



MUSEO
STORICO DELLA FISICA
E
CENTRO
STUDI E RICERCHE
ENRICO FERMI

GIORNATE DI STUDIO CENTRO FERMI

ROME, 18-19 DECEMBER 2018



CENTRO FERMI'S PROJECTS 2018-2019

LUISA CIFARELLI — Centro Fermi, Rome (IT)
European & Italian Physical Society
University & INFN, Bologna (IT) — CERN, Geneva (CH)

Mission

CENTRO FERMI is a research institution created in **2001** devoted to **interdisciplinary** studies and to **dissemination of scientific culture**

→ dual mission

It aims to integrate the knowledge generated in different fields, and to promote discussion among top scientists with different areas of expertise, in order to create what **Enrico Fermi** would have liked to establish in Italy:

a centre dedicated to frontier research in physics and to its wide applications for the benefit of humankind.

Governance & Staff

President: **Luisa Cifarelli**

Administration Board: **Carla Andreani, Giovanni Batignani**

Director General: **Cinzia Santarelli**

Coordinator Strategic Projects: **Rosario Nania**

Scientific Council (CS): **William Barletta, Angela Bracco, Pierluigi Campana, Eugenio Coccia, Joseph Niemela**

Internal Evaluation Committee (CIV): **Silvia Dalla Torre, Sergio Ferrara, Angiolino Stella**

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+ Grantees & TD Researchers ()** & **Associate Researchers (***)**

(*) TI: "Tempo Indeterminato", i.e. Permanent Staff

(**) TD: "Tempo Determinato", i.e. Non Permanent Staff

(***) Belonging to other Institutions

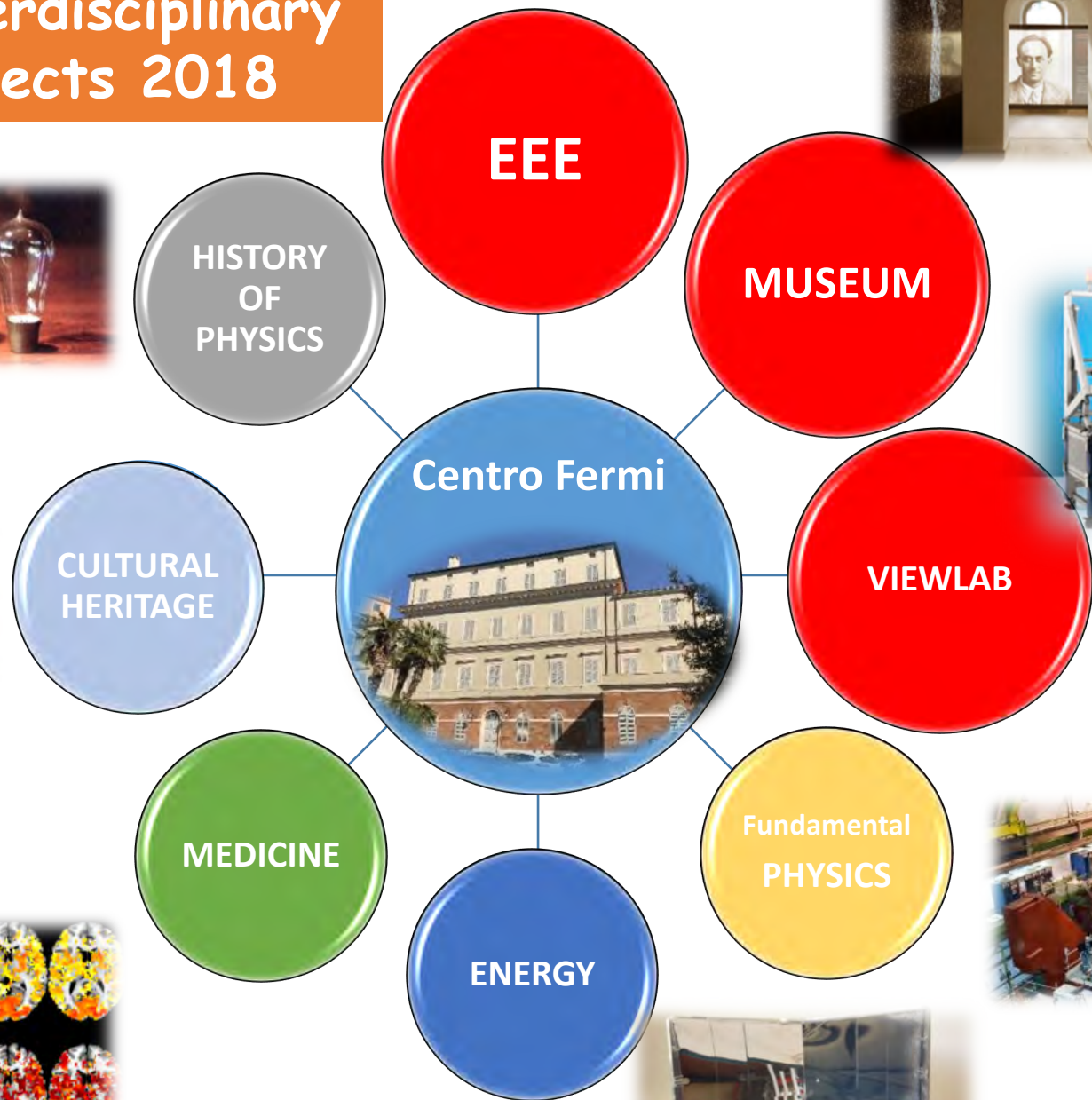
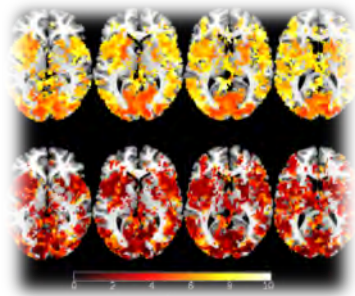
Main Activities

The activities of **CENTRO FERMI** characterize its uniqueness:

1. **Grants**, for "New Talents" and Senior/Junior researchers, to study **original and interdisciplinary research** topics;
2. **Research Projects**, including those defined as **Strategic Projects**, for the realization and promotion of interdisciplinary original research;
3. **Activities for the Dissemination of Scientific Culture and Historic Memory**, through the restoration of the "**Monumental Complex**" of **Via Panisperna**, the old Institute of Physics which has an extraordinary historical value, to be used in part for the **Museum**.

Grants

- **CENTRO FERMI** Grants - Fermi Grants (scholarships, research grants and collaboration assignments) - are competitive with other National and European scholarships for prestige and sometimes for amount.
- About **400** annual Fermi Grants have been awarded since 2002 (renewals or new contracts).
- Candidates are selected by public calls.
- A Fermi Grant award is typically appointed for one year period (renewable up to 2 times, according to Italian rules).
- Most of the Fermi Grant awards have won competitions for **prestigious** (permanent) positions in Universities or Research Institutes in Italy or abroad.



LINEE DI RICERCA	
1	Extreme Energy Events (EEE) – La Scienza nelle Scuole
2	Tecniche Avanzate per la Fisica Fondamentale
3	Tecniche Avanzate per Applicazioni Biomediche
4	Energia
5	Ambiente e Patrimonio Culturale
6	Storia della Fisica
7	Attività Museali e Laboratori (VIEWLAB)

PROGETTI INDIVIDUALI
<ul style="list-style-type: none"> – BioTarget: Radiazioni Ionizzanti ed Effetti su nuovi Target Biologici – CORTES: Cosmological Radiative Transfer in Early Structure – HIGHSPINS: Higher Spins and their Symmetries – Sistemi Complessi e Autogravitanti – The Double Copy Paradigm – Onde Gravitazionali da Sistemi Binari Coalescenti – Sugraphene: The Algebraic and Geometric Structure of Supergravity from Black Holes to Condensed Matter

PROGETTI INTERDISCIPLINARI	
1. Extreme Energy Events – La Scienza nelle Scuole PROGETTO STRATEGICO	EEE
1. Tecniche Avanzate per la Fisica Fondamentale 2-1. Quark-Gluon Coloured World – ALICE and beyond 2-2. Problematiche Aperte della Meccanica Quantistica 2-3. Fisica Fondamentale nello Spazio 2-4. Microcavit� Fotoniche 2-5. Innovative Mirror Coating Research	QGCW PAMQ FISP MIFO ICORE
3. Tecniche Avanzate per Applicazioni Biomediche 3-1. Tecnologie per le Neuroscienze 3-1.1 Tecniche di Risonanza Magnetica Funzionale del Cervello 3-1.2 Piattaforma per l'Analisi Multimediale Integrata in Neuroscienze Applicate 3-1.3 Risonanza Magnetica per lo Studio delle Microlesioni del Cervello 2. Tecnologie per l'Adroterapia 3-2.1 Imaging Dosimetrico per Adroterapia 3-2.2 Monitor for Neutron Dose in Hadrontherapy 2. Microcircuiti Neuronal Locali	TNEU T-MENS PAMINA MICROBRADAM TADR IMDO MONDO MNL
4. Energia 1. Fotovoltaico a Concentrazione 2. Sistemi Intrinsecamente Sicuri – Accelerator Driven Systems for Research on Nuclear Technology	CPV SIS
5. Ambiente e Patrimonio Culturale 1. Sistemi Diagnostici per Tomografia Tridimensionale con Raggi X 2. Microtomografia per l'Archeologia e la Paleoantropologia 3. Tecniche Neutroniche per Archeologia e Analisi Forense 4. Basi Scientifiche e Tecnologiche della Meteo-Climatologia	TTRX SAPIENS TNAAF METC
6. Storia della Fisica 6-1. Elettrificazione e Illuminazione in Italia tra il XIX e XX Secolo 6-2. I Fisici Italiani tra Ricerca Scientifica e Impegno Civile 6-3. Prosopografia della Fisica Italiana	HISTEL HISTSEN HISTPRO
7. Attivit� Museali e Laboratori [*] PROGETTO STRATEGICO	VIEWLAB

In 2019 new **VIEWLAB Project**

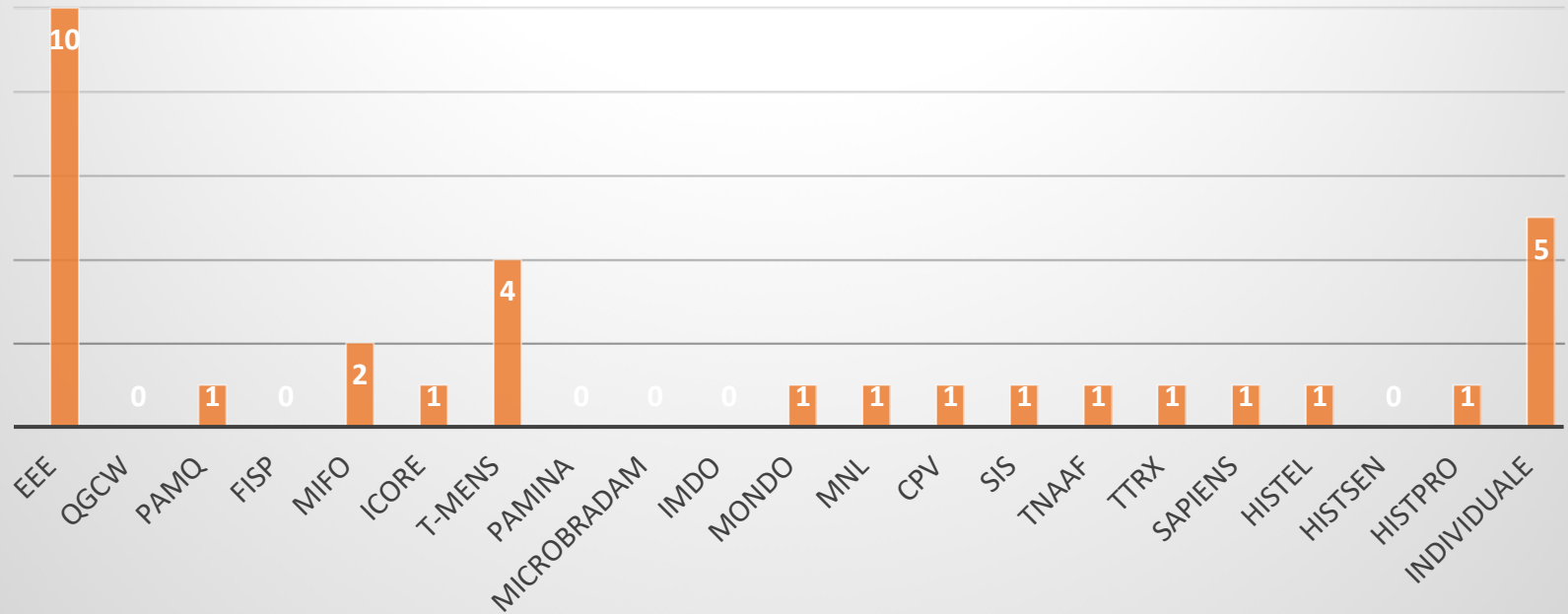
- Focusing on the realization of **exhibition installations and demonstration workshops/labs** for the Museum highly innovative from a technological point of view
- Starting from the experience of the exhibitions already successfully tested in Genoa and Bologna
→ even more emphasis on **interactive aspects** with the public, **with more versatile solutions** (greater use of projections instead of fixed panels)

There are already contacts with numerous **Italian and foreign institutions** for possible exchanges of materials and findings related to temporary thematic installations.

- The VIEWLAB Project will also integrate the construction of demonstration laboratories
 - ✓ for the EEE Project
 - ✓ the SAHF Project (Environment and Cultural Heritage) which will embed as case study the new Lilibeo Project
- In this way the Museum will be accompanied by a rich program for the public of experiments to be realized in laboratories that will be made available within the Centro Fermi

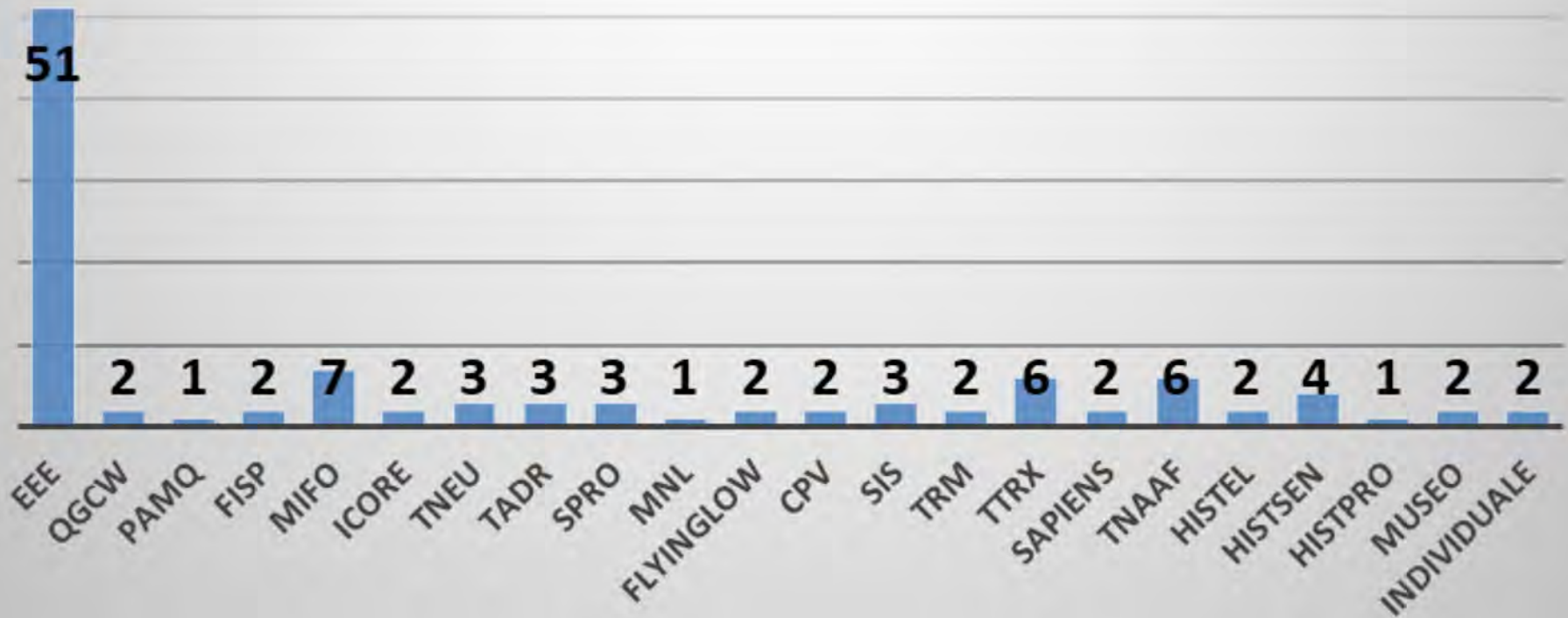
Grants per project 2018

Total: 32



Associazioni Centro Fermi 2018

Total: 108



MIUR notes about PTA

RACCOMANDAZIONI ALL'ENTE (2017)

"Come proposto nel precedente anno, si raccomanda che le disponibilità finanziarie siano impegnate su progetti da sviluppare nel Centro, benché si ritenga importante la collaborazione con altri enti e università. Ciò soprattutto ora che è stata terminata la ristrutturazione della sede di via Panisperna, cosicché non solo possa funzionare come richiamo museale ma anche come centro in cui si svolgono le ricerche, cercando di differenziarle da quelle dell'INFN e INAF che già le supportano adeguatamente."



Museo Storico della Fisica e Centro Studi
e Ricerche Enrico Fermi

Rendiconto 2018
e PTA 2019-2021

Progetti Interdisciplinari Individuali del
Centro Fermi

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Thanks to Project
Leaders for the
contributions



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e Ricerche Enrico Fermi

Rendiconto 2018
e PTA 2019-2021

Progetti Interdisciplinari Individuali del
Centro Fermi



Eletrificazione e Illuminazione
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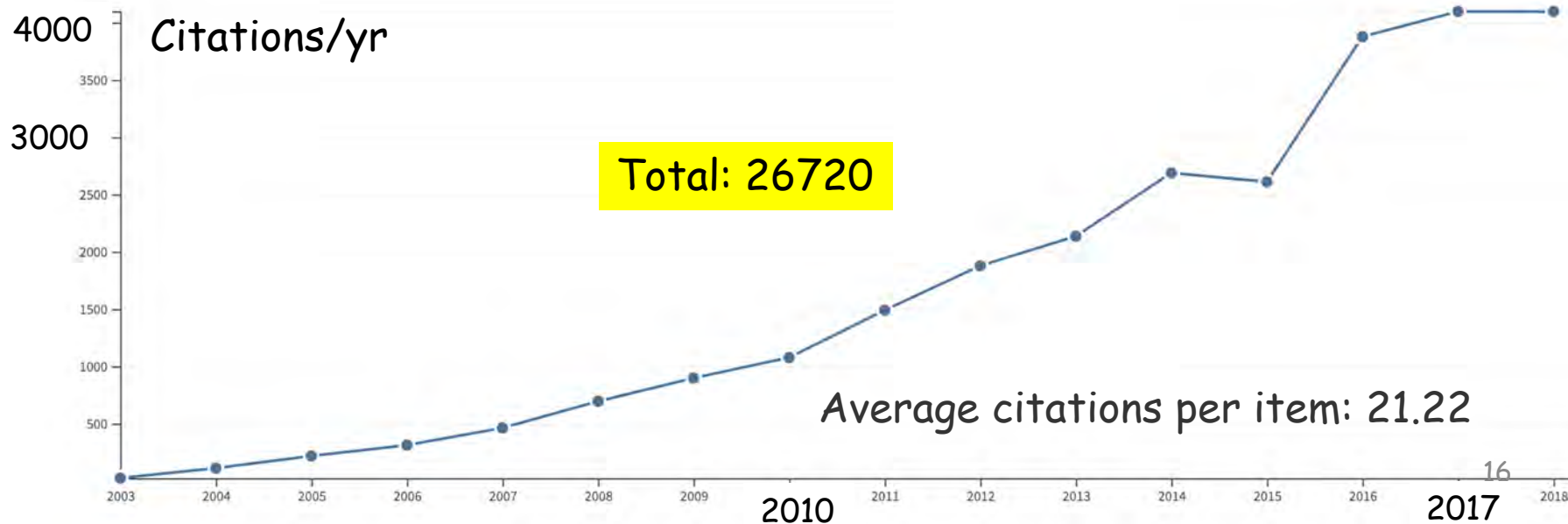
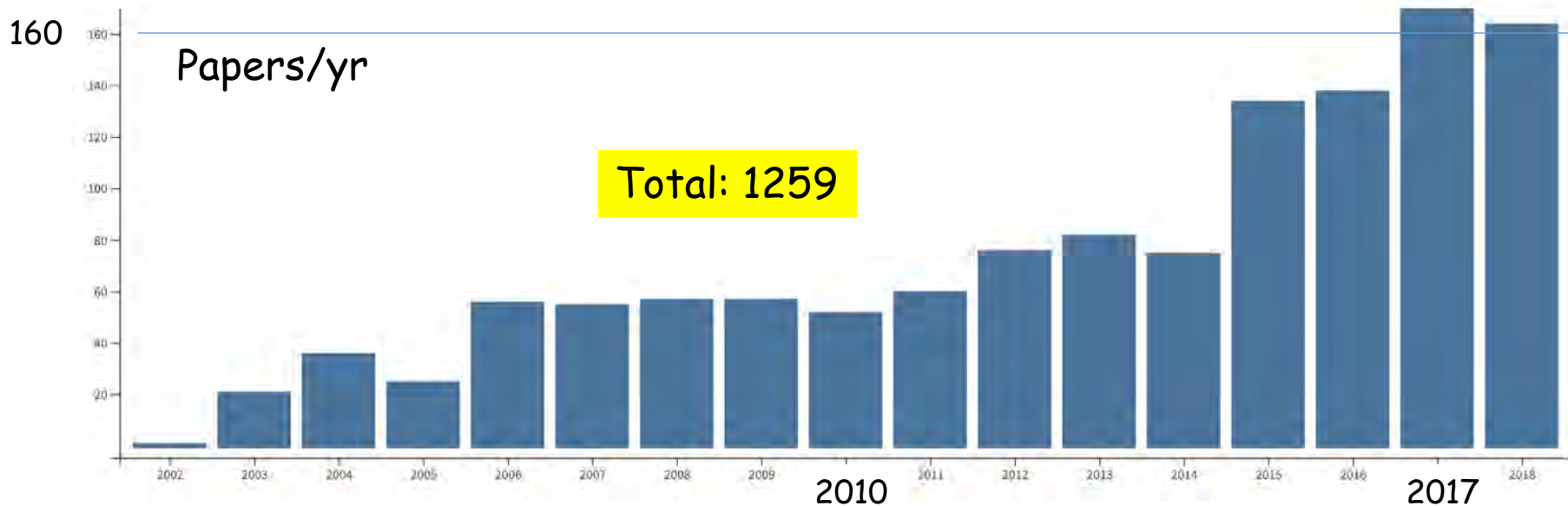
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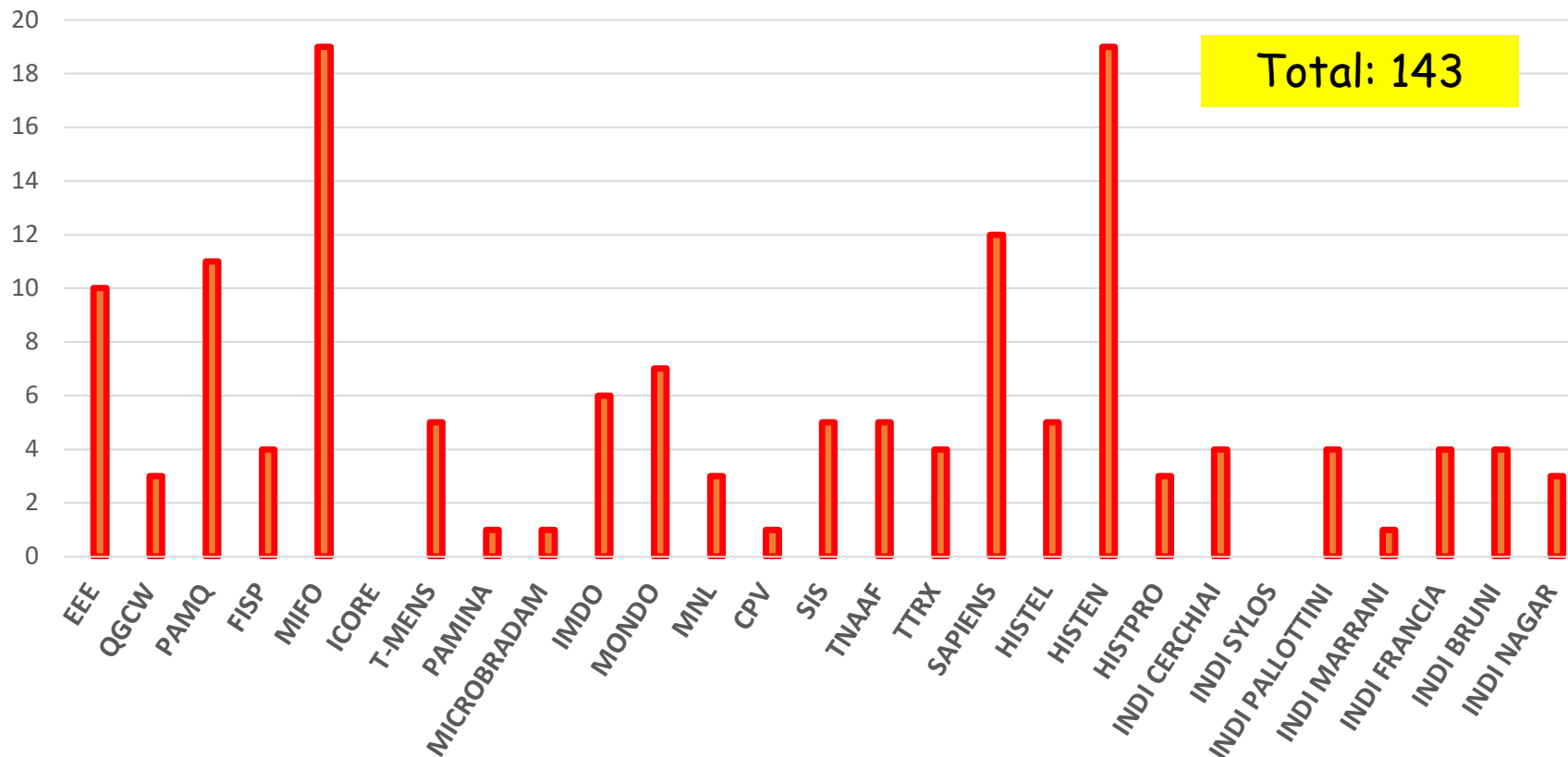
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Research Products

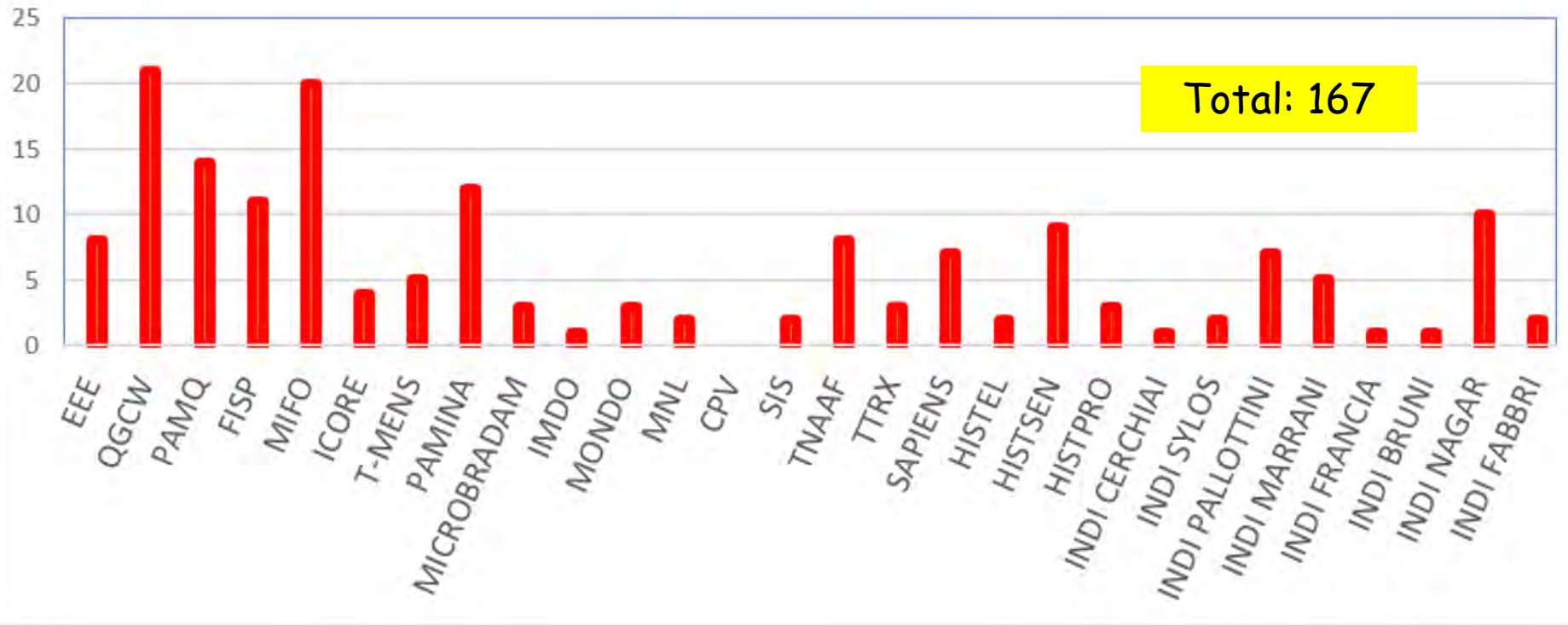
Published papers
(source: Web of Science
Updated: 16/12/2018)



CF Presentations at Conference 2018



CF publicatons 2018



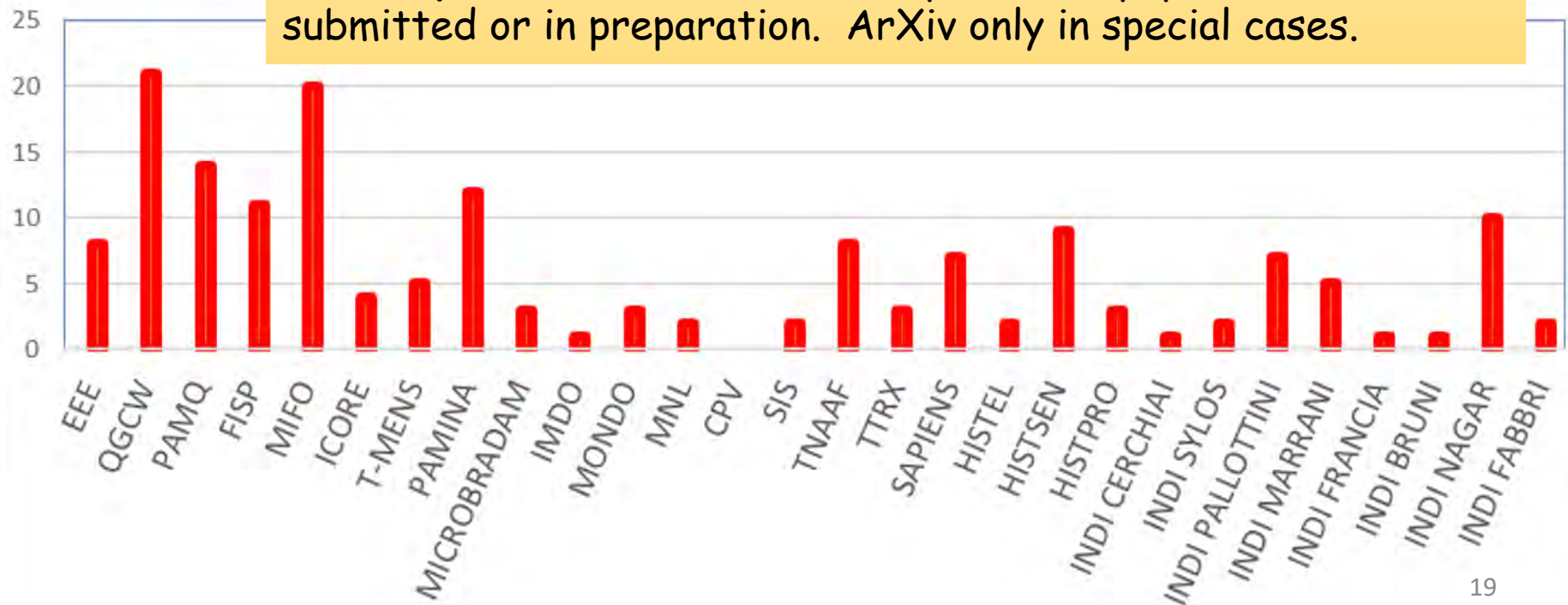
It is important to keep track of the publications for each project. MIUR referees would like to have a short list included in the annual PTA.

It is important to have the correct reference:

Centro Fermi - Museo Storico della Fisica e Centro Studi e Ricerche "Enrico Fermi"

Compendio del Viminale - Piazza del Viminale 1 -00184 Rome (Italy)

It is important to include ONLY published papers, i.e. NO submitted or in preparation. ArXiv only in special cases.



Funding 2018/2019

- **FOE MIUR 2.0 M€ / year (10% increase w.r.t. 2017)**
- **"Fondi Premiali" MIUR:** on average 0.8 M€ / year (up to 2017, as in the previous 5 years) based on VQR (*Valutazione Qualità della Ricerca*) and research proposals according to H2020 guidelines

Funds 2015 (given in 2018, with proposals submitted Nov 2016):

- **SAHF** Science and Heritage @ FERMI **APPROVED**
0.214 M€

CENTRO FERMI
(in collaboration with many Museums)

- **SPARE** Space Radiation Shielding **APPROVED**
0.178 M€

INFN-ASI-CENTRO FERMI

Funds 2016-2017 (given in 2018): **0.450 M€ / year**
fixed contribution based on VQR only → **FOR LAST TIME**

Funding 2018/2019

- External funds: so far on average 0.35 M€ / year in the last 5 years

In 2018:

MICROBRADAM	0.135 M€
PAMINA	0.487 M€

- Funds for Fermi Museum 1.300 M€

→ In 2019 additional funds ???

YES, for personnel

New decrees in 2018

«Assunzioni di ricercatori e tecnologi negli enti pubblici di ricerca»

concerning **extraordinary recruitment** within 2018 allowing to hire **1 TI Research Staff** member at CENTRO FERMI

+ 43.900 € → FOE in 2019

Within 31/12/2018 possibility to “**stabilize**” TDs with three or more years of work.

8 people recruited (**6 TI Research Staff** members & **2 TI Administration Staff** members)

+ 251.000 € → FOE in 2019

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Personnel 2018/2019

To sum up, in 2019:

< 50% of FOE 2.250.000 € for Personnel

→ In 2019/2020:

Completion of Centro Fermi recruitment plan
(co-funding):

3 TI Research & Technology Staff members

1 TI Administration Staff member



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MEETINGS, WORKSHOPS CONFERENCES

29-31 May 2017 (Erice)

Extreme Energy Events (EEE) – Science inside Schools

**7th Centro Fermi Projects Meeting
Meeting with Schools all over Italy**

Measurement of the
Earth Radius
published in GdF



6-8 December 2017 (in Erice)

Extreme Energy Events (EEE) – Science inside Schools

**8th Centro Fermi Projects Meeting
Meeting with Schools all over Italy**

Measurement of the
Cosmic Rays flux at
different altitude
published in GdF





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MEETINGS, WORKSHOPS CONFERENCES

6-8 December 2018 (in Erice)

Extreme Energy Events (EEE) – Science inside Schools

**9th Centro Fermi Projects Meeting
Meeting with Schools all over Italy**

Measurement of the
Cosmic Rays flux for
different shieldings
(to be published in GdF)



7 November 2018 (in Bologna)

International Symposium

"60 YEARS OF SUBNUCLEAR PHYSICS IN BOLOGNA"

Accademia delle Scienze dell'Istituto di Bologna – Sala Ulisse



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Conferences, Workshops, Schools with support from Centro Fermi

1. ***13th Workshop of International School on Magnetic Resonance and Brain Function*** on "Investigating brain function and structure by magnetic resonance and compatible approaches" (Erice, 22-29 April 2018)
2. ***International Conference Quark Matter*** (Venezia, 14-19 May 2018)
3. ***6th Annual Conference on Large Hadron Collider Physics LHCp*** (Bologna, 4-9 June 2018)
4. ***9th Course of International School of Science Journalism*** on "What's next: Challenges and opportunities for tomorrow's fundamental physics" (Erice, 24-29 June 2018)
5. ***International Conference on "Is quantum theory exact? The quest for the spin-statistics connection violation and related items"*** (Frascati, LNF, 2-5 July 2018)
6. ***5th Course of International School of Neutron Science and Instrumentation*** on "Neutrons for chemistry and materials science applications" (Erice, 4-13 July 2018)
7. ***4th European Nuclear Physics Conference EuNPC*** (Bologna, 2-7 September 2018)
8. ***4th Course of International School of Brain Cells and Circuits Camillo Golgi*** on "The sensorymotor system from cellular microcircuits to large scale networks" (Erice, 3-5 December 2018)

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3. **6th Annual Conference on Large Hadron Collider Physics LHCp** (Bologna, 4-9 June 2018)

Centro Fermi is sponsor of the *Guido Altarelli Award*, an international prize for young researchers, assigned at the *International Workshop DIS2018* (Kobe University 16-20 April 2018)

- 2-5 July 2018)
6. **5th Course of International School of Neutron Science and Instrumentation** on "Neutrons for chemistry and materials science applications" (Erice, 4-13 July 2018)
7. **4th European Nuclear Physics Conference EuNPC** (Bologna, 2-7 September 2018)
8. **4th Course of International School of Brain Cells and Circuits Camillo Golgi** on "The sensorymotor system from cellular microcircuits to large scale networks" (Erice, 3-5 December 2018)

Conferences, Workshops, Schools organised by / with support from Centro Fermi



Organisation in 2019:

- 1. Meeting to celebrate Enrico Fermi on the occasion of the inauguration of Centro & Museo Fermi (Roma, Summer 2019)*
- 2. 10th Centro Fermi Projects Meeting dedicated to EEE Project (Torino, March 2019)*
- 3. 11th Centro Fermi Projects Meeting dedicated to EEE Project (Roma, Autumn 2019)*

Support in 2019:

- 1. International Conference Strange Quark Matter - SQM (Bari, 10-15 June 2019)*
 - 2. Workshop DIS 2019 (Torino, 8-12 aprile 2019) - Sponsorship of Guido Altarelli Award*
 - 3. Erice Schools*
 - 4. Varenna Schools*
- etc.

- Congresso SIF 2018
Sezione 7 - Didattica e storia della fisica
Primo premio per la migliore comunicazione: *"Il dizionario biografico dei fisici italiani"*
Adele La Rana, Museo Storico della Fisica e Centro Studi e Ricerche "Enrico Fermi"
- Cavaliere della Romania
"Per il suo importante contributo nel campo delle scienze esatte"
Catalina Curceanu, INFN LNF e Museo Storico della Fisica e Centro Studi e Ricerche "Enrico Fermi"
- L'Oréal - UNESCO Prize For Women in Science
"Per le sue ricerche su meta-materiali per aumentare la sensibilità dei rivelatori Virgo e LIGO di onde gravitazionali"
Maria Principe, Museo Storico della Fisica e Centro Studi e Ricerche "Enrico Fermi"



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Articles in the press

"Centro Fermi: dalla ricerca in fisica alle applicazioni biomediche"
Il Sole 24 Ore (26/01/2018)

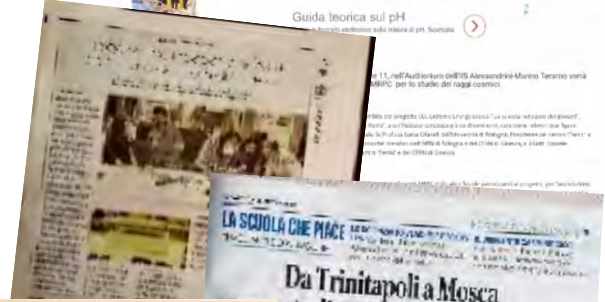
**"Inaugurato il telescopio MRPC all'Alessandrini di Teramo
premiati gli studenti più meritevoli"** - *certastampa.it (07/02/2018)*

**"Teramo, inaugurazione del telescopio per i raggi cosmici all'istituto
Alessandrini - Marino"** - *CityRumors.it- Abruzzo (03/02/2018)*

"I ragazzi che indagano la fisica con l'aiuto del Cern di Ginevra"
La Repubblica (01/03/2018)

"Da Trinitapoli a Mosca studiando i raggi cosmici"
La Gazzetta del Mezzogiorno (02/03/2018)

"La Fisica tra storia e arte per rivelare il passato"
Il Sole 24 Ore (04/06/2018)



Articles in the press

"La lucertola che scampò all'Apocalisse vulcanica"
Corriere della Sera (17/06/2018)

"Fotovoltaico a concentrazione: al via TwinFocus"
Il Sole 24 Ore (29/10/2018)

"Measuring cosmic ray showers near the North Pole with the Extreme Energy Events project"
Il Nuovo Saggiatore (Nov-Dic 2018)

"Studenti a caccia di raggi cosmici"
Corriere del Sud - Cronaca di Cosenza (02/12/2018)

"Cosmic research poles apart"
Cern Courier (10/12/2018)

"Fisica e beni culturali: le nuove iniziative del Centro Fermi a Roma"
La Repubblica (18/12/2018)

"A caccia di raggi cosmici: al Polo Nord"
Il Sole 24 Ore (24/12/2018)



"La lucertola che scampò all'Apocalisse vulca
Corriere della Sera (17/06/2018)

"Fotovoltaico a concentrazione: al via Twin
Il Sole 24 Ore (29/10/2018)

"Measuring cosmic ray showers near the N
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"A caccia di raggi cosmici: al Polo Nord"
Il Sole 24 Ore (24/12/2018)

IL NUOVO SAGGIATORE

BOLLETTINO DELLA SOCIETÀ ITALIANA DI FISICA



The EEE Project



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Istituto Nazionale di Fisica Nucleare

To study cosmic rays in Italy

→ **Extreme Energy Events – Science Inside Schools (EEE)**
experiment

- Proposed by A. Zichichi in 2004
- Presently coordinated by **Centro Fermi** in Rome in collaboration with **CERN**, **INFN** and various universities



The EEE network is made of about **60 telescopes** and allows unique studies of cosmic rays, including a search for **very long distance correlations between cosmic ray showers**



Società Italiana
di Fisica

The EEE telescopes are each made of three **MRPCs** (Multigap Resistive Plate Chambers) built at CERN by high-school students which are installed and monitored in school buildings by the students themselves

Dual role

- Cosmic ray experiment
- Scientific Education

51 MRPC tracking telescopes
in High Schools

+ 2 telescopes at CERN

+ 6 telescopes in INFN Units

Total : 59 telescopes

+ 54 High Schools participating
without telescopes

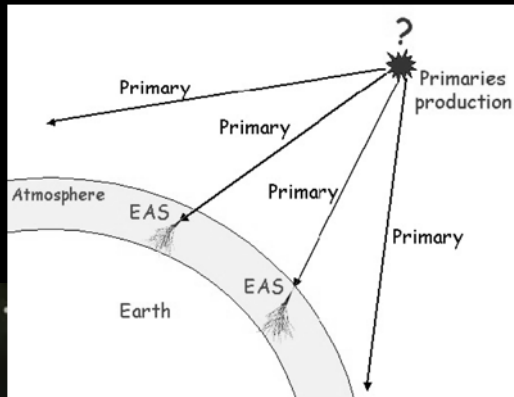


$\approx 0.5 \times 10^6 \text{ km}^2$
 $\approx 10^\circ$ of latitude/longitude



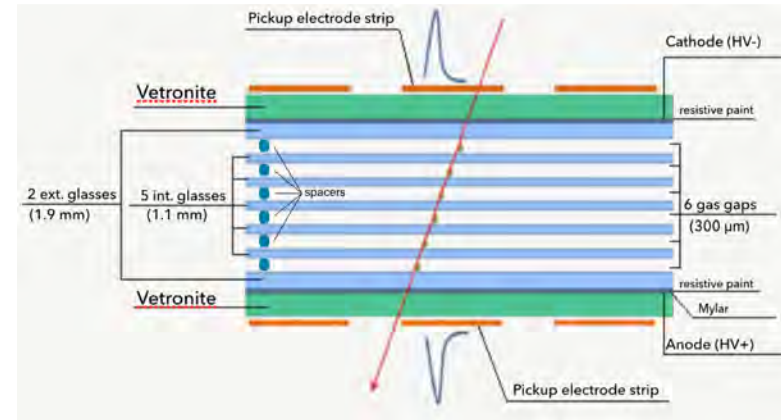
Physics goal of EEE Project

Detect atmospheric showers of very high or extreme energy by detecting secondary muons on ground coming from very high energy primary cosmic rays



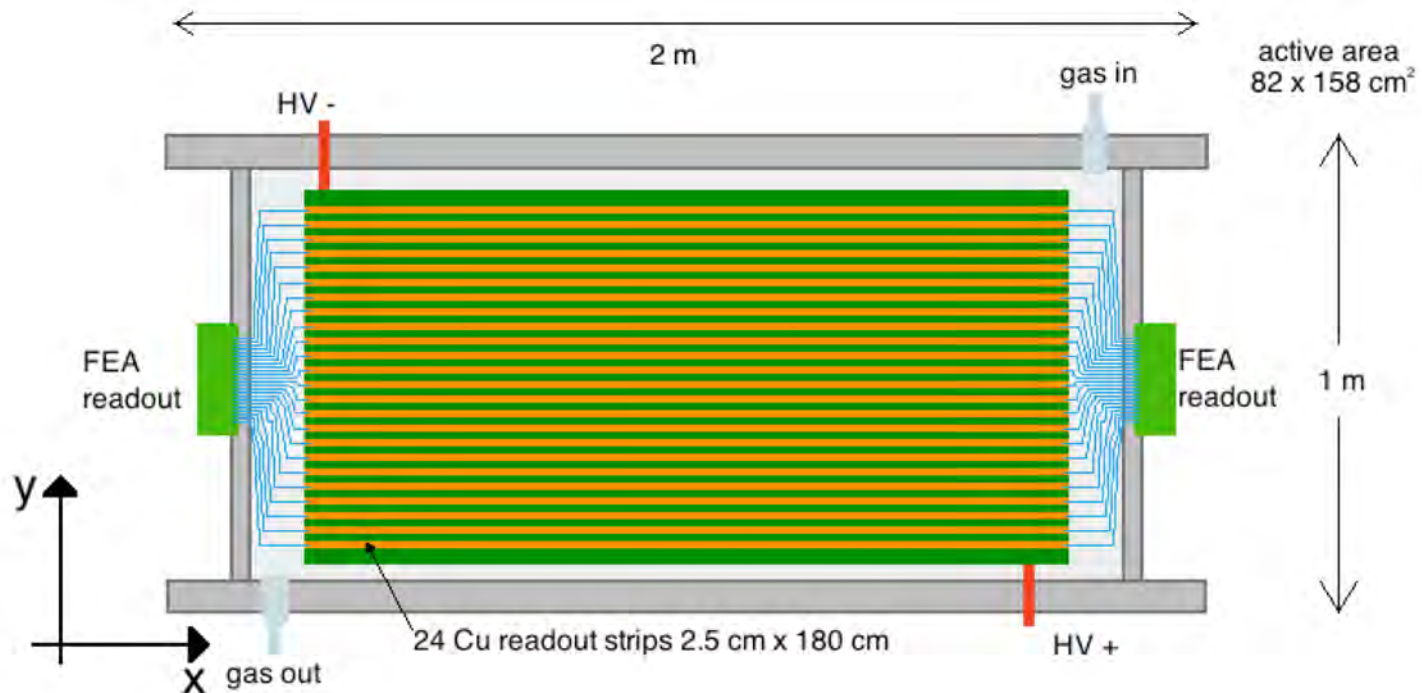
Main features of EEE MRPC

- The MRPCs developed for the EEE Project are characterized by **6 gas gaps** each, **300 μm** thick, obtained by separating **glass plates**, 1.1 mm thick, 80 x 160 cm² in dimensions, by means of commercial **nylon fishing lines** used as spacers



- The outer glass plates are coated with **resistive paint**, and act as high voltage electrodes, while the inner ones are left electrically floating
- The gas mixture is **C₂H₂F₄** (tetrafluoroethane, Freon) / **SF₆** (hexafluoride) mixed in **98 / 2 %** proportions, flowing at a typical rate of 2–3 l/h

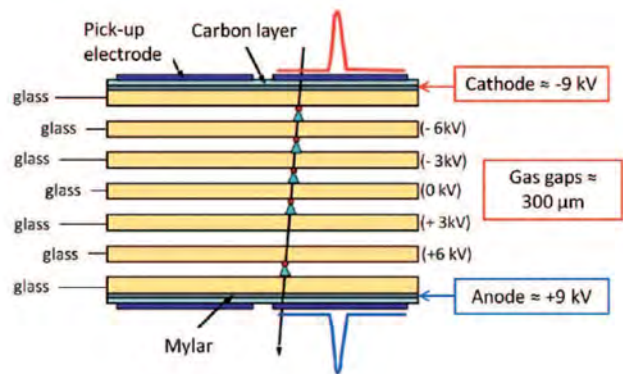
Main features of EEE MRPC



- Since readout strips (180 cm along x, 2.5 cm with 0.7 cm pitch along y) lie longitudinally on the chambers, one coordinate (x) of the muon impact point is given by the difference of the signal arrival times at the two strip extremities, while the other (y) is directly obtained from the position of the fired strip

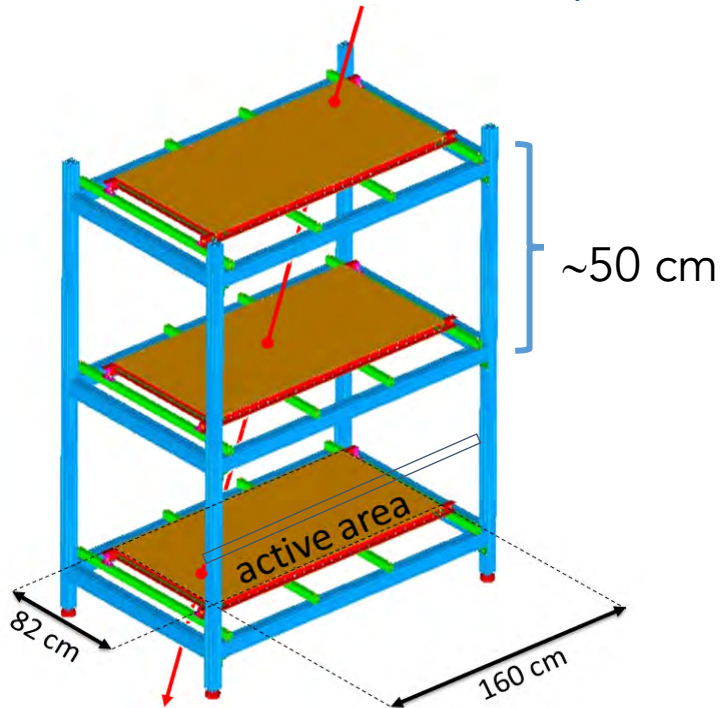


EEE Project MRPC construction

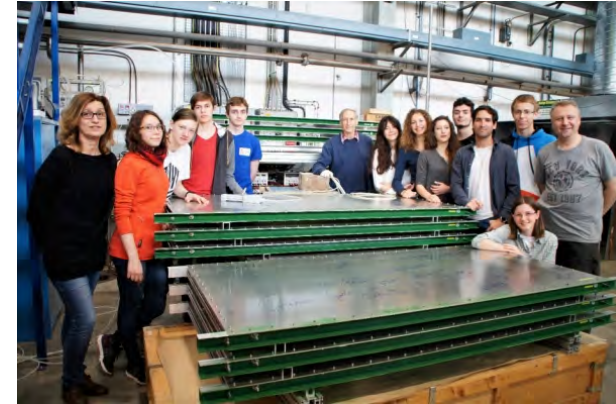


The EEE Project

MRPC chambers are built by High School students at CERN (starting from 2004) and maintained by them under the supervision of EEE researchers



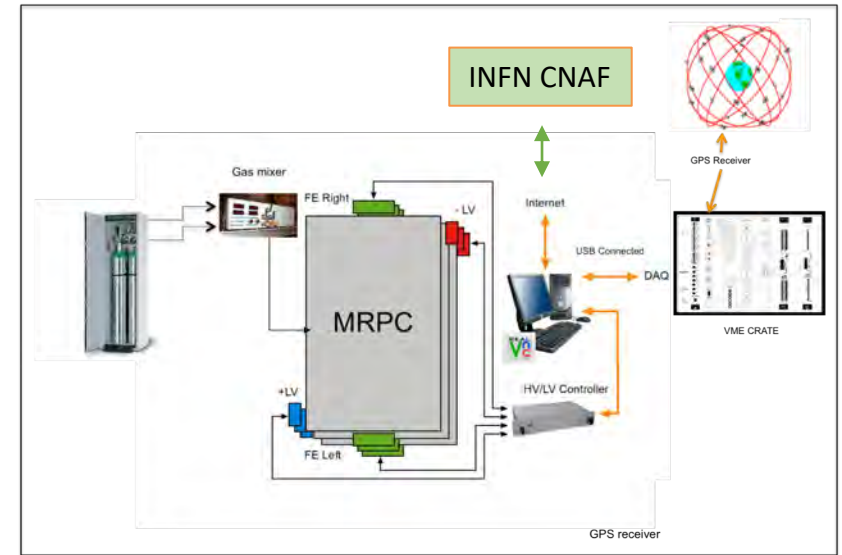
Acceptance
 $\Omega = 1.6 \text{ sr}$



- 3 MRPC planes with 24 strips each read at both ends \rightarrow 144 readout channels
- The trigger requires a hit signal on each end of the 3 MRPCs within a $\pm 500 \text{ ns}$ window
- Cosmic muons are tracked & reconstructed



- Time stamp via **GPS**
- Data taken and transferred to **INFN CNAF** for track reconstruction & storage
- Overall statistics **until now**
(6 data taking runs of ≈ 50 telescopes)



→ **more than 80 billion cosmic rays reconstructed & analysed**

BUT to study

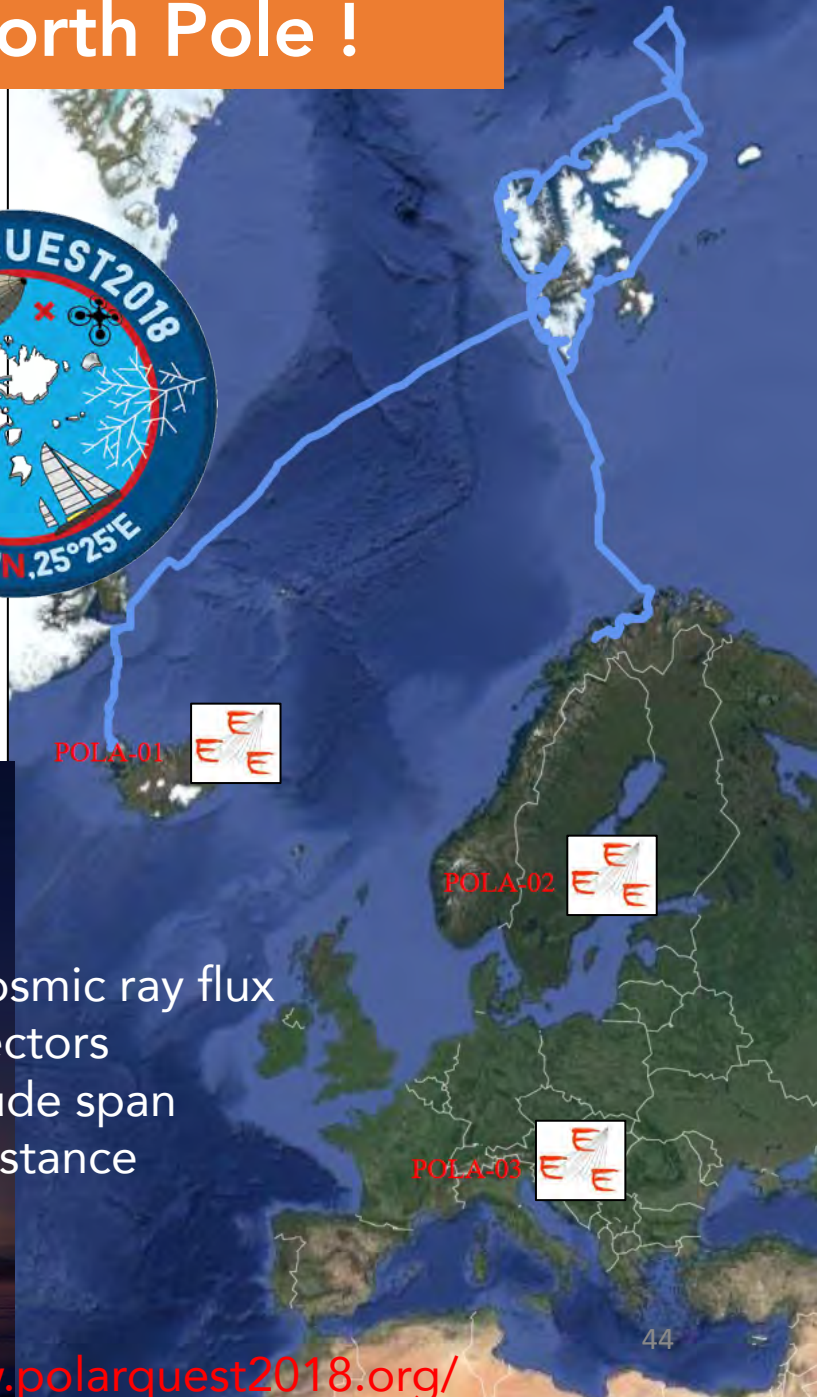
- the **effects of latitude** on cosmic ray flux
- **very, very large distance** (several 10^3 km) shower correlations ...

→ **the EEE project sails to North Pole !**

The EEE project sails to North Pole !



Airship Italia – 1928
Umberto Nobile



Polar QuEEEst 1928 – 2018
on board of Nanuq

Measure cosmic ray flux
with 3 detectors
40° in latitude span
5000 km distance



The EEE project sails to North Pole !



ExPeDitiOn Timeline

21 July 2018

Departure of Nanuq from Isafjordur,
Iceland
(66° 04' N, 23° 07' W)



1 August 2018

Arrival Longyearbyen,
Svalbard
(78° 13' N, 15° 39' E),
Ny Alesund, Svalbard
(78° 55' N, 11° 55' E)



4 - 24 August 2018

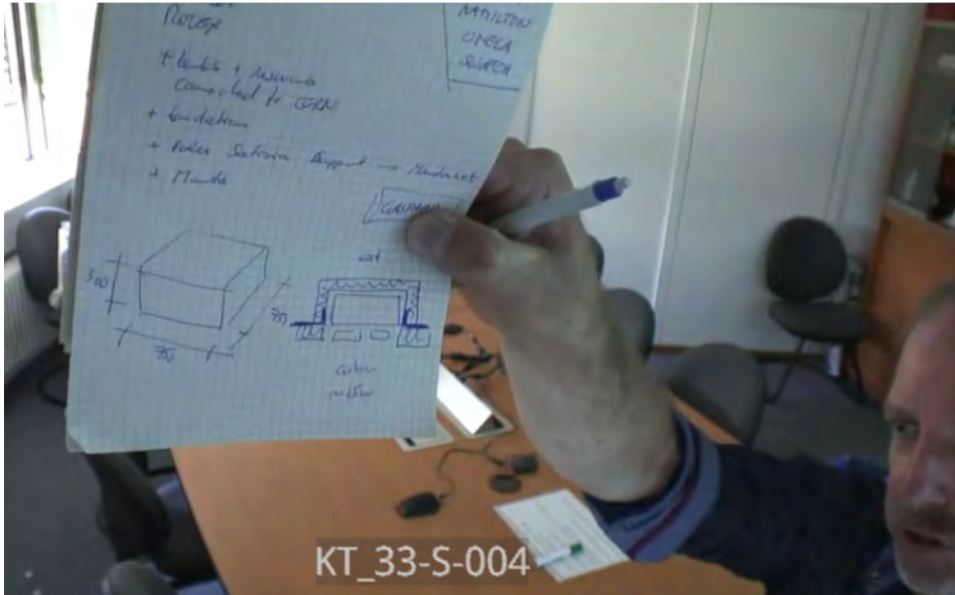
Nobile Expedition GEOHACK
Location
Nordaustlandet, Svalbard
(81° 14' N, 28° 14' E)



**4 September
2018**

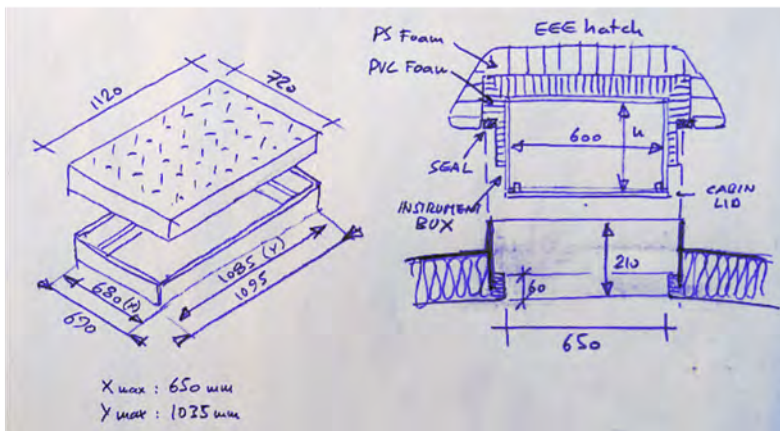
Tromsø, Norway
(69°40'58"N 18°56'34"E)

Requirements for PolarQuEEEst detector

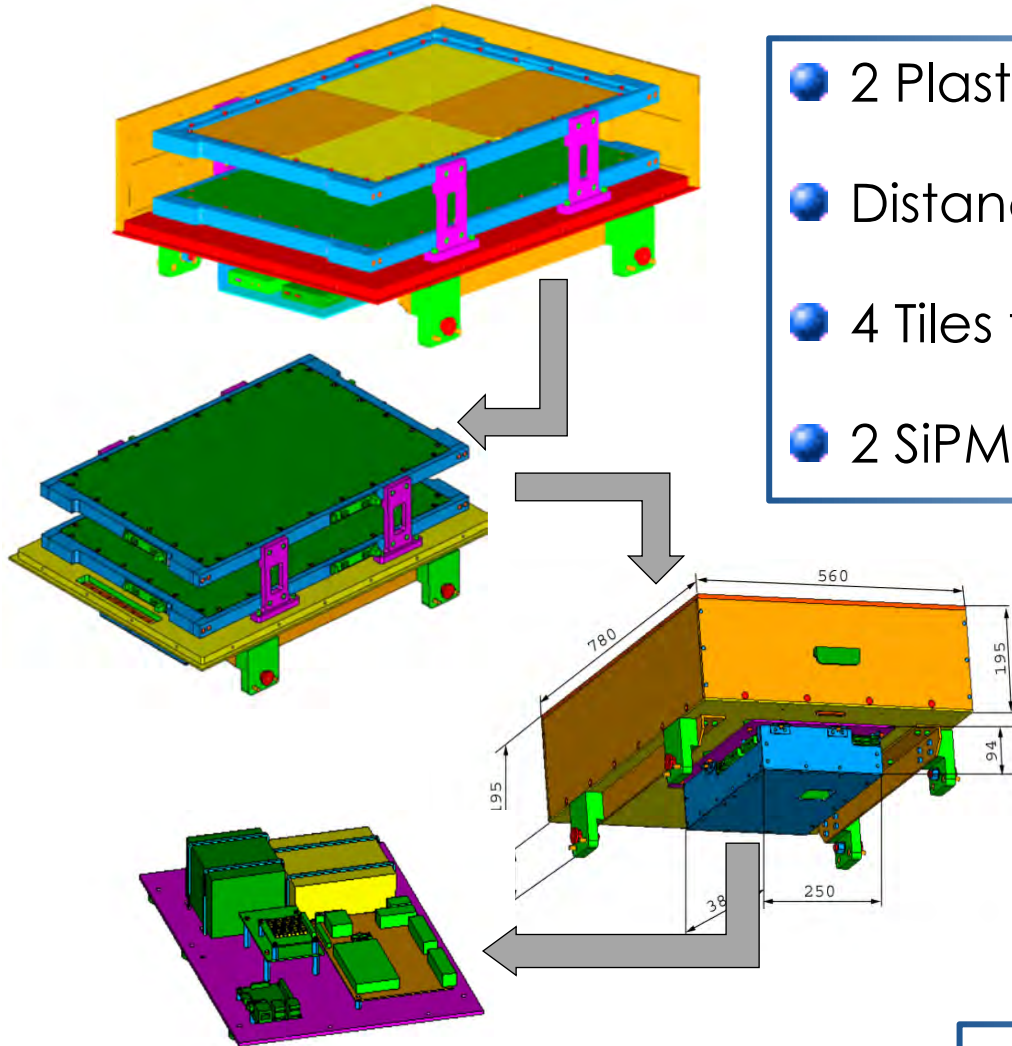


The Detector on the Polar Nanuq boat has been designed to fulfill the requests on

- dimension
- weight (~ 50 kg)
- power consumption (< 15 W)



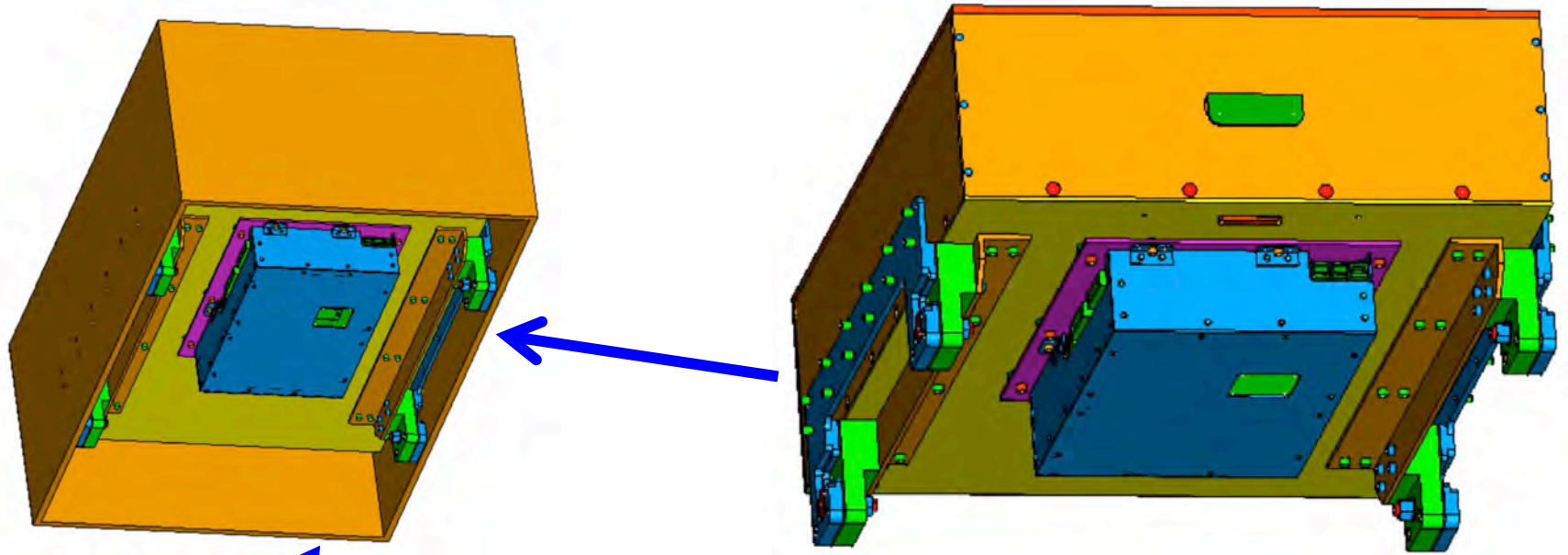
Design of PolarQuEEEst detector



- 2 Plastic scintillator planes
- Distance between planes: 11 cm
- 4 Tiles for each plane: 30 cm x 20 cm
- 2 SiPMs per tile (16 SiPMs in total)

INFN Bologna Technical Design
Service & Mechanical Workshop

Anchoring inside Nanuq

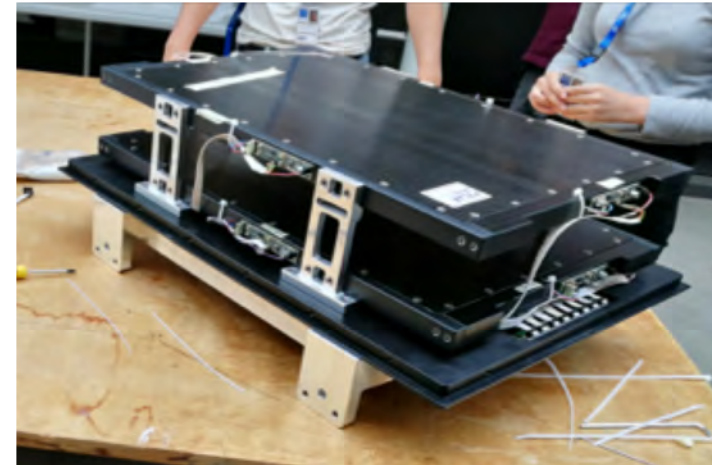
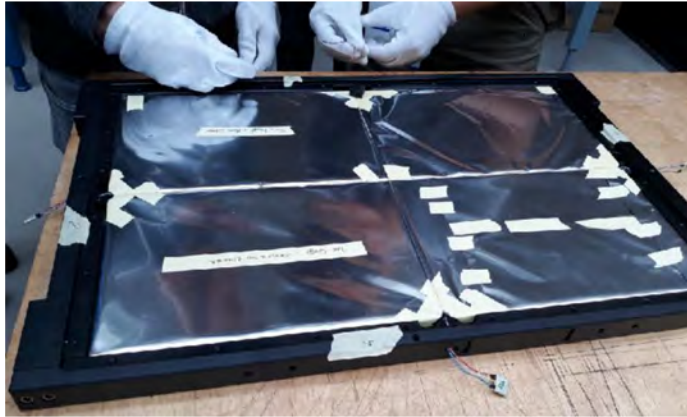


Cosmic hatch and anchoring system



Assembling

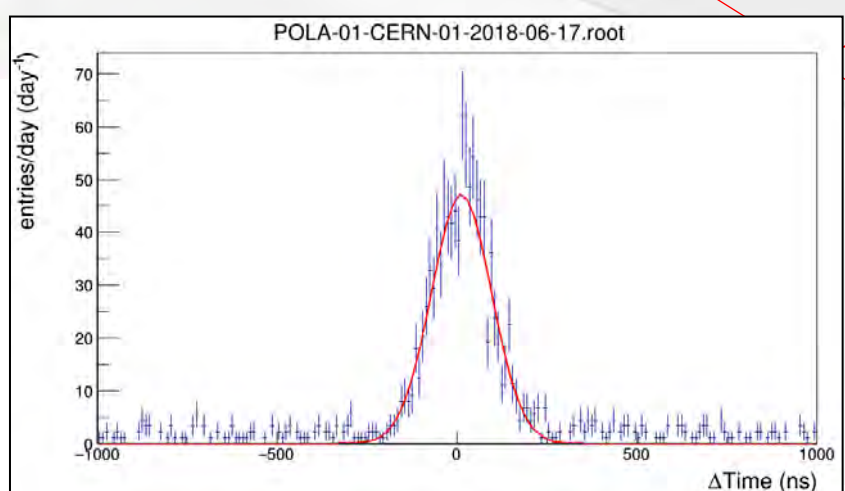
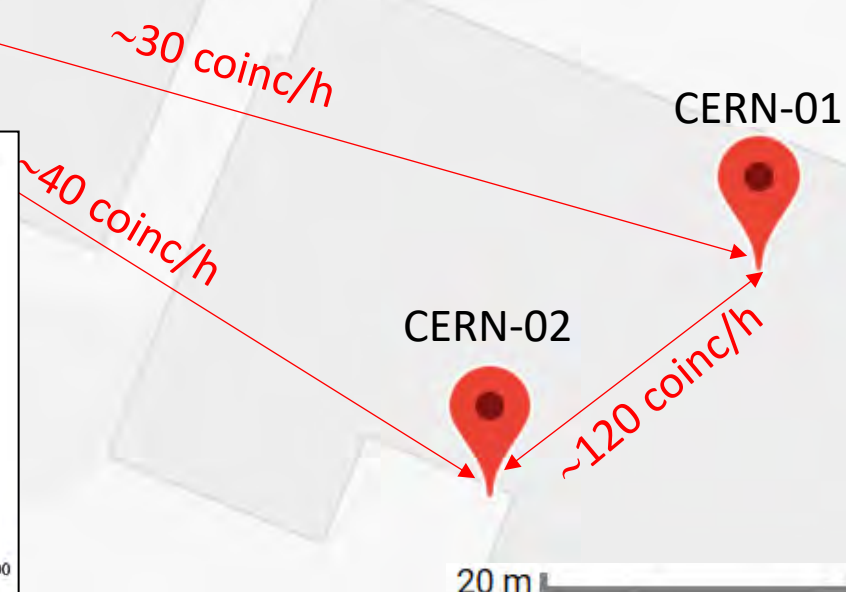
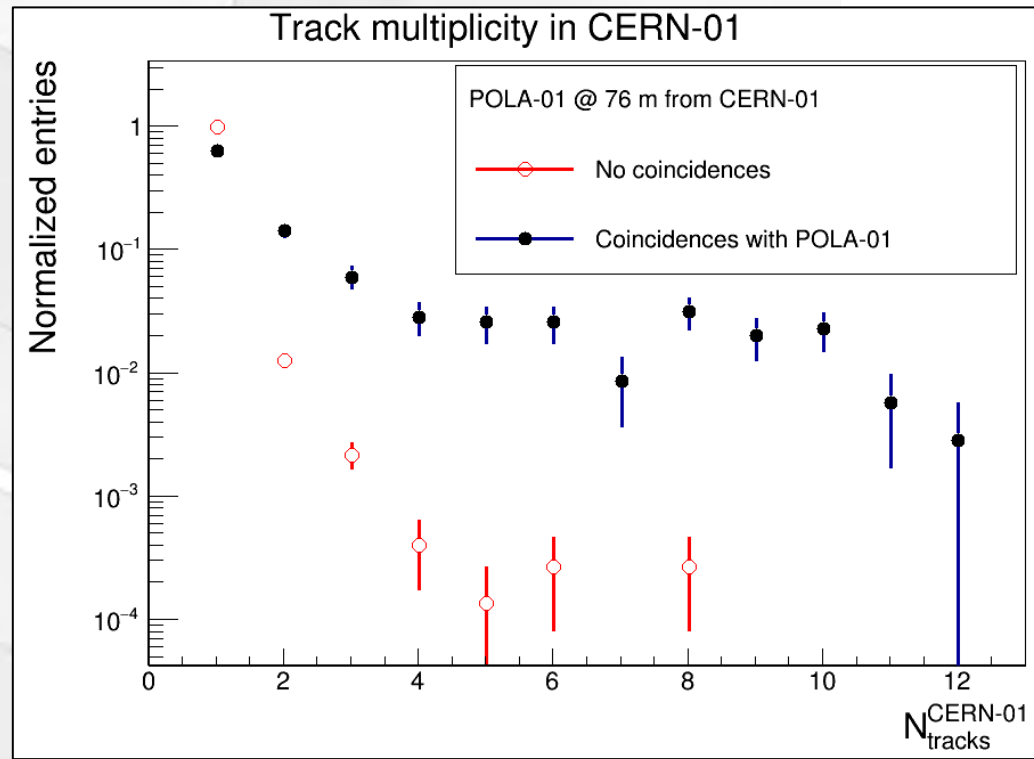
Performed at CERN by high schools students from Italy, Switzerland and Norway



24 May 2018

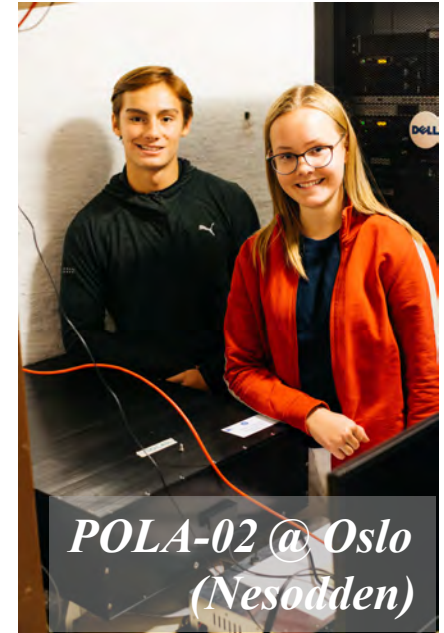
≥ 3 SiPMs coincidence required
→ Single POLA rate ≈ 30 Hz

Tests at CERN



Installation

All the detectors installed by the end of July 2018



POLA-01 on board

The trip

The PolarQuEEEst expedition started on the 22 July (data from 21 July) from Isafjordur and ended in Tromso on 3 September

During this period one PolarQuEEEst detector (POLA-01) was hosted on Nanuq and sailed towards the North Pole

Two other identical detectors were installed in two high schools: one in Norway (POLA-02) and one in Italy (POLA-03)

Data monitor accessible at
eee.centrofermi.it/monitor





Nanuq leaving Isafjordur (Iceland)



Nanuq en route to the Svalbard Islands



Nanug at the Svalbard Islands



Nanuq at the Svalbard Islands

Nanuq at the
Svalbard
Islands

approaching
the pack ice



On board of Nanuq



Navigation shift on Nanuq



PolarQuEEEst Statistics

Trip length

Nanuq sailed for 45 days covering about **3500 NM**

Duty cycle

The POLA-01 cosmic ray detector has taken data almost continuously for about **984 hours**

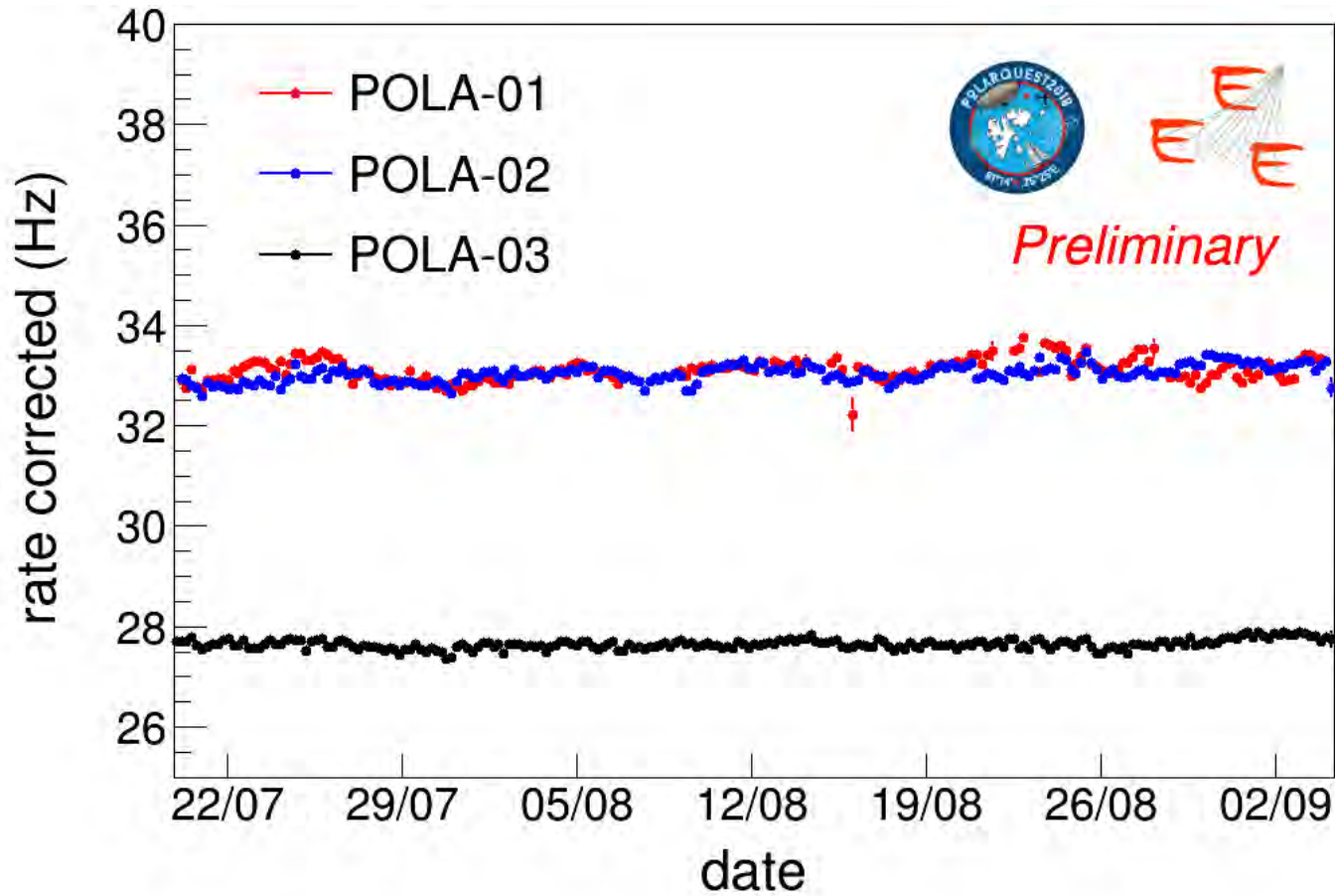
Detector efficiency

- for **POLA-01: about 91%** efficiency due to various reasons (main power down, difficult weather conditions, detector reset)
- for POLA-02 and POLA-03: essentially 100% efficiency (they were functioning during the whole period)

Collected muons

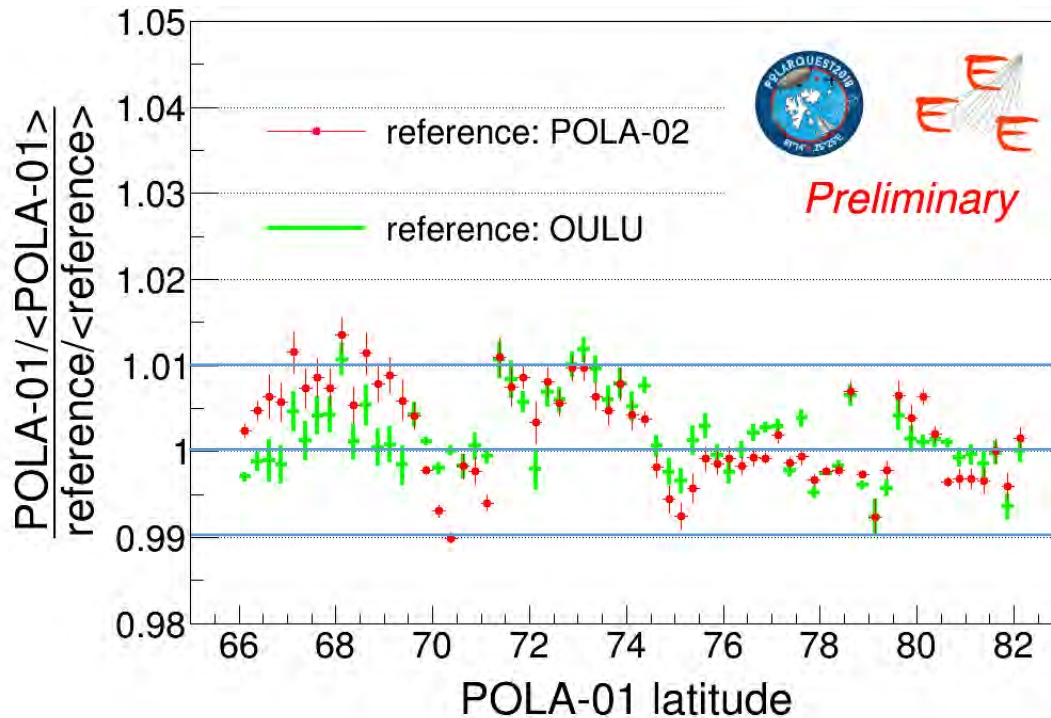
In total, more than **100.000.000 muon tracks per detector** were collected

Rate (corrected)

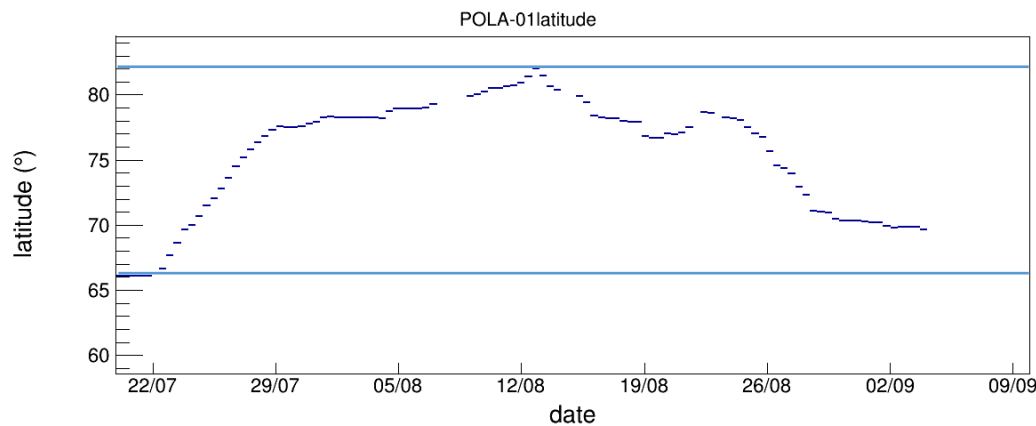


Rate vs. latitude

POLA-02 (in Oslo @ 59° N)
used as reference since
closer in latitude than
POLA-03 (in Turin @ 45° N)



No significant effect
observed
→ possible
variation < 1%

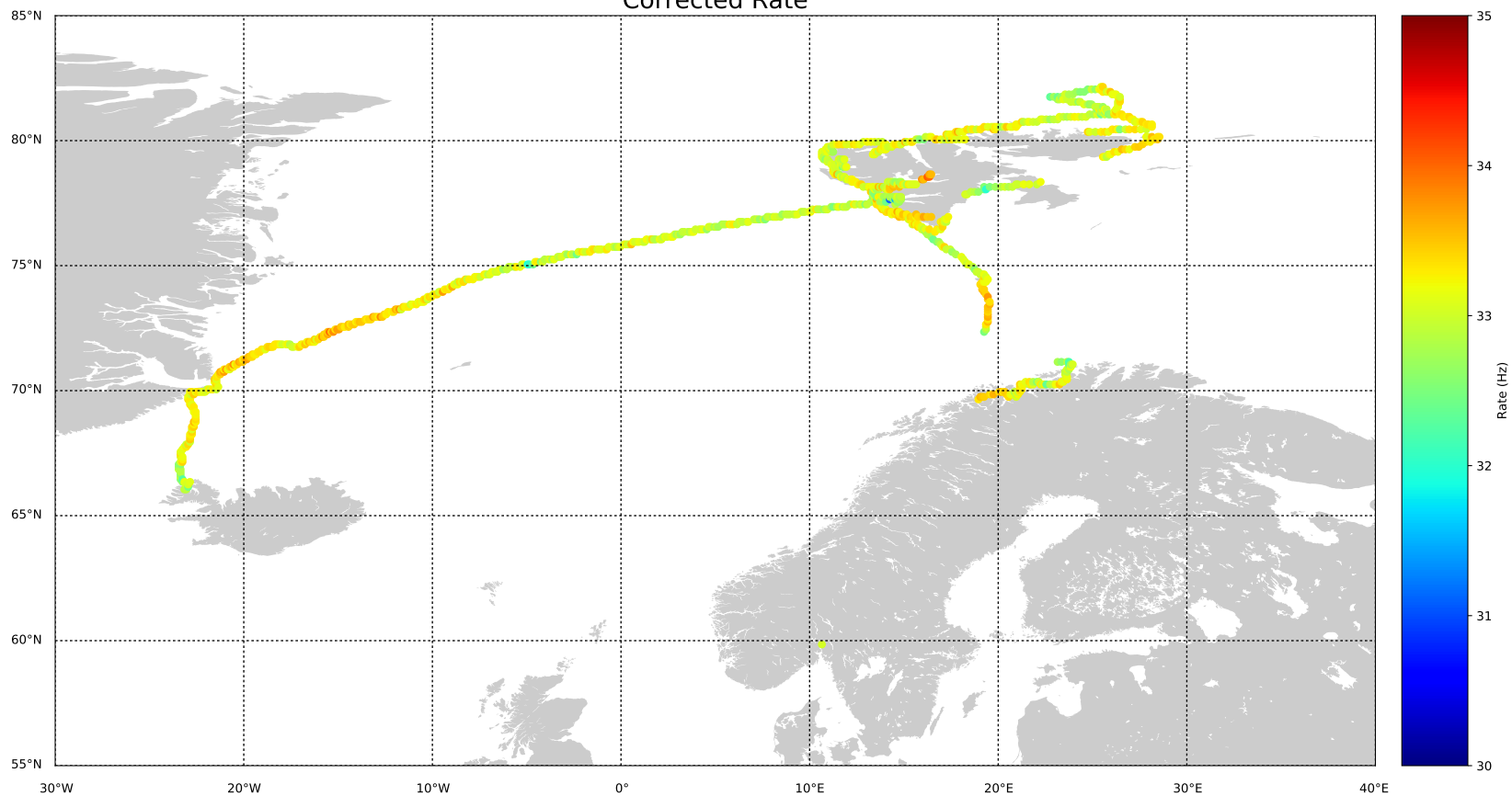


82° N (max) – North of Svalbard

POLA-01 on Nanuq

66° N (min) - Iceland

Corrected Rate



Cosmic ray measurements

Cosmic rays measured everywhere

protons (p), muons (μ), electrons (e), ...

photons (γ), neutrons (n), neutrinos (ν), ...

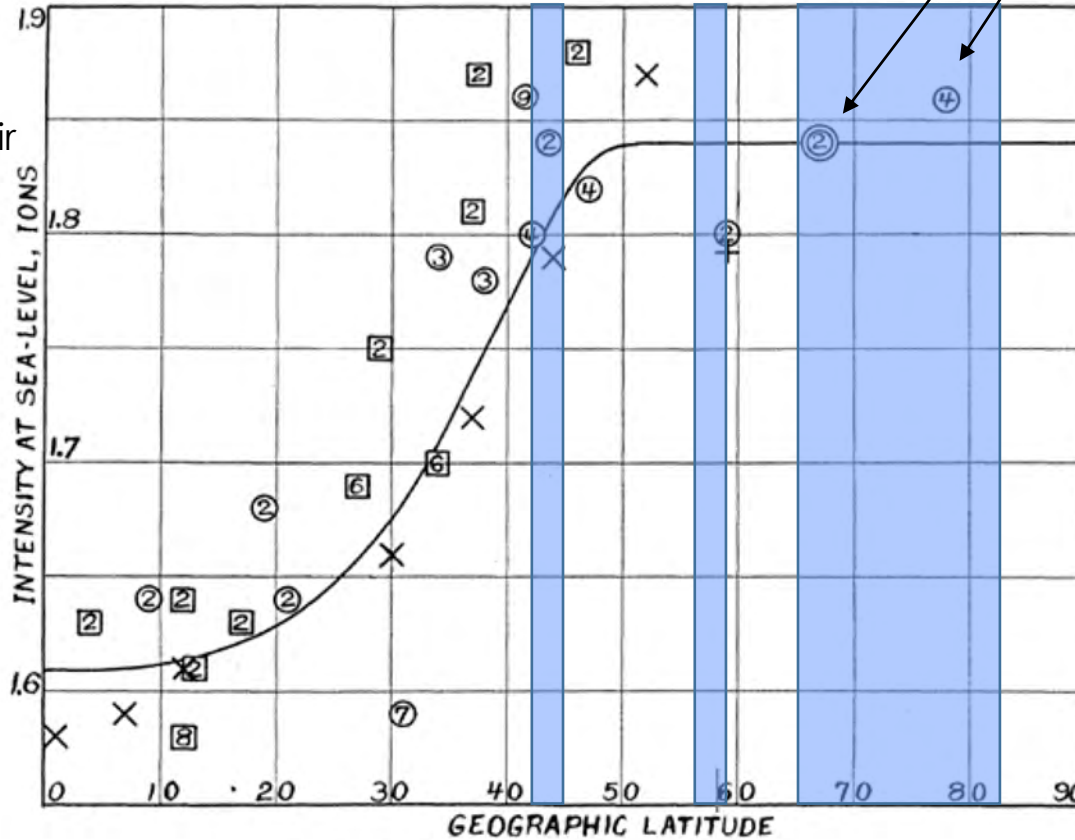
- in space
- on ground (high altitude & sea level)
- underground & underwater

A.H. Compton – Phys. Rev. 43 (1933) 387

GEOGRAPHIC STUDY OF COSMIC RAYS

(Northern Canada & Alaska)
(Svalbard)

Ions/cc s
in standard air



G. Lemaître,
M.S. Vallarta
theory

Phys. Rev.
42 (1932) 914

FIG. 8. Intensity vs. geographic latitude.

□ Southern hemisphere — ○ Northern hemisphere

2 Compton

+ Millikan (Pasadena)

x boat from Genoa to Singapore



PolarQuEEEst

GEOGRAPHIC STUDY OF COSMIC RAYS

Ions/cc s
in standard
air

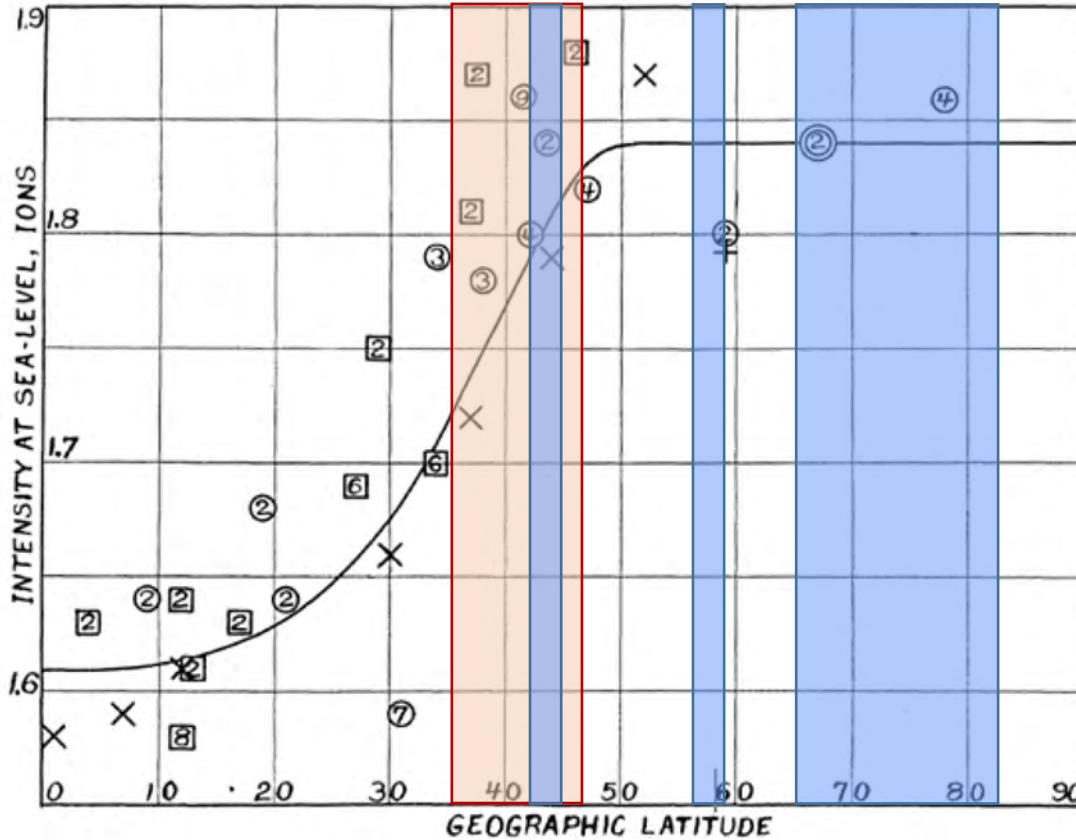


FIG. 8. Intensity vs. geographic latitude.



PolarQuEEEst latitude coverage



EEE latitude coverage (36°N - 46°N)

G. Lemaître,
M.S. Vallarta
theory

→ electrons coming
from remote space
of ≈ 7 GeV energy

→ latitude variation
attributed to magnetic
effects outside the
atmosphere



- Thanks to PolarQuEEEst
 - Precision study of the cosmic ray intensity at high latitudes up in the Arctic polar region where no published data exist
 - Check of the saturation of the cosmic ray intensity (suppression of the low-energy intensity) at higher latitudes
 - Very useful probe to understand the configuration of the cosmic ray energy spectrum affected by the Sun activity

The arrival in Longyearbyern after Svalbard circumnavigation



Gianluca Casagrande, Paola Catapano, Peter Gallinelli,
Alwin Courcy, Safiria Buono, Mathilde Gallinelli Gonzalez,
Dolores Gonzalez, Mike Struik, Ombretta Pinazza, Rémy Andrean

PolarQuest2018

Paola Catapano, CERN Communication Group

- 15 February 2018, Rai 3 «Geo&Geo»
 - 29 June 2018, RAI 1 «La vita in diretta»
 - 2 December 2018, RAI 3 «Kilimangiaro»
- + Facebook live ...

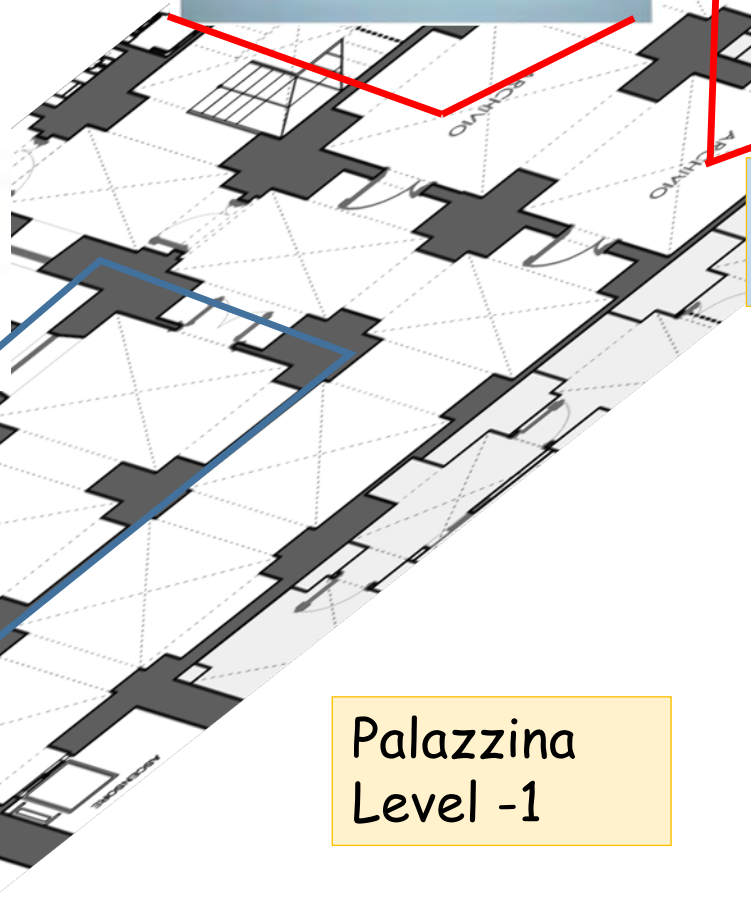
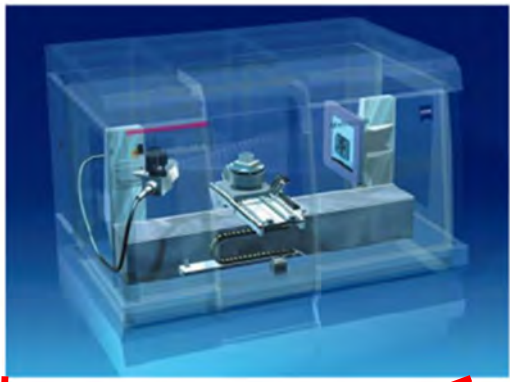
- CERN Colloquium «Measuring cosmic ray showers up to the North Pole» (Geneva, 26 September 2018)
- CERN photo exhibition
- Conference at Festival della Scienza «Raggi cosmici al Polo Nord» (Genova, 2 November 2018)
- Meeting at Società Geografica Italiana «PolarQuest 2018: risultati scientifici e risvolti geografici» (Roma, 27 November 2018)
- Meeting at Museo dell'Aeronautica (Vigna di Valle, 28 November 2018)
- And many others ...

- CERN Colloquium «Measurement at the North Pole» (Geneva, 26)
- CERN photo exhibition



Project VIEWLAB

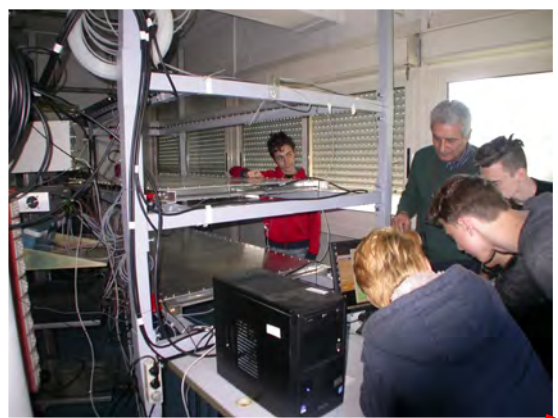
Micro-imaging XRF and Raman Spectroscopy



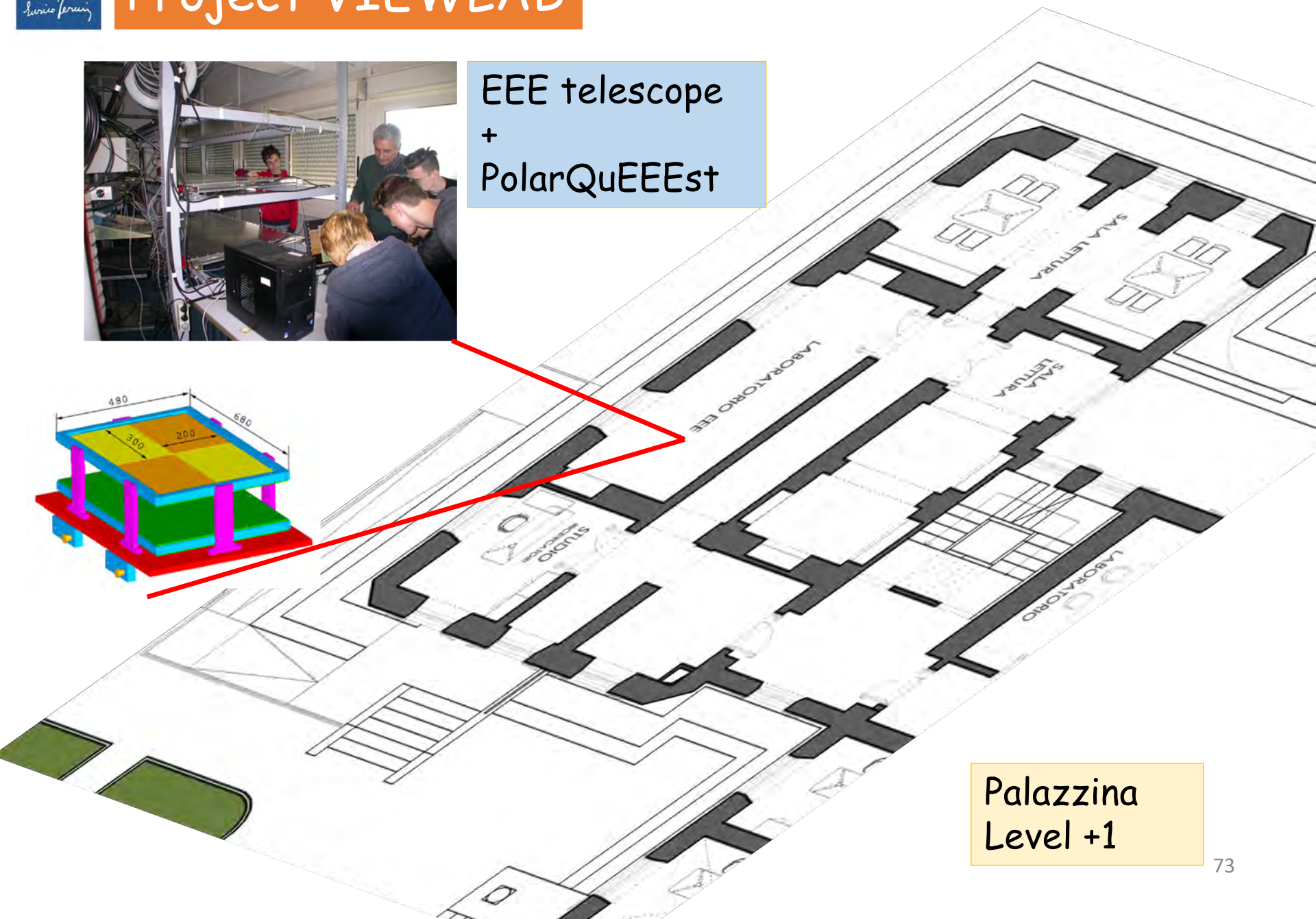
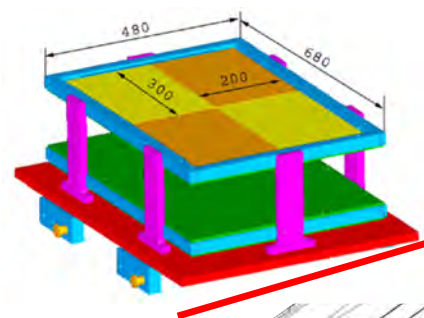
Cabinet for X-ray tomography

Palazzina Level -1

Project VIEWLAB



EEE telescope
+
PolarQuEEEst



Palazzina
Level +1



The Lilibeo Project

- *Nature of component materials: pigments*
- *Nature of component materials and state of preservation: corrosion products and patinas on metals*



*First measurement campaign
mid Feb 2019*



The Lilibeo Project

- *Link between colours and materials in the mosaics and paintings*
- *Link between the characterization of the open-air findings and environmental conditions*



*First measurement campaign
mid Feb 2019*



The Lilibeo Project

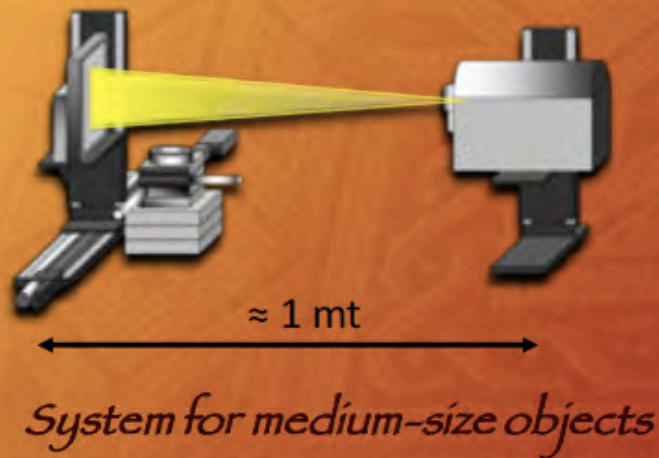


Punic Ship



The Lilibeo Project

CT analysis in Bologna

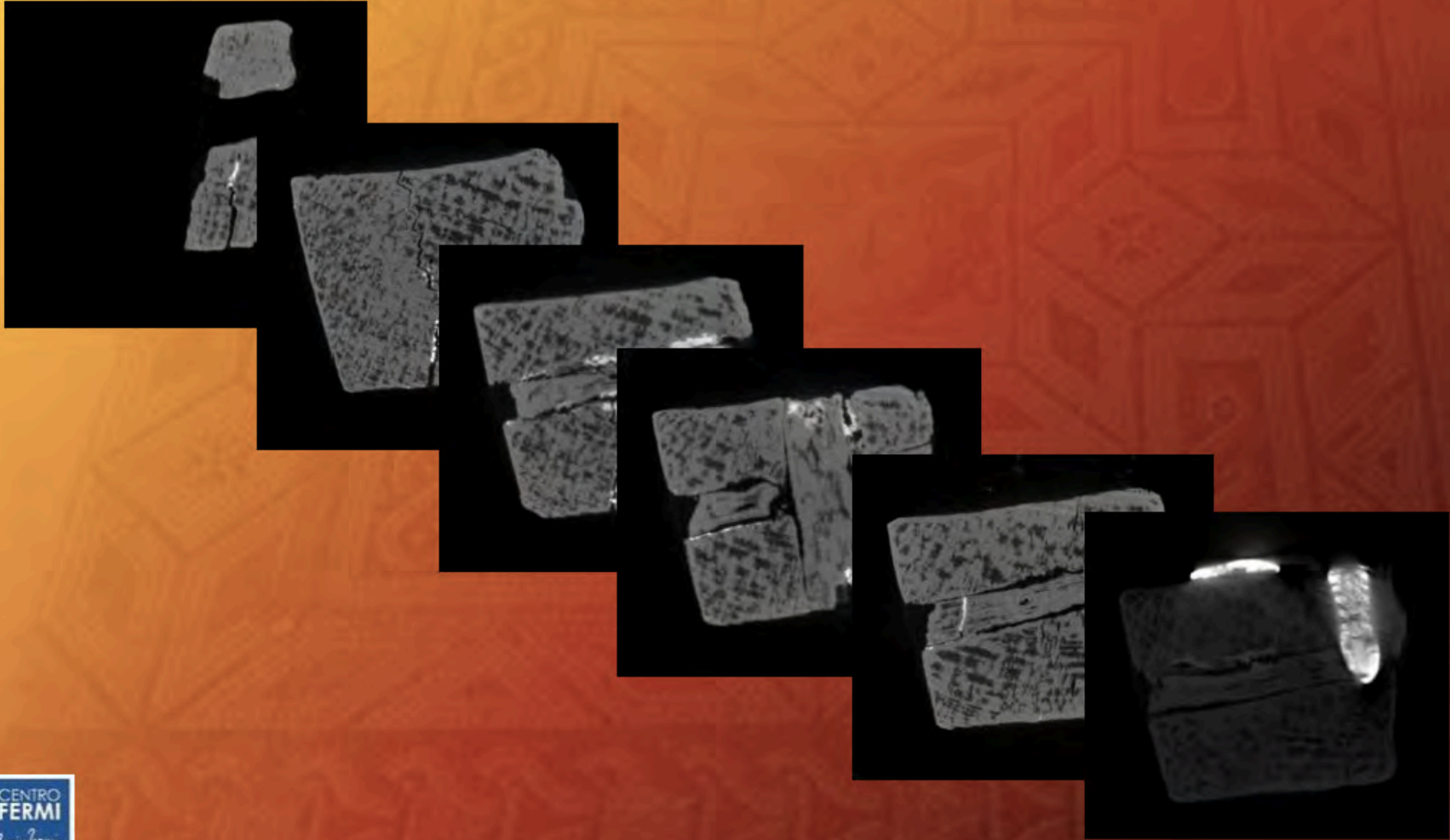


Punic ship fragment

CT analysis in Bologna



CT analysis in Bologna



Status of CENTRO FERMI

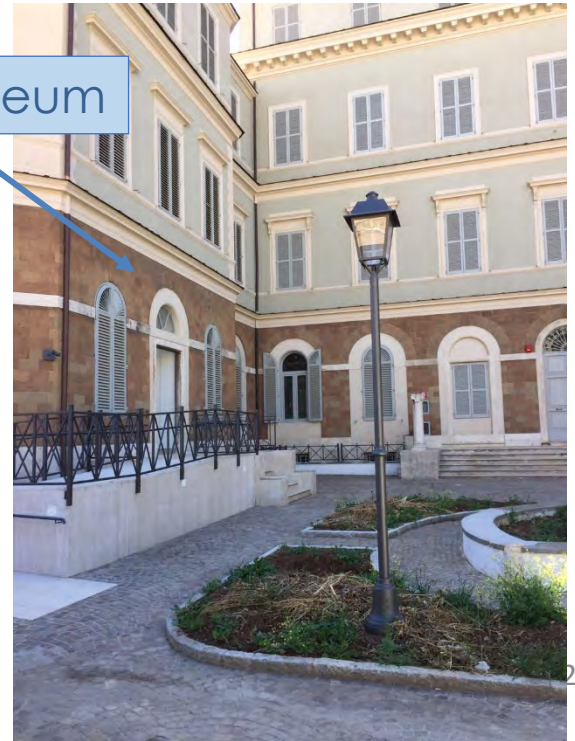


NOW





New Museum



1. OUR UNIVERSE OF FERMIONS AND BOSONS
IL NOSTRO UNIVERSO DI FERMIONI E BOSONI



2. THE FORMIDABLE THEORY OF BETA RADIATION
LA FORMIDABILE TEORIA DEI RAGGI BETA



3. AN ALL ITALIAN NOBEL PRIZE
UN PREMIO NOBEL TUTTO ITALIANO



4. "THE ITALIAN NAVIGATOR HAS LANDED IN THE NEW WORLD ..."
"IL NAVIGATORE ITALIANO È SBARCATO NEL NUOVO MONDO..."



5. THE MYSTERY OF COSMIC RAYS
IL MISTERO DEI RAGGI COSMICI



INVITATION TO THE EXHIBITION
INVITO ALLA MOSTRA

A BRILLIANT LIFE
UNA VITA SCINTILLANTE



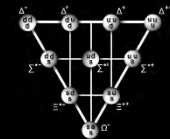
CENTRO FERMI'S PROJECTS
I PROGETTI DEL CENTRO FERMI

A CREATIVE ENVIRONMENT
UN AMBIENTE CREATIVO

7. FERMI'S LAST GIFT TO ITALY
L'ULTIMO DONO DI FERMI ALL'ITALIA



6. AND NOW ACCELERATORS
E ADESSO GLI ACCELERATORI



VIEWLAB Project

→ Centro Fermi STRATEGIC PROJECT



Rendering from the first ideas for the Museum





Rendering from the first ideas for the Museum

The new Aula Magna E. Fermi



CENTRO FERMI as an international cultural centre

- Fermi Museum to be included in the national / international network of Science Museums
- Fermi Museum to be included in the Roman Museums' circuit
- Centro Fermi to become an exclusive location for "scientific tourism": exhibitions, conferences, schools meetings, events ...
- Centro Fermi to become a Point of Presence (PoP) for learned societies and international organizations such as: EPS / SIF, APS, NuPECC, IPPOG, ECSITE, WFS ...
- Centro Fermi to become a major scientific cultural centre in Rome, in Italy, and worldwide

... in 2019 ???????



Thank you for your attention