

## LICEO SCIENTIFICO STATALE "Arcangelo Deacchi"



Extreme Energy Events Science inside Schools

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Upgrade Bari-01 set-up with Arduino: a status report

Conferenza Nazionale del progetto «Extreme Energy Events La scienza nelle Scuole» Torino 6-8 marzo 2019

#### In this presentation:

- Our Team
- Arduino's set-up vs Oregon's set-up
- Open questions about rate-pressure correlation





Our students presented a demonstrative and interactive experiment to explain in a simple and funny way the use of Arduino, Raspberry and Python in an educational workshop



### GENERAL ACTIVITIES

*Physics tells...4 histories of experiments* November 2018: students from other institutes joined to the world of EEE project.





We organized the event into four steps, focused on a different amazing experiment of particle physics: Thomson's experiment by Helmholtz's coils, the photoelectric effect, the cloud chamber and the EEE telescope.





"La Fisica racconta... quattro storie di esperimenti", un percorso realizzato dagli studenti del Progetto EEE del Liceo Scacchi di Bari



cosmiche analizza studenti del Proge

EEE News

Portare la Scie

Liceo Scientifico "A. Scacchi" Bari

#### Discover Cosmic Rays

### GENERAL ACTIVITIES





Dipartimento Interateneo di Fisica in Bari, 29/11/2018: students analyzed the distribution of the zenithal angle of secondary cosmic muons, using data from EEE's telescopes. After that, they replicated the analysis at school.

#### **CERN EXP(EEE)RIENCE,** 7/12/18: we had a

unique chance to visit the world's largest particle physics laboratory.

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Pro: Original software ready to use and an user-friendly interface with graphs and indicators. Possibility to store data on pc

Cons: software is not customizable, updates are not released any longer and after few years we saw some problems related to use, for example missed communication with external sensors.

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# SET-UP



see RUN COORDINATION MEETING 24 -10-2018





- Arduino UNO
- 2 DS18B20 temperature sensors
  - ±0.5°C Accuracy from -10°C to +85°C
  - one of these is used for external temperature, a 1Wire to I2C converter is used in order to set the sensor as far as possible
- 1 BME280 Temperature, Humidity and Pressure Sensor
  - Humidity with ±3% accuracy
  - Barometric pressure with ±1 hPa absolute accuracy
  - Temperature with ±1.0°C accuracy

# CURRENT SET-UP





External temperature sensor: DS18B20 with the I2C bridge DS2482



#### SOFTWARE AND CODE – WINDOWS OS

- Arduino
- https://www.arduino.cc/en/Main/Software
- Anaconda (python, pyserial, ...)
- -<u>https://www.anaconda.com/download/</u>
- pyserial installed with conda run
- conda install -c anaconda pyserial



- see RUN COORDINATION MEETING 24 -10-2018
- User codes
- Arduino sketch to read the sensors and to send the data to PC through Serial port (USB)
- python code to get the data on the serial port and to write data file
- Plot data with a python code using matplotlib

# TIMESTAMP





Arduino does not have any DateTime functionality

- Only time from board began running the current program
- millis() function returns the number of milliseconds
  - This number will overflow (go back to zero), after approximately 50 days
- micros() function returns the number of microseconds
  - This number will overflow (go back to zero), after approximately 70 minutes
- We use the PC timestamp when reading the data trough the serial port
  - We use the UTC time
  - A time difference between Arduino time with millis() and the PC time is also calculated

## PLOTTING DATA



**Daily check of Arduino Data** 

#### Oregon/Arduino Correlation Plots



Correlation between Oregon and Arduino data are good, in particular for the pressure measurements. Less accuracy in Humidity values.



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#### Open questions about rate-pressure correlation

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30F

BARI-01 2019-02-11--2019-02-12

Indoor temperature [° C]

Outdoor temperature [° C]

Extreme Energy Events

[hPa]

1040

GIORNALE DI FISICA DOI 10.1393/gdf/i2015-10225-8 VOL. LVI, N. 3

Luglio-Settembre 2015

#### Nuovi risultati dell'esperimento EEE al Liceo "A. Scacchi" di Bari(\*)



# Actual Rate-Pressure Correlation Plots



# CONCLUSIONS

- Arduino set-up to monitor the temperature, the pressure and the humidity is running in BARI-01
  - The PC timestamp seems to be enough without requiring external hardware
- The external Oregon sensor is not properly working
  - A new sensor or the final Arduino set-up should be soon planned
- This set-up is used to investigate barometric effects
- Currently we don't notice any correlation rate/pressure as expected
  - Indeed this issue was already seen so
- If possible, we would like to add POLA-01 tc order to cross check the MRPC response



Studentessa dello Scacchi al CERN di Ginevra

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# THANKS FOR ATTENTION

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