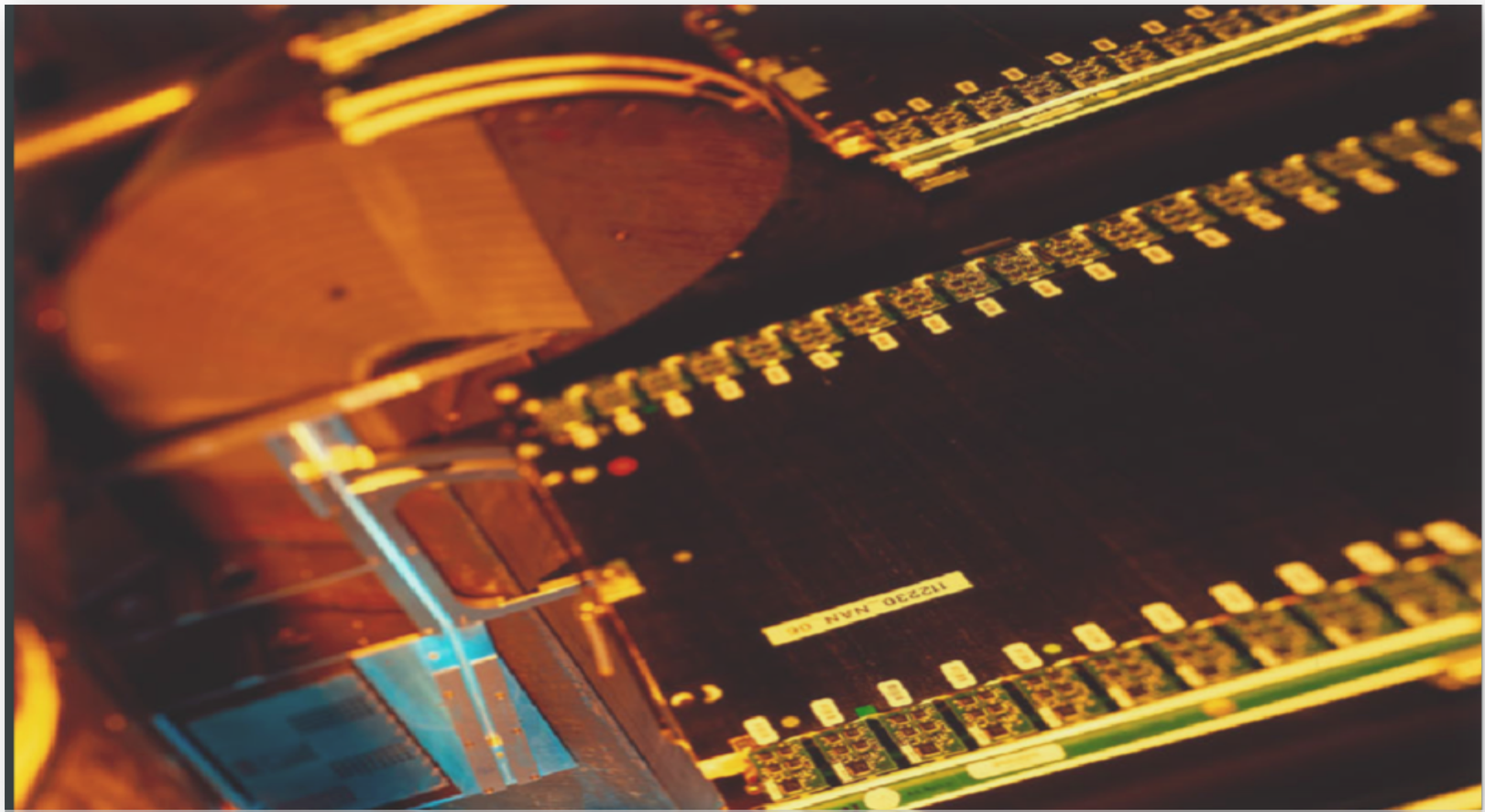


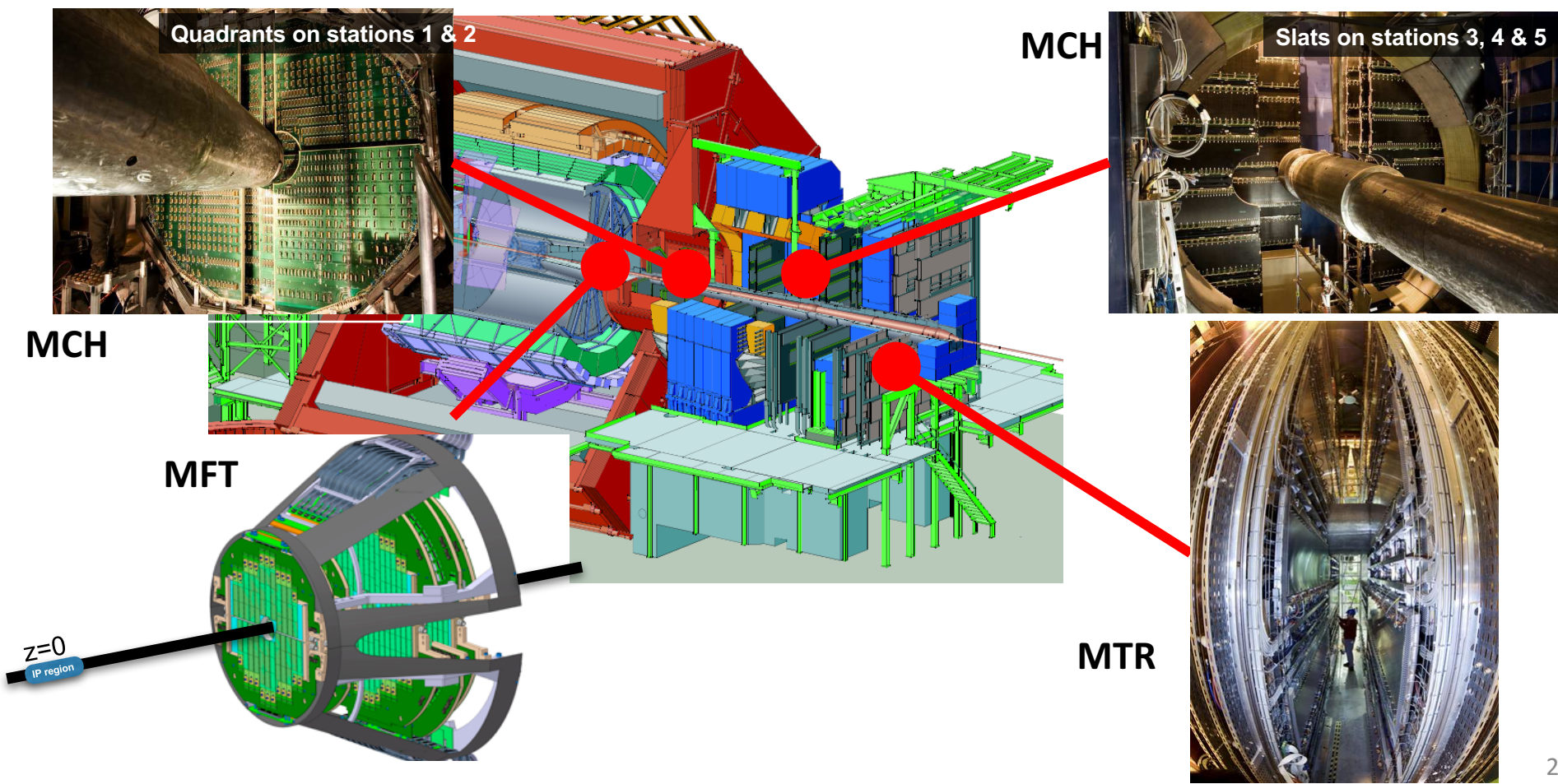


The Muon Tracking Upgrade

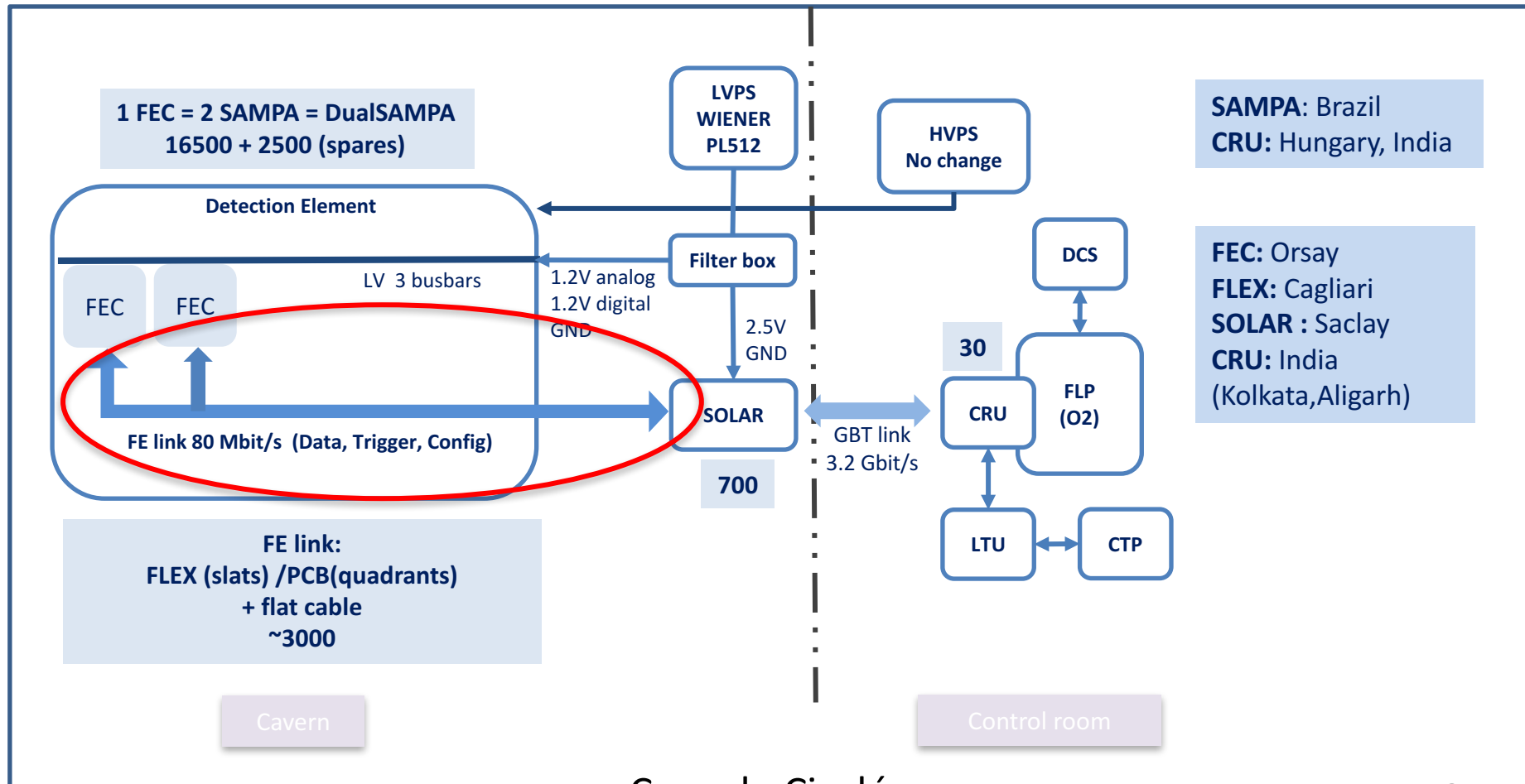
Roma, 5 luglio 2019

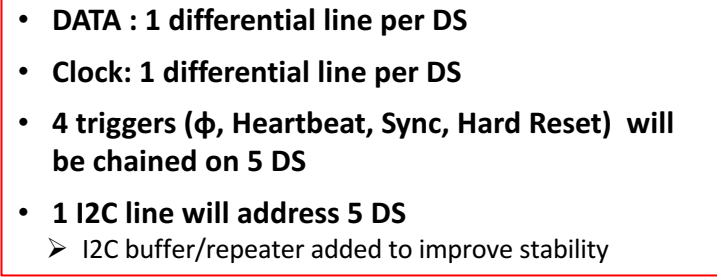
Corrado Cicalo'

The muon Tracking



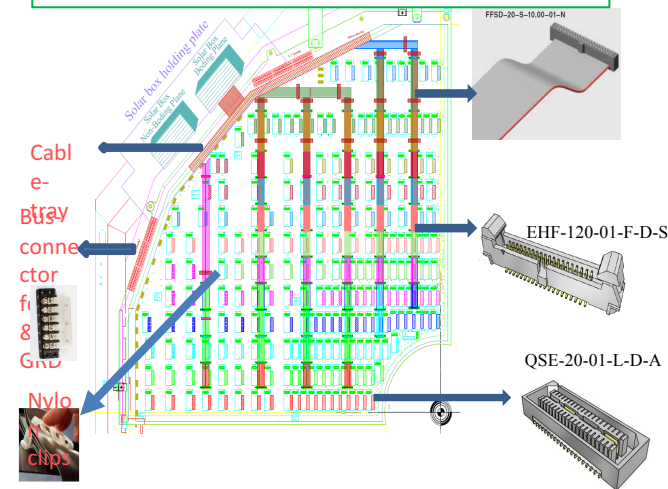
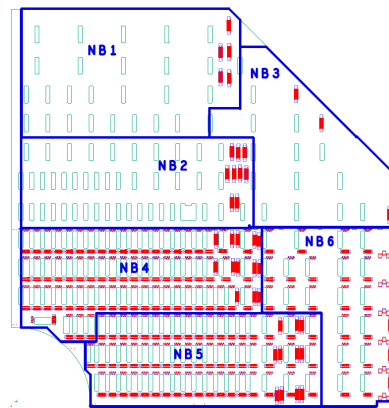
MCH upgrade project



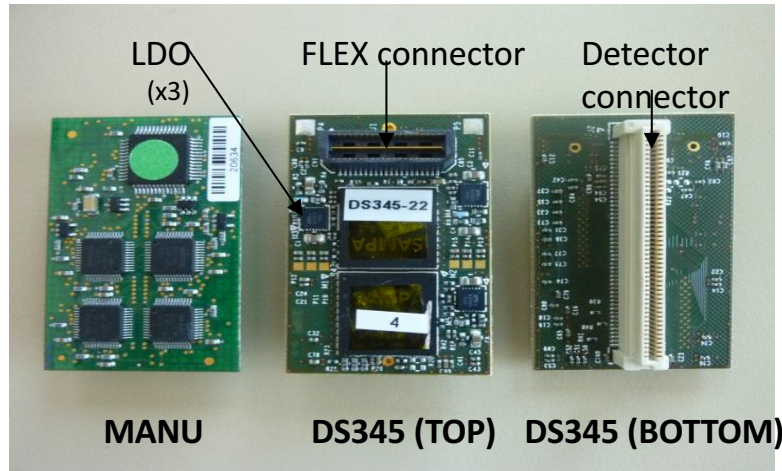


PCB Station 1: IPN Orsay

New design, more compact
Rigid pads → Hybrid circuit



MCH Upgraded Readout – DualSAMPA Front-end Boards



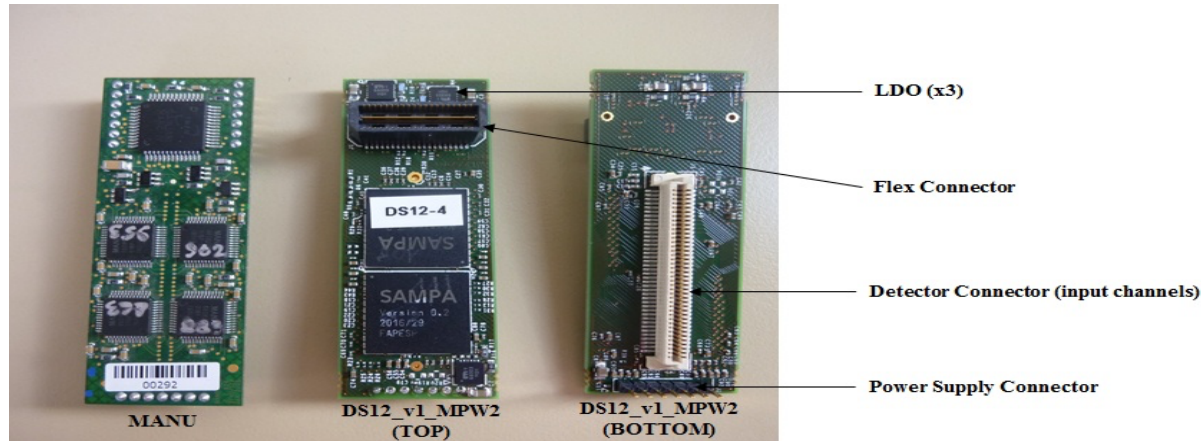
2 SAMPA chained on one DualSAMPA board

2 types of DualSAMPA:

➤ DS12 for quadrants,

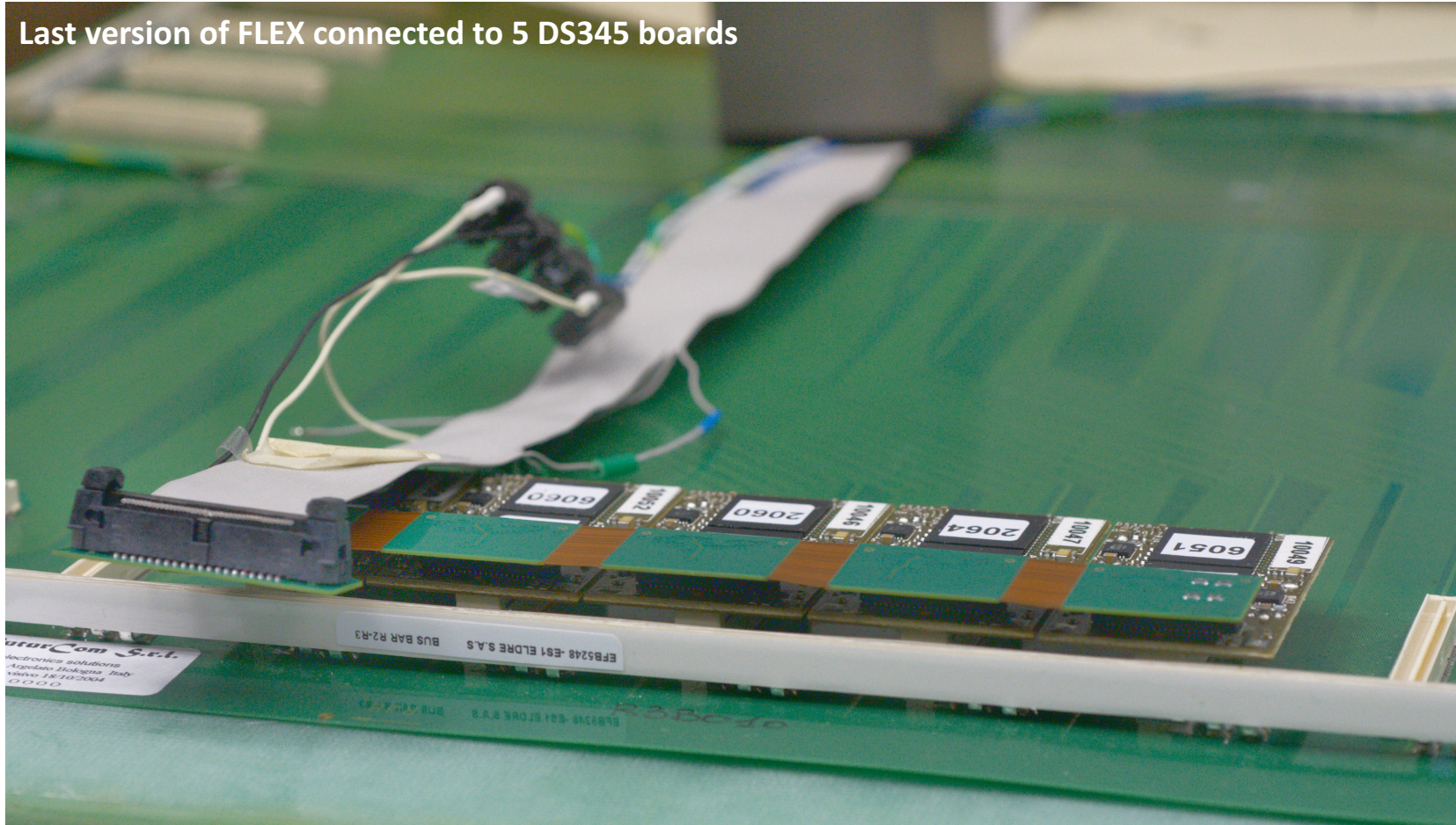
➤ DS345 for slats

Prod. Readiness Rev. on July 10, 2018
Pre-series prod. from Nov. 2018 to Feb. 2019



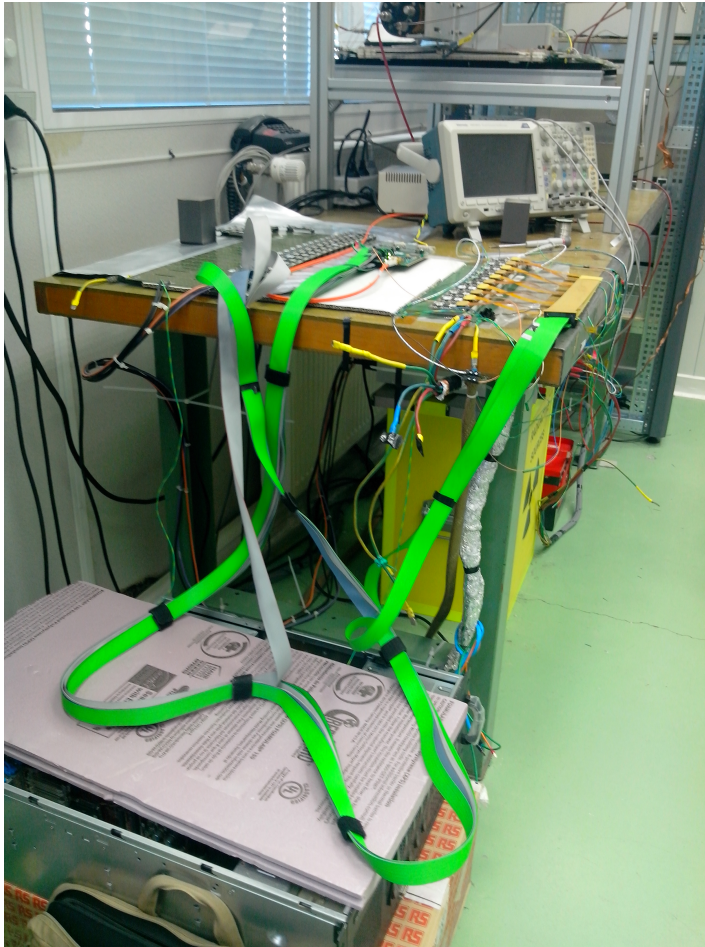
Latest Version of FLEX Boards

Last version of FLEX connected to 5 DS345 boards



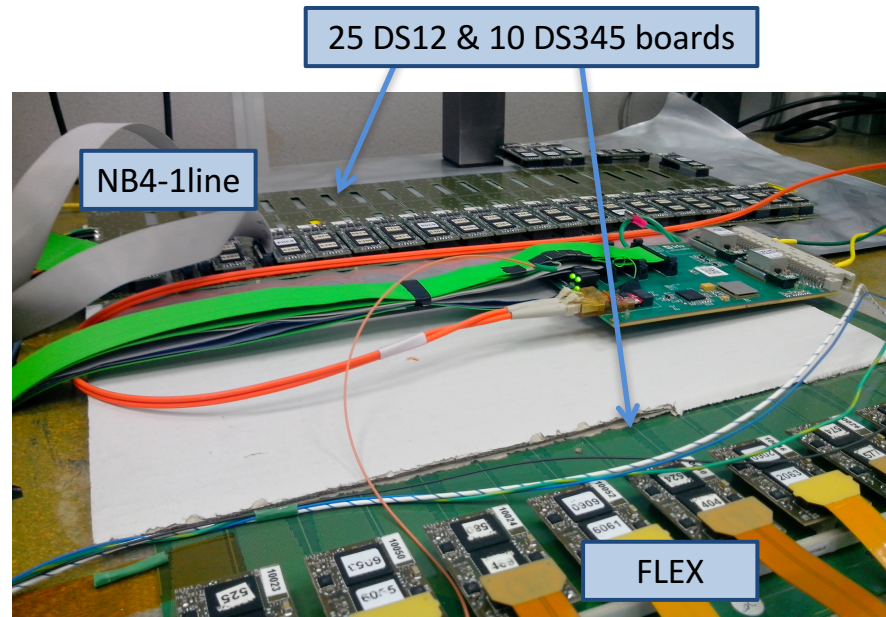
Latest prototype is OK from both mechanical and electrical points of view

Integration Test-Bench @ CERN (SLAT + Quadrant)



Readout test with 7 ribbon cables (3m, 4m & 6m)
Closely packed to check for interferences

More than 6000 readout cycles without errors
35 DS boards tested together

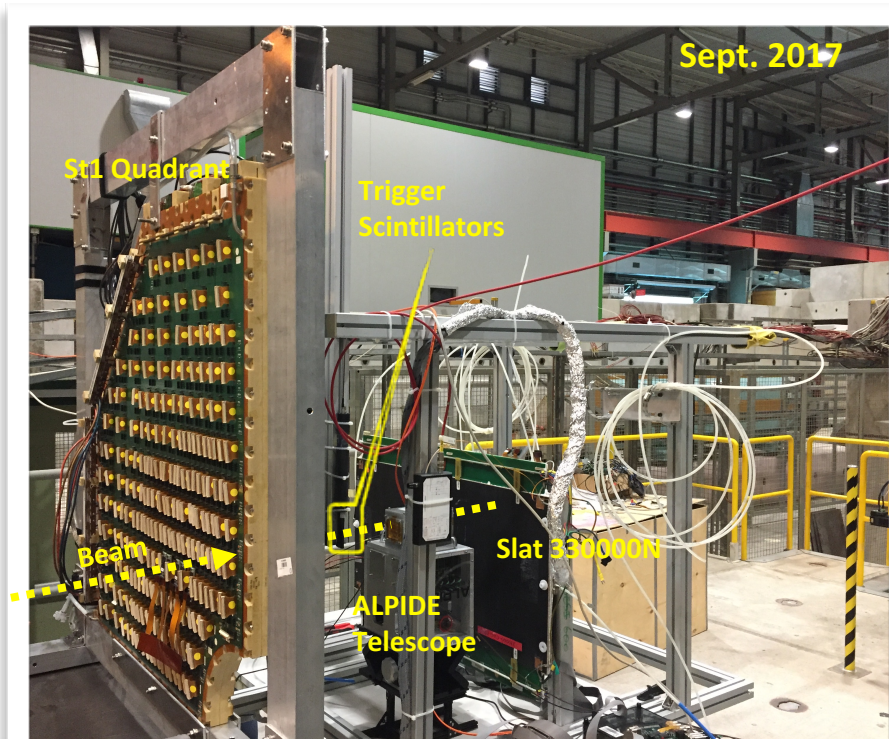


Testbeam Results

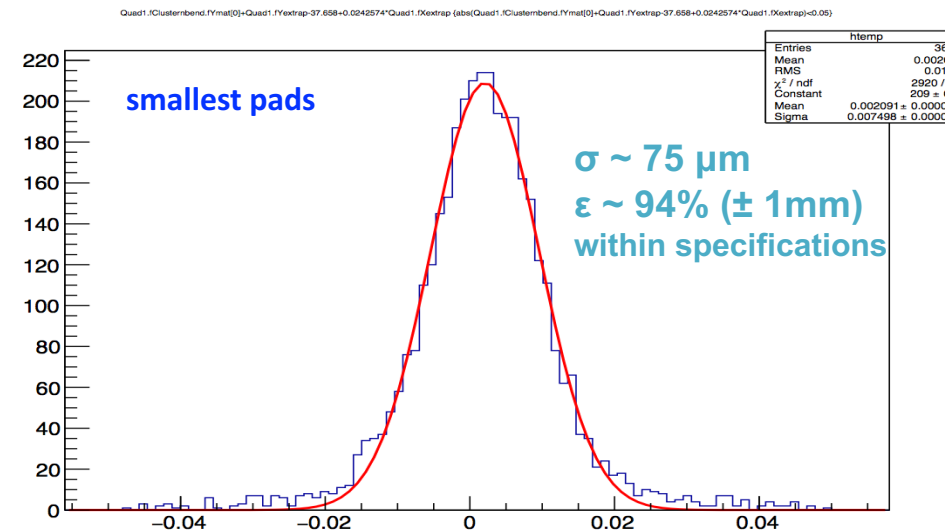
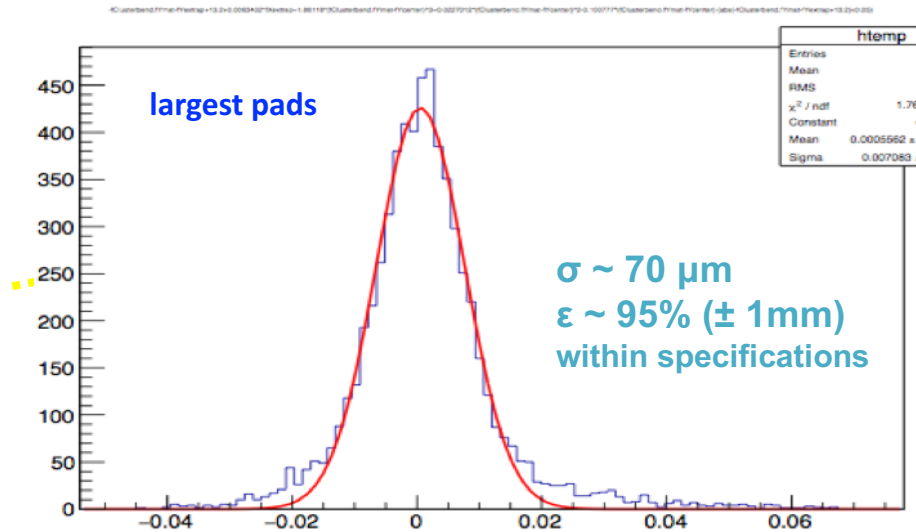
Test of the full readout chain

@ SPS in Sept. 2017 / Oct. 2018

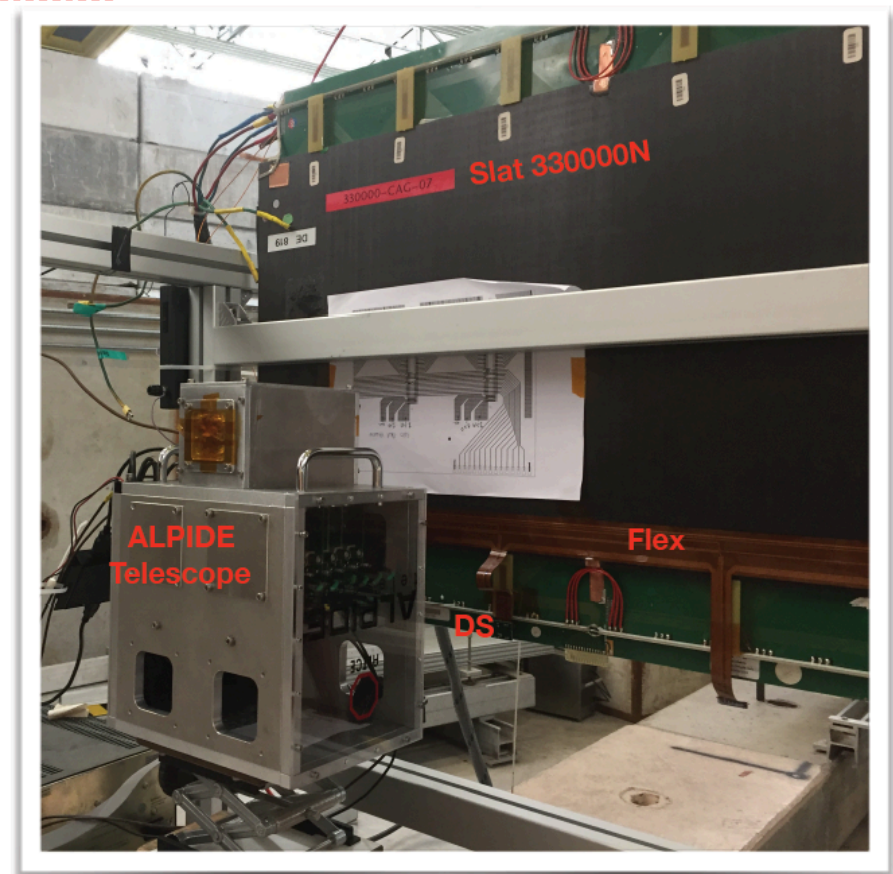
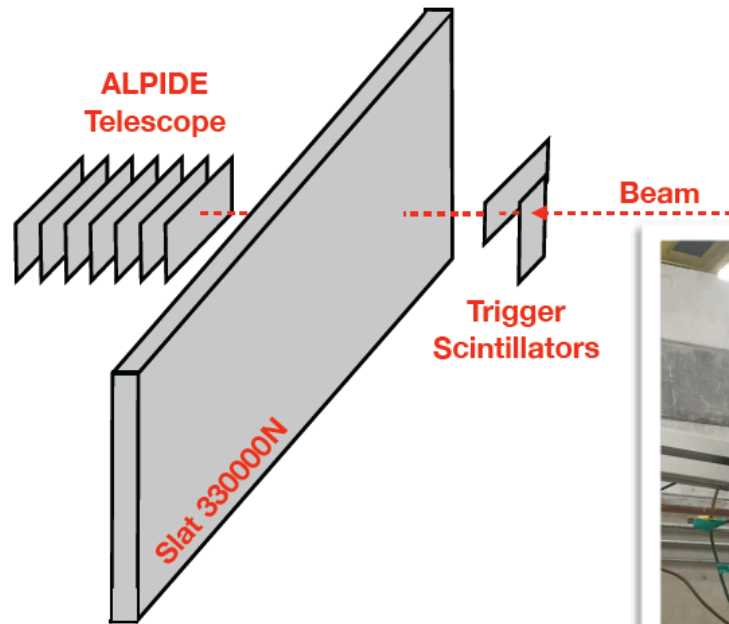
20 GeV/c muon beam



Spatial Resolution



The setup



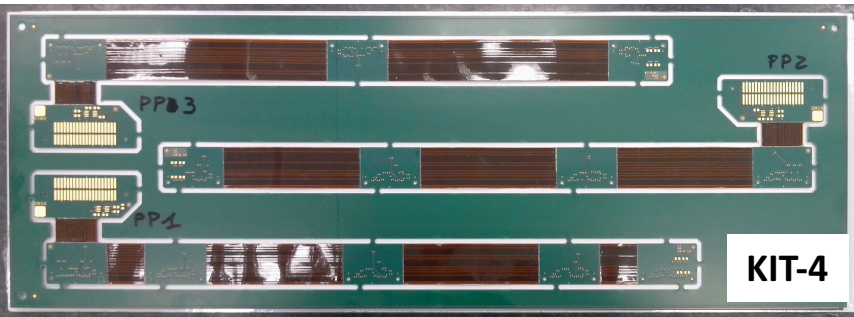
Produzione FLEX

- 3000 pezzi, 26 tipologie, 16 kit (raggruppamento codici)
- Assegnazione 102keuro (bilancio 2018).
- Gara vinta dalla SOMACIS di Ancona. 137 keuro.
- Extracost coperto dalla collaborazione
- Preserie prodotta → test al CERN OK
- Produzione di serie: start 2/7/2019
- Primi lotti: 20/7/2019. Fine produzione: settembre 2019
- Consegna al CERN

Preserie. KIT 1

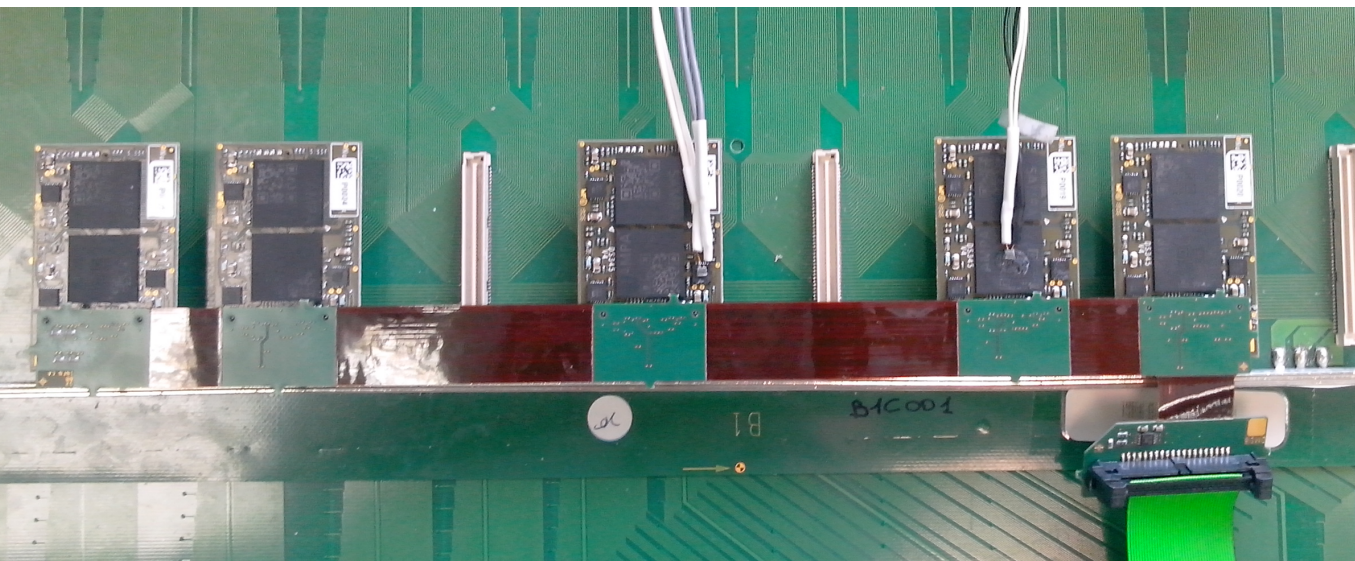


FLEX



First 15 samples of KIT-4 received from SOMACIS, 6 FLEX populated with connectors and tested

- Reliable I2C communication with SAMPA chips
- No synchronisation or readout issues
- More than 14 000 configuration/readout cycles successfully completed

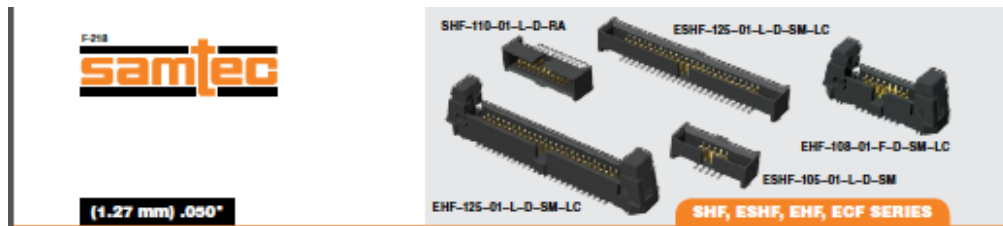


- Impedance of diff. lines checked, **OK within 20%**

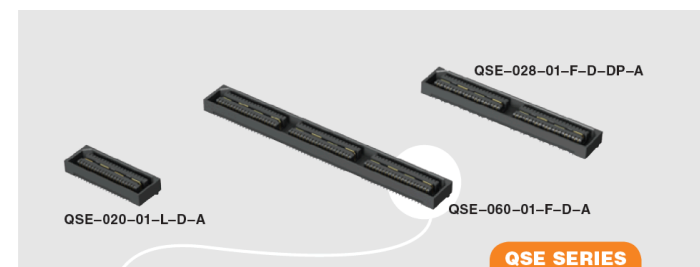
FLEX- codici da produrre. 26disegni

PCB	Flex Type	Length	Total	Total with Spare Slat	Conn DS	Total Conn DS	DS connectors W Spare Slat	Conn Solar	Total Conn S	Solar Conn W Spare Slat
R2-R3	Flex R2_3-5-tb	160.00	48	54	5	240	270	1	48	54
R2-R3	Flex R2_3-3-tb	95.00	24	27	3	72	81	1	24	27
R2-R3-D1	Flex D1_R2_3-5-tb-tnb	189.00	192	220	5	960	1100	1	192	220
R3	Flex R3-1-bb	42.00	16	17	1	16	17	1	16	17
R1-R2	Flex R1_2-4-tnb-tb	149.00	12	16	4	48	64	1	12	16
R2	Flex R2-4-bb	127.00	8	10	4	32	40	1	8	10
R2	Flex R2-3-bnb	121.00	8	10	3	24	30	1	8	10
R1	Flex R1-3-bb	144.00	4	6	3	12	18	1	4	6
R1	Flex R1-2-bnb	107.00	4	6	2	8	12	1	4	6
R1	Flex R1-3-tnb	118.00	4	6	3	12	18	1	4	6
D1	Flex 1-5-bb	189.00	152	176	5	760	880	1	152	176
D1	Flex 1-4-bnb	201.00	76	88	4	304	352	1	76	88
D1	Flex 1-3-bnb	144.00	76	88	3	228	264	1	76	88
D1	Flex 1-4-tnb	201.00	76	88	4	304	352	1	76	88
D1	Flex 1-3-tnb	144.00	76	88	3	228	264	1	76	88
D2	Flex 2-5-tb	349.00	238	272	5	1190	1360	1	238	272
D2-S2	Flex S2_2-3-tnb	258.00	248	285	3	744	855	1	248	285
D2	Flex 2-5-bb	349.00	238	272	5	1190	1360	1	238	272
D2	Flex 2-4-bnb	372.00	238	272	4	952	1088	1	238	272
S2	Flex S2-4-tb	269.00	10	13	4	40	52	1	10	13
S2	Flex S2-5-bb	269.00	10	13	5	50	65	1	10	13
S2	Flex S2-3-bnb	258.00	10	13	3	30	39	1	10	13
D3	Flex 3-2-tb	229.00	248	274	2	496	548	1	248	274
D3	Flex 3-2-tnb	258.00	248	274	2	496	548	1	248	274
D3	Flex 3-3-bb	269.00	248	274	3	744	822	1	248	274
D3	Flex 3-2-bnb	258.00	248	274	2	496	548	1	248	274
TOTAL			2760	3136		9676	11047		2760	3136

Connettori FLEX – Dual SAMPA – CAVI FLAT

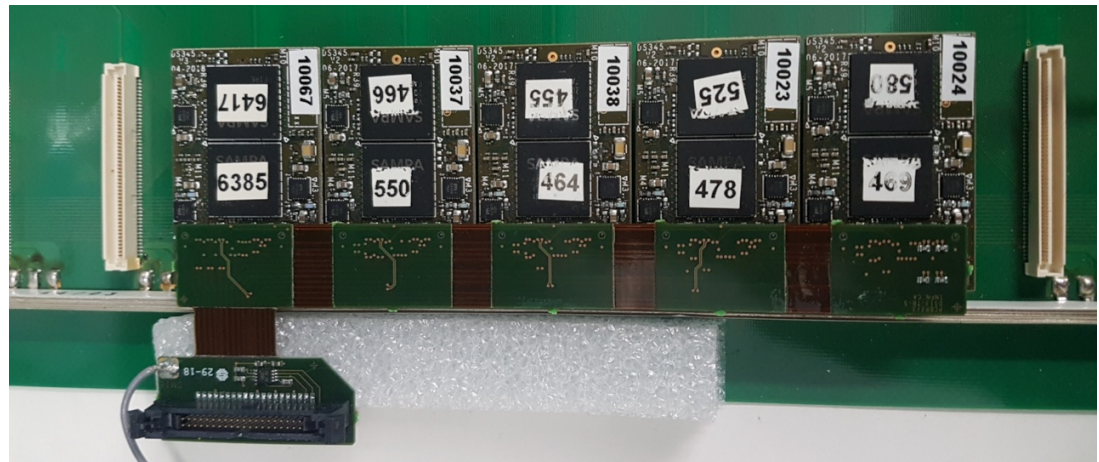


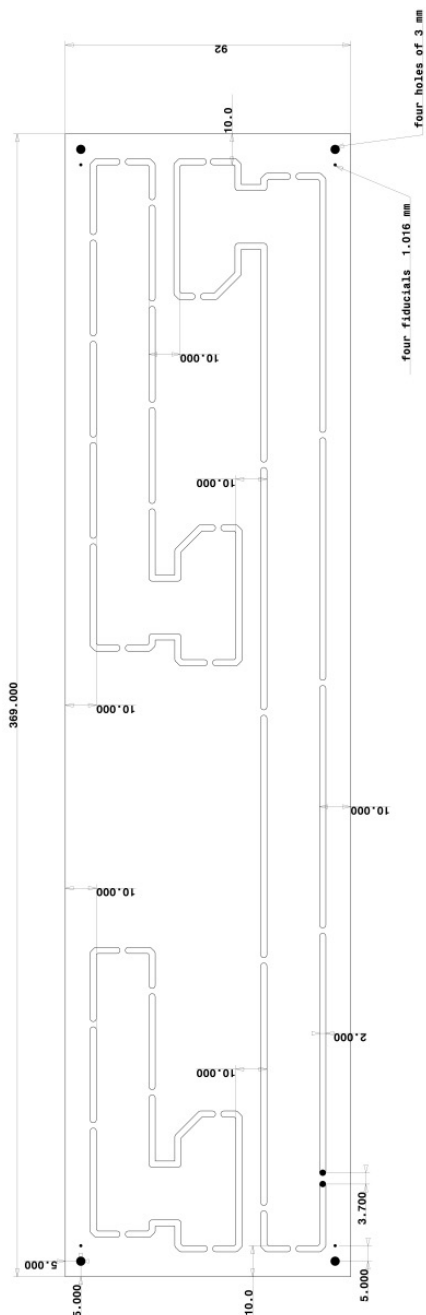
- Budget
- 12000 connettori SAMTEC (DS-FLEX) QSE-020-01-L-D-A
- 5000 connettori SAMTEC (FLEX-Ribbon) EHF-120-01-L-D-SM
- Assegnazione 2018: 45keuro.
- Vincitore gara: ADELSY(distributore SAMTEC).
- Acquistati e consegnati al CERN
- Problema FILM *pick-and-place* mancante!
- Modifica SAMTEC. Rispediti.
- Tempistiche: 10-15 giorni.



Montaggio FLEX

- Budget INFN 32keuro (2018)
- Montaggio connettori (SMD) + componenti
- Individuate 4 aziende italiane (Futurcom, BA.EL., GR-elettronica, MB)
- Prototipi gia' montati presso due ditte
- Gara in corso

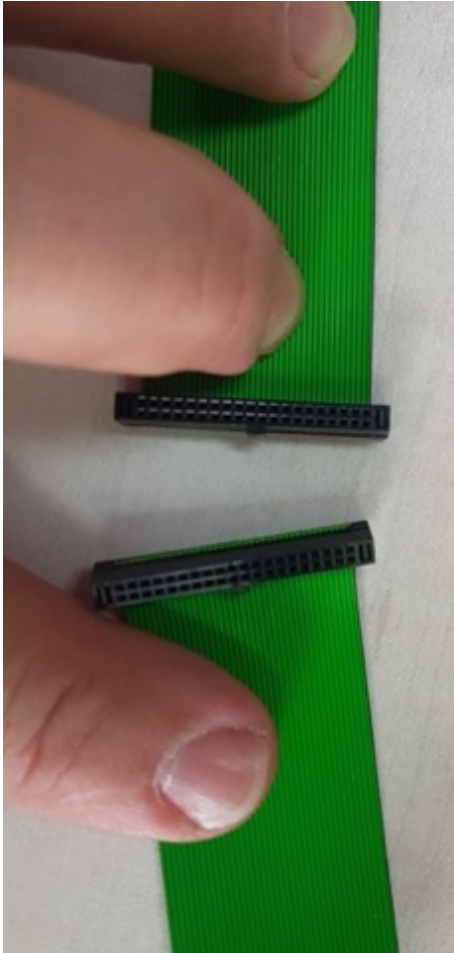




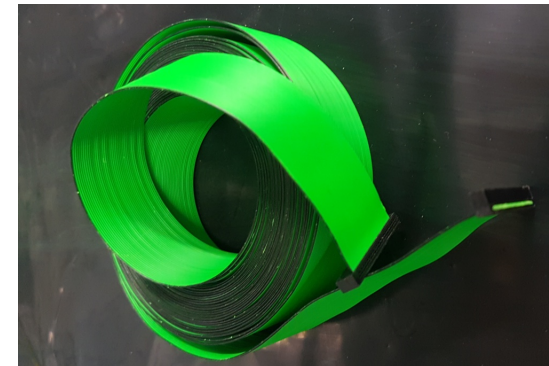
Componenti da montare sui FLEX

KIT	QTY KIT	FLEX in KIT	Res and Cap	TCA9803	EHF conn.	QSE conn.
1	11	2 FLEX-R3-BB 3 FLEX-R2R3-TB-3	45	5	5	11
2	10	1 FLEX-R1-TNB 1 FLEX-R1-BNB 1 FLEX-R2-BNB 1 FLEX-R2-BB	36	4	4	12
3	22	1 FLEX-R1R2-BB-TNB-4 3 FLEX-R2R3-TB-5	36	4	4	19
4	14	1 FLEX-S2-BNB 1 FLEX-S2-TB 1 FLEX-S2-BB	27	3	3	12
5	90	1 FLEX-D1_TNB-3 1 FLEX-R1-TB_D1-BNB-3	18	2	2	6
6	90	1 FLEX-D1-BNB-4 1 FLEX-D1-TNB-4	18	2	2	8
7	110	2 FLEX-R2R3-TNB	18	2	2	10
8	90	2 FLEX-D1-TB-5	18	2	2	10
9	135	2 FLEX-D3-TB	18	2	2	4
10	135	2 FLEX-S2D2_TNB	18	2	2	6
11	135	2 FLEX-D3-TNB	18	2	2	4
12	135	2 FLEX-D3-BNB	18	2	2	4
13	135	2 FLEX-D3-BB	18	2	2	6
14	135	2 FLEX-D2-TB	18	2	2	10
15	135	2 FLEX-D2-BB	18	2	2	10
16	135	2 FLEX-D2-BNB	18	2	2	8

Cavi FLAT (Ribbon) – connessione FLEX - SOLAR



- Circa 3000 cavi FLET (RIBBON) di lunghezze comprese fra 1.7m e 4.5m
- Totale circa 9km di cavi (+2km old da riciclare)
- CERN Safety Compliance Non e' possibile usare gli stessi cavi attualmente installati
- Lavorazione presso l'atelier CERN
- Ordine eseguito per cavi e connettori.
- Attualmente in lavorazione I cavi per la stazione 3



Attività svolte in Caverna

- Rimozione, modifica e re-installazione delle **LV Filter Box** (scatole con i filtri per la bassa tensione per l'alimentazione delle FEE) - la modifica era necessaria perché la nuova elettronica assorbe più corrente e useremo 2 alimentazioni invece di 3
- Smontaggio dei **Crocus** (CRATES contenenti le schede di reasout)
- Rimozione dei **cavi di ReadOut** in quanto con l'upgrade i percorsi dei cavi sono diversi e anche la quantità
- Rimozione **cavi di alimentazione** dei Crocus
- Disconnessione dei **cavi di bassa tensione** delle camere e modifica disposizione LV Power Supply nei Rack
- **Connessione dei cavi LV** secondo la nuova disposizione
- Installazione dei **Crate Solar**

Status DCS

Fatto/ in progress

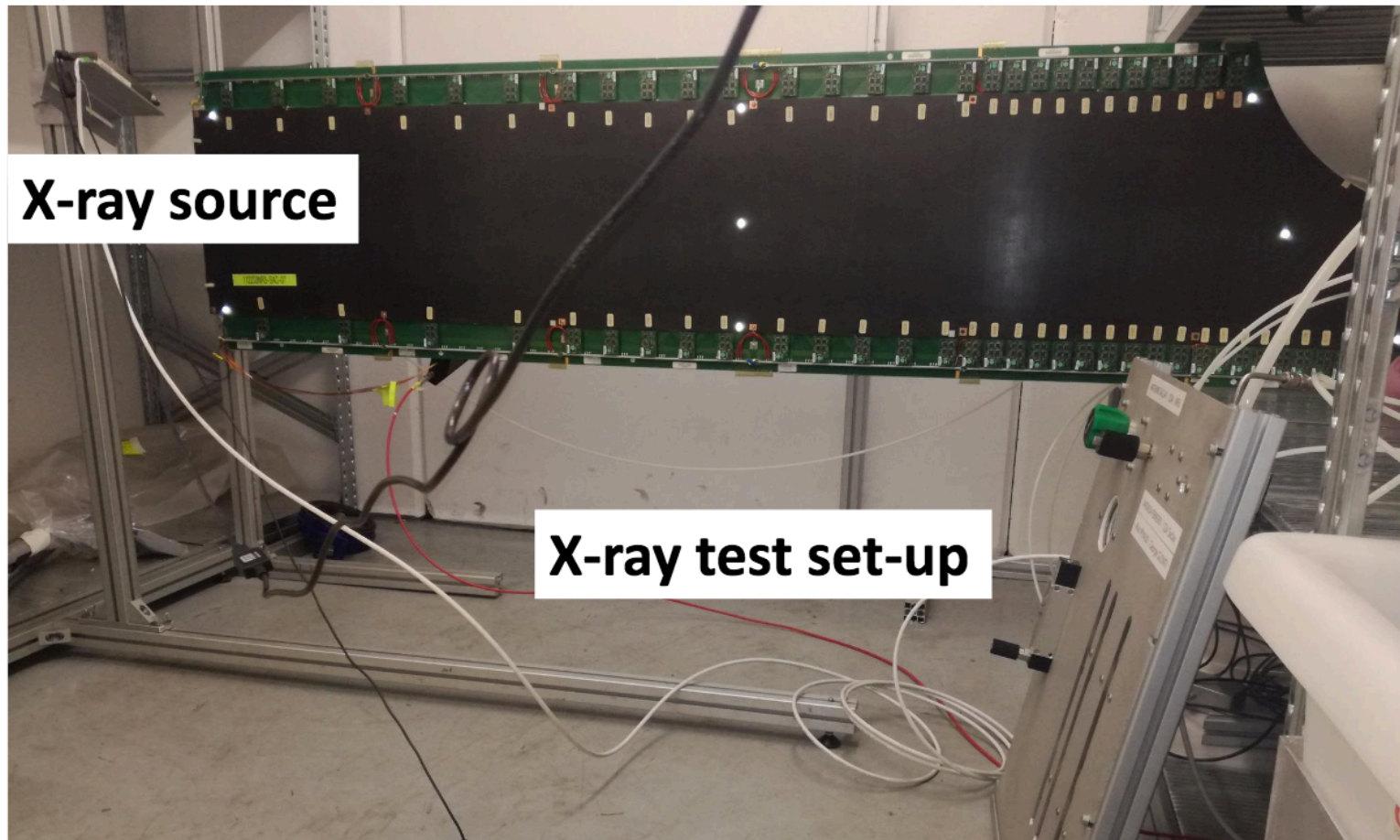
- nuovi pannelli per la **configurazione dei Solar/ Sampa**
- implementazione di ALF/FRED per **l'invio e la ricezione dei comandi di configurazione** dell'elettronica tramite la CRU

Da fare:

- Nuova UI con la nuova disposizione delle **Power Supply**
- Aggiungere le **nuove LVPS** (14 in più rispetto a prima) nei pannelli
- **Rifare le FSM** con la nuova logica (sostituzione delle parte relativa ai Crocus con i Solar)
- Integrare la parte di **configurazione dei Solar** nella UI
- Recovery automatico dei trip HV.

Test dei rivelatori con raggi X

Individuare eventuali tracce di colla fra i piani catodici → trip HV



Situazione X-Ray tests

- **30 detectors tested so far, 3 still waiting**
 - 24 spares + 9 taken directly from P2
 - 15 found **OK**
 - 14 detectors to be opened and cleaned
 - 1 detector re-tested after cleaning, **OK**
 - 1 already cleaned detector still waiting to be closed and re-tested
- **All detectors that tripped during high-lumi test in 2018 are also unstable with X-ray**

All repaired detectors will have to be re-tested
Substantial amount of work still to be done...

Time Planning

produzione SOLAR: July - Oct 2019

produzione FLEX: July - Oct 2019

produzione Dual Sampa: July 2019 - March 2020

Assemblaggio/Istallazione/1st commissioning Stazioni
345: Agosto 2019 - Agosto 2020

Assemblaggio Quad station 1 (Lab): Nov 2019 - April 2020

Istallazione Quad Station 1 (cavern): April 2020 - May 2020

Assemblaggio Quad station 2 (Lab): Nov 2019 - April 2020

Istallazione Quad Station 2 (cavern): June 2020 - July 2020

Milestones

31-12-2018	MTRACK Upgrade - Inizio istallazione nella zona sperimentale della nuova elettronica di <u>frontend</u>		0	0	Rinviata al 2019	100
31-12-2018	MTRACK Upgrade - Produzione circuiti stampati flessibili, saldatura connettori e test		20	30	30	80
1	MCH	30/06/19	MTRACK Upgrade - Completamento produzione e-link, saldatura connettori e test		80%	
2	MCH	31/12/19	MTRACK Upgrade - Installazione nella zona sperimentale della nuova elettronica di frontend (60%)		60%	

Milestones 2020 MUTRACK

- 1) Completamento istallazione nuova elettronica di frontend → 31 LUG 2020
- 2) Primo Commissioning rivelatori → 31 DEC 2020

Stime costi (2019)

- Produzione FLEX: 102kEuro assegnati dalla CSNIII nel 2018. Ok. Possibile lieve extracost, da negoziare fra i gruppi. → 137 keuro.
- Saldatura connettori: 32keuro. Ok nel 2018.
- Acquisto connettori: 39keuro. Ok gara in corso
- Fibre: originariamente nel MoU. Coperte dalla collaborazione (50kCHF).
- Cavi Ribbon: come da MoU 80keuro. Assegnati nel 2019. Ok, in corso di lavorazione.

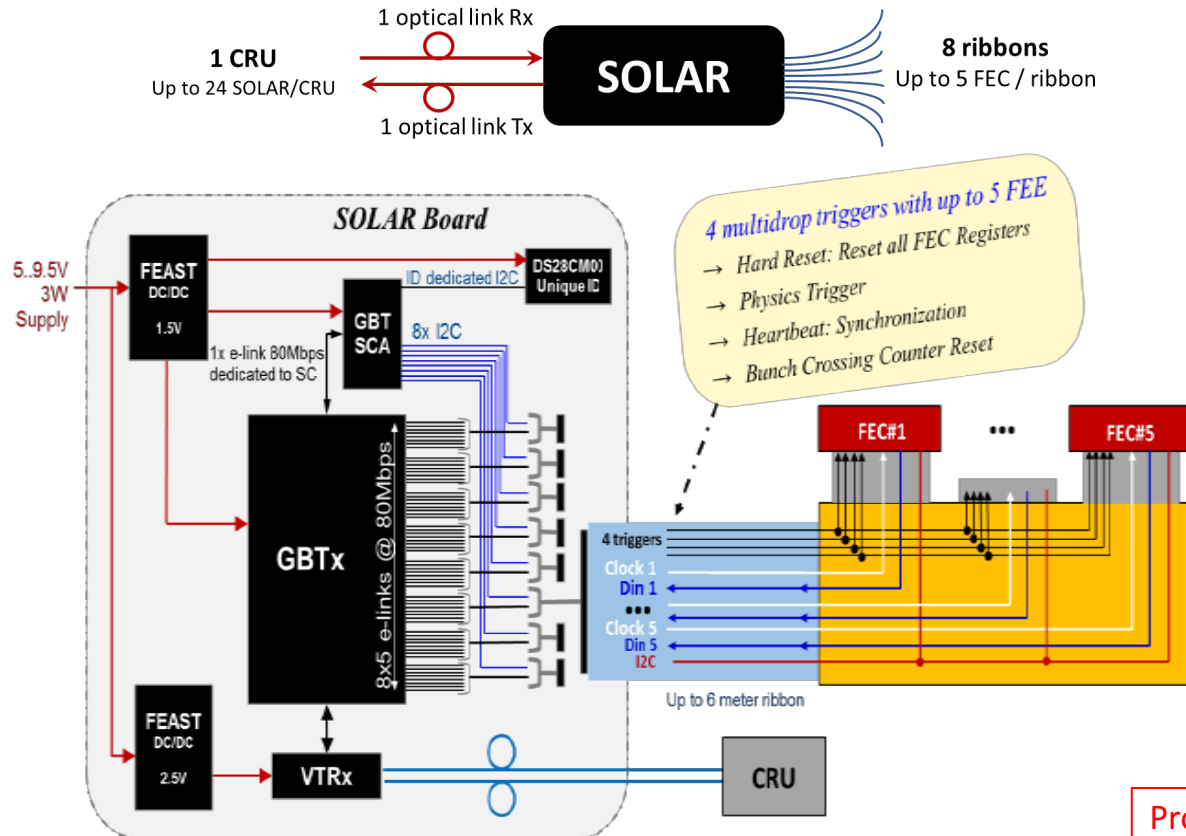
Richieste per il 2020

- **Aumento composizione del gruppo ALICE**
Cagliari (da 9,5 a 12,5 FTE)
- Nel 2018: assegnati 75keuro - spesi 75 keuro.
- Nel 2019: assegnati 76,5keuro – spesi 48 keuro
- **Richieste specifiche Missioni:** Per test FLEX, installazione nuova elettronica, commissioning:
- **Richieste specifiche Consumo:** lavorazioni al cern su schede di test, lavorazioni su circuiti FLEX, riparazione rivelatori dopo test X-RAY -->

END

MCH Upgraded Readout– SOLAR Concentrator Board

CEA Saclay



➤ Input

- Up to 40 DualSAMPAs (8 connectors of 5 DualSAMPAs)

➤ Output

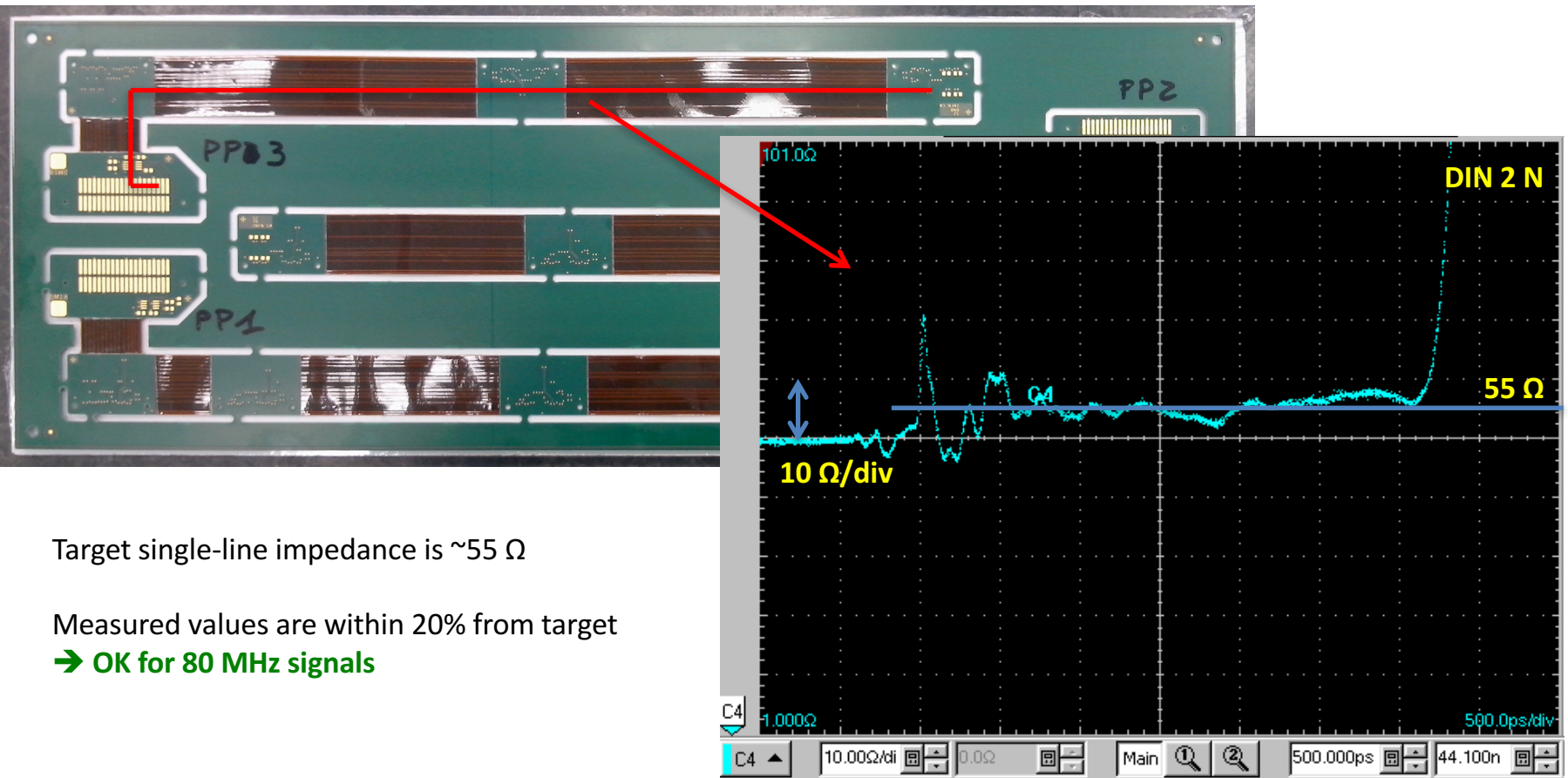
- 1 double optical fiber

Extensive use of CERN components

- GBTx concentration chip
- GBT-SCA for slow control
- VTRx for Optical fiber interface
- FEASTMP DC/DC for powering

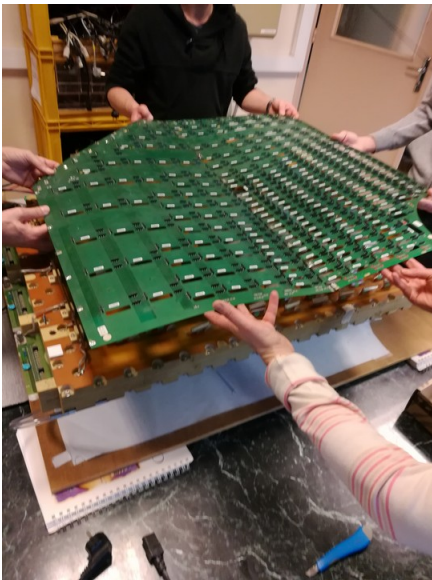
Production Readiness Review on May 25, 2018
Pre-series production in September 2018

Example of Single Line Impedance Measurement on FLEX

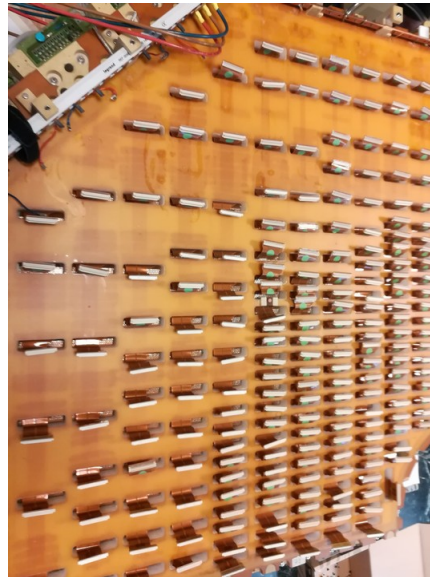


Large PCB for ST1 Quadrants

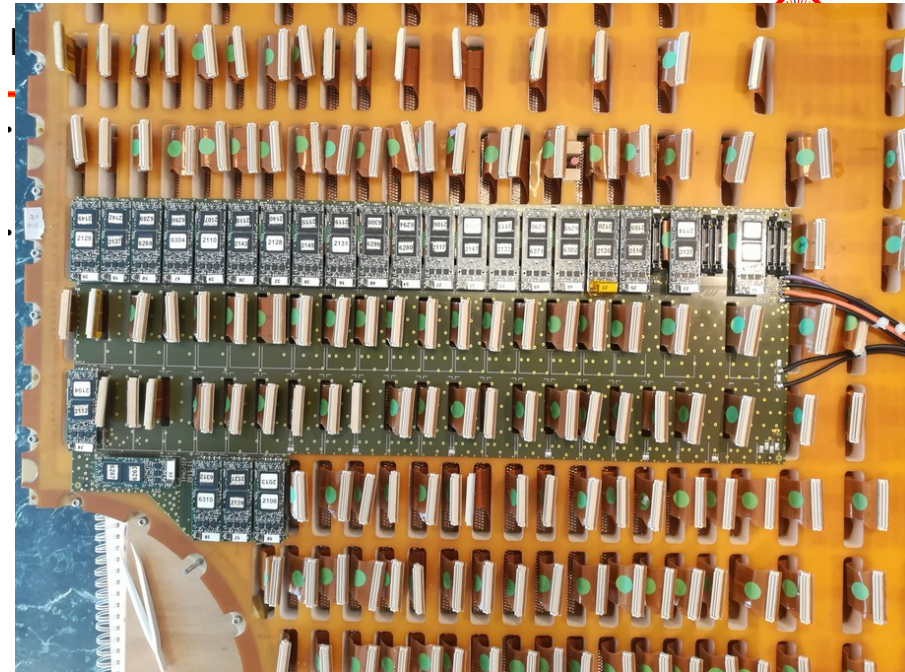
- Removed former PCB on Q9 non-bending side
 - Delicate but rather “simple”
 - Achieved in about one hour
- Placed NB4-1line on the quadrant
 - Takes some time....
 - New PCB fixation system being studied



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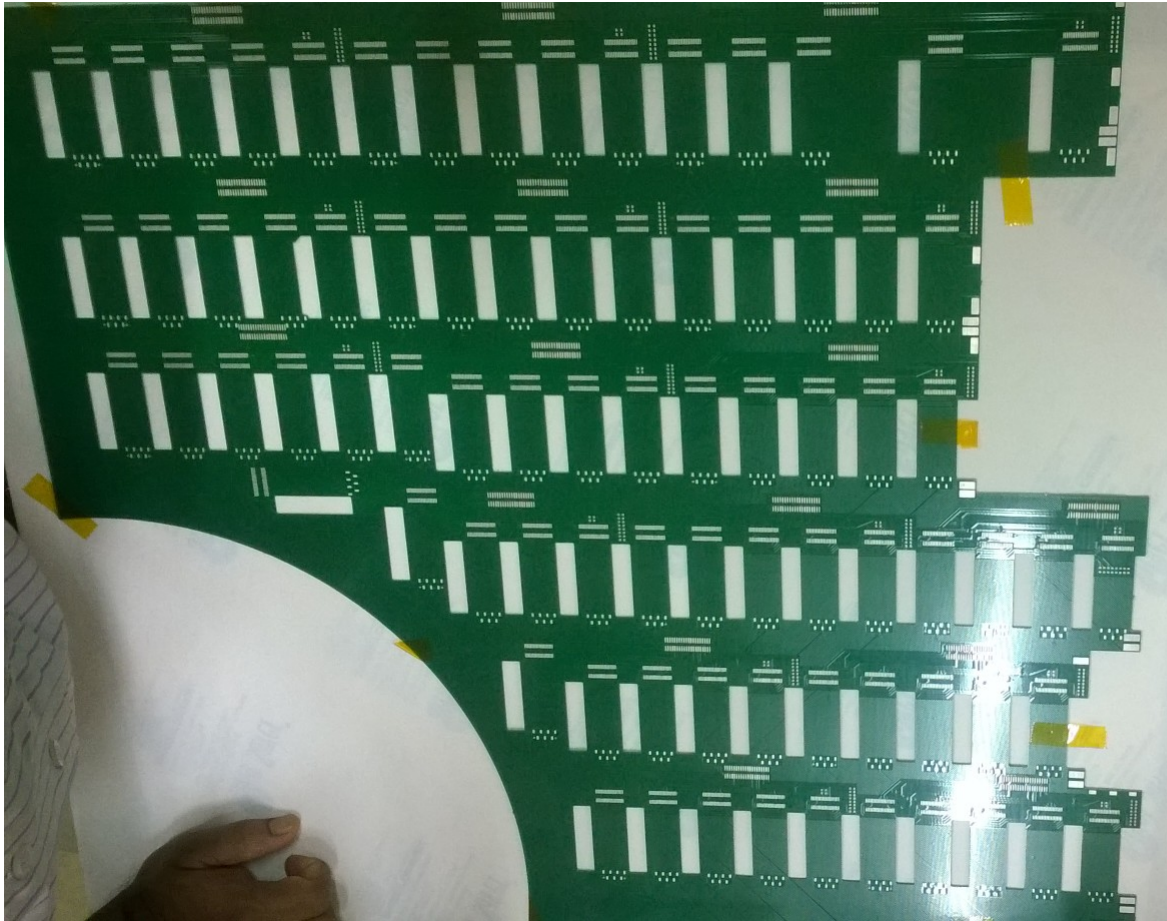


ALICE Group @ IPN



Large PCB for ST2 Quadrants

India Kolkata+ Aligarh



Assembled prototype expected at CERN at the end of July. To be included in the readout integration test-bench

Cost-time planning: new estimate

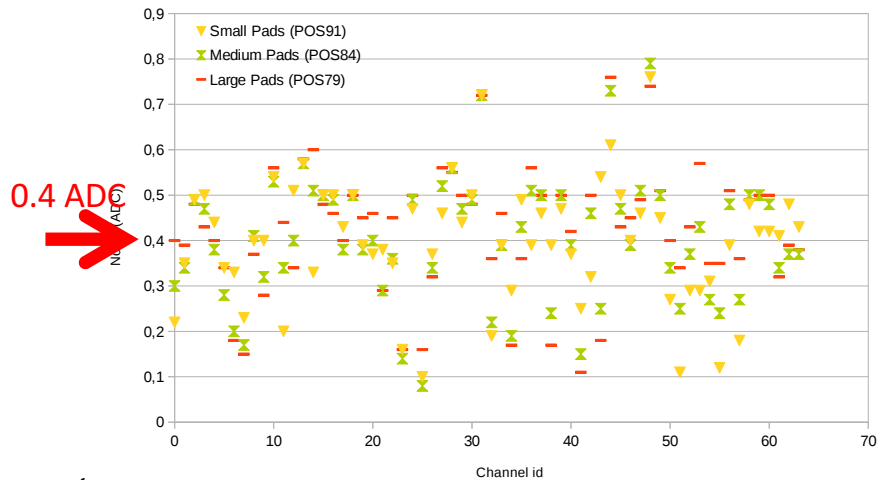
- **Connectors:** 37keuro (2017, 45 keuro s.j.)
- **FLEX production** (102keuro), FLEX mounting (32keuro). Total 134keuro (2018)
- **Cables** (SAMTEC). Actual estimate 88keuro. (2019)

Total (2017-2018-2019): 259keuro

DualSAMPA Noise Performances

- DS12v2 with 200 Ω input resistors (same DS tested in the 3 positions)
- PL600 LPVS induced a sizable noise in the setup
 - Move to lab. LVPS (Agilent)

DS12v2_SAMPAV4 Noise connected to Station 1 Quadrant



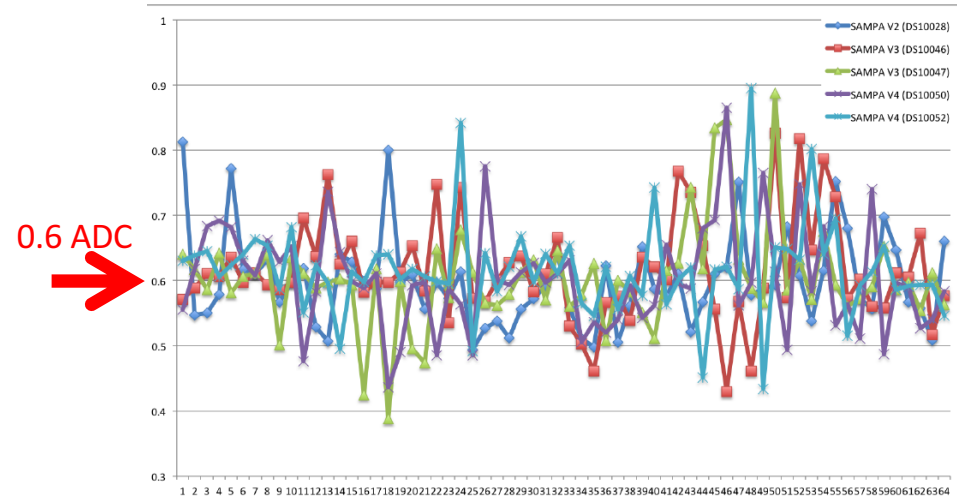
Average noise on ST1 Quadrant:

Small pads: 0.39 ADC

Medium pads: 0.40 ADC

Large pads: 0.42 ADC

Noise Measurements – DS345 Connected to SLAT



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ALICE Group @ IPNO

Average noise on Slat:

0.6 to 0.7 ADC

FLEX production: contacted companies

- Baselectron (prototype produced, mass production estimated, ok)
- SOMACIS (good, prototype to be delivered)
- ERMES (prototype in production)
- CISTELAIER (prototype in production)

Cagliari group

Persone coinvolte nel progetto upgrade:

- Mauro Arba: FLEX integration, DCS
- Corrado Cicaló': coordination
- Davide Marras: FLEX conceptual design, circuit design, tests
- Sabyasachi Siddhanta: coordination, test
- Stefano BOI, borsista
- Alice Mulliri, dottoranda
- Carlo Puggioni: software test