



MUSEO
STORICO DELLA FISICA
E
CENTRO
STUDI E RICERCHE
ENRICO FERMI

R. Nania
Scientific Coordinator



A **Research Institute** funded in 2001 by the Italian Ministero per Istruzione Università e Ricerca dedicated to frontier research in physics and its wide applications for the benefit of humankind (**Education and Outreach**), in the spirit of E. Fermi legacy.



Three main focus points:

- **Grants** for Junior/Senior researchers
- **Interdisciplinary Research Projects**
- **Dissemination of Scientific Culture and Historic Memory** also through the restoration of the "Monumental Complex" of Via Panisperna, to be used in part for the Museum

President: L. Cifarelli

Researchers : 6 permanent , ≈40 Grants , > 100 associated



HISTORY
OF
PHYSICS

EEE



MUSEUM



Centro Fermi



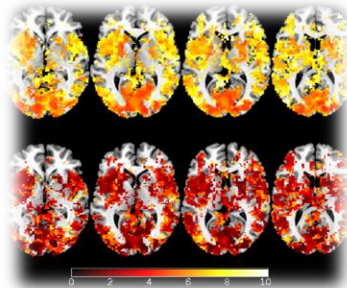
Fundamental
PHYSICS



CULTURAL
HERITAGE



MEDICINE



ENERGY



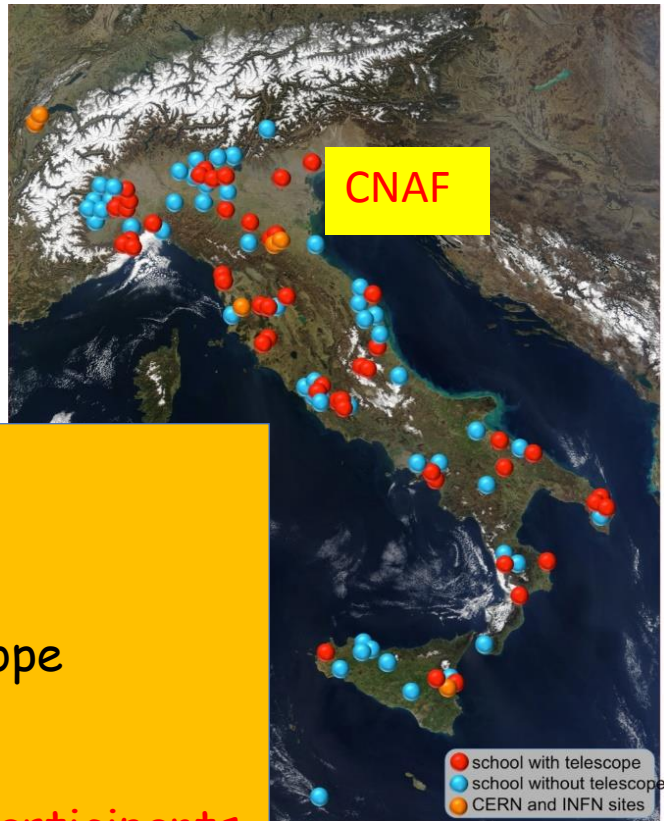
The Extreme Energy Events (EEE) Science inside Schools

Since 2004 , EEE conjugates a **real experiment on Cosmic Rays**, with the largest area coverage, with a **direct participation of students and teachers** in all aspects of the experiment, from building the detectors, to monitoring the operations/data taking and analyzing the data.

INFN, CERN, MIUR (Italian Ministero Istruzione e Università) collaborate to the project.



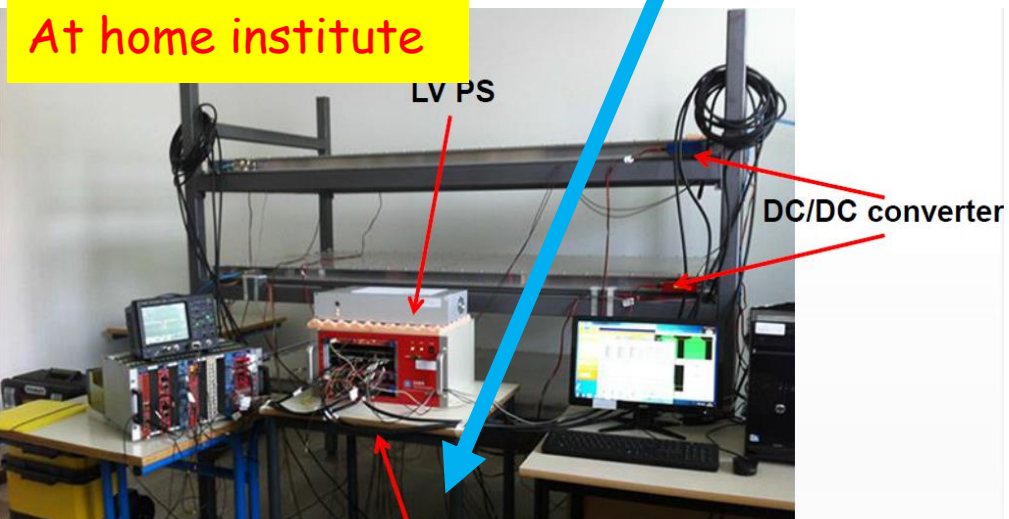
The EEE project



At CERN

Few numbers for EEE:
≈ 57 Institutes with a Telescope
≈ 47 Institutes without Telescope
≈ 2000 students-teachers /year
Since 2004 more than ≈ 10000 participants

At home institute



The EEE project web panels: Data taking and analysis control



Progetto Extreme Energy Events - La Scienza nelle Scuole

[<http://eee.centrofermi.it/monitor>]

EEE MONITOR

Ultimo aggiornamento: ore 14:14 - mercoledì 11 ottobre 2017 [by e3monitor]

ELOGBOOK delle SCUOLE per il RUN 4 ELOGBOOK dello SHIFTER Set Automatic Shift REPORT Messages Automatic Shift Report ARCHIVE

Home Page EEE Masterclass Download the Excel Sheet New DB Interface Connectivity Report Data Request

[EEE Monitor] Start of RUN4: October 2, 2017

[EEE Monitor] RUN 4 - Countdown - Day number: 10

Total number of candidate tracks ($X^2 < 10$) in the database: 52028515378

Questa tabella mostra la situazione dei telescopi in acquisizione:
 in verde sono indicati i telescopi in presa dati e trasferimento nelle ultime 3 ore e con parametri di acquisizione ragionevoli nell'ultimo run analizzato.
 in giallo sono indicati i telescopi in cui trasferimento e/o acquisizione sono sospesi da più di 3 ore o con tracce ($X^2 < 10$) minori di 10 Hz nell'ultimo run analizzato.
 in rosso sono indicati i telescopi in cui trasferimento e/o acquisizione sono sospesi da più di due giorni o con tracce ($X^2 < 10$) minori di 5Hz nell'ultimo run analizzato.

Scuola	Giorno	Ora	Nome dell'ultimo File trasferito	Numero Files trasferiti oggi	Ultima Entry nell'e-logbook delle Scuole del Run	Nome dell'ultimo File analizzato dal DQM	Report giornaliero DQM	RATE of Triggers for the last Run in DQM	RATE of Tracks For the last Run in DQM	Link DQM
ALTA-01	mer 11 ottobre	13:33	ALTA-01-2017-10-11-00041.bin	47 [History]	11:19 11/10/2017	ALTA-01-2017-10-11-00042.bin	11/10 [History]	40.0	35.0	ALTA-01
ANCO-01	mer 11 ottobre	13:53	ANCO-01-2017-10-11-00025.bin	28 [History]	09:22 11/10/2017	ANCO-01-2017-10-11-00025.bin	11/10 [History]	24.0	13.0	ANCO-01
AREZ-01	mer 11 ottobre	13:54	AREZ-01-2017-10-11-00027.bin	36 [History]	12:53 11/10/2017	AREZ-01-2017-10-11-00027.bin	11/10 [History]	30.0	27.0	AREZ-01

Students and researchers are able to access data both for detector monitoring and for data/MC analysis

Request a subset of data

Submit Preview Back

Fields marked with * are required

Entry time: Thu Oct 5 18:41:18 2017

Author*: BOLO-01

Output format: RUDI

MC:

Telescope ID: CATA-01

Start time: May 9 Year: 2017

Stop time: May 12 Year: 2017

RunNumber:

Seconds:

Nanoseconds:

Theta:

Phi:

ChiSquare:

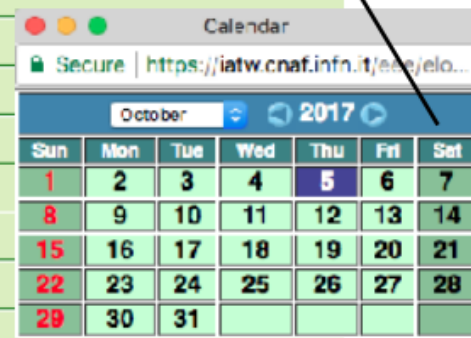
TimeOfFlight:

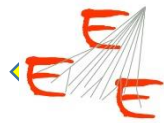
TrackLength:

Delta Time:

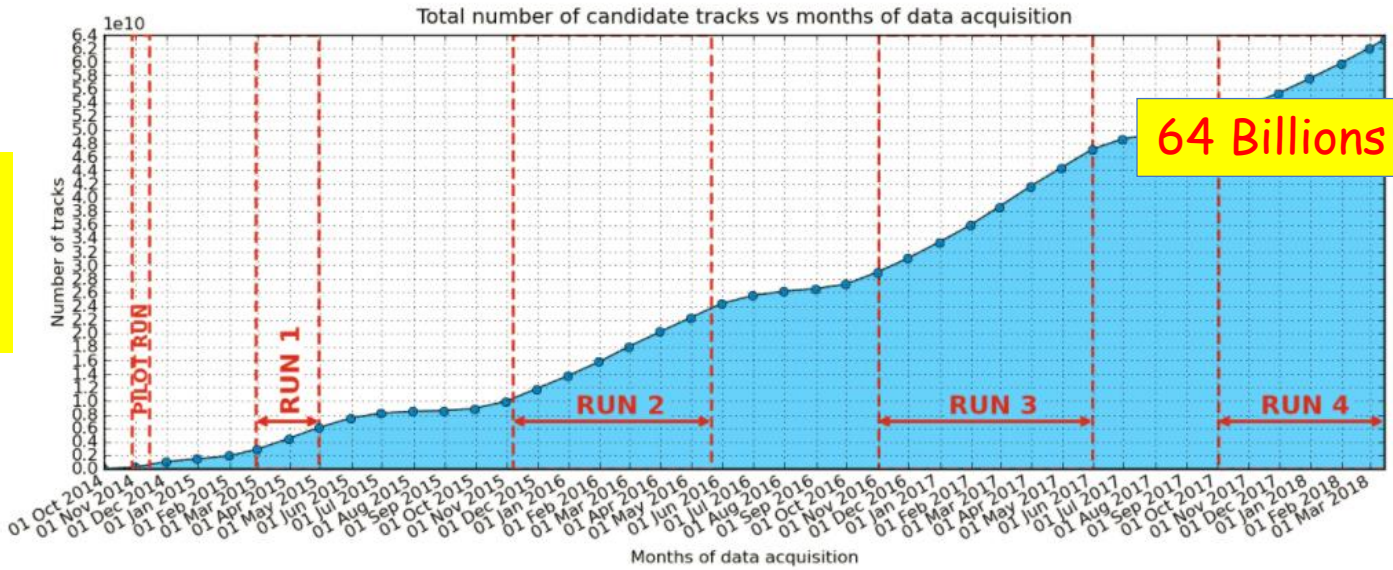
Cut: DeltaTime < 3 && ChiSquare < 7

10

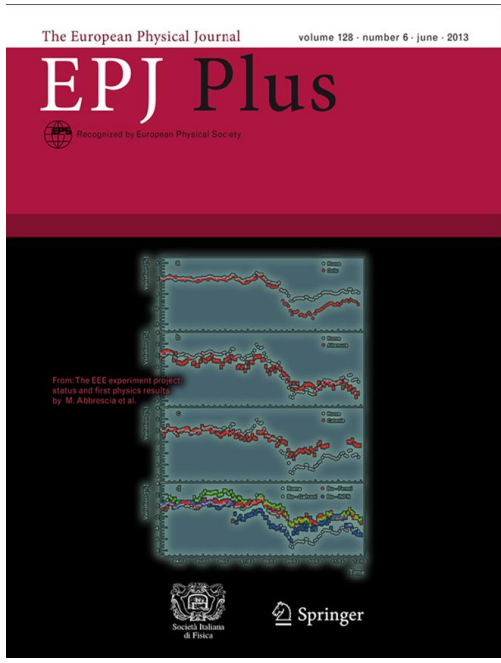




The EEE Runs



64 Billions tracks



Forbush detection

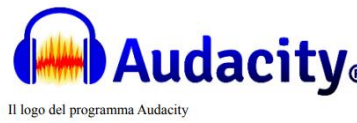


Project Conferences
 Monthly vidyo meetings
 Institutes visits
 Masterclasses ...

SCHEDA TECNICA DELL'ESPERIMENTO PER LA RILEVAZIONE DELLA FREQUENZA DEL SUONO EMESSO DALLA BOMBOLA DELE TELESCOPIO EEE

MATERIALE OCCORRENTE:

- Un computer portatile con un microfono interno oppure un computer collegato ad un microfono esterno.
- Il software open source Audacity, scaricabile da questo link <http://www.audacityteam.org/>
- Un martelletto gommato, come quelli utilizzati per colpire i diapason negli esperimenti di acustica



How to measure the amount of gas in a bottle by mean of sound frequency
 Liceo F. e M. Campana (Osimo)

EEE in Erice 2017

Both measurements will be published in the *Giornale di Fisica* with students' signature.

Measurement of the Earth Radius

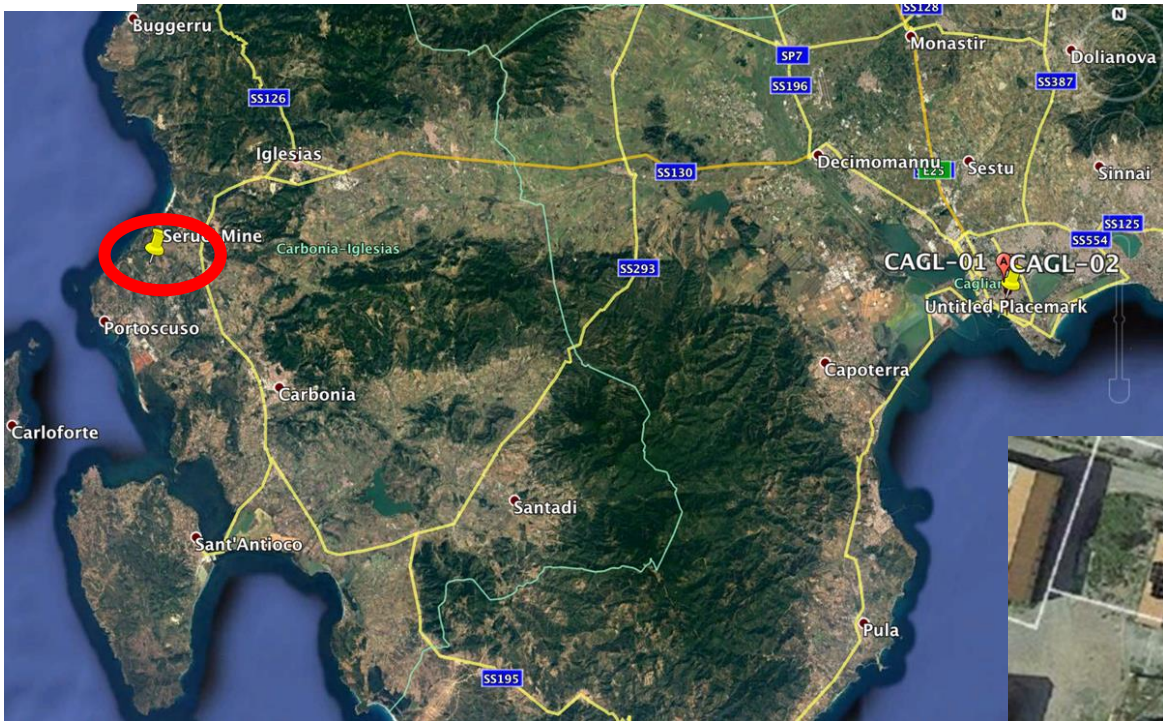


Measurement of Cosmic rays flux at different altitudes



Geo&Geo TV magazine

... and now EEE measures cosmic rays flux in mine



Seruci mine , 50 km west from Cagliari, Sardinia island

Old mine ≈ 300 m deep. The bottom is reachable by car. Students are allowed to enter and participate.

This is the site where the ARIA project will be placed. Purification column to supply Argon for the **DarkSide** experiment, with a very low content of ^{39}Ar .





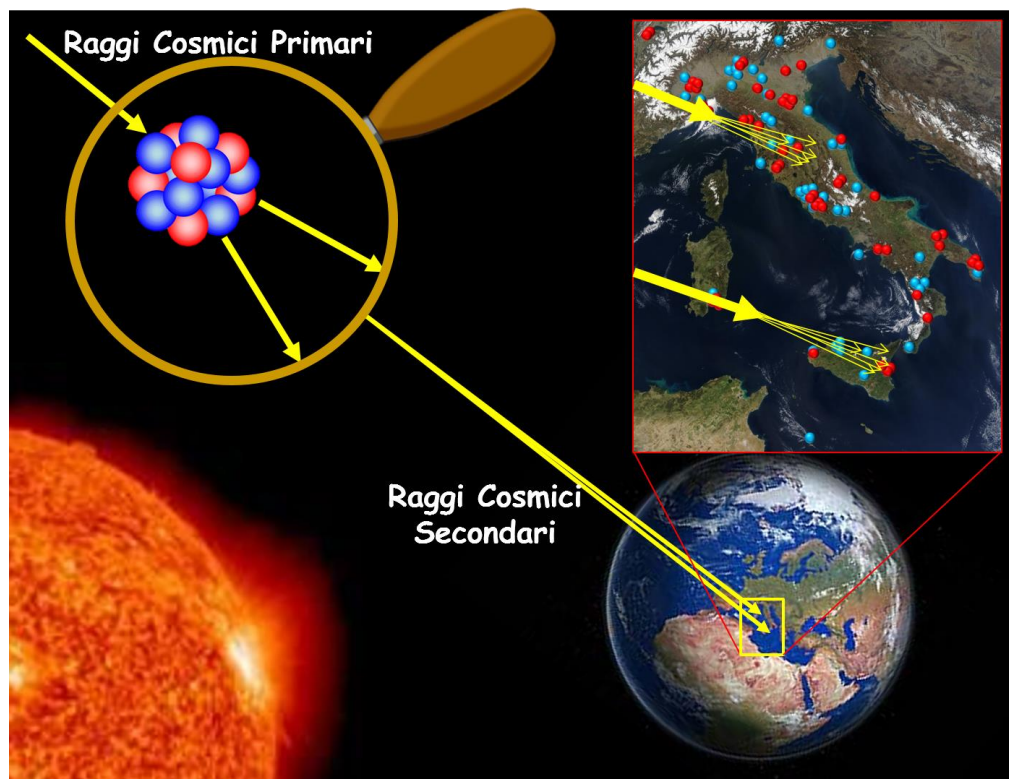
Eur. Phys. J. Plus (2018) 133: 34
DOI 10.1140/epjp/i2018-11898-x

THE EUROPEAN
PHYSICAL JOURNAL PLUS

Regular Article

Search for long distance correlations between extensive air showers detected by the EEE network

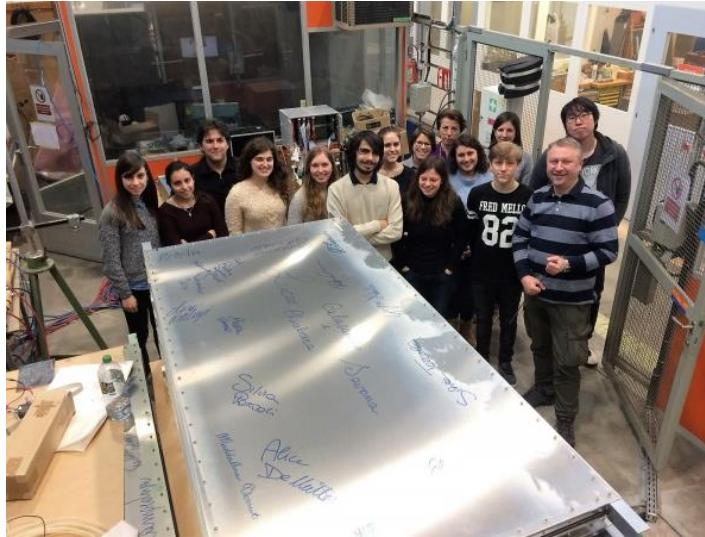
M. Abbrescia^{1,2}, L. Baldini^{1,3}, R. Baldini Ferroli^{1,4}, G. Batignani^{1,3}, M. Battaglieri^{1,17}, S. Boi^{1,8}, E. Bossini^{1,5}, F. Carnesecci^{1,6}, A. Chiavassa^{1,7}, C. Cicalo^{1,8}, L. Cifarelli^{1,6}, F. Coccetti¹, E. Coccia^{1,9}, D. De Gruttola¹, S. De Pasquale^{1,11}, F.L. Fabbri^{1,4}, V. Frolov¹⁶, P. Galeotti^{1,7}, M. Garbini^{1,6}, G. Gemme^{1,17}, I. Gnesi^{1,7}, S. Grazzi¹, C. Gustavino^{1,12}, D. Hatzifotiadou^{1,6,15}, P. La Rocca^{1,18}, C. Mandaglio^{1,19}, O. Marazoto Rodriguez¹⁴, C. Maron¹³



Greisen-Zatsepin-Kuzmin (GZK) effect

EEE International connections

Students build
chambers at CERN
(≈ 4 stud. +1 teach.
per institute)



ENTRE

Le Museo Storico della Fisica e Centro Studi e Ricerche "E. Fermi", ci-après dénommé le "Centro Fermi", ayant son siège à Rome, site du Viminale, code fiscal n. 97214300580, représenté par son Président, le Professeur Luisa Cifarelli, née à Rome le 11 juin 1952, ayant élu domicile pour le présent acte au siège du Centro Fermi et ayant reçu pouvoir de signature par le Conseil d'administration à sa séance du 09/11/2017, par la délibération n. 96, et par le Professeur Antonino Zichichi, né à Trapani le 15 octobre 1929, en qualité de Team Leader du Centro Fermi pour les expériences EEE, QGCW-ALICE et LAA.

d'une part,

ET

L'Organisation européenne pour la Recherche nucléaire, ci-après dénommée le "CERN", Organisation internationale ayant son siège à 1211 Genève 23, Suisse, représentée par son Directeur général, Dr. Fabiola Gianotti, ayant élu domicile pour la signature du présent acte au siège du CERN,

d'autre part,

ci-après «la Partie» ou «les Parties»;



Participation of schools and students from outside Italy

- Moscow Chemical Lyceum
- Themistokli Ghermenji Lyceum (Korce, Albania)
- Instituto de Ciencias Nucleares UNAM (Mexico)
- Oslo University (Oslo)

EEE International connections



Follow-up with exchanges of visits between schools: Liceo Staffa Trinitapoli (Bari) and Moscow Chemical Lyceum

Prot. Centro Fermi n. 1935/17 del 11/09/2017

Memorandum of Understanding

Collaboration agreement between

University of Santiago de Compostela (USC), Pazo de San Xerome, Praza do Obradoiro s/n, E-15782 Santiago de Compostela (Spain)

and

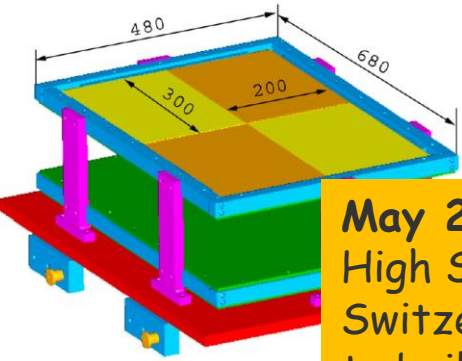
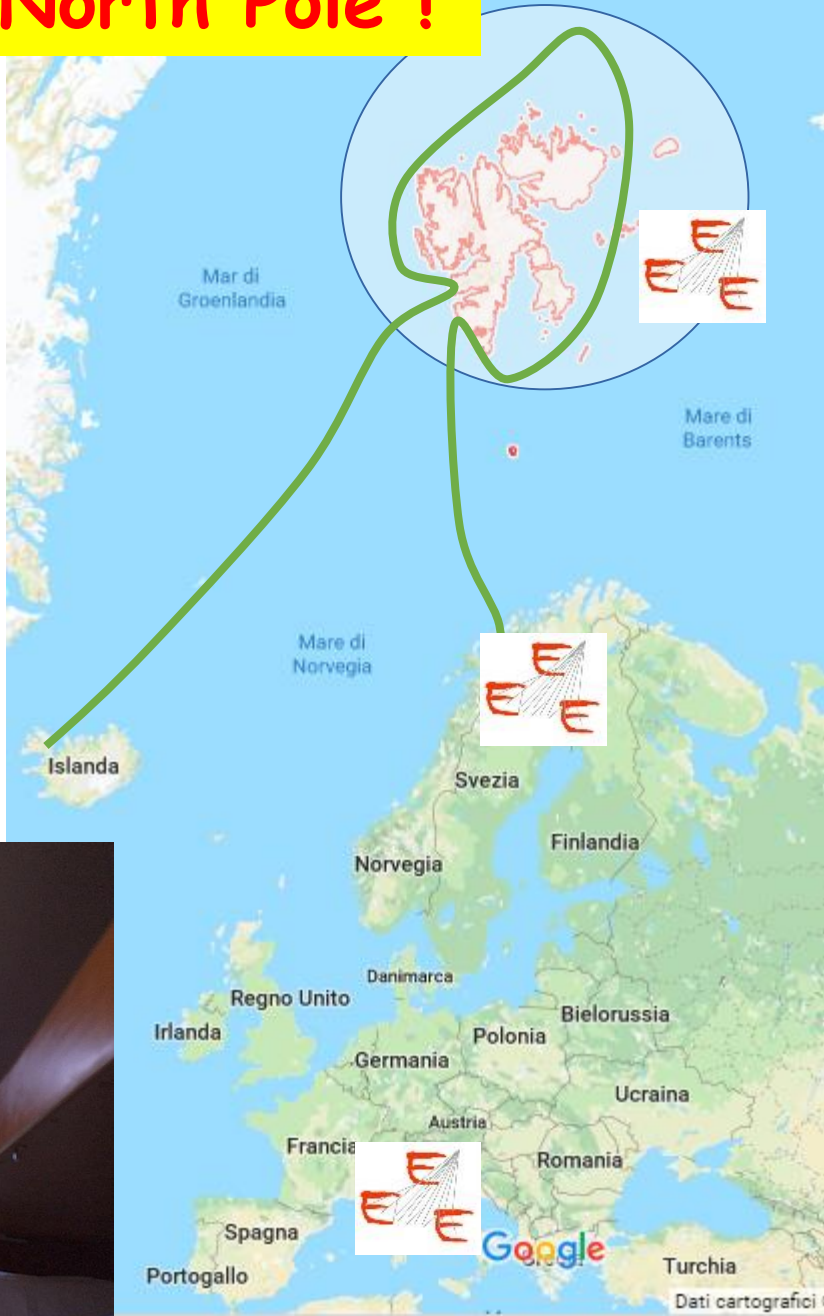
the "Museo Storico della Fisica e Centro Studi e Ricerche Enrico Fermi" (Centro Fermi), Compendio del Viminale, Piazza del Viminale 1 – 00184 Roma (Italy)

aiming to the analysis of EEE cosmic ray data and their possible correlation with the atmosphere properties

EEE with Santiago de Compostela to search for correlations between cosmic rays and atmosphere properties

The goal of his proposal is to open a collaboration between the USC and the Centro Fermi in order to analyze the correlations between the detectors of the EEE experiment and the atmospheric properties. The members of the University of Santiago de Compostela taking part in this agreement are experts with previous experience in such kind of analysis. The Centro Fermi provides the EEE data base and is interested in promote such kind of research in Italy.

The EEE project sails to North Pole !

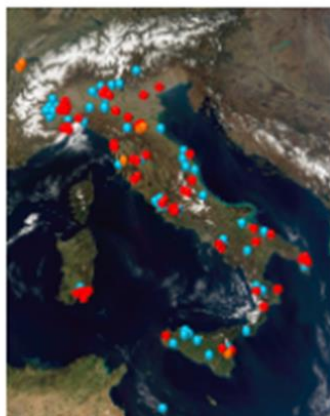


May 22nd - May 25th
High Schools from Norway,
Switzerland and Italy at CERN
to build the detectors.



Extreme Energy Events (EEE) - La Scienza nelle Scuole

dimensione font | Stampa | Email



Il Progetto EEE - La Scienza nelle Scuole consiste in una speciale attività di ricerca, in collaborazione con il CERN, INFN e il MIUR, sull'origine dei raggi cosmici, condotta con il contributo determinante di studenti e docenti degli Istituti Scolastici Superiori.

In ciascuna delle scuole aderenti al Progetto viene costruito un "telescopio" fatto con i più moderni e avanzati rivelatori di particelle (Multigap Resistive Plate Chambers, MRPC), da mettere in coincidenza tramite strumentazione GPS con i telescopi di altre scuole allo scopo di rivelare i muoni cosmici e gli sciami estesi, grandi anche quanto intere cittadine o più, prodotti dai raggi cosmici primari di più alta energia.

Ai ragazzi viene dato, inoltre, l'importantissimo compito della costruzione degli stessi rivelatori a partire da elementi di base, affinché si rendano conto di come si possa passare da materiali poveri a strumenti di altissima precisione. La costruzione dei rivelatori avviene nei laboratori del CERN, nei luoghi più esclusivi della ricerca più avanzata, che vengono resi a tale scopo accessibili ai ragazzi.

Attualmente risultano operative o prossime all'operatività tutte le stazioni realizzate (50) presso le scuole ed è in corso l'acquisizione dati volta, in particolare, alla ricerca di eventi coincidenti tra stazioni vicine e stazioni lontane.

[Vai alla pagina: [EEE Monitor - DQM](#)]

The Project Extreme Energy Events - Science Inside Schools (EEE), is a special research activity about the origin of cosmic rays, performed in collaboration with CERN, INFN and MIUR and carried out with the essential contribution of students and teachers of high schools.

Each of the participating institutes hosts a "telescope" made of the most advanced particle detectors (Multigap Resistive Plate Chambers, MRPC). EEE telescopes are put in coincidence using GPS, with the goal to detect cosmic muons and extensive showers (as large as a small town), produced by primary cosmic rays of the highest energy. Data from all telescopes are sent to CNAF-INFN, in Bologna, to allow track reconstruction so that all relevant information can be stored in a database to be later available for analysis.

Students are involved in the fundamental task to build the chambers, starting from simple materials to arrive to sophisticated high precision detectors. This task is accomplished at CERN, one of the most important particle physics laboratories in the world, which is made open to students specifically for this project. Students have also the task to control the correct operation of the telescope installed at their school.

Presently about fifty high schools distributed across Italy host a telescope. Other 50 institutes participate to the project by analyzing data. More than 60 billion tracks have been collected in the past years and are presently studied by students and professional researchers performing interesting analysis, some of which have already been published in various international scientific journals.

[Visit the web page: [EEE Monitor - DQM](#)]



EEE News

Il Progetto EEE porta gli alunni liguri al CERN di Ginevra



L'Istituto Staffa di Trinitapoli invitato a Mosca per studiare i raggi cosmici



Al Liceo Casiraghi di Cinisello Balsamo gli studenti indagano i raggi cosmici



Inaugurazione del Telescopio EEE al Liceo Quadi di Vicenza



Inaugurazione del telescopio EEE all'IS Alessandrini - Marino di Teramo



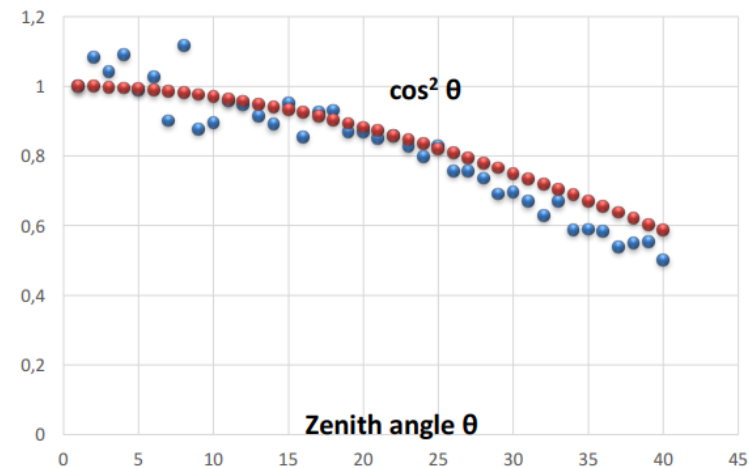
EEE web site and news available both in italian and english

IPPOG Meeting
International Workshop on
High School Cosmic Ray Experiments
15-16 February 2017 (Rome)



EEE at ICD 2017

47 Schools , 550 students



Liceo Galvani (BO):
data from their telescope

Presently schools are involved in the measurement of muon velocity

Conclusions and request

- The EEE project is an experiment based on scientific research AND dissemination of scientific culture for high school students
- The EEE project is an experiment exceeding Italian borders, with many and increasing international connections
- The EEE project is well in line with the main purposes of the IPPOG collaboration and it is able to contribute significantly to IPPOG with students, researcher and resources
- The EEE project will benefit a lot from the IPPOG collaboration to further increase the international connections.
- The EEE project has a specific and independent role in Italy and is complementary to the INFN inside IPPOG

As a consequence, we propose **Centro Fermi - EEE** as a new member of the **IPPOG** collaboration.