# DUNE-RM1 Activities

Antonio Di Domenico
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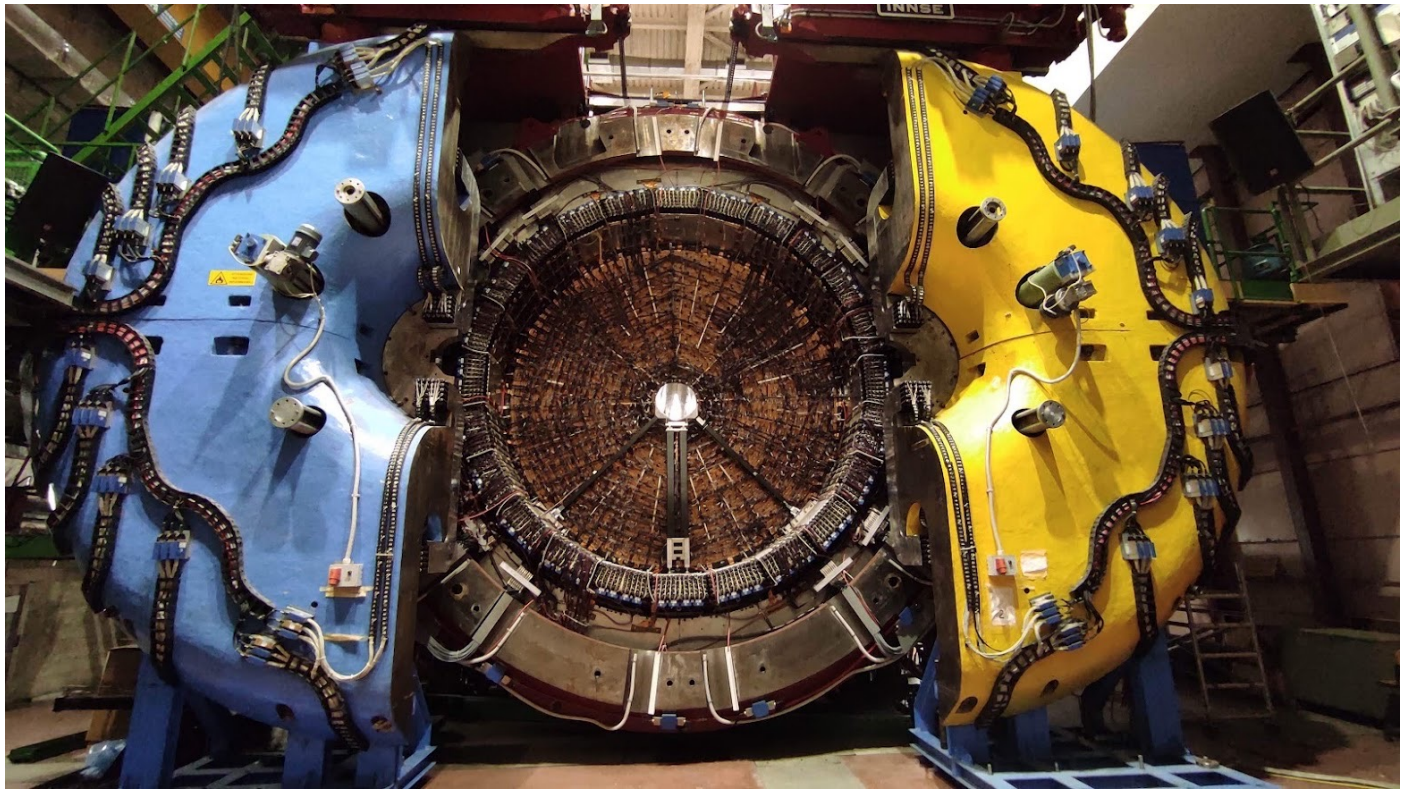


Riunione discussione preventivi CSN1 – Bologna 20th June 2024

# KLOE-to-SAND activities at LNF

Plan of operations:

✓ Removal of all cables and the FEE+HV racks

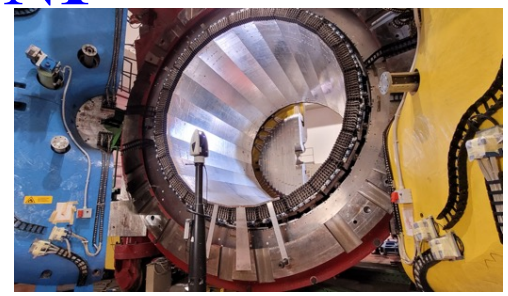
✓ Extraction of the Drift Chamber

**Calorimeter**

✓ Laser tracker survey before ECAL dismounting

✓ Extraction of Barrel (24 modules)

- original insertion/extraction machine completely refurbished and operational; movable platform built;
- extraction completed on 9th May (less than 3 months)

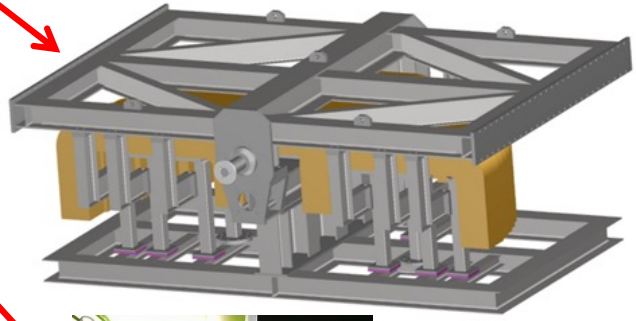


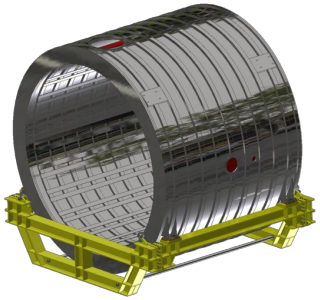
- Dismounting of EndCaps
  - original insertion/extraction/rotation machine is being refurbished and modified
- Operational test of ECAL modules
- Studies for the ECAL working point & FEE

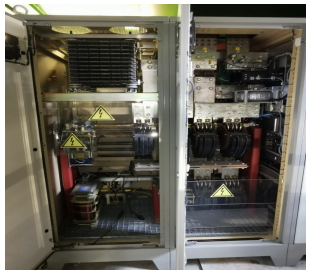
**Magnet and Yoke**

- Installation of new Power Supply
  - new power supply units and revamping of power circuitry (dump resistors, contactors etc.) provided by OCEM
  - Control system and full support for magnet test/ dismount/remount by ANSALDO ASG
- Cooling of coil
- Operational test of magnet
  - in preparation
- Extraction of coil
- Dismounting of Iron Yoke

**Packaging & Shipping at Fermilab**

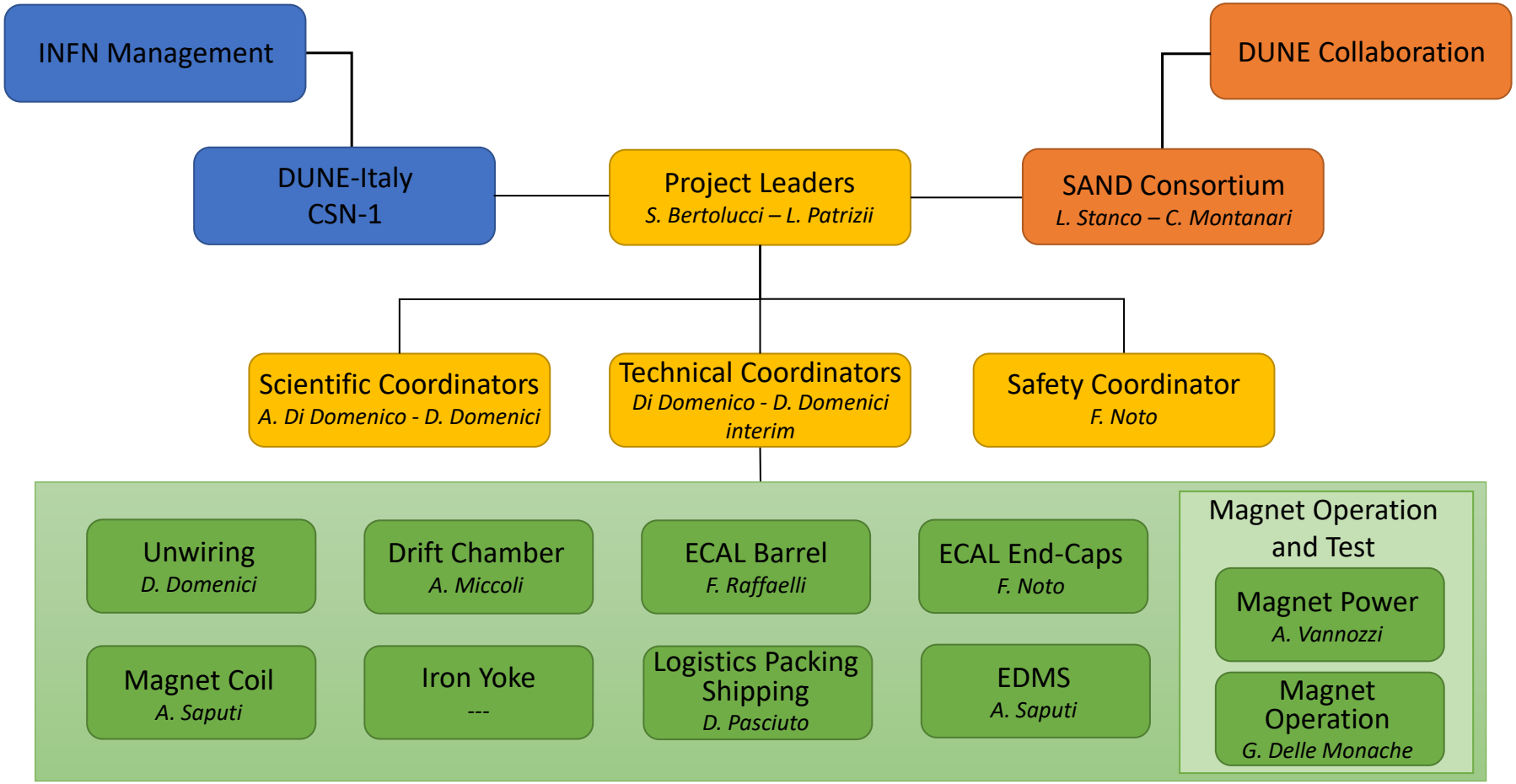




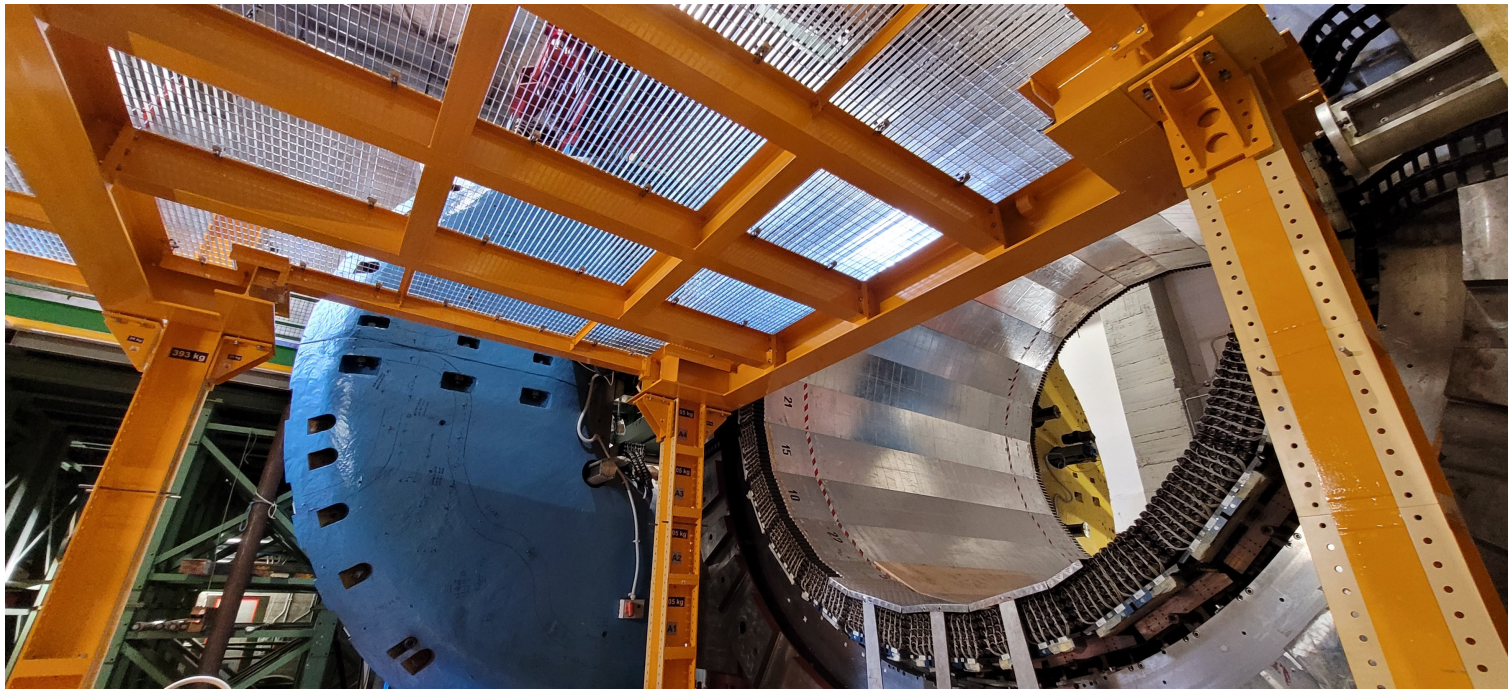


KLOE PS Dump resistor and contactors

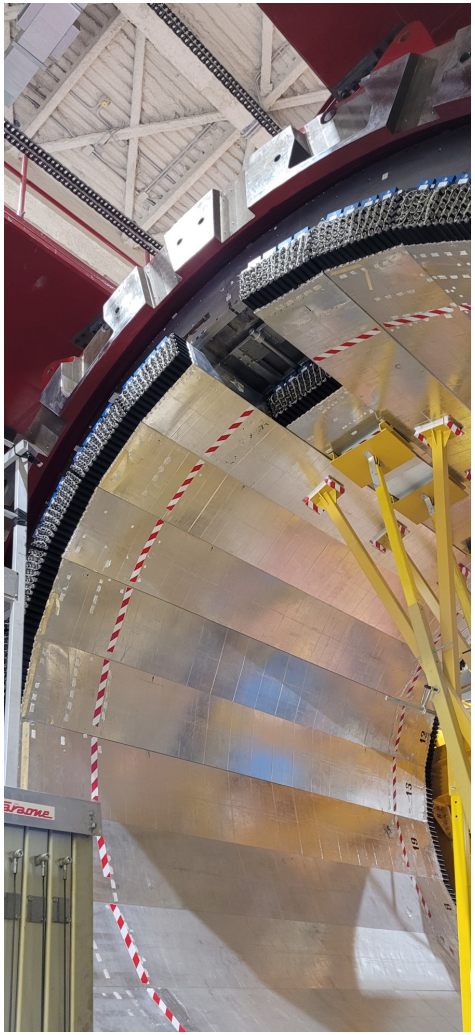
# KLOE-TO-SAND Project OBS

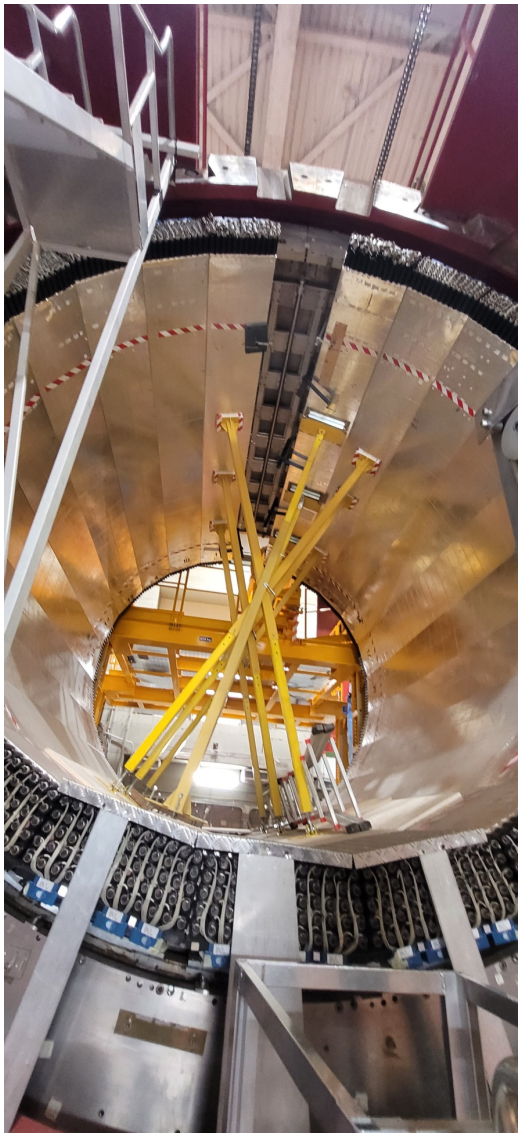


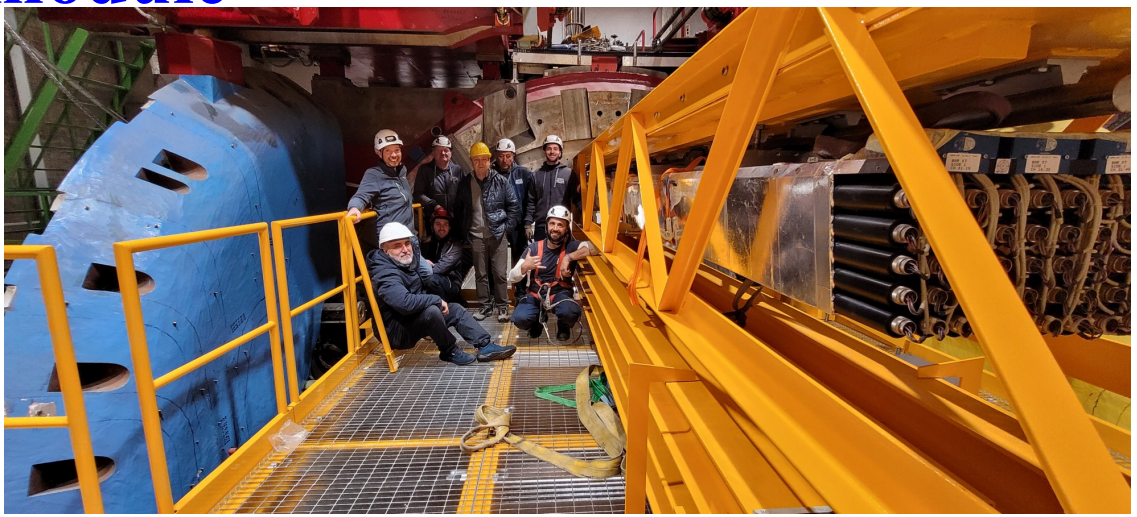
# mounting the movable platform



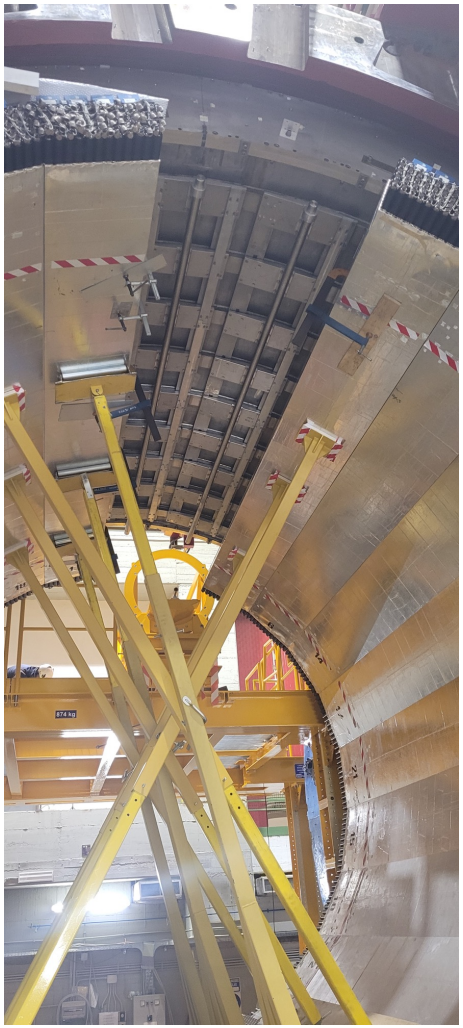
# Extraction of the first barrel module

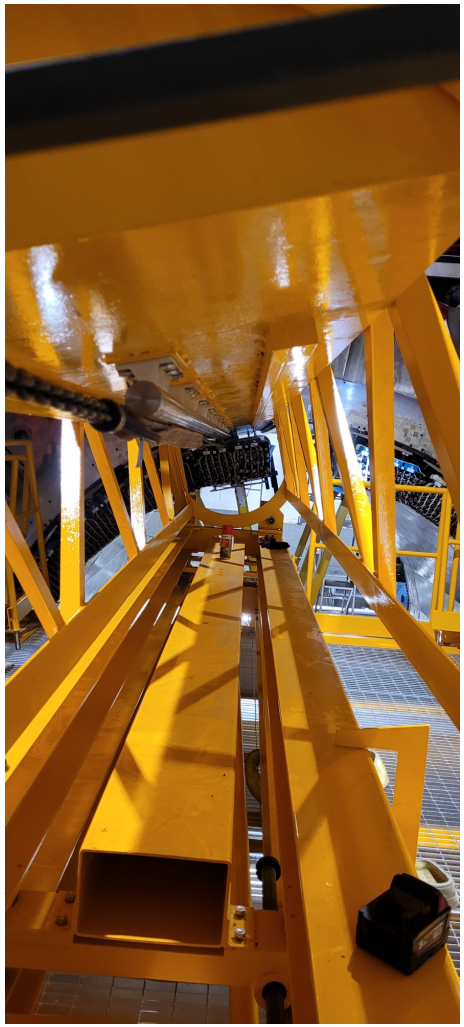


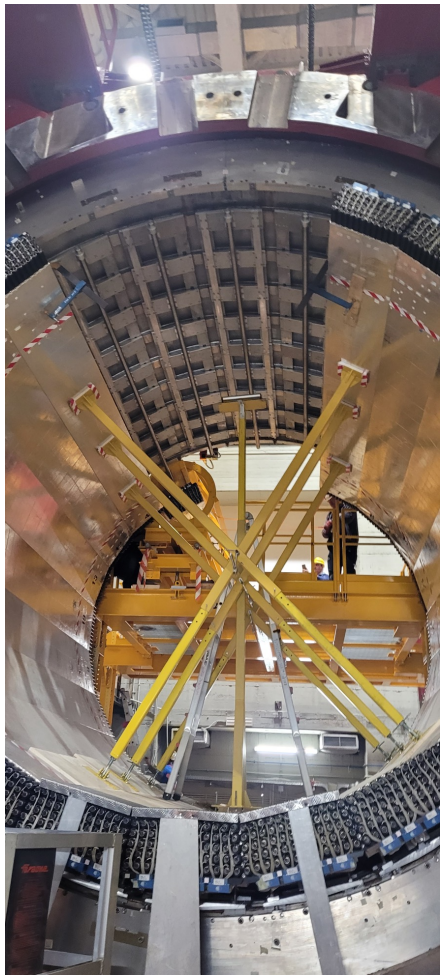




# ECAL barrel dismounting in progress



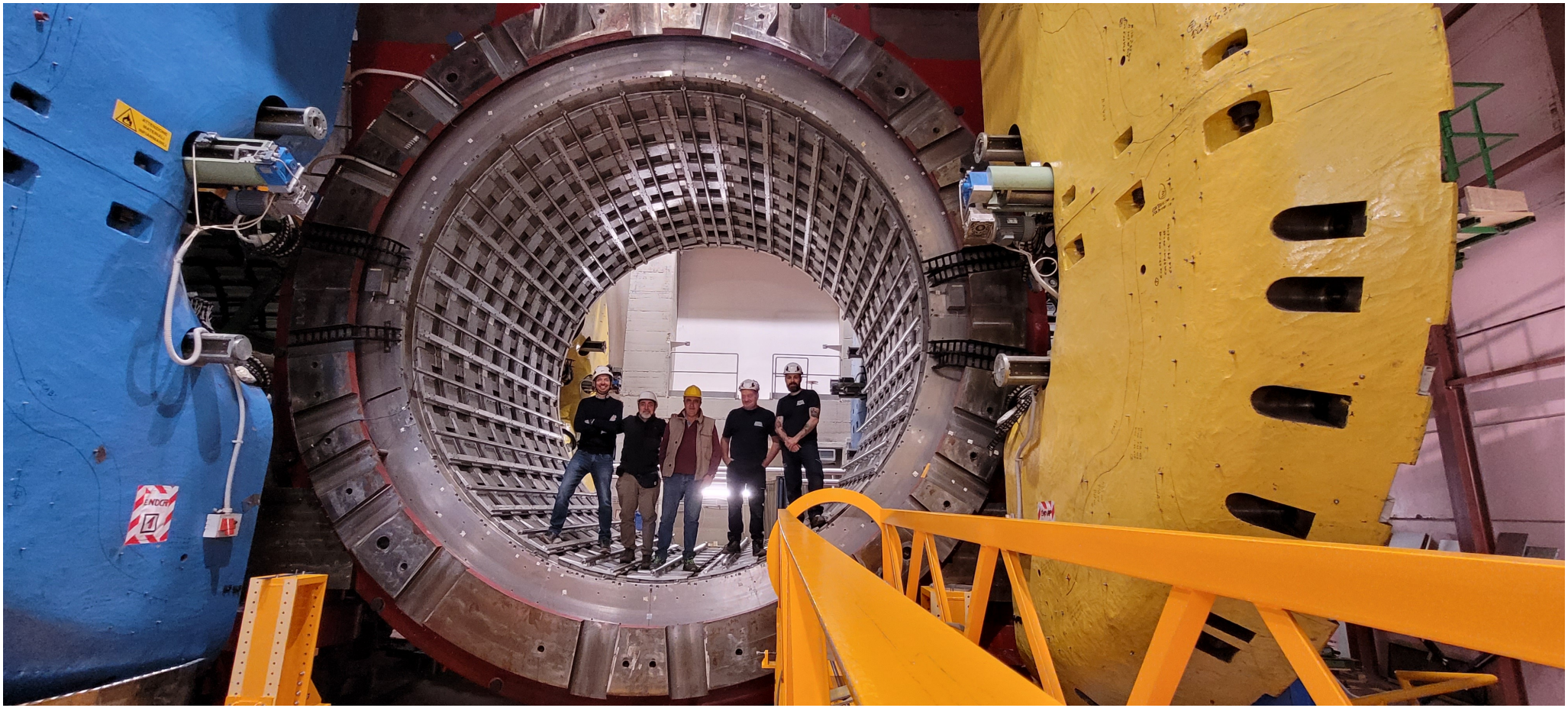




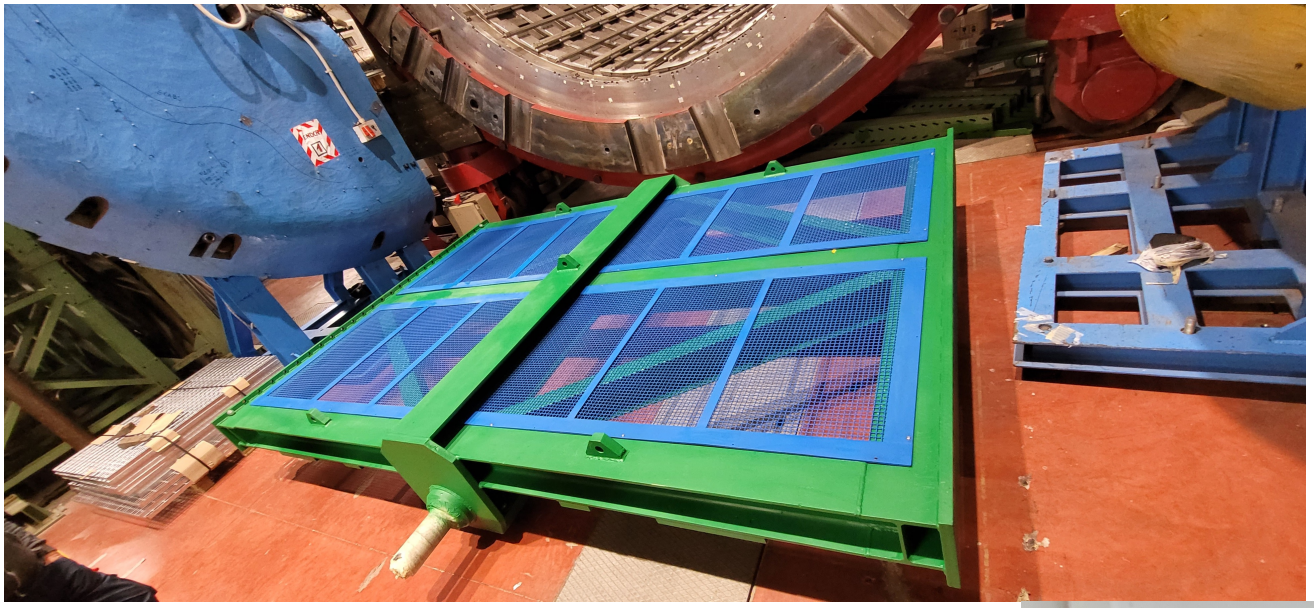
# ECAL barrel dismounting in progress

# ECAL barrel dismounting in progress

# ECAL barrel dismounting COMPLETED!



# ECAL Endcap dismounting: preparation

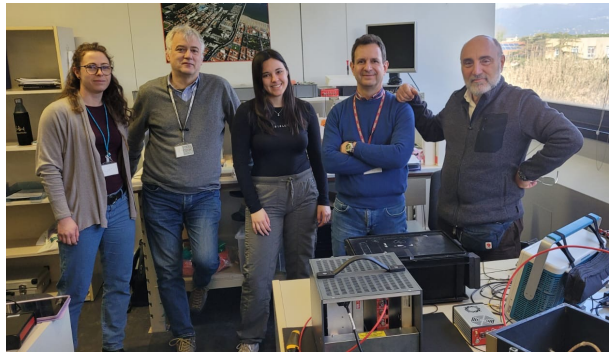


# ECAL test at LNF

Test area

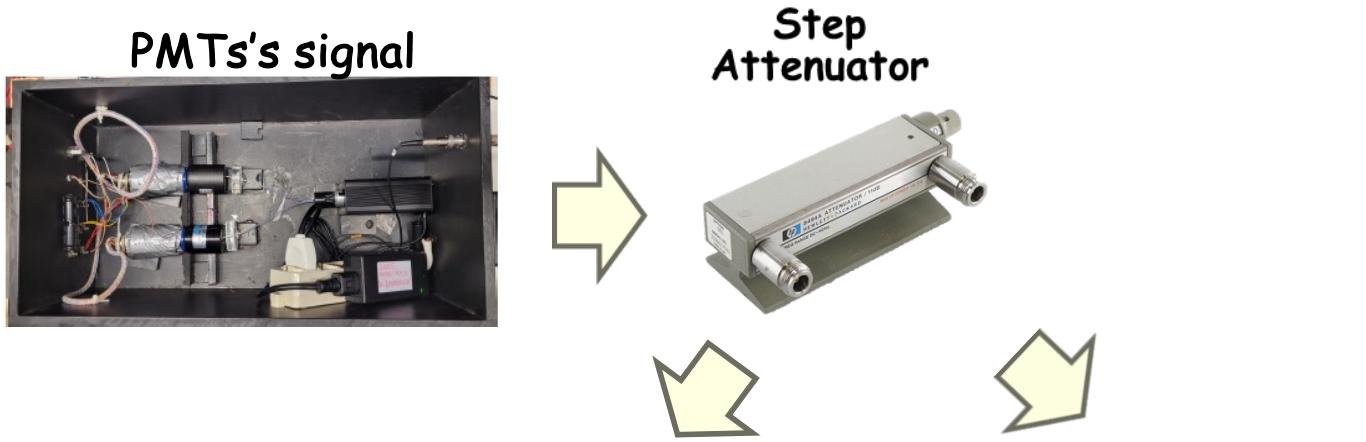
Refurbishment area

# Test in collaboration with CAEN for the final choice of ECAL electronics



## Pico TDC test

Test setup 2:




- PMT WA5656
- PMT WA8792
- Signal splitted:

i. Pico TDC

ii. Digitizer

- Resolution comparison
- TDC: Start on Ch0 with trigger from LED Driver. Stop on Ch1 and Ch2 (dual threshold) with variable amplitude.
- Digitizer: autotriggering on the Ch0.

# SAND Calibration WG

P.Gauzzi
(Universita' La Sapienza e INFN – Roma)

June 7, 2024

## Scope of Calibration WG

- Calibration: from detector signals to physical variables
  - ECAL: energy, time and positions of the particles
  - STT: *r-t* relations, track momentum, dE/dx for PID, ....
  - GRAIN: tracks, time, energy, ....
  - Timing alignment among the subdetectors (for the determination of the interaction time)
- Start to define a strategy for each subdetector:
  - Sources: cosmics, particles from beam, (radioactive sources ?)
  - Choose suitable processes (given the expected fluxes of particles in the detector) (*e.g.* for the ECAL: cosmic μ's as MIPs, MIPs from the beam, electrons and photons ....)
  - Set a calibration procedure (at which level of precision ? How much time expected for a calibration ?)
- Reference people:
  - ECAL: P.Gauzzi
  - GRAIN: A.Surdo
  - STT: ……

# ECAL Calibration in SAND

**MIPs from cosmic rays:**

- **muon flux at surface ~ 0.02 μ/(s cm$^2$)**
- **with an effective cross-section of the ECAL for vertical muons of ~ 5×10$^5$ cm$^2$**
  **⇒ ~ 10$^4$ μ/s on ECAL (⇒ 100 Hz of "golden mips" in KLOE)**
- **Underground reduction of a factor of about 100**
  **⇒ ~ 100 μ/s on ECAL (without any selection)**
- **Rough estimate by rescaling the KLOE numbers**
  **⇒ 1 day (24 hrs): ~ 10 evts/cell**
- **Relaxing the "golden mip" selection: in few days ~ 10$^3$ evts/cell**

# ECAL Calibration in SAND

**MIPs from beam (rock, magnet and Fe yoke, upstream ECAL modules)**

| Cut | ECAL | | Rock muons | | Magnet events | |
|---|---|---|---|---|---|---|
| | Events | $\varepsilon$ (%) | Events | $\varepsilon$ (%) | Events | $\varepsilon$ (%) |
| No cut | 2.23 | 100.0 | 1447.26 | 100.000 | 50.82 | 100.000 |
| $\mu$ in ECAL FV | 2.23 | 100.0 | 12.73 | 0.880 | 18.92 | 37.229 |
| STT & ECAL hits | 1.63 | 72.9 | 6.05 | 0.420 | 3.443 | 6.775 |
| NN cut | 1.56 | 95.5 | 0.10 | 0.007 | 0.07 | 0.136 |

Table 40: Number of events per spill (9.6 $\mu s$, $7.5 \times 10^{13}$ pot) and selection efficiency for the signal from $\nu_\mu$ CC in the front barrel ECAL and the backgrounds from rock muons and magnet events.

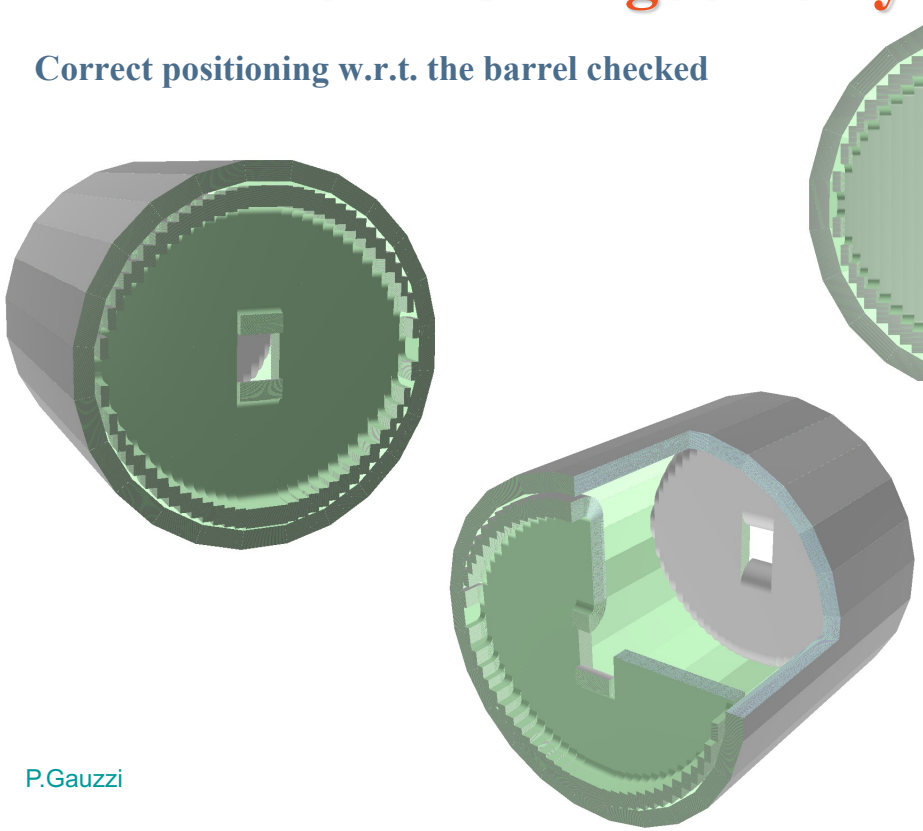
**(from DUNE-doc-13262, A Near Detector for DUNE)**

**~ 1.5 × 10$^3$ μ/spill (1 spill = 9.6 μs every 1.2 s) without any selection**

- **Can we use also charged π's as MIPs ?**
- **Maybe a MC study could be useful**
- **Could be useful a calibration with cosmics of all the modules with the final FE electronics before re-assembling the ECAL**

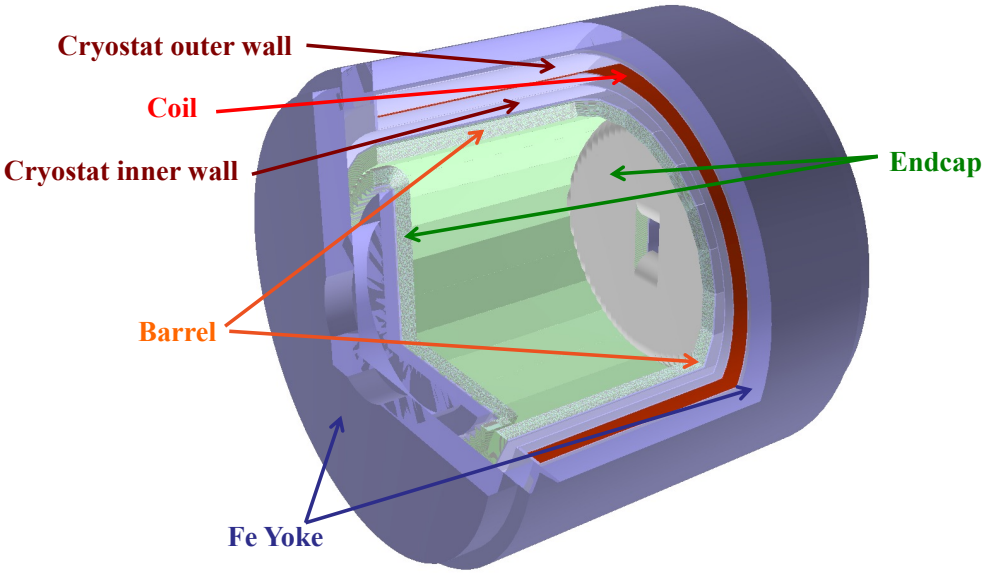
# Full ECAL geometry

- Correct positioning w.r.t. the barrel checked



P.Gauzzi

# Full ECAL geometry



# DUNE-Roma1: Anagrafica 2025

| nome | posizione | percentuale |
|---|---|---|
| A. Di Domenico | PA | 90% |
| P. Gauzzi | PA | 90% |
| D. Pasciuto | tecnologo | 20% |
| C. Piscitelli | Tecnico Senior | 0 % |

apertura sigla DUNE a RM-1

+ 1 laurendo magistrale

richieste servizi 2025:
1 MU officina meccanica
1 MU officina elettronica

# DUNE-Roma1: attività

## Coinvolgimento del gruppo nell'esperimento DUNE:

Il gruppo storicamente ha contribuito a KLOE ed in particolare alla costruzione dell'ECAL.

- Responsabilita':
  - Co-Chair DUNE/SAND/ECAL WG (A. Di Domenico);
  - Co-Scientific coordinator del progetto KLOE-to-SAND (A. Di Domenico);
  - Co-Technical coordinator (interim) del progetto KLOE-to-SAND (A. Di Domenico);
  - Co-Chair SAND CALIBRATION WG (P. Gauzzi);
  - Responsbilita' della DUNE/SAND/ECAL geometry nel Software WG (P. Gauzzi);
  - Responsabilità di "Logistics, Packaging and Shipping" del progetto KLOE-to-SAND (D. Pasciuto).

- Forte coinvolgimento in sinergia con il gruppo DUNE-LNF con compiti organizzativi e trasferimento know-how in tutte le fasi dello smontaggio di KLOE e del test di ECAL, e successivi commissioning ed installazione di SAND a FNAL.
- Studi con simulazione, test su PMT e moduli ECAL per la scelta finale della FEE per il calorimetro (2 tesi magistrali).
- Partecipazione al DUNE/SAND/Software WG con contributi sulla geometria di ECAL e algoritmi di clustering e ricostruzione degli eventi.
- Partecipazione alla progettazione ed alla costruzione di un prototipo del tracker a straw tubes (STT) di SAND presso INFN-Pisa (D. Pasciuto).

## Prospettive di medio termine:

Nei prossimi anni il gruppo sara' impegnato con

- il completamento dell'operazione KLOE-to-SAND: (i) dismounting of ECAL barrel and end-caps modules (ii) test of ECAL (iii) test of magnet (iv) extraction of s.c. coil (v) dismounting of iron yoke
- Partecipazione allo sviluppo del software di ricostruzione in SAND
- partecipazione al progetto finale e costruzione degli STT
- installazione e commissioning di SAND al Fermilab a partire dal 2025/2026.

# DUNE-Roma1: Richieste economiche 2025

| Capitolo | Descrizione | Parziali (K-EUR) | Totale/Cap (K-EUR) |
|---|---|---|---|
| **inventario** | VME bridge CAEN 3718 per setup DAQ test stand | 3 | |
| **inventario** | workstation per test stand | 1 | |
| **inventario** | NAS 20TB per DAQ test stand | 1 | |
| **inventario** | Switch/Router per DAQ test stand | 0.5 | |
| **apparati** | prototipi schede (picoTDC e/o ADC) ECAL electronics CAEN | 10-20? | |
| **Totale** | / | | 5.5+(10-20) |
| **consumo** | Materiale consumo per setup test stand moduli ECAL e PMT ai LNF, inclusi connettori per patch panel, cavi di raccordo per 240 canali HV, e minuteria | 5 | |
| **Totale** | / | | 5 |
| **interno** | Missioni continuative a LNF per completamento smontaggio ECAL e test moduli ECAL e responsabilita'<br>3 tecnici : 8 MU<br>3-4 fisici : 22 MU | 15 | |
| **interno** | Studi costruzione e test meccanica di straw tube detector (missioni Pisa, CERN) | [5 SJ] | |
| **interno** | 3 collaboration meetings: CERN 1 week (1k euro) + FNAL 1 week (2.5k euro) + Valencia (1k euro) 1 week, per 3 persone. | 13.5 | |
| **interno** | Meeting al Fermilab:<br>totale di 2 missioni di 10 gg (8k euro), per due persone = 16k euro | 16.00 | |
| **interno** | Partecipazione DUNE ITALIA (Ferrara) -<br>4gg (incluso viaggio) per tre persone 800 euro x 3 | 2.5 | |
| **Totale** | / | 0 | 47 + [5 SJ] |

Richieste per HW Test ECAL

# ECAL-HV

Spesa-core
Offerta CAEN (da rinnovare):

WA7030PXAAA4 A 7030P - SYx527 H.V. channels +3 KV 1 mA (1.5 W) - Multipin Conn. common floating (48 ch) **4.760,00 (Iva esclusa)**

WSY4527BSCXA SY 4527B - Universal Multichannel Power Supply System - BASIC 600W **5.900,00 (Iva esclusa)**

WA4533D1200X A 4533 - SY4527 Optional Double Power Supply Unit 1200W **1.520,00 (Iva esclusa)** (Per 16 schede A7030AP in un sistema SY4527 è necessario un power supply supplementare da 1200W)

**n° 102 + 10 spare Schede A7030P (sconto 10% applicabile sopra i 20 pezzi) +IVA = 585366 euro**

**n° 7 +2 spare Sistemi SY4527B (sconto 5% applicabile sopra i 6 pezzi) +IVA = 61543 euro**

**n° 7 +2 spare Alimentatori supplementari A4533 (sconto 5% applicabile sopra i 6 pezzi) + IVA = 15855 euro**

**TOTALE = 669764 euro**
**Patch panel + cavi raccordo ~ 30 k euro**

# ECAL - LV

Spesa-core

Offerta CAEN:

A25251 8 full floating channels 8 V/12 A **2.620,00 (Iva esclusa)**
**Usa stesso mainframe delle schede HV**

**n° 10 + 2 spare Schede A2551 (sconto 10% applicabile sopra i 20 pezzi) +IVA = 38351 euro**

**TOTALE = 38351 euro**
**Patch panel + cavi raccordo ~ 10 k euro**