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Impacts in didactic and science awareness of the Extreme Energy Events Observatory

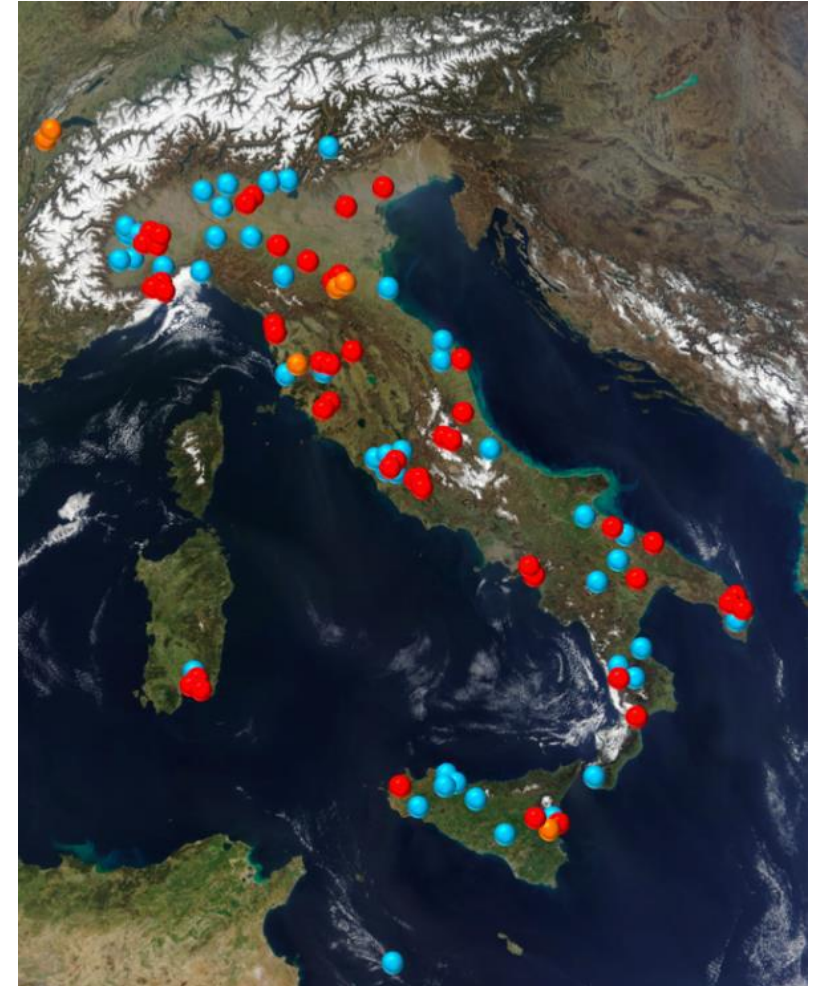
Grazzi Stefano, Museo Storico della Fisica e Centro Studi e Ricerche 'Enrico Fermi'

SIF 2017, 11-14/09/2017, Trento

EEE Project: a real experiment open to schools

Extreme Energy Events Project (EEE) – “La scienza nelle Scuole” is an **experiment that studies high-energy cosmic radiation**, using muon tracking detectors distributed **over an area > ½ million km²**, from Geneva to Lampedusa

Born in 2004 from an idea of A. Zichichi, aim **to involve high school students in a real physics experiment**

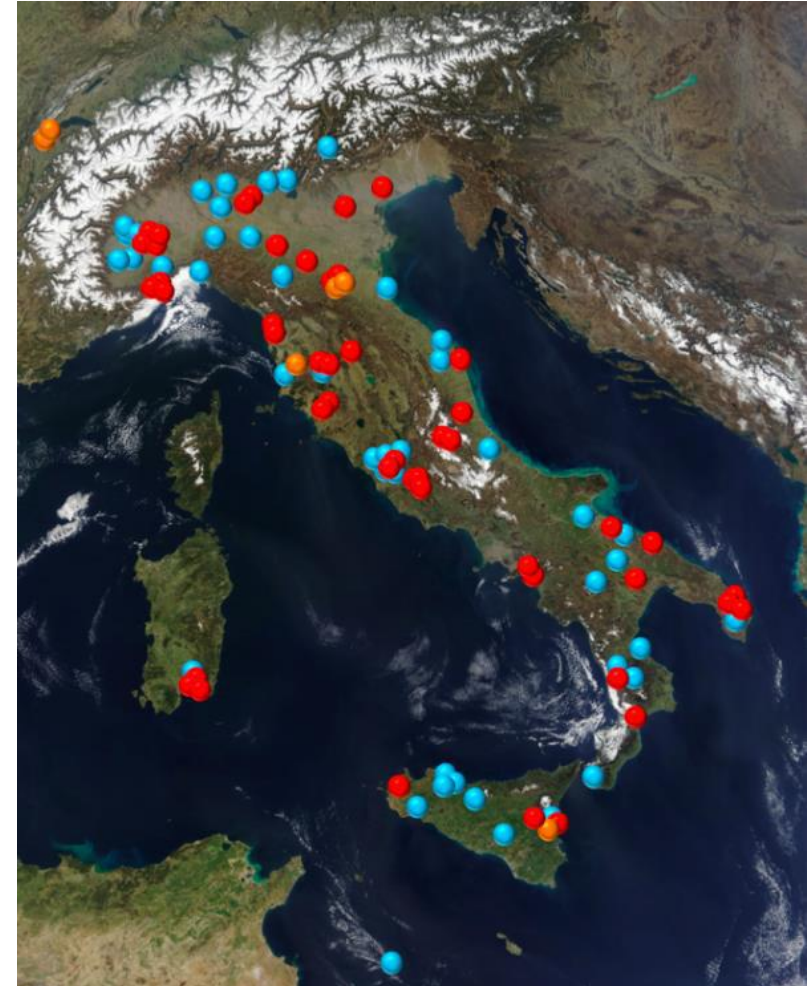


EEE Project: a real experiment open to schools

It is funded and coordinated by the *Museo Storico della Fisica e Centro Studi e Ricerche 'Enrico Fermi'* in Rome in collaboration with **CERN, INFN & MIUR**

The project has exceeded 100 participating high schools (10-20 students/school)

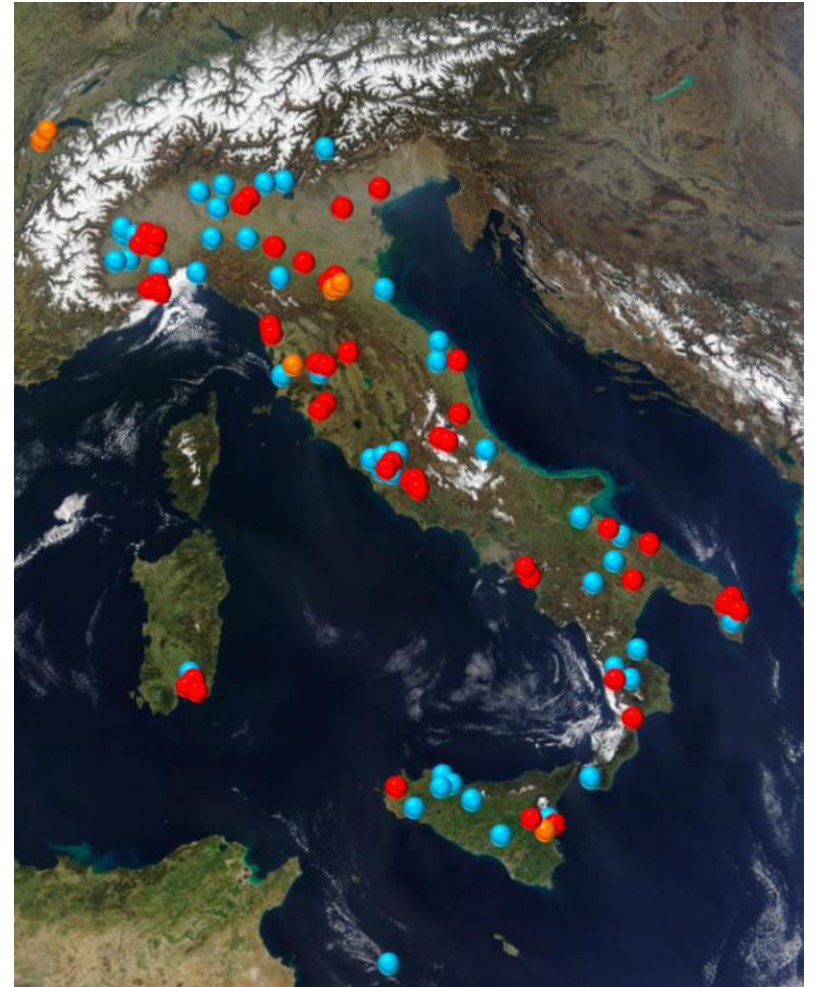
About 50 host a detector and the others are involved in data taking and analysis together with twinned schools



EEE Project: a real experiment open to schools

As real experiment several analyses have been performed & published:

- Search coincidences b\w near telescopes
- Study of muon flux decrease due to solar events
- Study of Anisotropy at sub-TeV scale
- Study of muon decay through up-going events
- Search long distance correlations (hundred km)
- Determination of telescopes performance



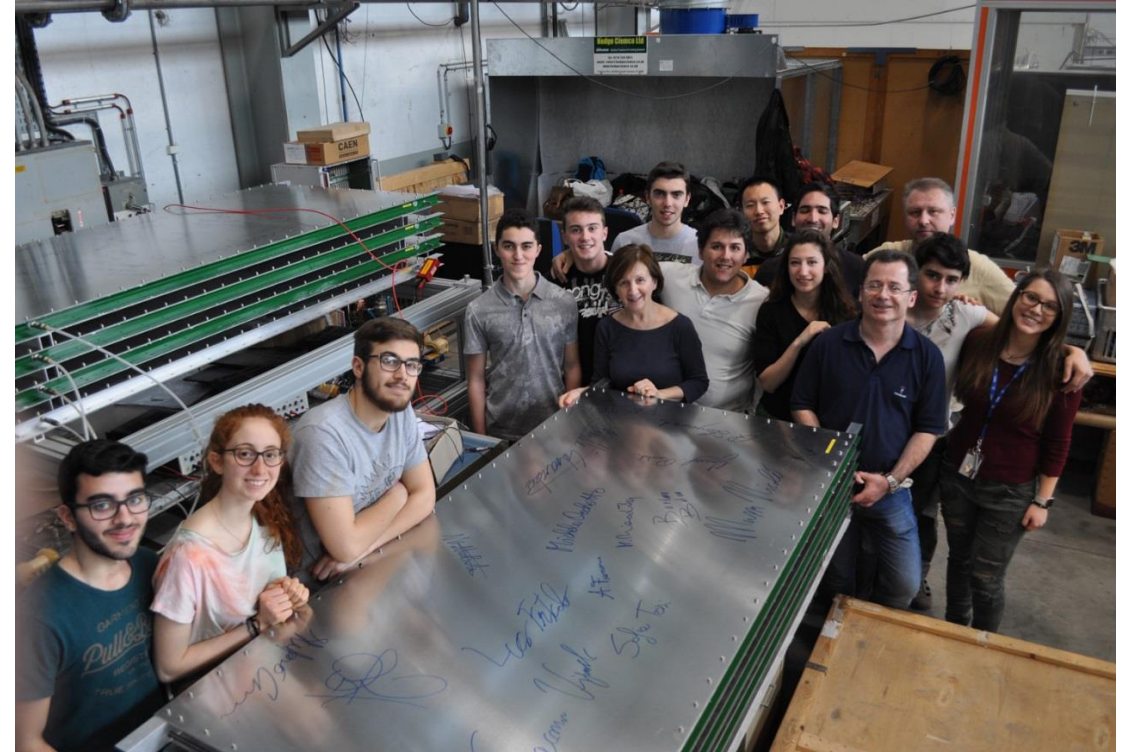
First approach to project: Construction of telescope

- Groups of **3-4 students** and teachers, go to work, **with great enthusiasm**, at **CERN** to build their telescope (composed by 3 MRPC Chambers)



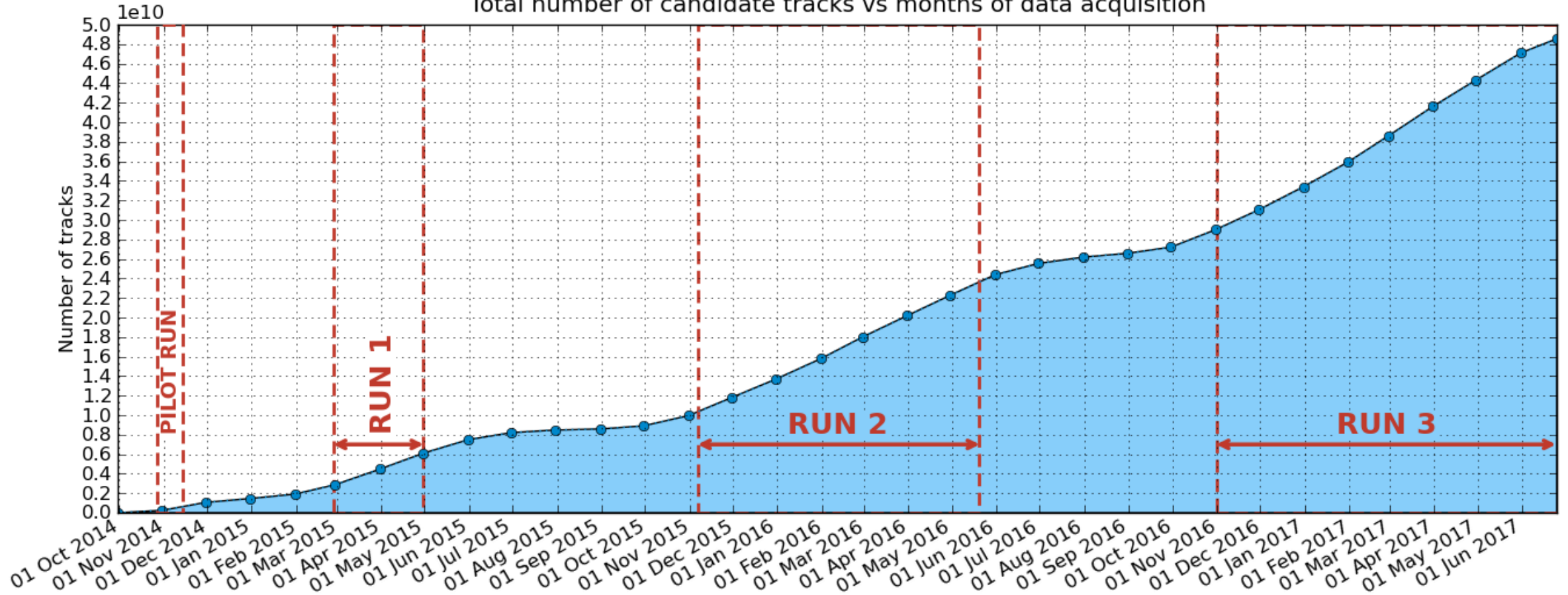
First approach to project: Construction of telescope

- Groups of **3-4 students** and teachers go to work, **with great enthusiasm**, at **CERN** to build their telescope (composed by 3 MRPC Chambers)
- After construction, students & teachers **complete installation of telescope into school** and put it in **operation.**



Operative Phase: Students daily activities & Monitoring

Total number of candidate tracks vs months of data acquisition

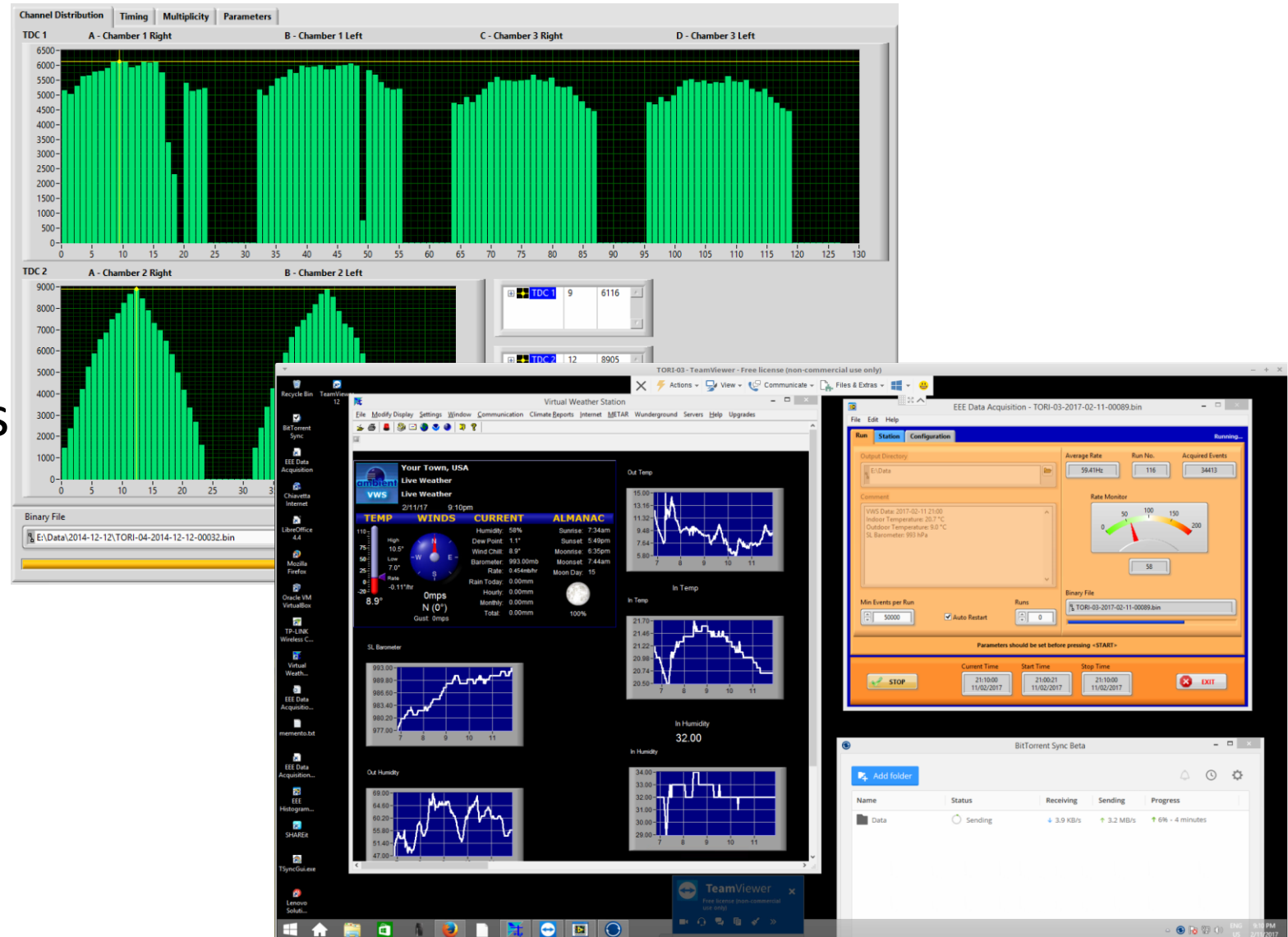


Since 2014, coordinated RUNs are done with the whole set of operative stations involved. **Student work was a key factor to reach the 100 Mtracks/day.**

Operative Phase: Students daily activities & Monitoring

Each day students check:

- Data Acquisition
- Telescope's hits distribution
- Environment parameters



Operative Phase: Students daily activities & Monitoring

Each day students check:

- Data Acquisition
- Telescope's hits distribution
- Environment parameters
- High and Low Voltages values
- Gas System

The image is a composite of three parts related to the gas system monitoring:

- Top Panel:** A control panel with two columns of indicators. The left column is labeled "INDICATORI DI PRESSIONE" and the right "INDICATORI DI FLUSSO". The left column shows values for SF₆ (104) and FREON (106). The right column shows values for SF₆ (502) and FREON (500).
- Bottom Left Panel:** A software interface showing data for three RPCs (RPC1, RPC2, RPC3). It includes HV and IR values for each, and a table of HV and IR values for negative and positive channels. At the bottom, there are sliders for "Low_V_RPC1", "Low_V_RPC2", "Low_V_RPC3", and "Power_Board", along with "Start", "Enable", and "stop" buttons.
- Bottom Right Panel:** A photograph of a gas cylinder with various gauges and pressure reducers. Labels point to "Riduttori di pressione", "Manometri pressione in bombola", "Manometri pressione ridotta, verso il miscelatore", "SF₆", and "Freon 134a".

Operative Phase: Students daily activities & Monitoring

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Data from monitoring (taken also using *remote desktop program*) are saved into an

online Elog.



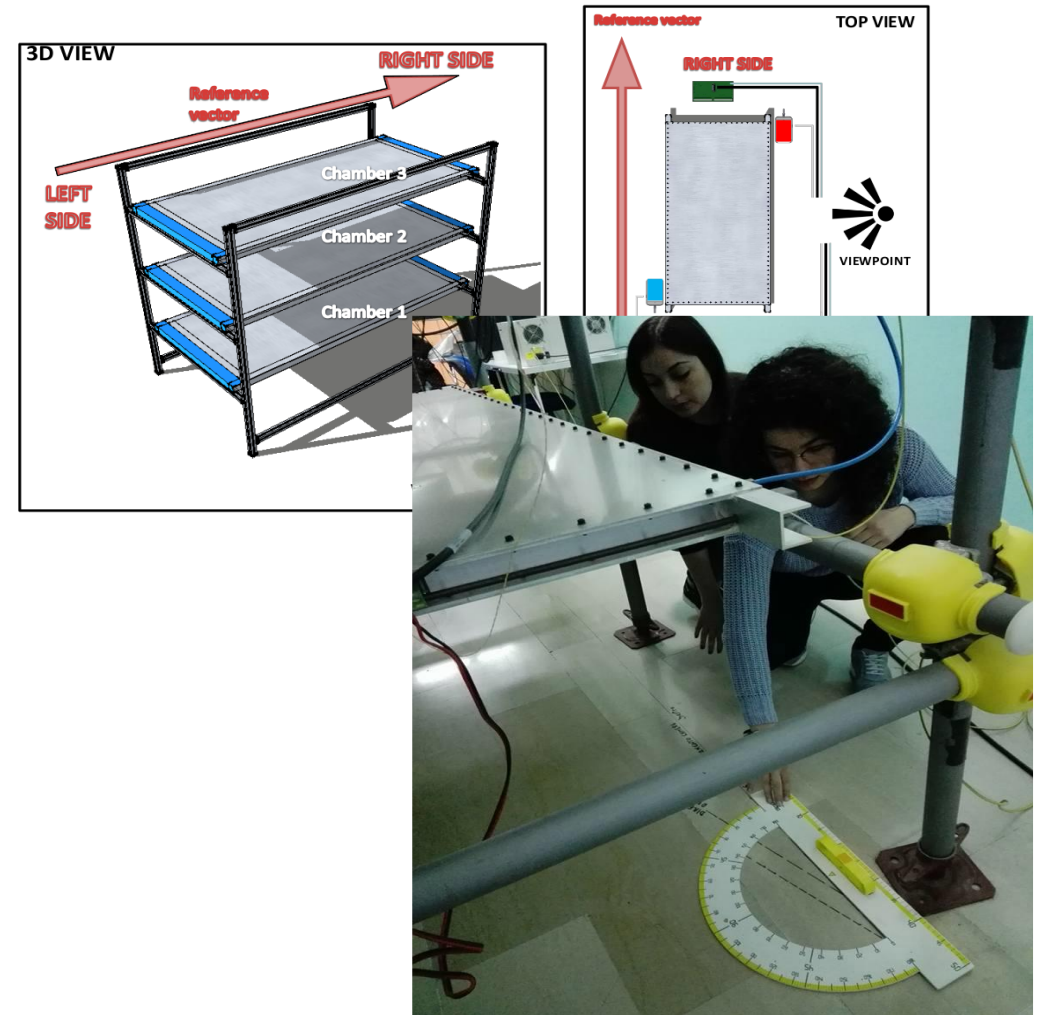
Scuola: Codice EEE dell'Istituto Scolastico	TORI-04
Operatore: Nome e Cognome di chi inserisce i dati	Ivan Gnesi
MRPC1 HV_POS (V): MRPC1: misura Alta Tensione [+] (valore di esempio: 9100)	8043
MRPC1 HV_NEG (V): MRPC1: misura Alta Tensione [-] (valore di esempio: 9100)	8432
MRPC1 I_POS (microA): MRPC1: misura Corrente [+] (valore di esempio: 0.03 [usare il punto per i decimali])	0.121
MRPC1 I_NEG (microA): MRPC1: misura Corrente [-] (valore di esempio: 0.03 [usare il punto per i decimali])	0.160
MRPC1 LV (V): MRPC1: misura Bassa Tensione (valore di esempio: 4.5 [usare il punto per i decimali])	4.2

Works on Field: calibration & active measures

Students & teachers, **with researchers**, perform some measurements which are used for official analysis:

- **Telescope orientation**
- **Chambers efficiency**
- **Telescope performances correlated with atmospheric parameters**
- ... and others

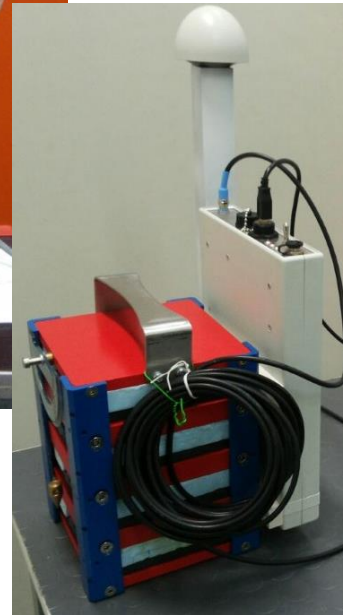
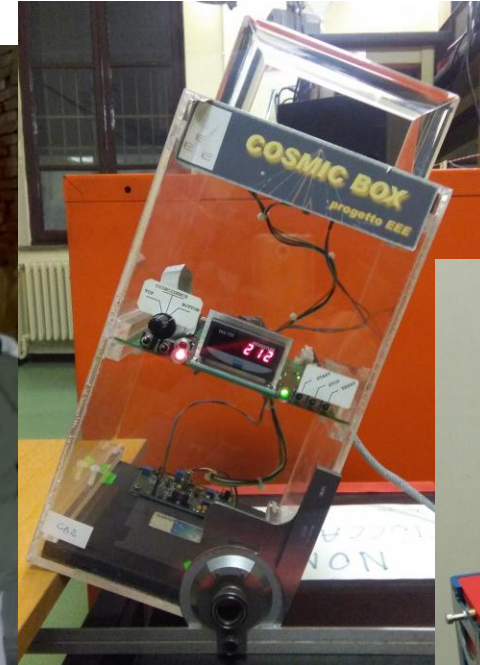
EEE Telescope: orientation respect to magnetic nord (β angle)



Works on Field: calibration & active measures

Some schools also use small scintillators detectors (**Cosmic Box**), for studies and activities:

- **Detector acceptance**
- **Cosmic rays flux & angular distribution**
-



Into Physics: Data analysis & Masterclass

EEE Monitor is tool to check data quality and have access to telescopes information:

- Telescope rates (trigger, good tracks)
- Tracks parameters (χ , tof, length, direction)
- Atmospheric parameters

Progetto Extreme Energy Events - La Scienza nelle Scuole

EEE Monitor

Ultimo aggiornamento: ore 17:42 - dom 12 giugno 2016 [by e3monitor]

ELOGBOOK delle SCUOLE	ELOGBOOK dello SHIFTER	New DB Interface (BETA)
Home Page EEE	Masterclass	Download the Excel Sheet for the Shifter's Report

RUN 2 ended on May 20, 2016. RUN 3 will start in autumn.

Total number of candidate tracks ($X^2 < 10$) in the database: 25876227385

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 5 Hz nell'ultimo run analizzato.

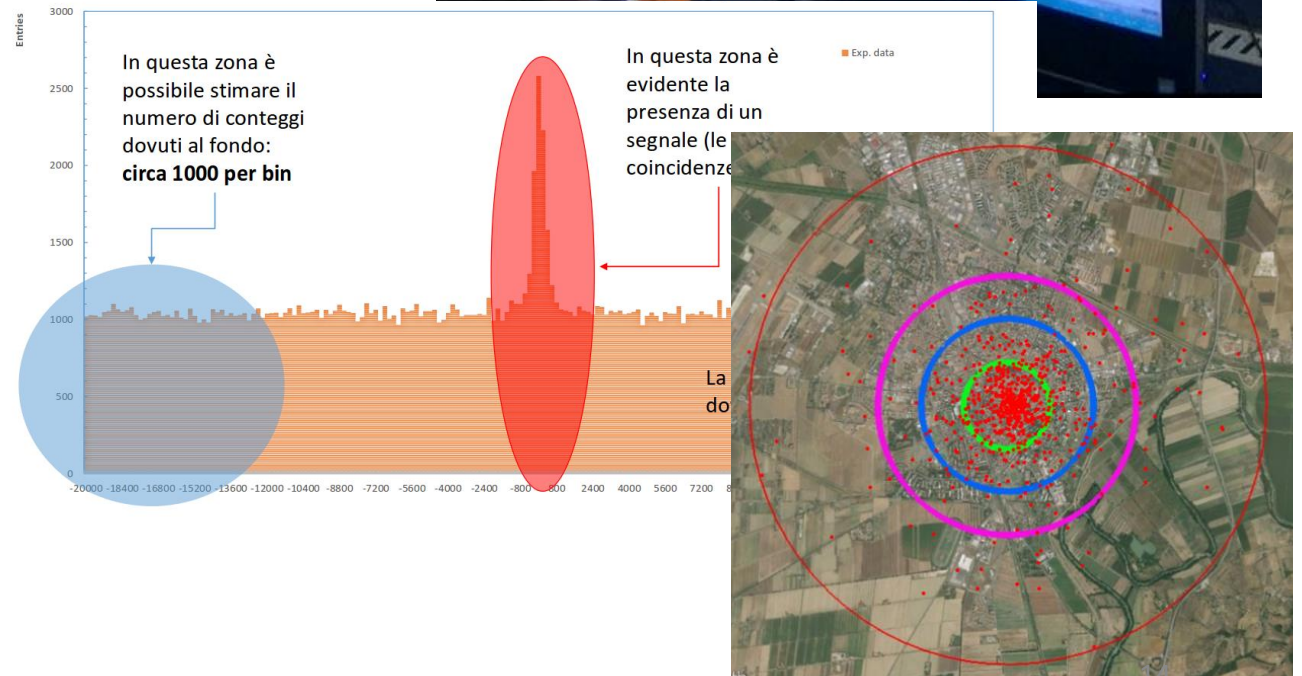
Scuola	Giorno	Ora	Nome dell'ultimo File trasferito	Numero Files trasferiti oggi	Ultima Entry nell'e-logbook delle Scuole del Run2	Nome dell'ultimo File analizzato dal DQM	Report giornaliero DQM	RATE of Triggers for the last Run in DQM	RATE of Tracks for the last Run in DQM	Link DQM
ALTA-01	ven 20 maggio	08:29	ALTA-01-2016-05-20-00020.bin	0 [History]	12:56 19/05/2016	ALTA-01-2016-05-20-00020.bin	21/05 [History]	29.0	21.0	ALTA-01
AREZ-01	dom 12 giugno	08:29	AREZ-01-2016-06-12-00015.bin	19 [History]	11:02 06/06/2016	AREZ-01-2016-06-12-00015.bin	12/06 [History]	33.0	24.0	AREZ-01
BARI-01	mer 25 maggio	21:12	BARI-01-2016-05-25-00011.bin	0 [History]	16:13 24/05/2016	BARI-01-2016-05-25-00011.bin	26/05 [History]	20.0	17.0	BARI-01
BOLO-01	dom 12 giugno	17:22	BOLO-01-2016-06-12-00058.bin	59 [History]	09:35 02/05/2016	BOLO-01-2016-06-12-00057.bin	12/06 [History]	47.0	39.0	BOLO-01
BOLO-02	dom 12 giugno	17:30	BOLO-02-2016-06-12-00127.bin	98 [History]	12:35 07/04/2016	BOLO-02-2016-06-12-00126.bin	12/06 [History]	43.0	36.0	BOLO-02

(<http://eee.centrofermi.it/monitor>)

Into Physics: Data analysis & Masterclass

EEE Masterclasses have been prepared to guide students through the analysis:

- Features of high-energy cosmic showers
- Hunting extreme events on Sun
- Looking for telescopes coincidences
- Statistics
- Reference system transformation
- ... many others under development



Time to discuss: Meetings & Symposia

Monthly Online Meetings are organized to allow all participating students (hundreds) to:

- **Review the RUN status,**
- **Exchange ideas & experiences**
- **Present their own work**

The screenshot displays a VidyoDesktop window titled "VidyoDesktop™ - EEE_run_coordination_meeting_-_open_to_schools@vidyoportal.cem.ch". On the left, a sidebar shows a search bar "Cerca partecipanti" and a list of 57 participants, including (Ospite) Andrea del Mase..., (Ospite) Beretta1, (Ospite) Bianchi - Liceo G..., (Ospite) CAG01-Effe, (Ospite) cagl01a, (Ospite) CAGL-02b, (Ospite) CannizzaroCollef..., (Ospite) Centro Fermi..., (Ospite) Chiabrera, (Ospite) Collegio Ballerini..., Corrado Cicalo, (Ospite) Damiana Periotto, (Ospite) Daniele, (Ospite) ducadegliabruzzi, and (Ospite) Edoardo Poccini... At the bottom of the sidebar, a microphone icon is labeled "Francesco Noferini". The main area is a grid of video feeds. The top-left feed shows a group of students in a classroom, with the name "Fabrizio Coccetti" at the bottom. The top-right feed is a black screen with the name "prof. R. zingoni liceo scientifico F. d'Assis" at the bottom. The middle-left feed shows a presentation slide titled "Statistica accumulata" with a line graph and text: "Dal 2014 EEE è in espansione coordinata. Tutti i dati sono positivi e mostrati in un grafico contro ICNAP. In questo momento abbiamo in discussione circa 3,5 milioni di tracce candidate. A settembre tutti i dati sono stati e saranno per includere nella analisi le informazioni su tracce multiple all'interno del nostro evento!" and the name "Francesco Noferini" at the bottom. The middle-right feed shows a classroom with the name "LiceoPasoliniPotenza" at the bottom. The bottom-right feed shows a large group of students in a lecture hall with the name "SCORZA" at the bottom.

Time to discuss: Meetings & Symposia

Joined visits b/w schools are regularly organized

Once per year all schools participate in a **general meeting**, aiming to:

- **Upgrade on scientific results and activities**
- **Present their own analysis and works**
- **Participate at analysis exercises**
- **Encourage work between distant schools**



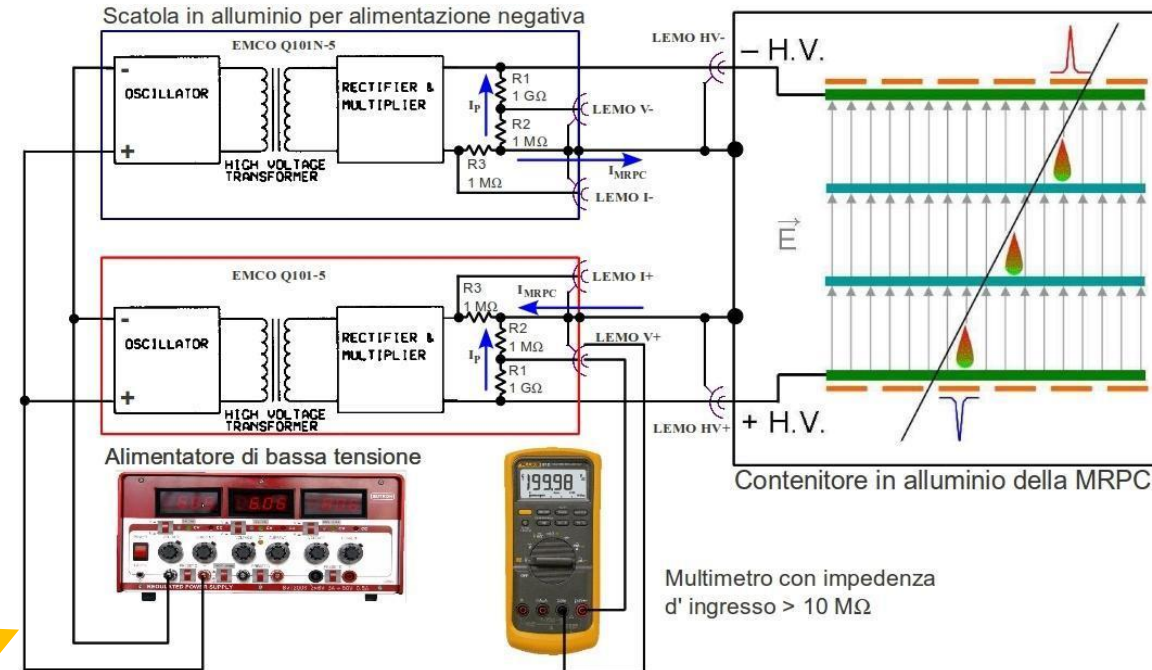
Thanks for attention

Inventive space: Spontaneous Initiatives

Teachers and students perform independent activities according to their specific courses.

The outcomes can become solutions and upgrades for Project:

- Feedback system for controlling the telescope's (MRPC) high voltage
- Monitoring of gas quantity and automated planning of gas bottle replacement



Out of schools: initiatives on the territory

Schools also organize independently **local initiatives**, which consist of:

- Workshops
- Local manifestation
- Articles on local newspapers
- ... many others



UNIVERSITÀ ALDO MORO I.I.S.S. Scipione Staffa Istituto di Istruzione Secondaria Superiore "Scipione Staffa" CERN FERMILAB

A scuola di raggi cosmici giornata di studio

Venerdì 2 dicembre 2016 ore 17,00
Aula Magna Istituto "STAFFA"
Trinitapoli (BT) - Via dei Cappuccini 23

Relatori:
Cosimo Antonino Strazzeri (Dirigente Scolastico)
"IL LICEO CLASSICO E LA RICERCA SCIENTIFICA"
G. di Staso - M. Lafata (Referenti Progetto EEE)
"DIECI ANNI DI FISICA NUCLEARE ALLO STAFFA"
Marcello Abbrescia (Dipartimento Interateneo di Fisica - Bari)
"EXTREME ENERGY EVENTS _ RUN3"

Interventi degli studenti:
Cristina di Lecce (Studentessa Universitaria Corso di Laurea in Fisica)
Daniele Montarsi (Studente Universitario Corso di Laurea in Informatica)

LA STAMPA
SABATO 26 NOVEMBRE 2016

Scuola

Gli studenti misurano i raggi cosmici

Le scuole savonesi e lombarde unite nel progetto «Extreme Energy Events». Venerdì scorso gli istituti della provincia di Savona che partecipano al progetto Extreme Energy Events si sono incontrate con le scuole della Lombardia al liceo Scientifico «Gandini» di Lodi.

