

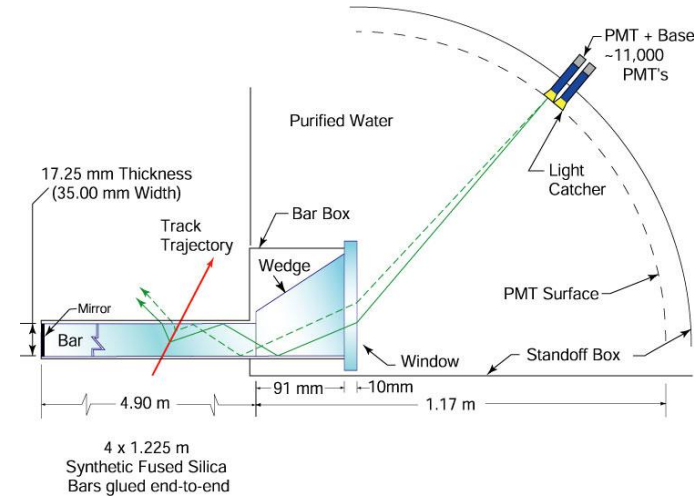
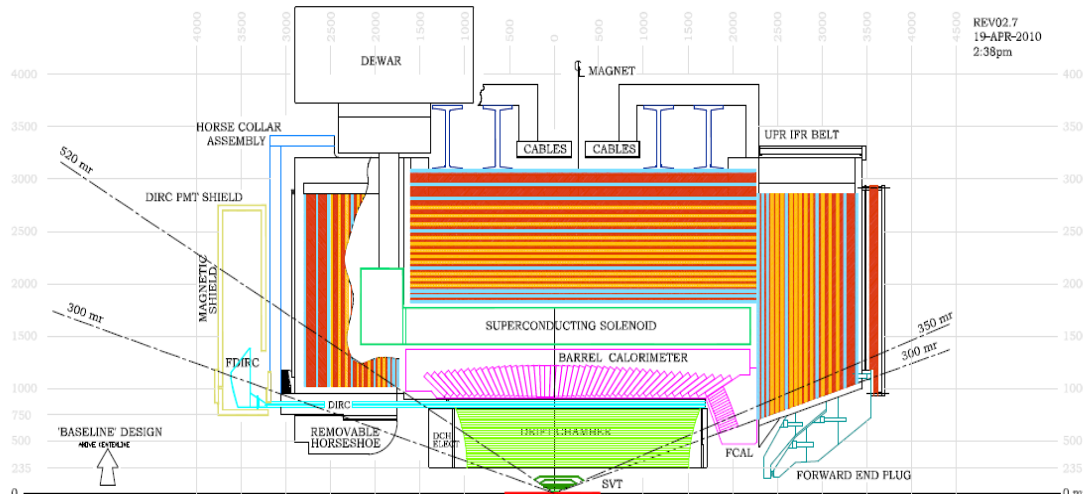
PID:
Status al 22 luglio 2011
draft v22.07.2011

Nicola Mazziotta
Mario Posocco
Gabriele Simi
Firenze Sept 8, 2011

Sezioni: PID 2012

- Bari: 7 fisici
- Padova: 6 fisici + 2 tecnologi

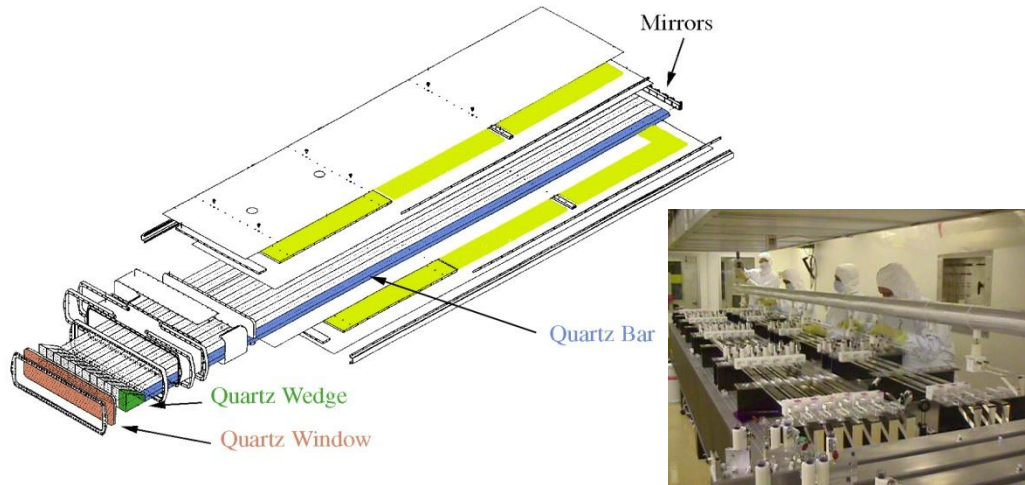
Particle IDentification (PID) Barrel-FDIRC



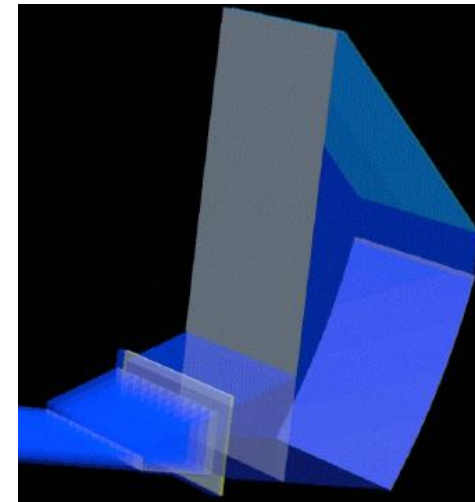
- Based on the successful BaBar DIRC
 - Detector of Internally Reflected Cherenkov light
- Main PID detector for the SuperB barrel
 - K/p separation up to 3-4 GeV/c
 - Performance close to that of the BaBar DIRC
- To cope with high luminosity ($10^{36} \text{ cm}^{-2}\text{s}^{-1}$) & high background
- Complete redesign of the photon camera
 - A true 3D imaging using:
 - 25x smaller volume of the photon camera
 - 10x better timing resolution to detect single photons
 - Optical design is based entirely on Fused Silica glass (FBLOCK)
 - Avoid water or oil as optical media

FDIRC concept

Re-use BaBar DIRC quartz bar radiators

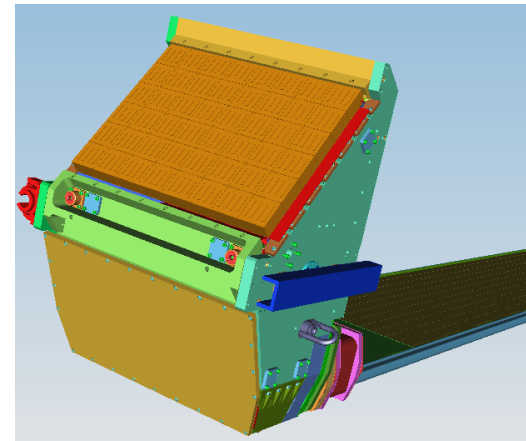
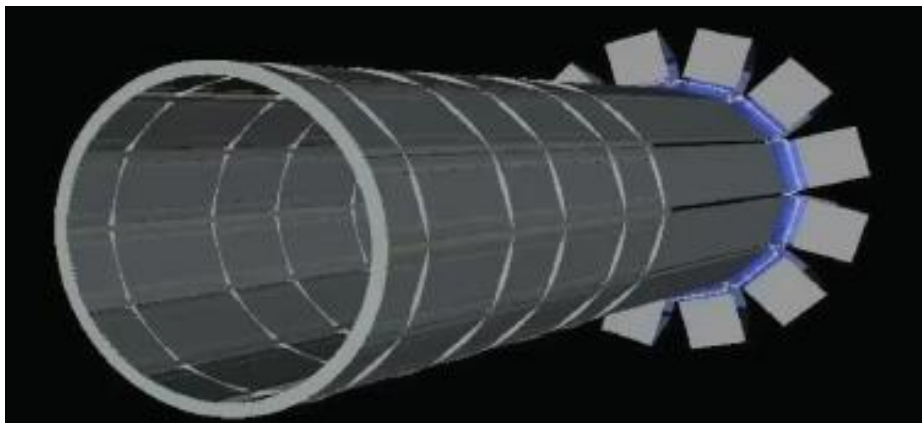


New photon



Geant4
simulation

Photon cameras at the end of bar boxes



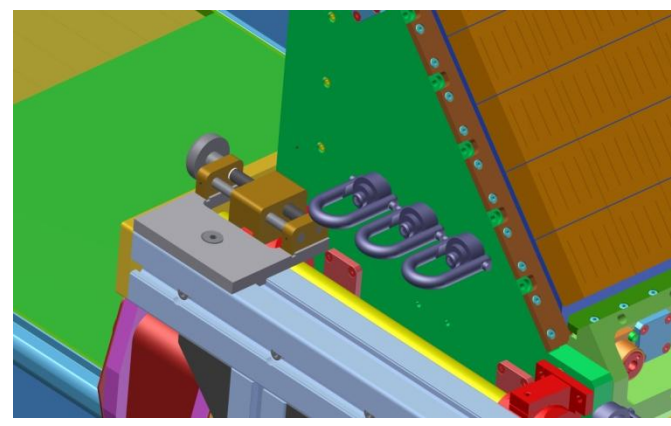
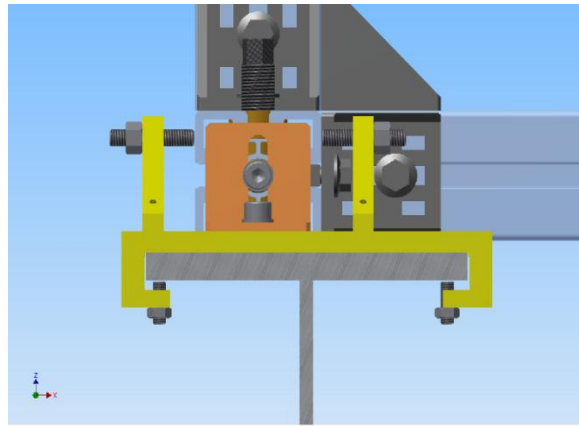
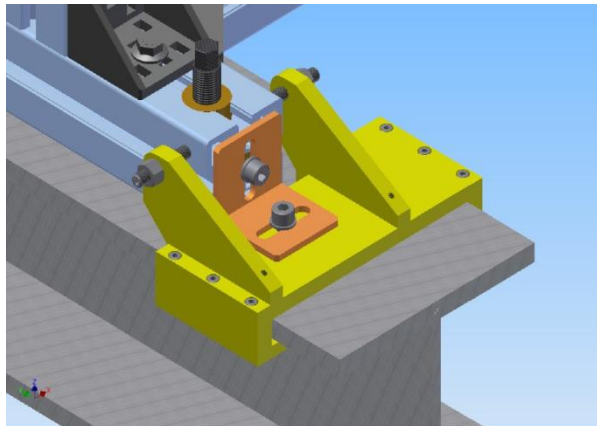
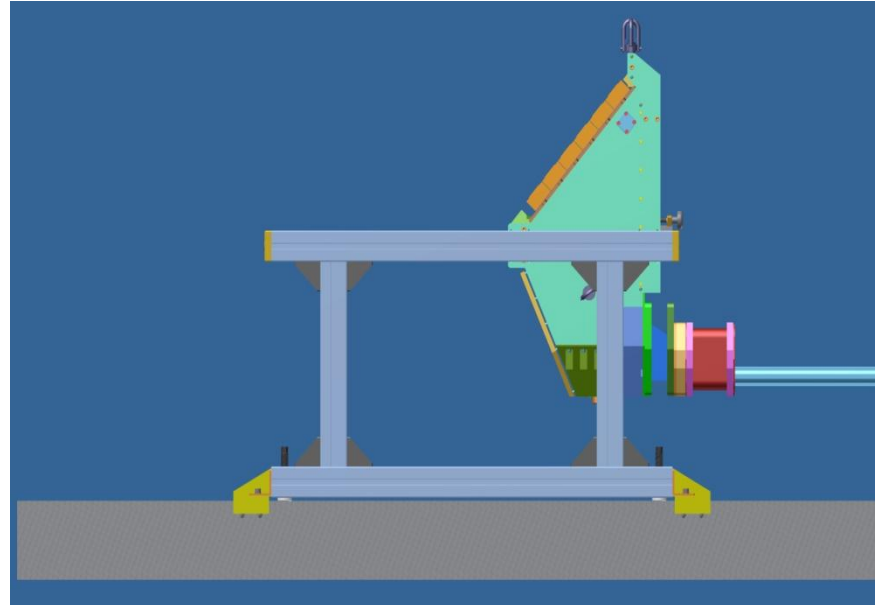
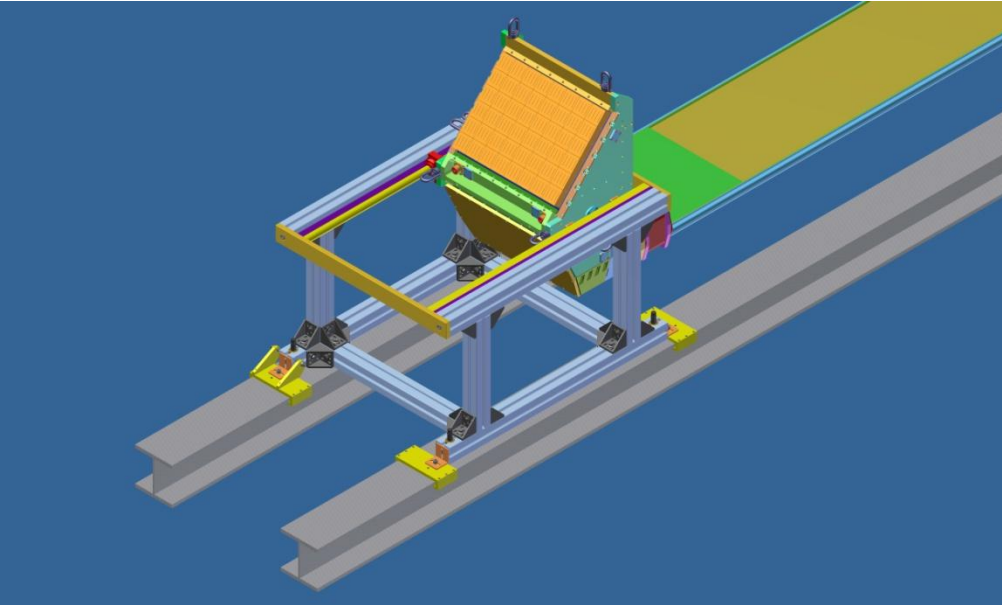
Current
mechanical
design

Attivita' 2011

- Meccanica del prototipo FDIRC (Bari e Padova)
 - Progetto e costruzione di Fbox, supporti, motherboard per MaPMT
 - Progetto e costruzione di Fblock e wedge dummy
 - Definizione procedure assemblaggio
 - Spedizione a Padova delle parti prodotti a Bari fine giugno
 - Operazioni preliminari assemblaggio in Padova
 - Spedizione a SLAC di tutte le parti meccaniche entro luglio
- Stazione di test dei MaPMT in Italia (Bari)
 - Caratterizzazioni: risposta al singolo fotone, timing, cross-talk, uniformità, di guadagno, stabilità sul lungo periodo, effetti di temperatura, effetti dovuto a B, ecc.
 - Definizione specifiche e procedure di accettazione dei MaPMTs
 - Debug elettronica
- Partecipazione alla realizzazione del set-up del CRT a SLAC seconda parte dell'anno (Bari e Padova)
 - Partecipazione alla presa dati
 - Analisi dei dati (ricostruzione immagine, correzione dell'aberrazione cromatica...), simulazioni
- SiPM R&D (Padova)

CRT FBOX support (INFN-BA)

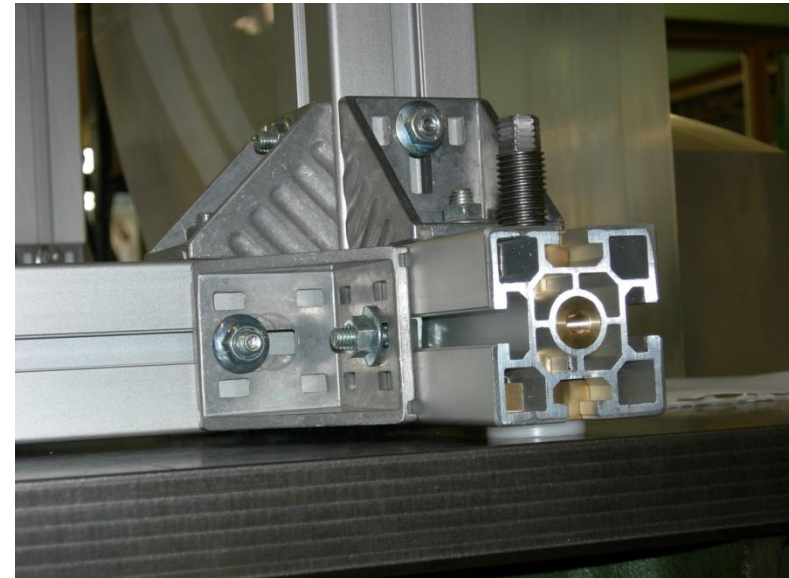
Servizio Progettazione Mecc. INFN-Bari



CRT Fbox support (INFN-BA)

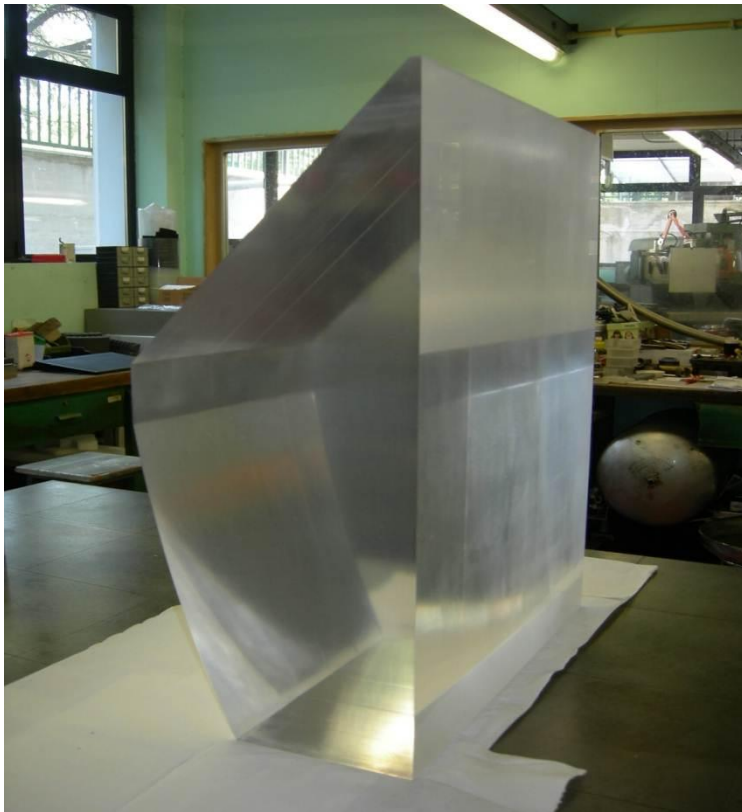


Servizio officina mecc. INFN-Bari

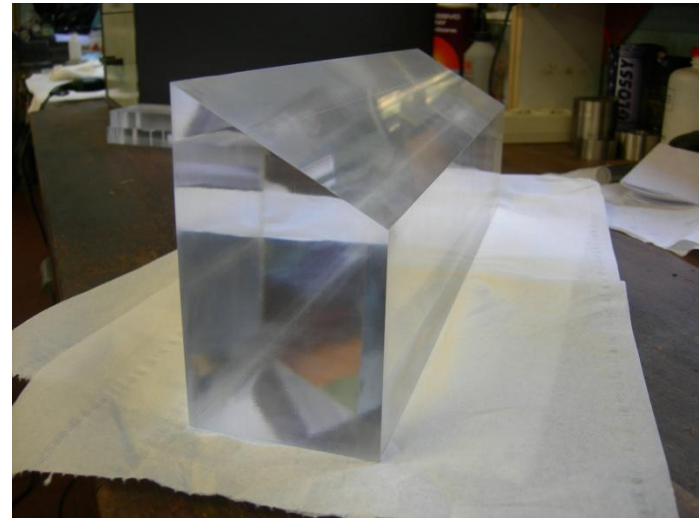


FBLOCK Dummy (INFN-BA)

- E' stato prodotto un modello ingegneristico del FBLOCK
 - 5 pezzi di plexiglas sono stati incollati a formare il dummy
- E' stato anche prodotto un dummy del new wedge

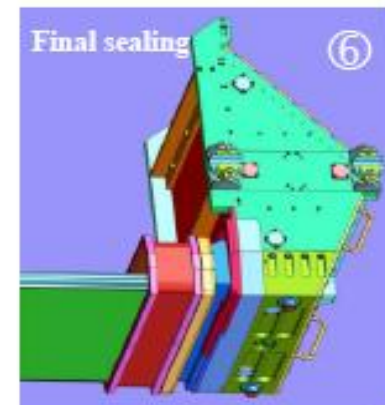
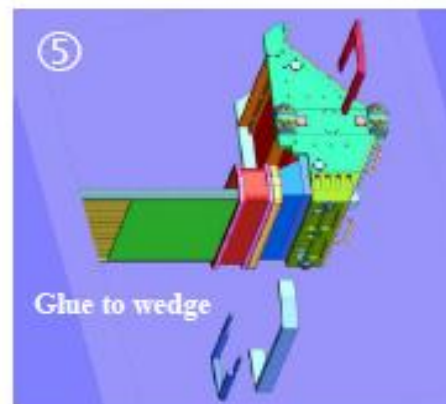
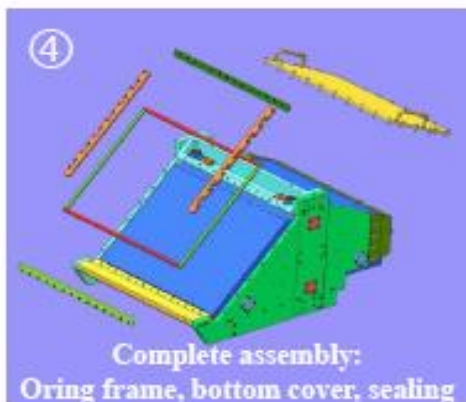
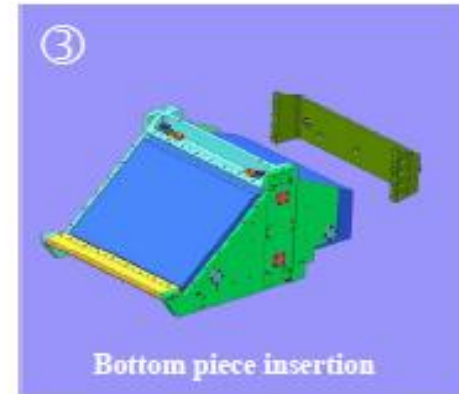
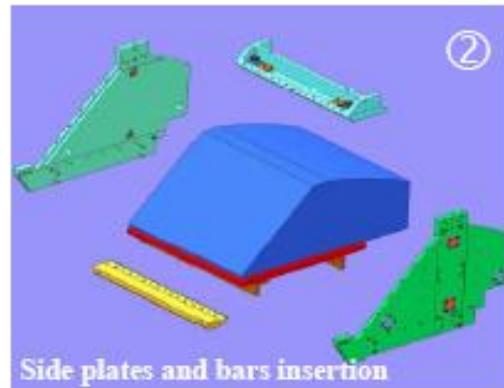


Servizio Officina Mecc. INFN-Bari

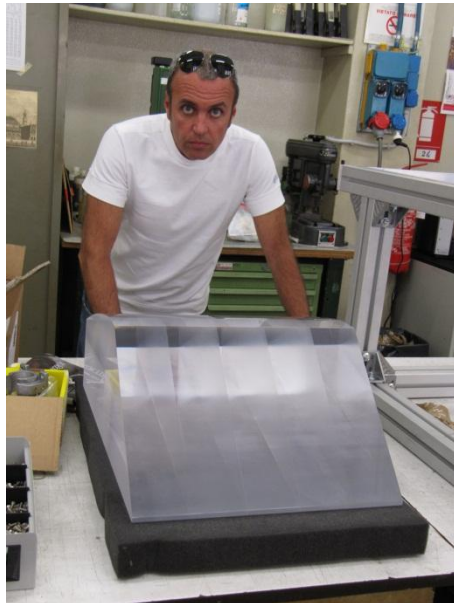
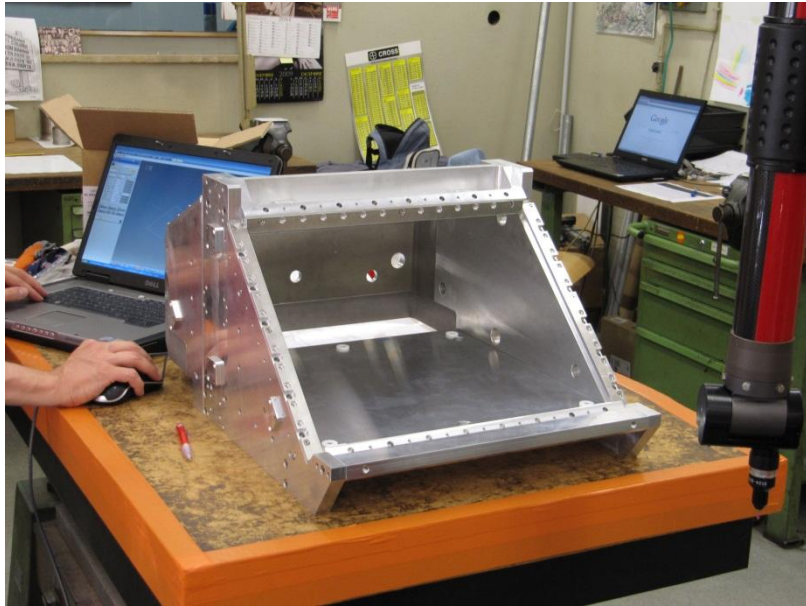


Fbox production (INFN-PD)

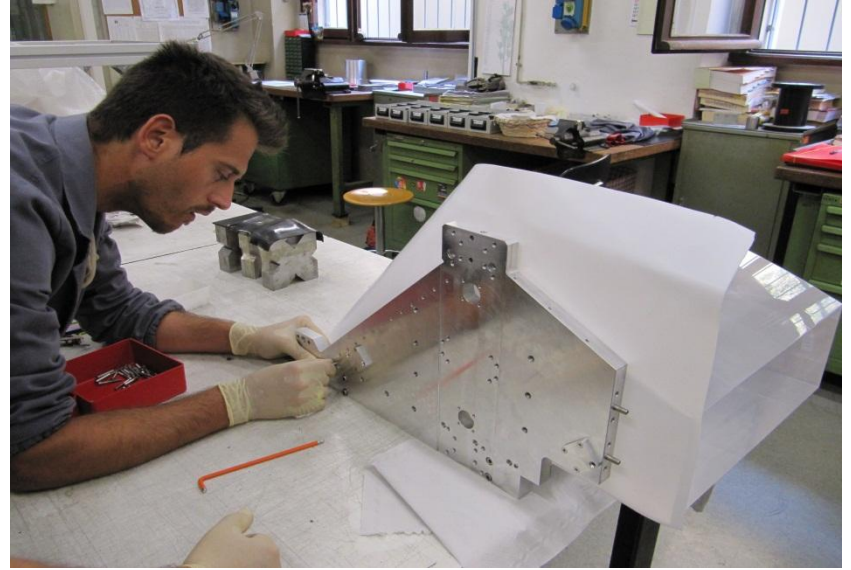
Draft of the Fbox assembly procedure



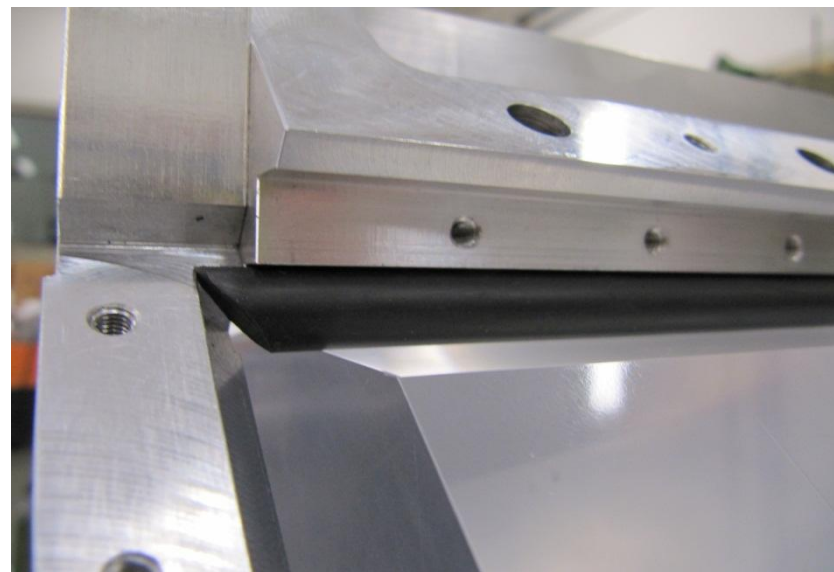
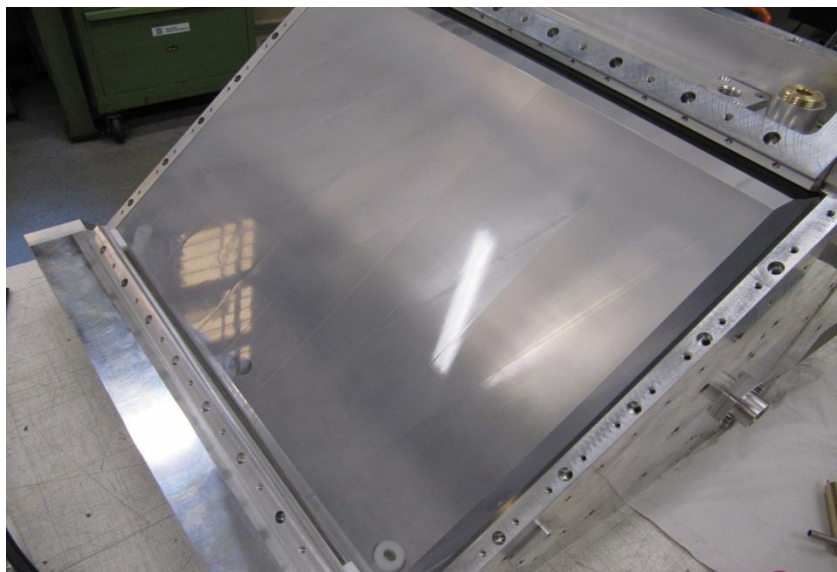
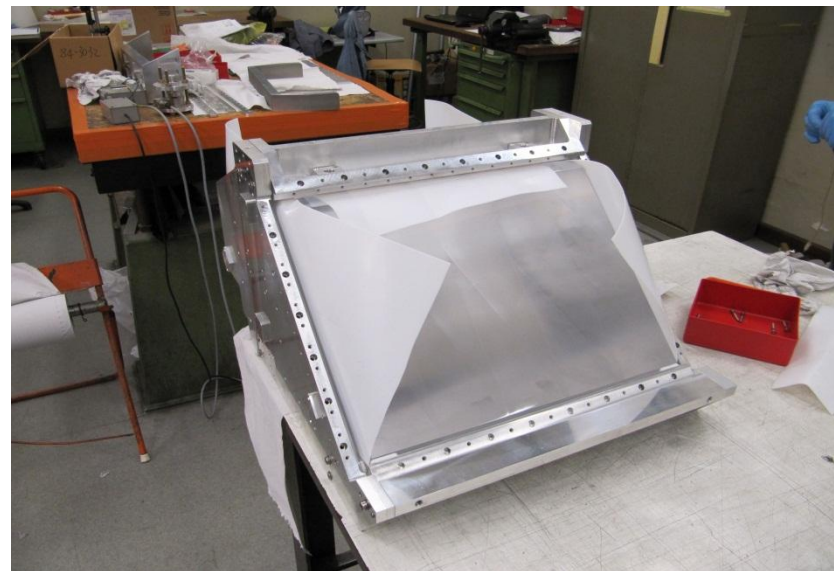
Operazioni assemblaggio presso INFN-PD (1)



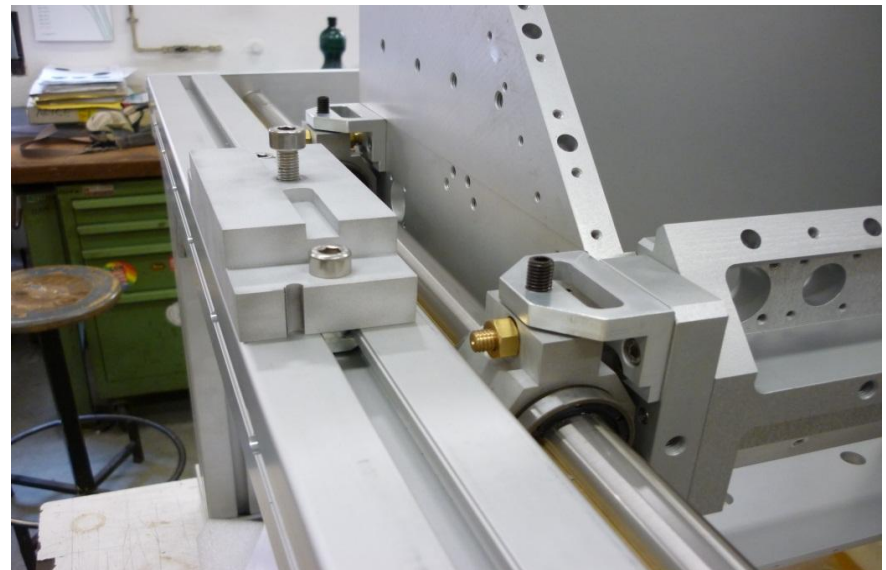
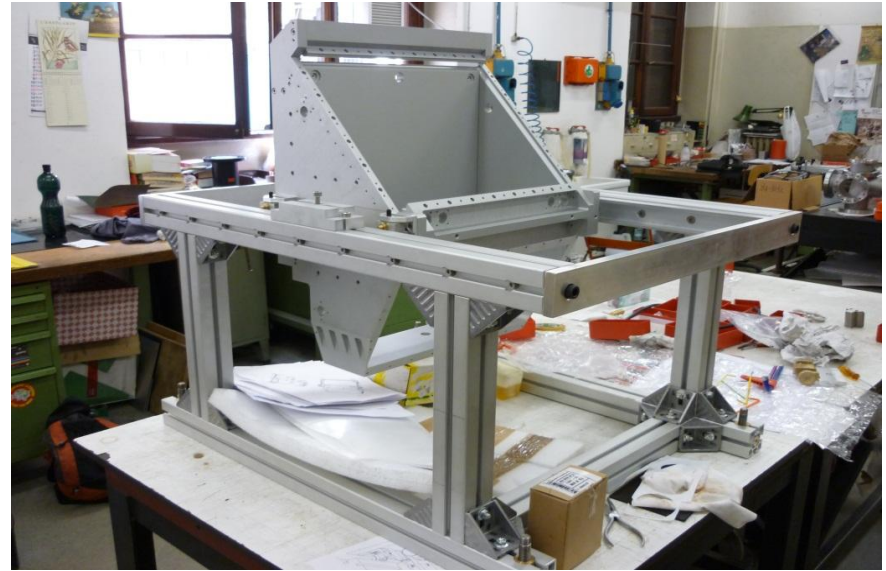
Operazioni assemblaggio presso INFN-PD(2)



Operazioni assemblaggio presso INFN-PD (3)



Operazioni assemblaggio presso INFN-PD (4)



FBLOCK and New Wedge

J. Va'vra

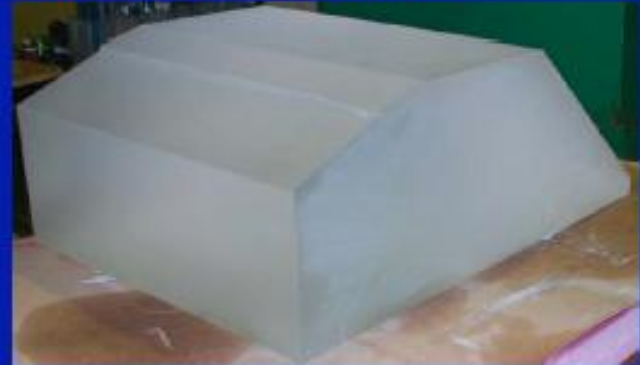
Saw to make a raw cut on the block:



Lifting of the raw block:



FBLOCK after a raw saw cut:



New wedge after a raw saw cut:



- Pictures show parts after a raw cut by the saw.

5/31/11

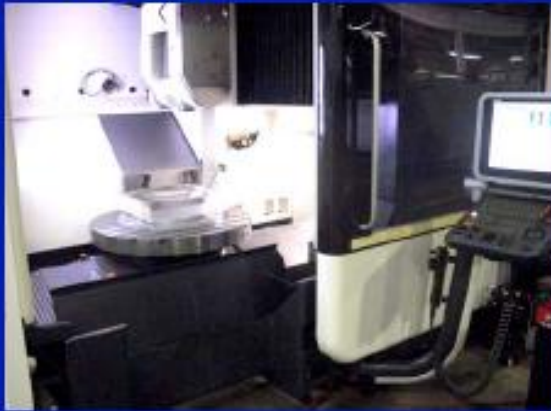
J. Va'vra, FDIRC status & tasks

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FBLOCK and New Wedge

J. Va'vra

NC machine:



FBLOCK on the machine:



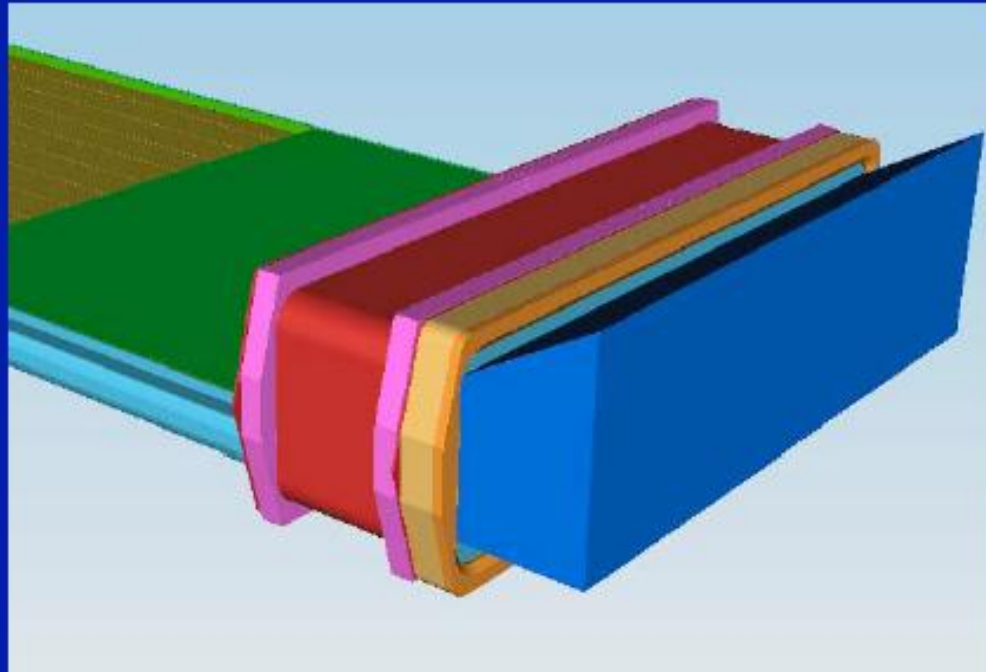
- **Precise grinding was done on a 5-axis NC machine (magnetically floating bearings). Machine costs: \$750k.**

5/31/11

J. Va'vra, FDIRC status & tasks

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Wedge to bar box gluing



- It will be done with Epotek 301-2 epoxy.
- It will be done in the clean room.
- Matt prepared a fixture for gluing.

5/31/11

J. Va'vra, FDIRC status & tasks

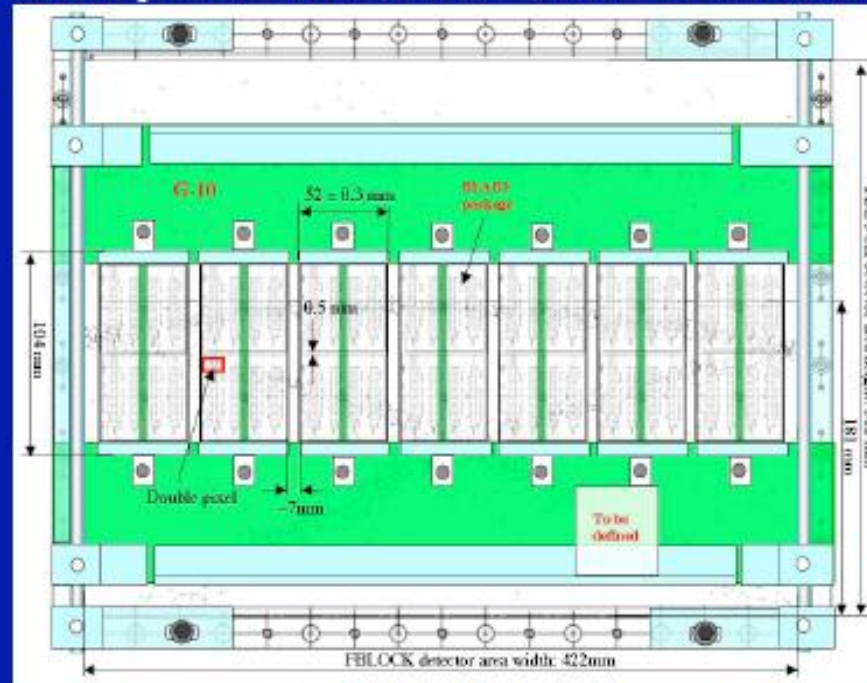
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Operazioni preliminari di incollaggio con il wedge dummy

FDIRC prototype detector layout

J.Va'vra with input from G. Varner, D. Roberts, M. Benettoni and M. McCulloch

Proposed
initial
BLAB3
layout:



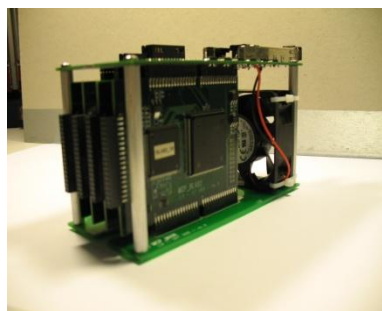
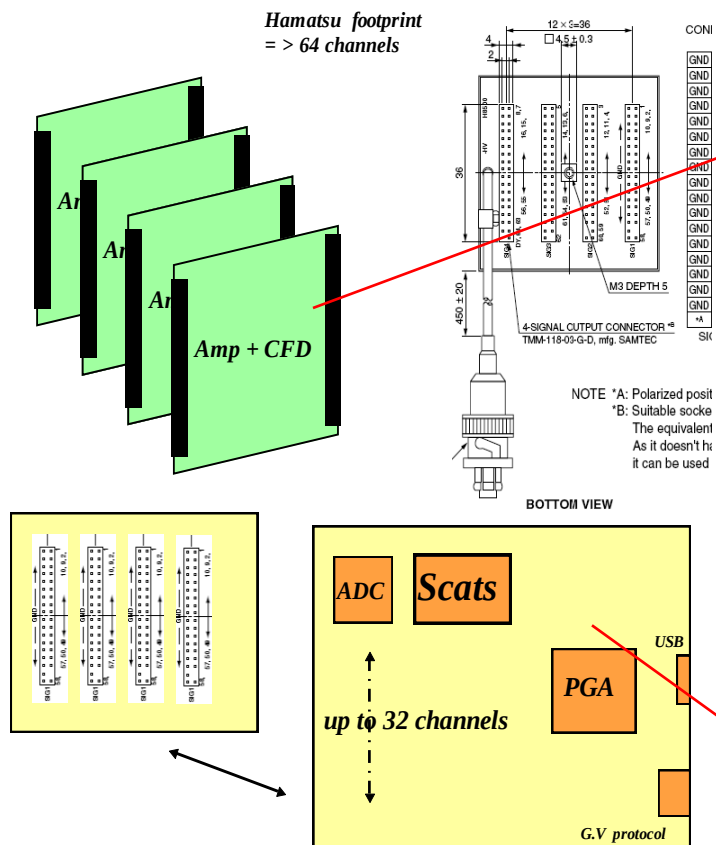
- Initial design assumes seven BLAB3 double-packages right now (14 detectors).
- BLAB3 electronics will read every pixel. LAL-Orsay electronics will combine two pixels horizontally, as is planned for the FDIRC at SuperB. One empty extra slot for a tube to monitor the CRT events & laser pulses, or a place for G-APD array ?
- It will be modified as we will have more H-8500 MaPMTs.

5/31/11

J. Va'vra, FDIRC status & tasks

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Electronic activities at Orsay



Mezzanine : -8 channels CFD like + Amp for charge measurement : the design is ongoing with a new collaborator @ LPNHE

We are building the PM setup thanks to the expertise of Veronique 's team.

We plan to test the performance of the mezzanine with a wave catcher board and its software : time (discriminator) and charge are acquired to measure the walk

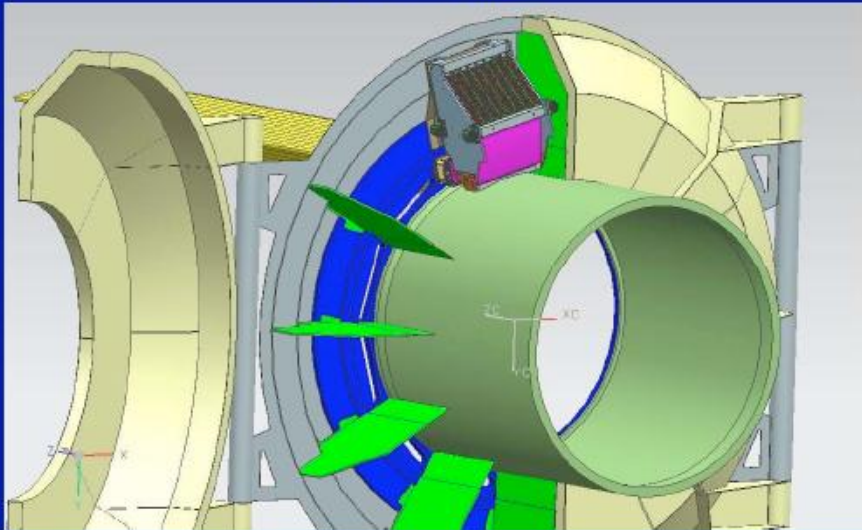
Mother board : ADC + SCATS + FPGA

- Associate time & charge
- Data packing.
- Bus interface : USB, GVbus

-> equips both PM test setup @ Orsay and CRT

How could FDIRC look like ?

Massimo Benettoni, Padova



- This drawing just shows a direction we are heading.

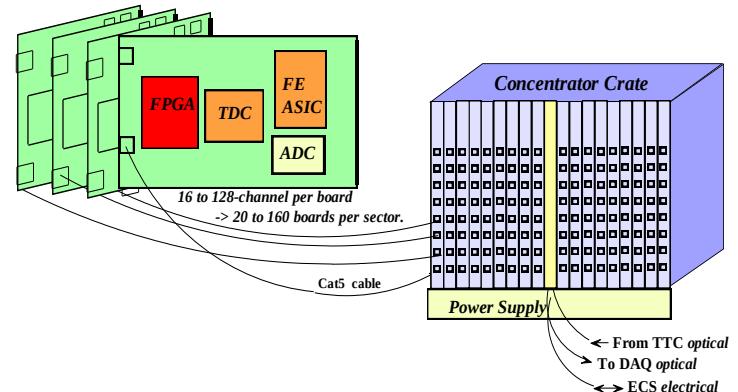
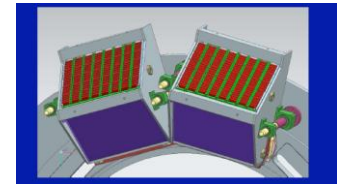
7/28/2009

J. Va'vra, FDIRC design update

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Electronics is split in two parts :
- one directly mounted on the PM base receiving the PM signal and processing it with TDC/ADC
- the other one concentrates and pack all the channels to send data to the DAQ

Detector : 12 sectors -> ~ 36 k channels



Electronics on the detector :

Mechanical constraints

->FBLOCK design

Thermal constraints

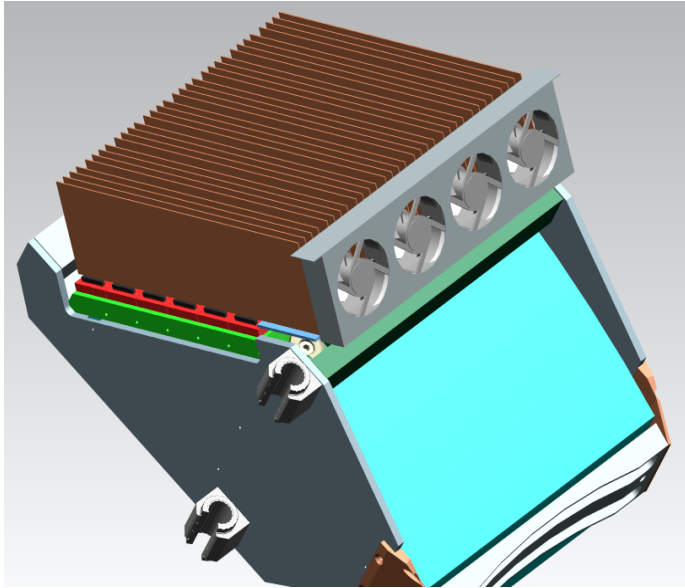
-> 200 w per crate to be confirmed

Power distribution issues .

->Could use rad hard power supply like LHCb

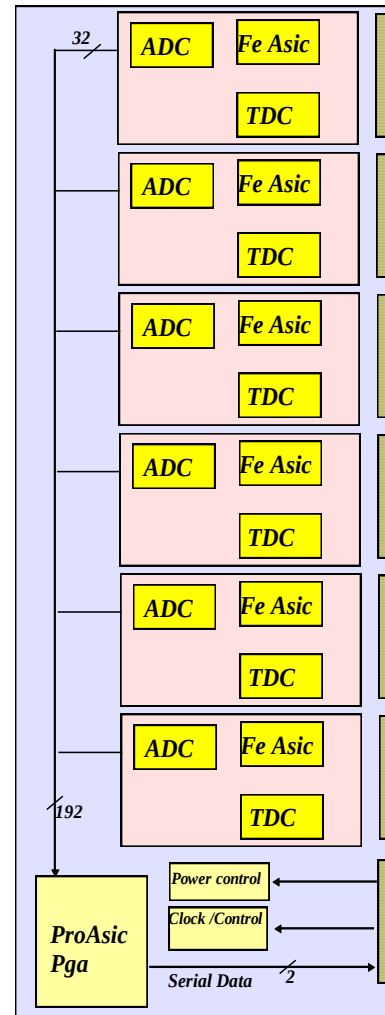
Cables and links

Only one link per sector

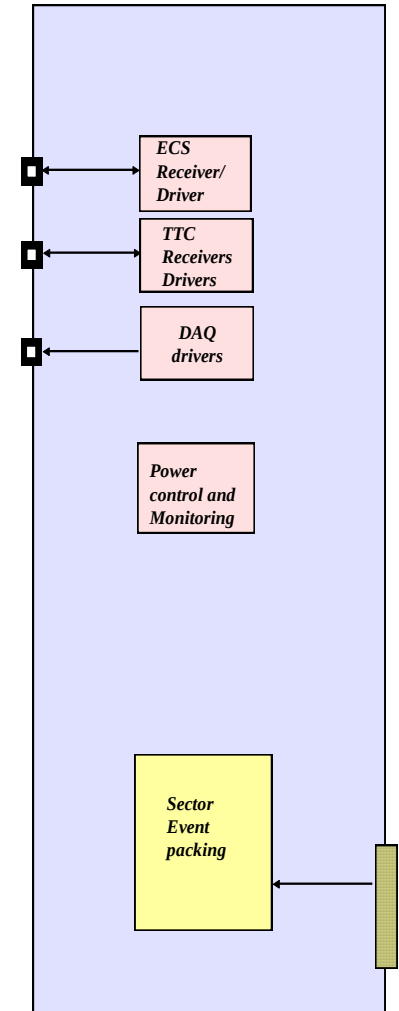


- PCB FE boards plugged into “crate slots”
- PCBs and backplane(s) partitioned in columns could be removed “completely”

FBLOCK



32 * 1U Fe Board

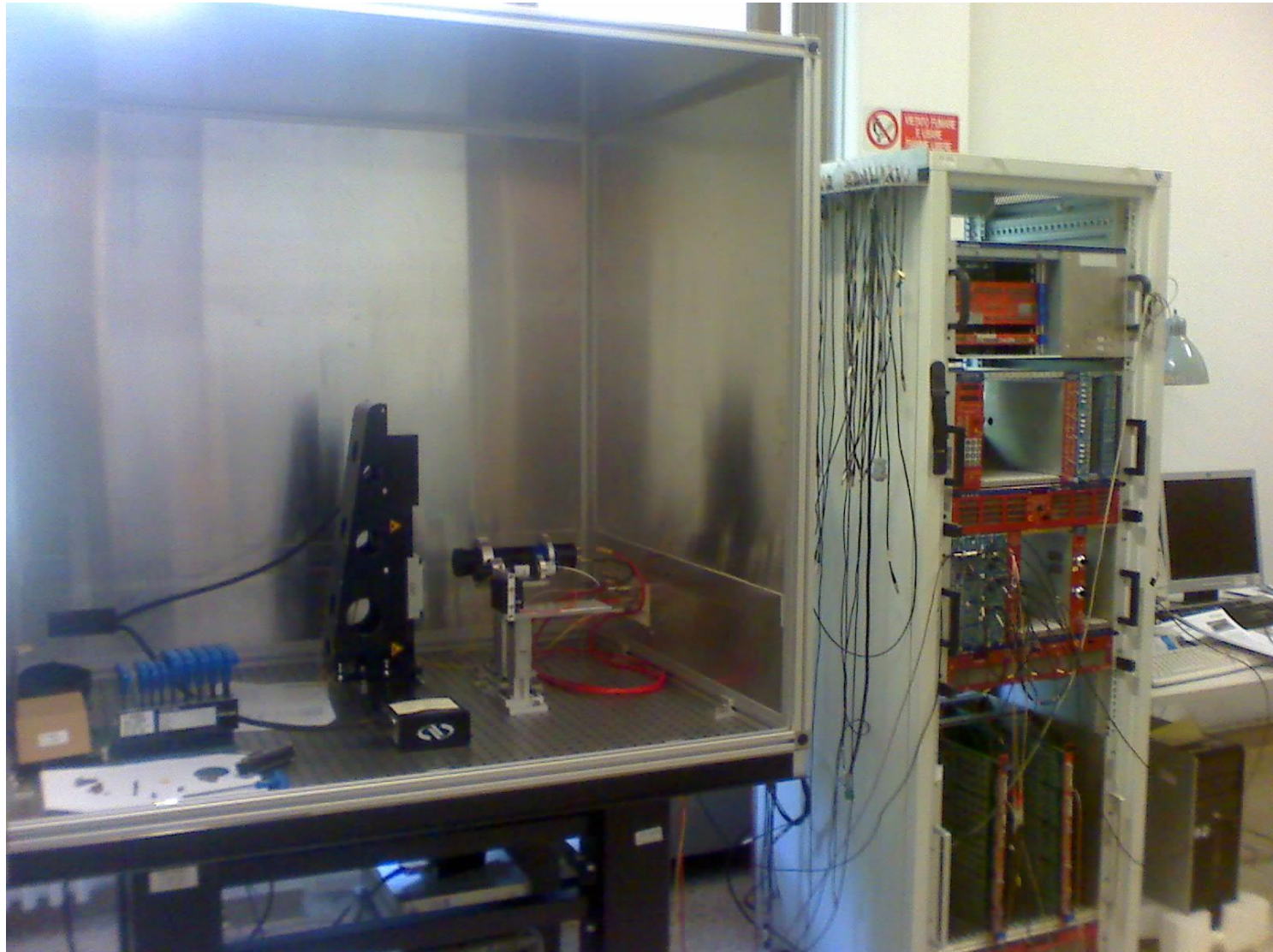


2U Sector Control board

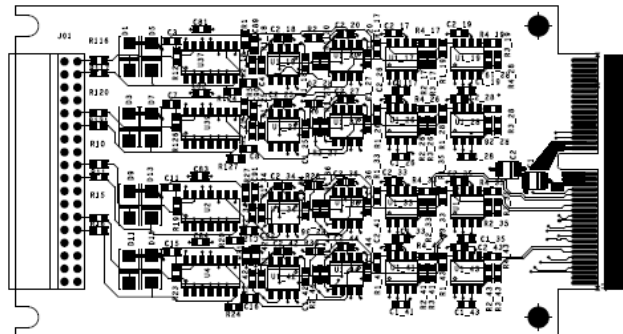
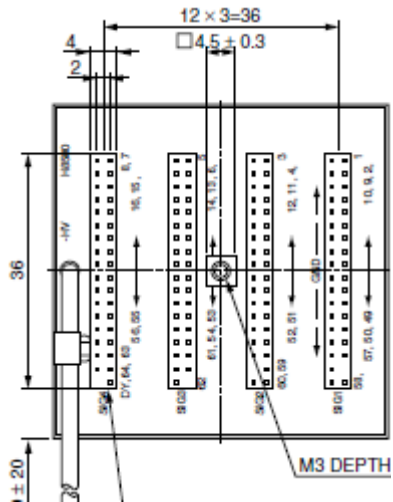
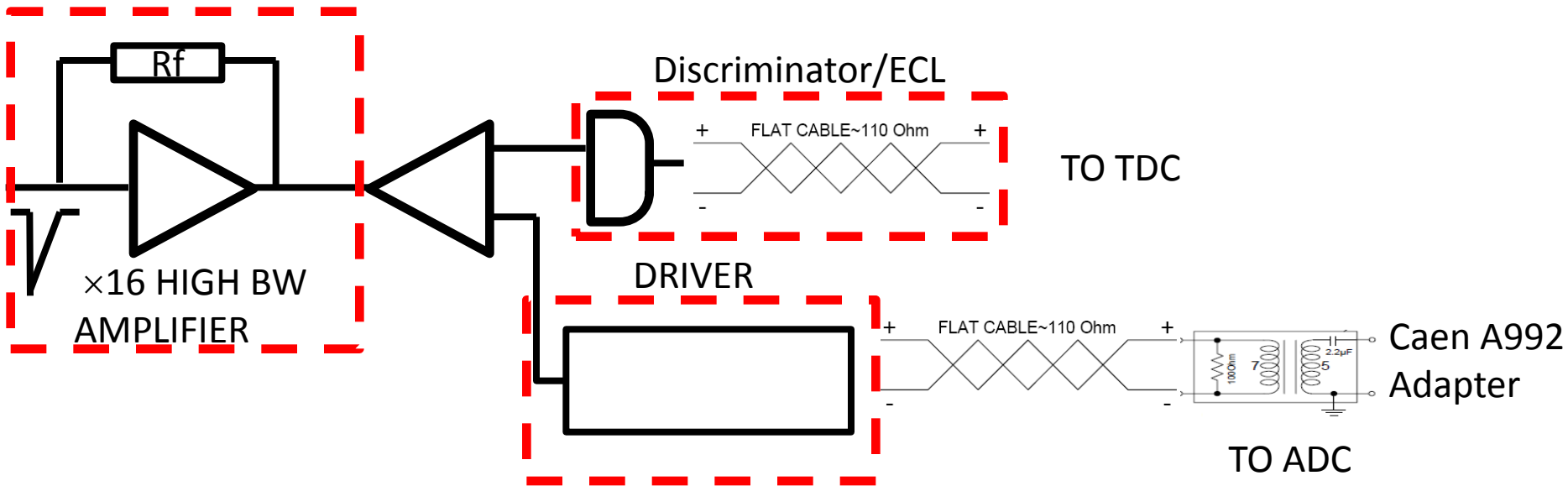
Piano sviluppo elettronica PID

- Pre-produzione TDC Orsay (SCATS)
 - Test e caratterizzazione con i set-up MaPMT (Bari e Padova)
- Pre-produzione “Mezzanine” (CFD like + Amp for charge measurement)
 - Test e caratterizzazione con i set-up MaPMT (Bari e Padova)
- Integrazione elettronica Orsay set-up CRT
 - Nuova presa dati con cosmici

Set-up studi MaPMT (INFN-BA)



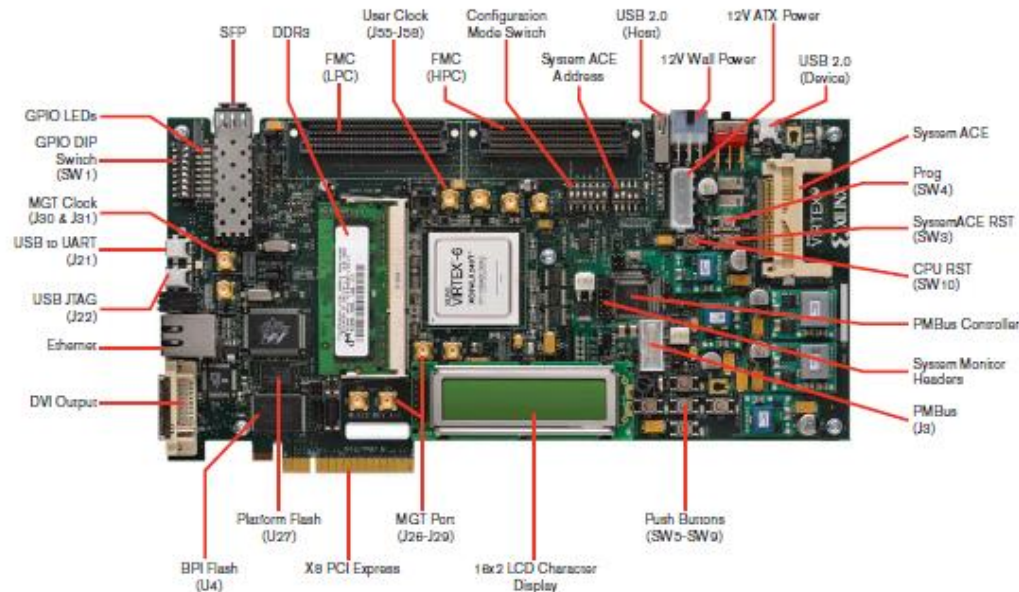
PCB AMPL+DISC (INFN-BA)



Possibilità di utilizzare questa scheda durante il CRT con una versione preliminare dell'elettronica sviluppata dal gruppo LAL

Electronics & PMT test station setup (PD)

- CAEN V1742 Waveform Digitizer
- Burle MCP PMT & H8500
- To be completed with
 - Xilinx ML605
 - 8 optical links input module
- ROM simulation (available)
- Code to read the DIRC data stream



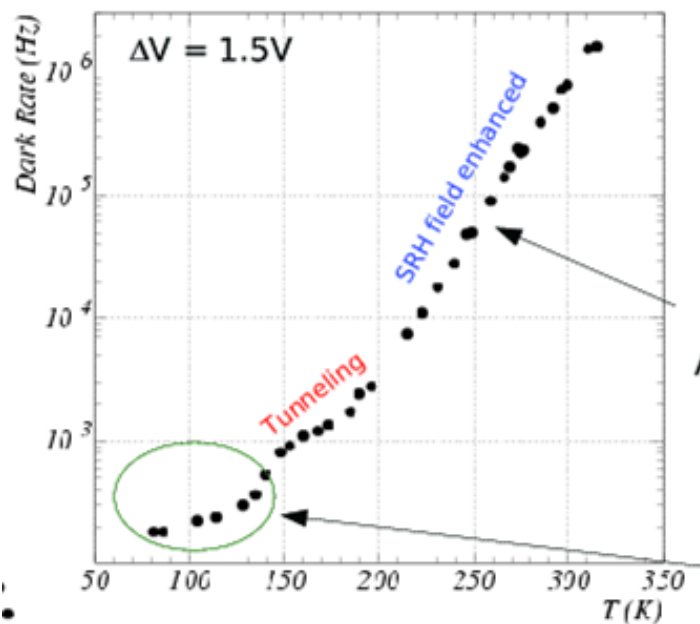
SiPM readout for barrel DIRC (PD)

- Idea:
 - substitute MaPMT readout with: SiPM (+ a focusing system), no modifications to fBlock
- Advantage:
 - detected photons 3x more due to higher PDE and wider spectral response
 - =>Cherenkov angle resolution $\sqrt{3}$ better
- Cost: similar or less (needs to be defined more precisely)
- R&D areas:
 - SiPM characterization, optical system, cooling & mechanical support, radiation hardness
 - problems: needs cooling and focusing=> more complication

SiPM: dark rate and cooling

- Dark rate@300K: 1MHz/mm²=>occupancy>100%
 - cooling necessary: at 200K => occupancy<1%
- Tested also on irradiated devices at T(CO₂)

Test at dry ice temperature (-78.5 °C)

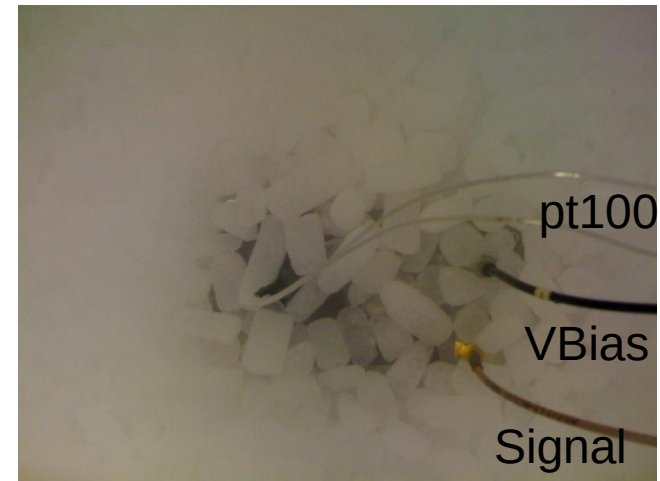


Measurement of
counting rate of ≥ 1 p.e.
at fixed $\Delta V = 1.5V$
($\rightarrow$ constant gain)

$$DCR \sim T^{1.5} \exp \frac{-E_{act}}{K_B T}$$

Activation energy $E_{act} \sim 0.36eV$

??? onset of carriers freeze-out
(carrier losses at very low T)



SiPM: Thermal insulation

- Difficult problem because of clear window to allow Cherenkov light. Two possibilities
 - Cool the entire FBLOCK and enclose it in an insulated container
 - Problem: expensive and difficult engineering
 - Reduce the size of the SiPM sensor by use of focusing optics: problems
 - Significant loss of efficiency
 - Temperature gradient in the crystal
 - Alignment
- => no satisfactory solution found

Impegni e attività: CRT 2012 (BA+PD)

- Finalizzazione/Update setup
 - Meccanica prototipi (Fbox, supporto Fbox, ecc)
 - Prototipo MaPMTs motherboard
 - Ottimizzazione/upgrade sistema tracciamento muoni cosmici
- Presa dati
- Software ricostruzione
- Analisi dati
- Simulazione dedicata

Sommario richieste 2012

- Proseguimento attività CRT a SLAC
 - Supporto per upgrade e realizzazione Fbox
 - Progettazione e realizzazione del prototipo della motherboard per i MaPMTs
 - Importante l'interazione con il gruppo di Orsay
 - Presa dati ed analisi
- Completamento scanning set-up MaPMT
- Studio e progettazione sistema HV
- Test di irraggiamento a LNL
- Progettazione, integrazione, prototipi, ecc. FDIRC-SuperB

Richieste PID 2012

Sede	Capitolo	Descrizione	Rich. k€	Richi. SJ k€
BA	INTERNO	Contatti per struttura meccanica	6	
BA	INTERNO	Contatti per responsabilità (resp. PID-IT condivisa tra BA e PD in quanto il PID non ha un convener italiano)	0.5	
BA	ESTERO	Contatti per responsabilità (resp. PID-IT condivisa tra BA e PD in quanto il PID non ha un convener italiano)	1	
BA	ESTERO	Partecipazione CRT a SLAC (8*1 week)	20	
BA	ESTERO	Contatti con il gruppo LAL (2*1week) per sviluppo elettronica	3	
BA	CONSUMO	Materiale di consumo per assemblaggio magneti in configurazine bobine di Helmholtz (fili di rame, meccanica di supporto, ecc)	3	
BA	CONSUMO	Upgrade elettronica con uscita LVDS per scanning set-up	4	
BA	CONSUMO	Produzione meccanica per prototipi e upgrade meccanica CRT (supporto Fbox, PMT motherboard)	5	
BA	CONSUMO	Prototipo scheda di supporto PMT per CRT	10	
BA	TRASPORTI	Trasporto meccanica prototipi	2	
BA	INVENTARIO	MaPMT H8500 dedicato a studi in campo magnetico	3.5	
BA	INVENTARIO	MaPMT H10966A-100 per studi PMT fotocatodi ad alto QE	4.5	
BA	INVENTARIO	1 Modulo ADC VME CAEN V792 (32 ch) per studi MaPMT	4.5	
BA	INVENTARIO	2 Moduli TDC VME CAEN V1290(32 ch, 25 ps LSB) per studi MaPMT	15	
BA	INVENTARIO	Sistema microPCI (chassis, CPU, HD, RAM, Ethernet) per test prototipi moduli di elettronica	7.5	
PD	INTERNO	Contatti per struttura meccanica	6	
PD	INTERNO	Contatti per responsabilità (resp. PID-IT condivisa tra BA e PD in quanto il PID non ha un convener italiano)	0.5	
PD	ESTERO	Contatti per responsabilità (resp. PID-IT condivisa tra BA e PD in quanto il PID non ha un convener italiano)	1	
PD	ESTERO	Partecipazione CRT a SLAC (8*1week)	20	
PD	ESTERO	Contatti con LAL (2*1week)	3	
PD	CONSUMO	Upgrade della FBOX per il cristallo del CRT	15	
PD	CONSUMO	Prototipo scheda di supporto FEE per distribuzione HV e link ottico con DAQ	10	
PD	TRASPORTI	Trasporto meccanica prototipi	3	
PD	INVENTARIO	2 MaPMT H8500 per la stazione di test di integrazione detector+elettronica	7	
PD	INVENTARIO	Scheda di sviluppo FPGA Xilinx ML605 per test di integrazione detector+elettronica	2	
PD	INVENTARIO	pc per acquisizione FPGA	2	
PD	APPARATI	Ordine 7 cristalli per FBLOCK (sub giudice ai risultati del CRT)		546
PD	APPARATI	Ordine per un cristallo per FBLOCK (richiesta alternativa alla precedente per 7 cristalli per upgrade FBLOCK)		78