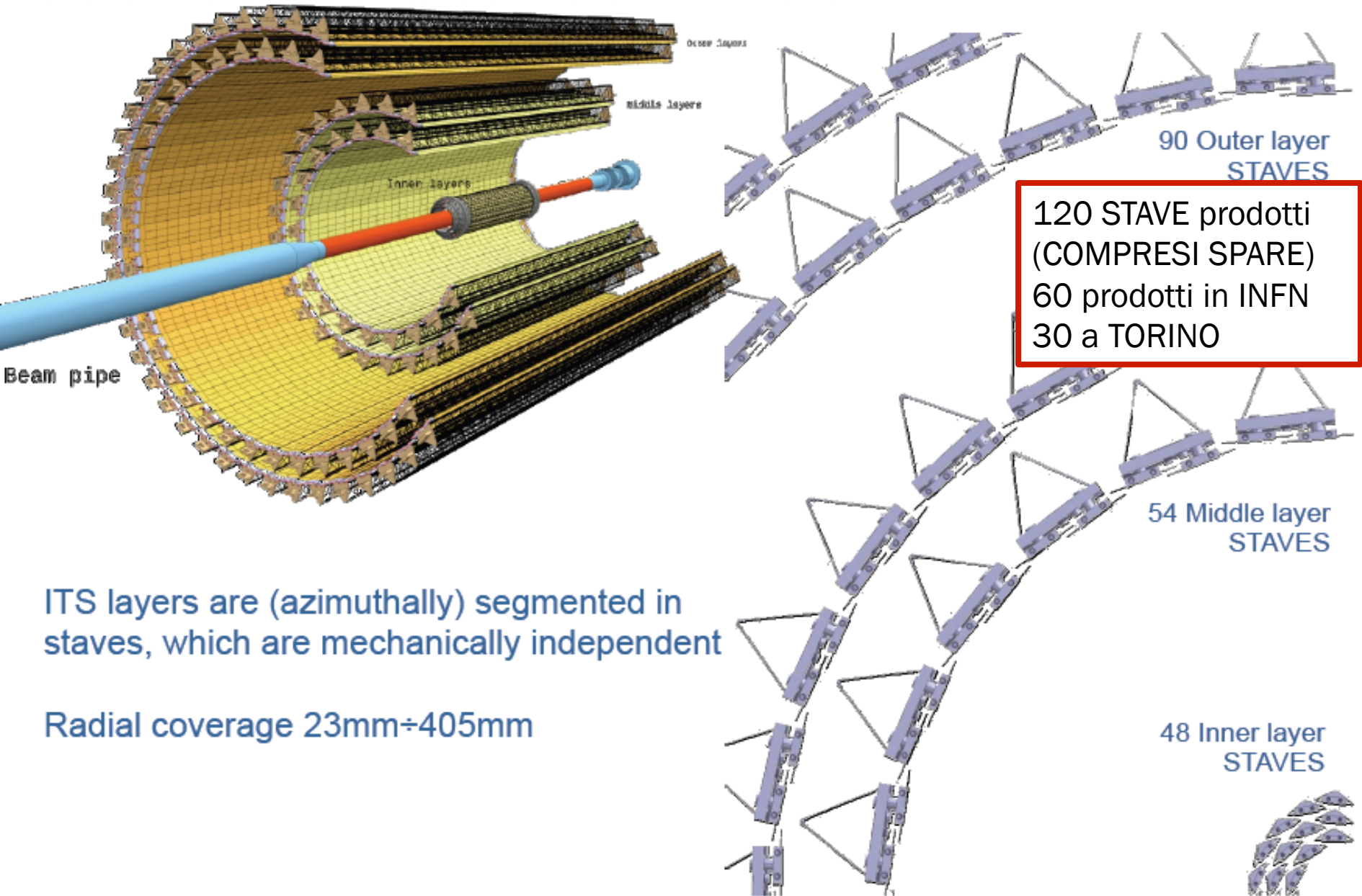


ALICE ITS UPGRADE: STATUS REPORT ATTIVITÀ 2016 E RICHIESTE 2017



S. Beolè per il gruppo ALICE ITS Upgrade

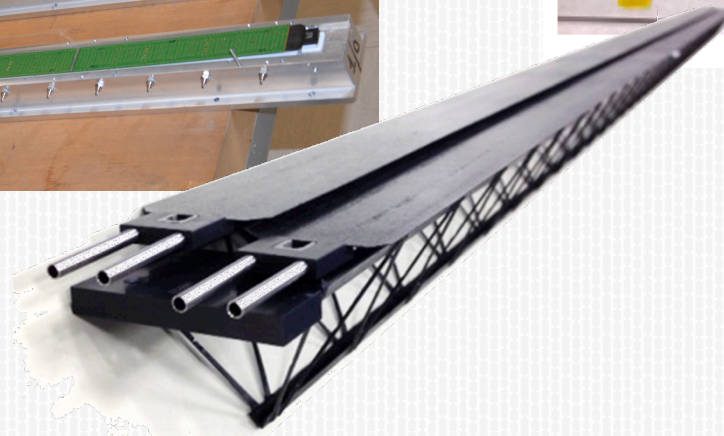
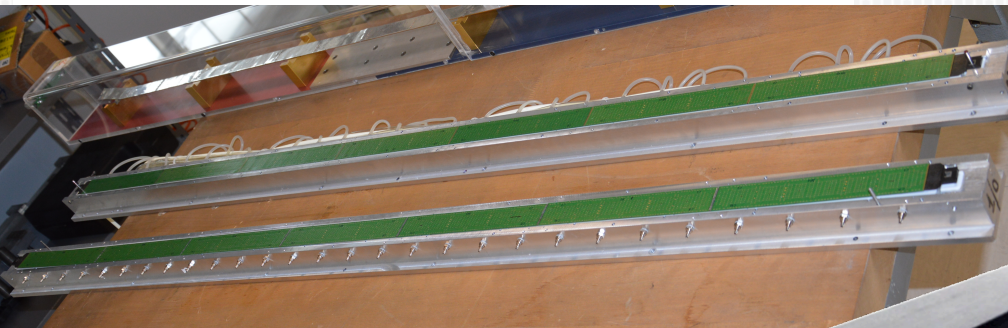
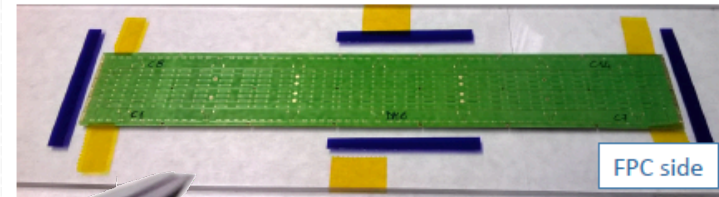
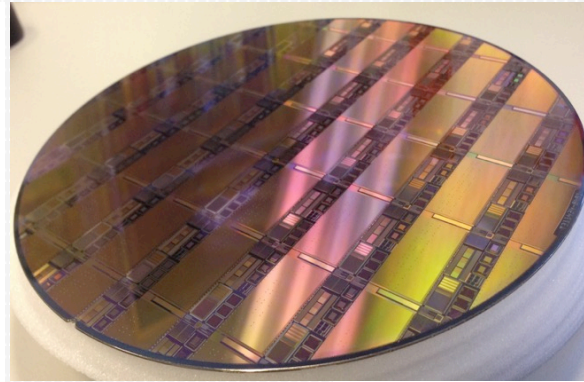
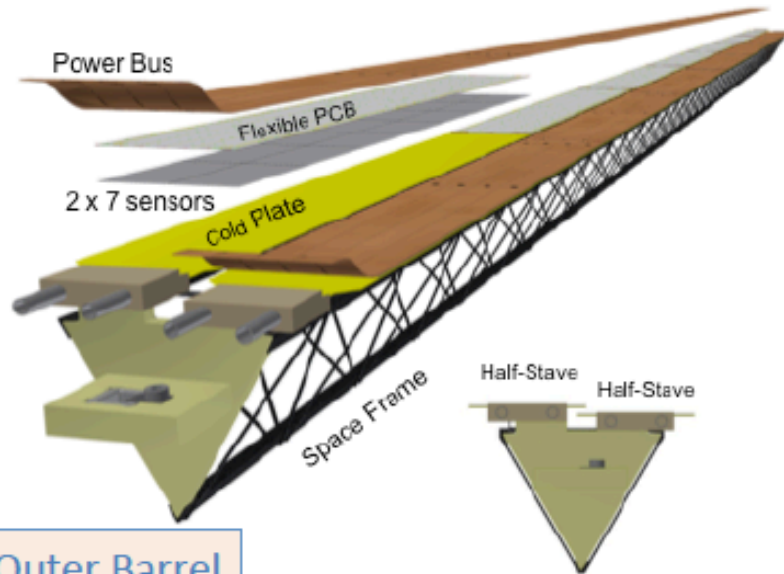
STRUTTURA DEL NUOVO ITS



ITS layers are (azimuthally) segmented in staves, which are mechanically independent

Radial coverage $23\text{mm} \div 405\text{mm}$

OUTER BARREL STRUCTURE



MILESTONES DEL PROGETTO

- × OTT 2015: EDR PIXEL CHIP
- × APR 2016: sottomissione della versione finale ALPIDE
- × **MAG 2016: EDR MODULE-STAVE**
- × NOV 2016: PRODUCTION READINESS REVIEW MODULE-STAVE

STAVE/MODULE EDR COMMITTEE REPORT

ALICE ITS Stave Engineering Design Review

May 3-4, 2016

Introduction:

The Committee wishes to congratulate the ITS project team on the high quality of the material presented, which demonstrated the exceptionally good progress made with design of components for this ambitious upgrade. Several important issues have been addressed and were presented: from ALPIDE design towards the production version, the designs of FPCs, mechanics and cooling for staves and the overall assembly and testing of HIC and staves for IB and OB. Several issues have been identified and overcome (eg connection FPC to chip, ALPIDE functionality in the system). The component designs, assembly setups and initial results on early HIC prototypes and staves look generally convincing and there are strong and experienced teams involved. It is clearly understood that the next months are critical to obtain decisive test results on more prototypes for production readiness, but the Committee did not identify any show-stoppers at this point. More detailed remarks and recommendations follow.

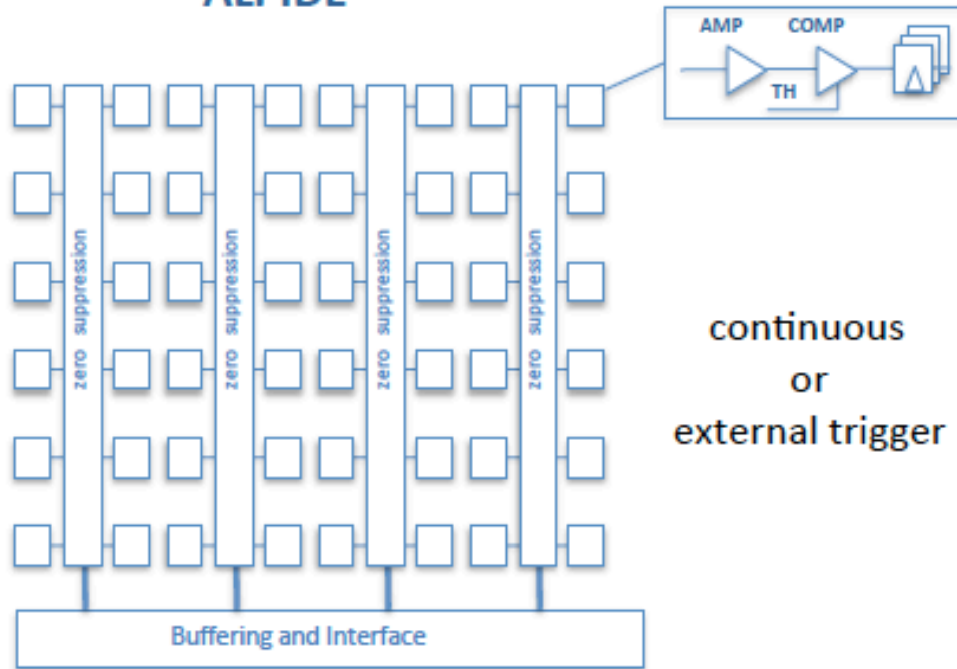
SENSORE: PIXEL CHIP

TORINO:

- progettazione DTU (G.Mazza, A. Lattuca): PLL e LVDS Driver

ALICE

ALPIDE



Architecture

- ▶ In-pixel amplification
- ▶ In-pixel discrimination
- ▶ In-pixel (multi-) hit buffer
- ▶ In-matrix sparsification

Key Features

- ◉ 28 μm x 28 mm pixel pitch
- ◉ Continuously active, ultra-low power front-end (40nW/pixel)
- ◉ No clock propagation to the matrix $\rightarrow$ ultra-low power matrix readout (2mW whole chip)
- ◉ Global shutter (<2 μs): triggered acquisition or continuous

ALPIDE Development

A Large Ion Collider Experiment

2012

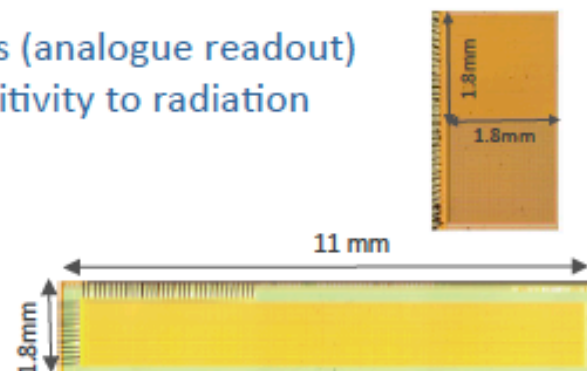
Explorer

- $20\mu\text{m} \times 20\mu\text{m}$ and $30\mu\text{m} \times 30\mu\text{m}$ pixels (analogue readout)
- pixel geometry, starting material, sensitivity to radiation

2013

pALPIDEss-0

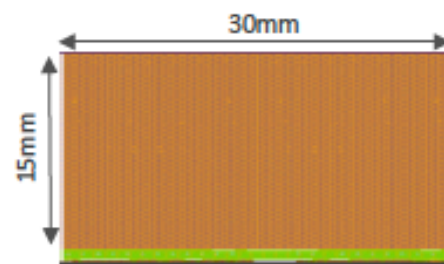
- Matrix with 64 columns x 512 rows
- $22\mu\text{m} \times 22\mu\text{m}$ pixels
- (in-pixel discrimination and buffering)
- zero suppression within pixel matrix



May-2014

pALPIDE-1

- **Full-scale prototype: 1024×512**
- 4 sectors with different pixels
- pixel pitch: $28\mu\text{m} \times 28\mu\text{m}$
- 1 register/pixel, no final interface



May-2015

pALPIDE-2

- Optimization of several circuit blocks
- final interface: allows integration into ITS modules
- NO high-speed output link (1.2 Gbit/sec replaced by a 40Mb/s)

Oct-2015

pALPIDE-3

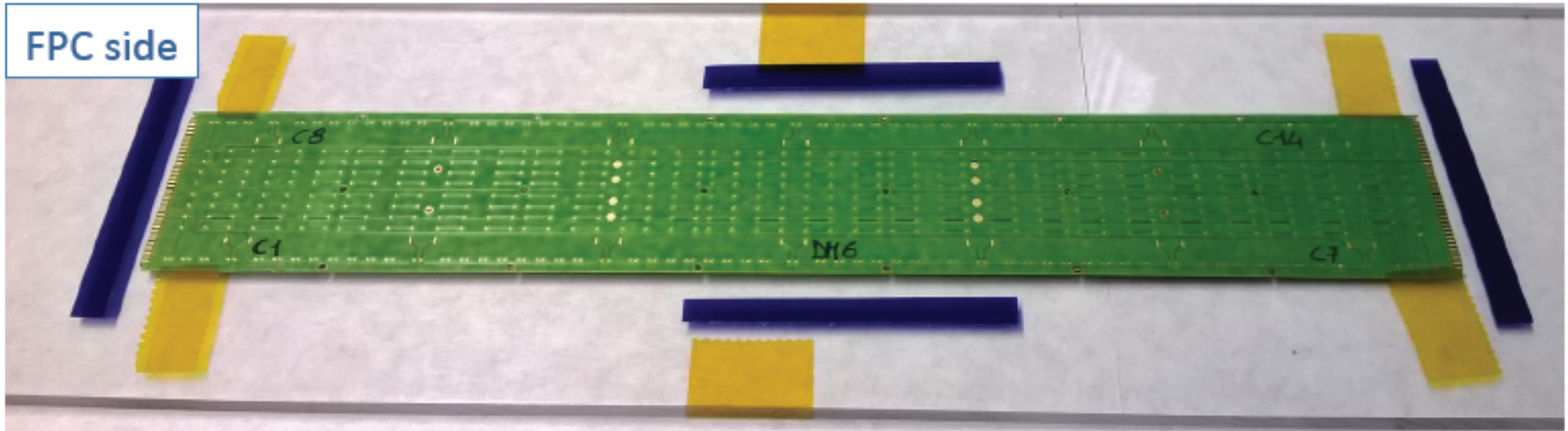
- 8 sectors with different pixel variants, 3 registers / pixel
- Final interfaces, more features including 1.2 Gbit/s output serial link
- Some optimization for yield improvement

Aug - 2016

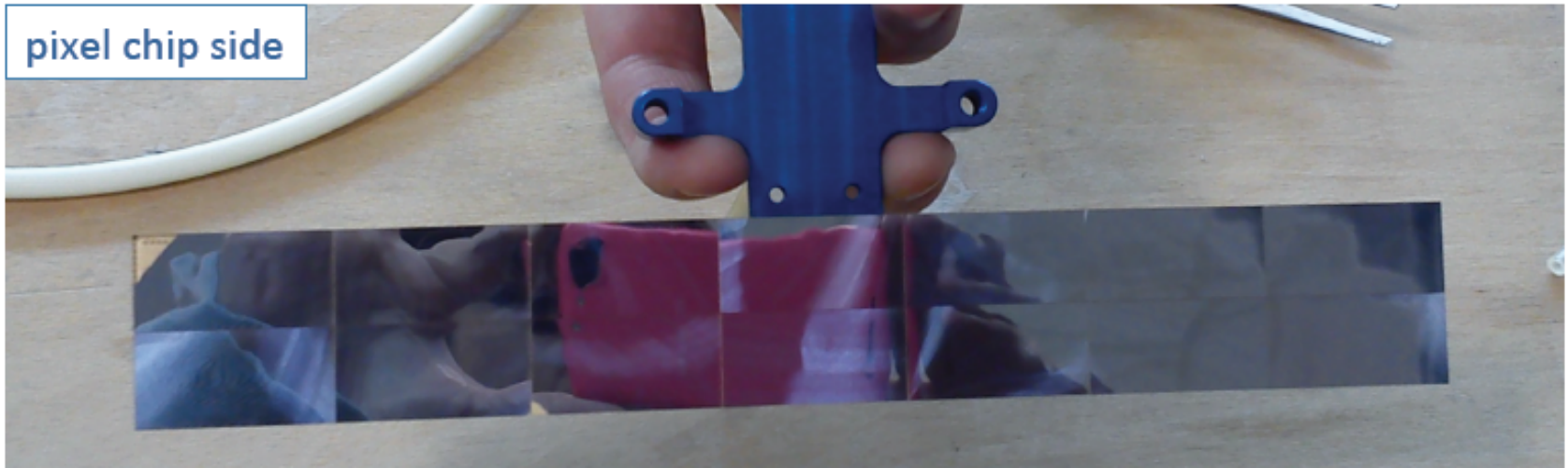
ALPIDE - Final Version

HIC: Interconnection of pixel chip on flexible printed circuit (FPC)

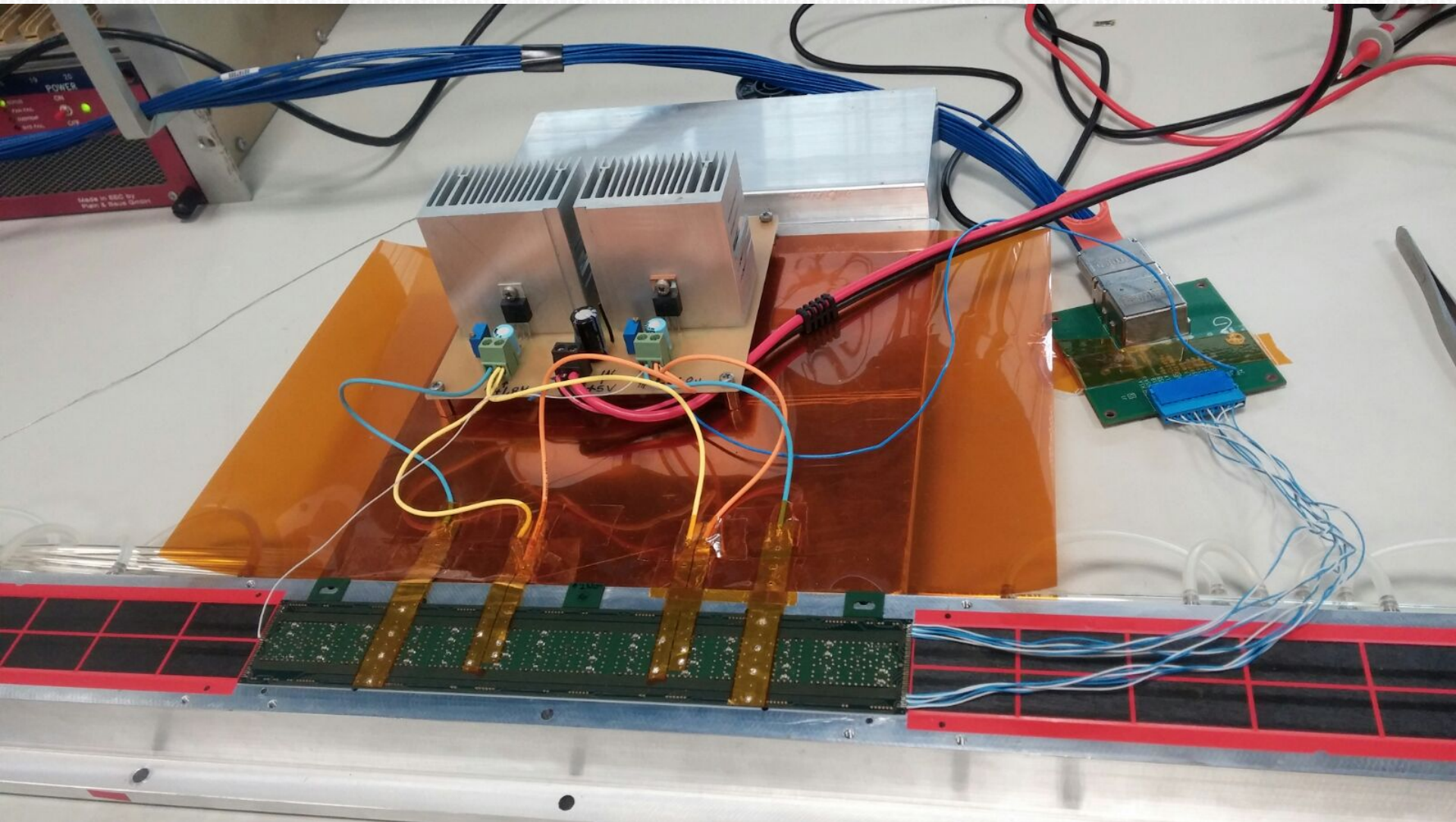
FPC side



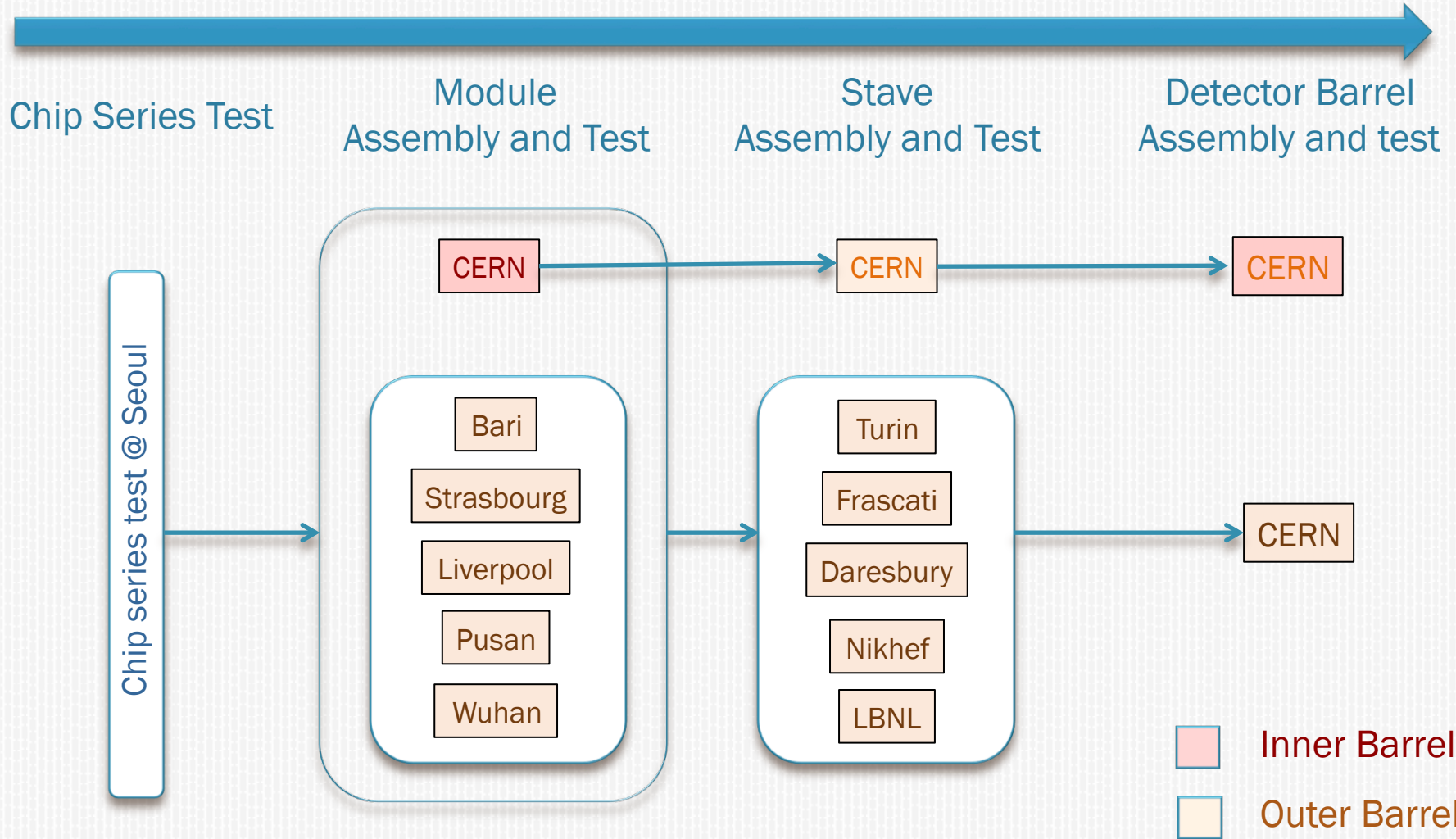
pixel chip side

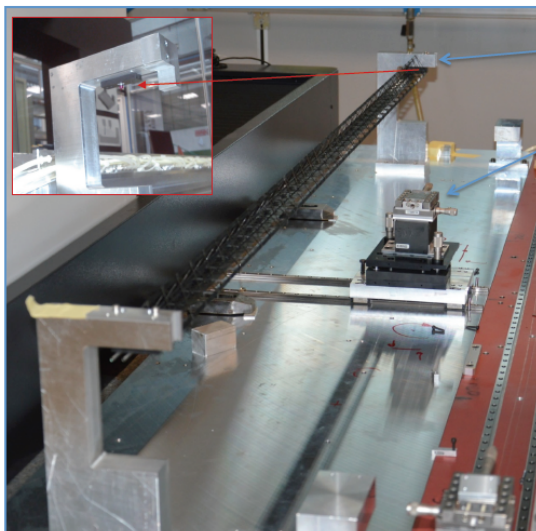


PRIMO MODULO FUNZIONANTE MONTATO SU COLD PLATE



Module and Stave Production Flow Chart

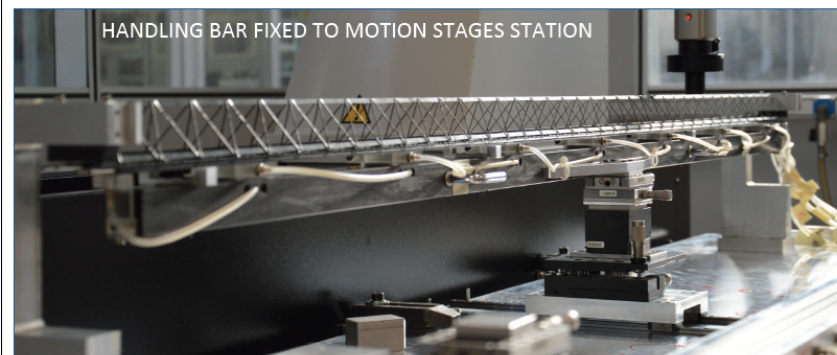
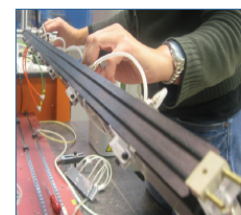


**ASSEMBLY JIG**

1. SPACE FRAME SUPPORT equipped with ruby spheres for reference system definition
2. MOTION STAGES STATION + RAILS to align HS and place it under the space frame
3. HS HANDLING BAR
 - lift-up and rotate the HS
 - place HS on to the motion stages station



Jig components are aligned, assembled and verified using Mitutoyo CMM



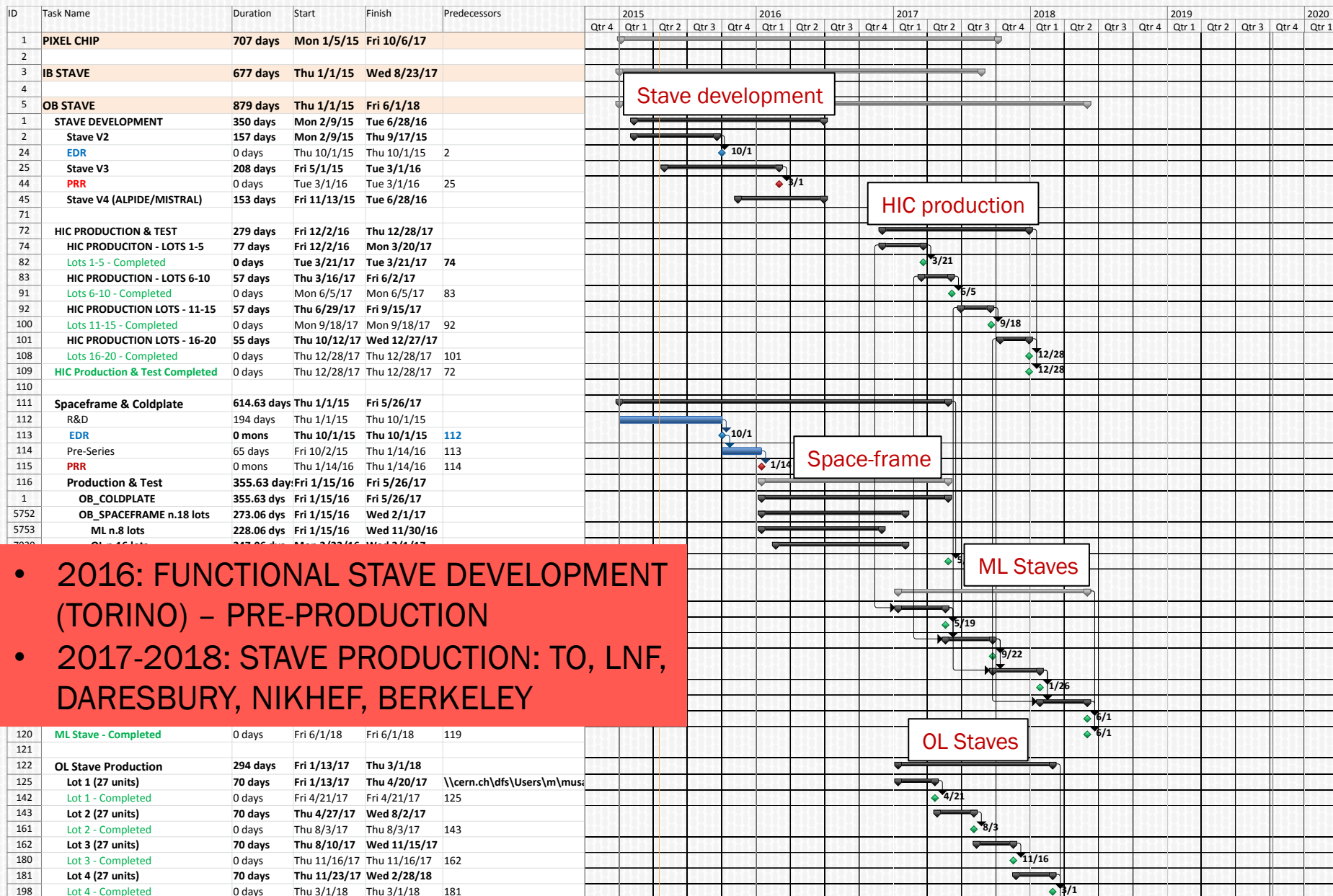
32

OB Stave Assembly – HS alignment and gluing to U-legs



- ✘ PROCEDURA SVILUPPATA A TORINO ACCETTATA COME UNICA PER LA PRODUZIONE DEGLI STAVE
- ✘ TORINO SITO PILOTA PER LA PRODUZIONE

Master Plan – OB HIC & Stave Production



RESPONSABILITÀ A TORINO/ALESSANDRIA



ITEM	RESPONSABILITA'	
CHIP	progettazione DTU (ALPIDE versione finale APR 2016)	
MODULO	• PROGETTAZIONE FPC (FLEX PRINTED CIRCUIT) • sviluppo delle procedure di test per la caratterizzazione e validazione dei moduli	
STAVE (PRODUZIONE E TEST)	TORINO SITO PILOTA PER LA PRODUZIONE DI STAVE: PRE-PRODUZIONE 2016 E INIZIO PRODUZIONE 2017	COORDINAMENTO DELLE ATTIVITA' DI PRODUZIONE NEI SITI BERKELEY-NIKHEF-DARES-BURY-LNF
ASSEMBLY DEL BARREL E INSTALLAZIONE (al CERN) 2019	??????	

ATTIVITÀ A TORINO/ALESSANDRIA



item	descrizione	
CHIP	test chip DTU (LUG-SET 2016) (test beam) test ALPIDE finale (LUG-SET 2016) (laboratorio e test beam)	
MODULO (TEST)	TEST moduli pALPIDE3 LUG-SET 2016 (Laboratorio e test beam) TEST moduli ALPIDE SET-OTT 2016 TEST in ingresso x produzione 2017-2018	
STAVE (PRODUZIONE E TEST)	PRODUZIONE stave 0: LUG-SETT 2016 stave 1-2: OTT-NOV 2016 stave 3->30 DIC 2016-DIC 2018	CARATTERIZZAZIONE sviluppo del sistema di test: 2016 test e validazione di 30 stave: 2017-2018
ASSEMBLY DEL BARREL E INSTALLAZIONE (al CERN) 2019	Test di stave post assembly Test di settori completi Validazione funzionale con raggi cosmici del barrel in laboratorio Installazione nell'esperimento e verifiche finali	

PROGRAMMA 2016



- ✕ design FPC versione definitiva
- ✕ caratterizzazione chip/moduli v3 e v4 (gen-set 16)
- ✕ assembly functional stave (mar-dec 2016)
- ✕ caratterizzazione stave (lug-dec 2016)
- ✕ allestimento stazioni di assembly versione R&D (dec 15 – feb 16)
- ✕ sviluppo e allestimento stazione di assembly versione definitiva (sep – oct 16)
- ✕ PRE-PRODUZIONE

produzione stave

+ fase 1 (gen-giu):

- × produzione a Torino, inizio produzione a LNF, validazione sistema di caratterizzazione degli stave
- × installazione tools per la costruzione degli stave a Berkeley, Nikhef, Daresbury.

+ fase 2 (lug-set):

- × produzione a TO + LNF
- × validazione dei tools e delle procedure a Berkeley, Nikhef, Daresbury.

STAVE ASSEMBLY: MAIN STEPS

- × TEST DI ACCETTAZIONE DEI MODULI
- × SURVEY METROLOGICO DEI COLD PLATE
- × ALLINEAMENTO moduli su COLD PLATE -> HS
- × INTERCONNESSIONE TRA MODULI
- × ALLINEAMENTO DI 2 HS E INCOLLAGGIO A SPACE FRAME -> STAVE
- × SALDATURA POWER BUS
- × TEST

rosso: elettronica

nero: meccanica di precisione
e metrologi

IL GRUPPO ALICE ITS UPGRADE

- × COORDINAMENTO NAZIONALE ITS UPGRADE
 - × S.BEOLE'
- × COORDINAMENTO DEL WORKING GROUP DI RICOSTRUZIONE
 - × M.MASERA
- × SOFTWARE: RICOSTRUZIONE DI TRACCE E DI VERTICI, COORDINAMENTO DEL WORKING GROUP DI RICOSTRUZIONE
 - + M.MASERA, M.SITTA, S.BUFALINO
 - + M. PUCCIO, L. BARIOGLIO
- × HARDWARE: costruzione di 30 stave OB
 - + B.ALESSANDRO, E.BOTTA, L.RAMELLO, S.BEOLE', M.AGNELLO, Y.CORRALES MORALES, F.PRINO
 - + S.TROGOLO, I.RAVASENGA

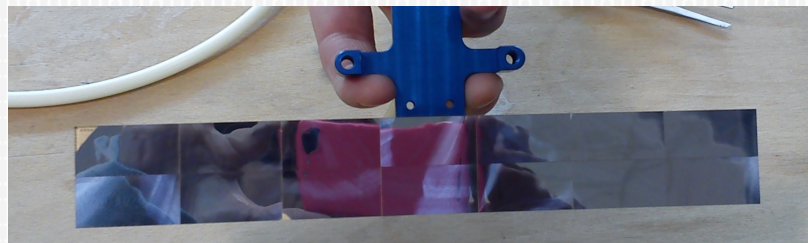
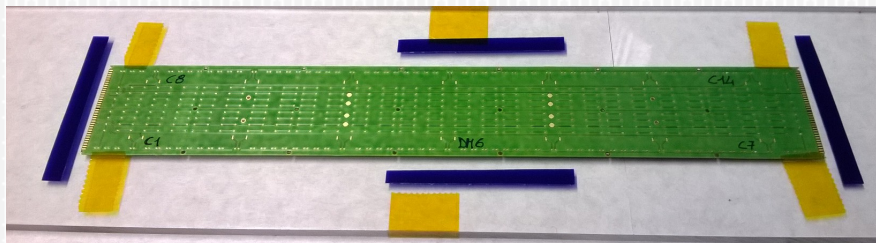
RICHIESTE SERVIZI ITSUP & SDD 2017



tipologia	N.	m. u.	attività
tecnici elettronica (Franco + ?)	2	18	ITSUP: module/stave test; saldature per interconnessione moduli SDD: manutenzione, messa a punto e upgrade della stazione di test del firmware delle SuperCarlosRX installata a Torino nel 2015.
tecnici meccanica (Fabio + Riccardo)	2	12	ITSUP: produzione pezzi x jig; uso Mitutoyo; assembly
microsaldatori (Flori)	1	12	ITSUP: allineamento moduli; interconnessioni;
tecnologi meccanici (Silvia)	1	12	ITSUP: responsabilità internazionale allestimento e messa in opera delle stazioni di assembly; supervisione produzione SDD: controllo e manutenzione del sistema di cooling del rivelatore sia durante lo shut-down invernale che durante la presa dati.
tecnologi elettronica e micro (Gianni)	1	6	ITSUP: sviluppo test dello stave – test moduli e stave

BACK UP

Outer Barrel Stave



- | | |
|--|----------|
| 1. Stave - EDR | Mar 2016 |
| 2. Space frame & Cold Plate - PRR | Jan 2016 |
| 3. Stave - PRR | Jun 2016 |
| 4. HIC - start production | Dec 2016 |
| 5. HIC - end production | Dec 2017 |
| 6. Space frame & Cold Plate - start production | Jan 2016 |
| 7. Space Frame & Cold Plate - end production | May 2017 |
| 8. ML Stave Assembly - start production | Jan 2017 |
| 9. ML Stave Assembly - end production | Dec 2018 |
| 10. OL Stave Assembly – start production | Jan 2017 |
| 11. OL Stave Assembly – end production | Dec 2018 |

