Extreme
Energy
Events
Science inside Schools

E.E.E. at *Liceo L.Galvani Bologna*

Erice, 6-7 December 2017

Luca Melega and Sofia Musi

Heartfelt thanks to

- Professor Antonino Zichichi
- Professor Luisa Cifarelli
- Dr. Rosario Nania
- Professor Gabriella Sartorelli
- Dr. Marco Garbini
- Dr. Francesco Noferini
- Professor Paola Giacconi
- Professor Ivan Poluzzi
- Professor Marina Maiani
- Professor Davide Ventura
- Professor Gabriele Lorenzoni
- Professor Maria Alboni
- Professor Roberta Quadrio

Our detector

What do we do?

- A.S.L. project
- About **100 students** of the last three years of the scientific course
- Students are divided into groups of 3-4 people each
- **Daily controls** to the detector
- Guided visits to the detector during opendays
- At the beginning of each school year we give a **presentation of the project to the third-year students**
- Afternoon **courses of modern physics**
- Participation to the **run-meetings**

Activities done

- Forbush individuation
- Measurement of the mean lifetime of the muon : $\tau = 2.24\mu s \pm 3\%$

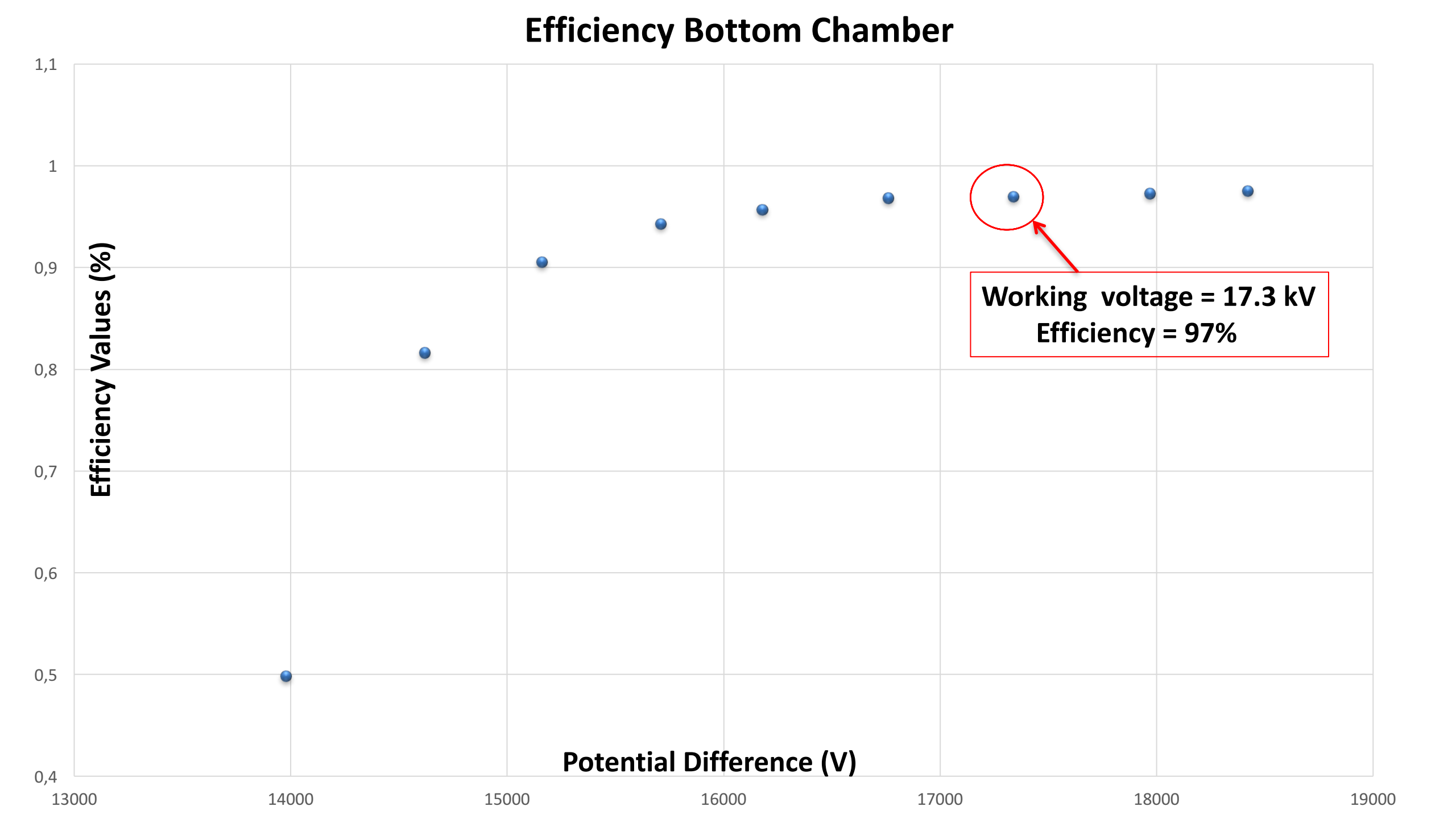
This year:

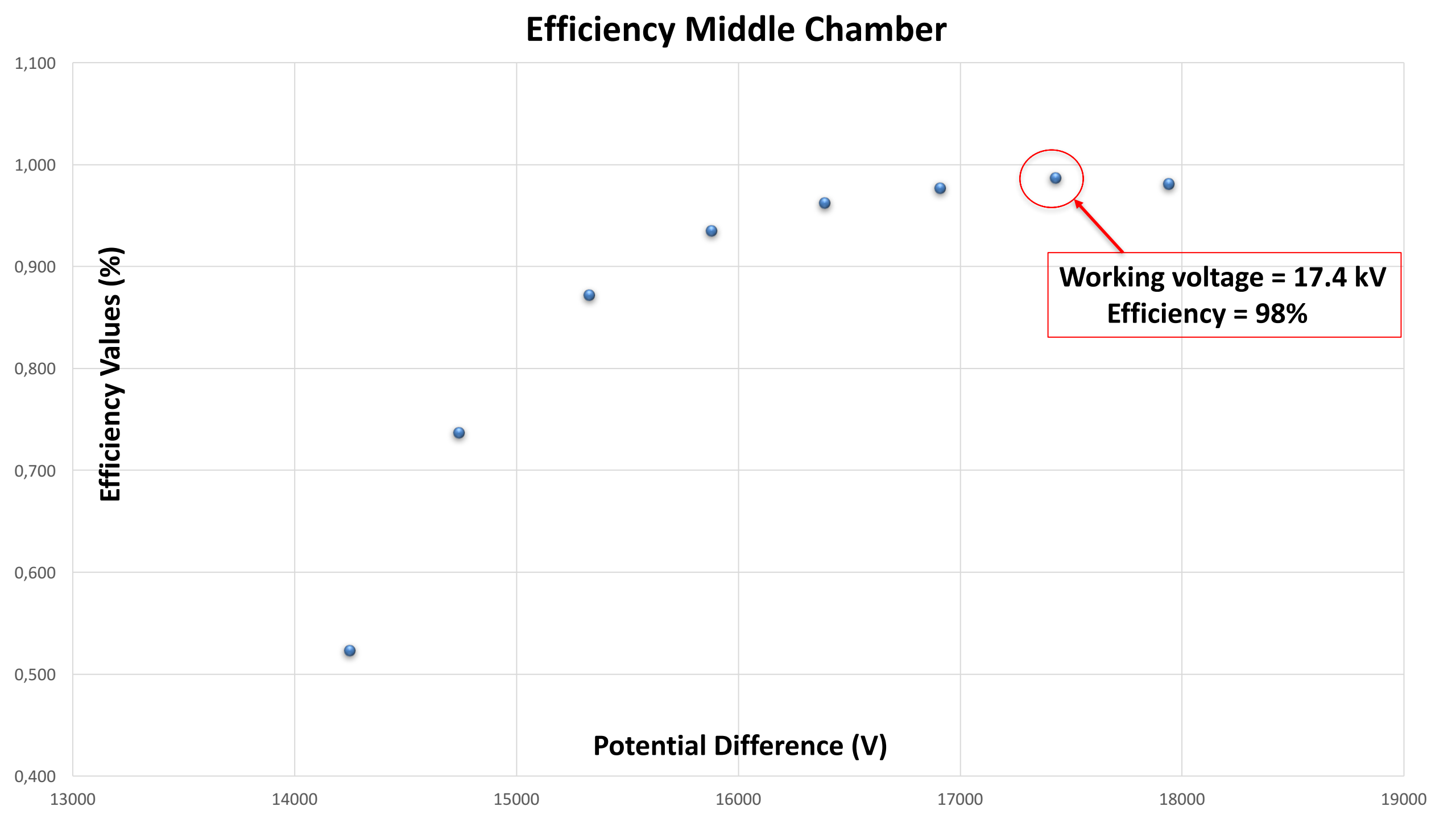
- **Construction of the chambers of the new detector at CERN laboratories**
- **Efficiency measurement for all three chambers**
- Orientation towards the geographical North
- *Notte dei ricercatori*
- ***International cosmic day***

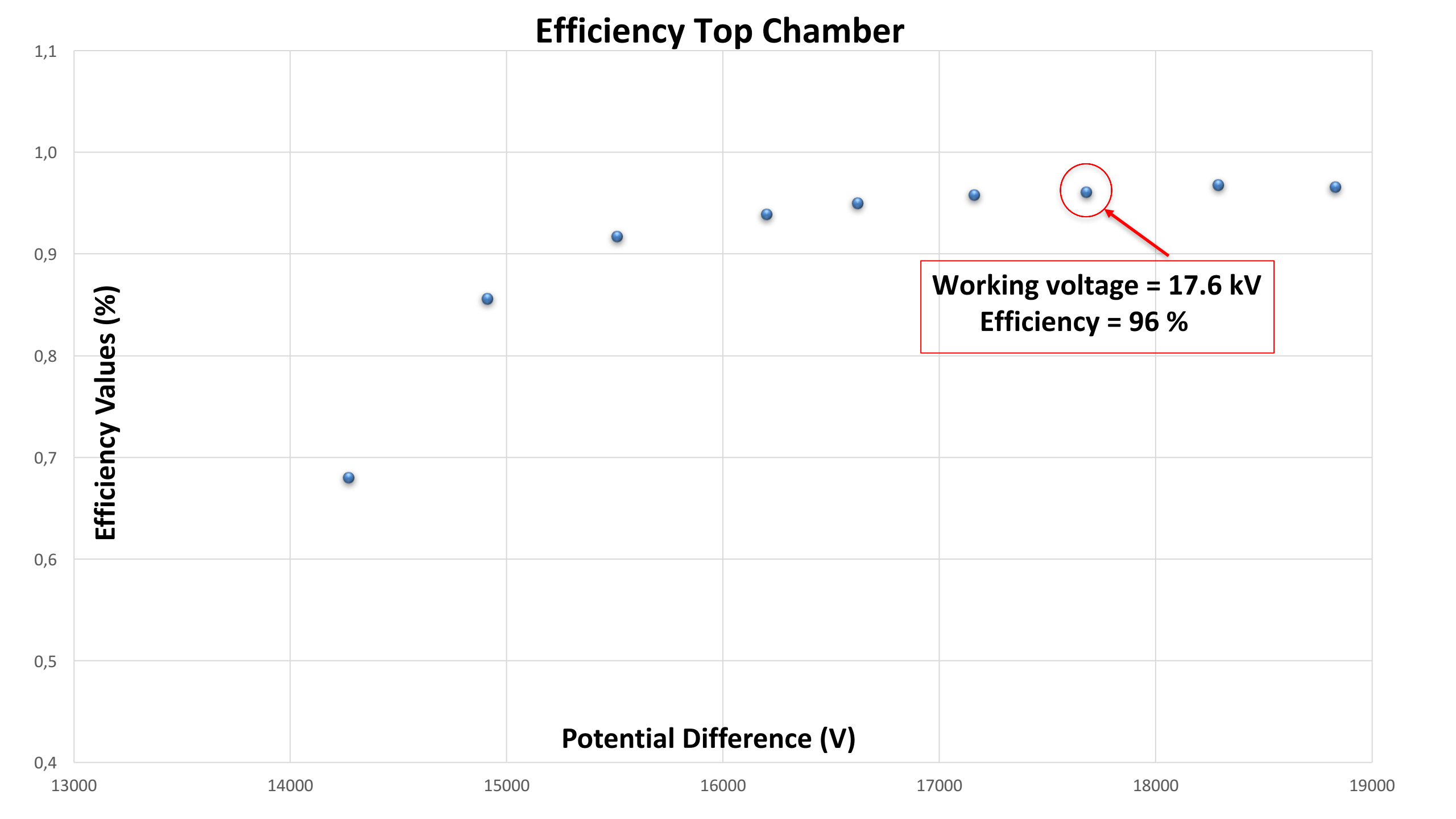
Efficiency Measure

Establish telescope chambers reliability

- First we **studied the operating instructions**
- We **measured the efficiency** of all three chambers, it took three mornings, **each morning a chamber**
- Thanks to an analysis program we **determined the efficiency** for each of them and **working voltage**
- Finally we **wrote the handbook** for procedures to be followed before operating the new detector.

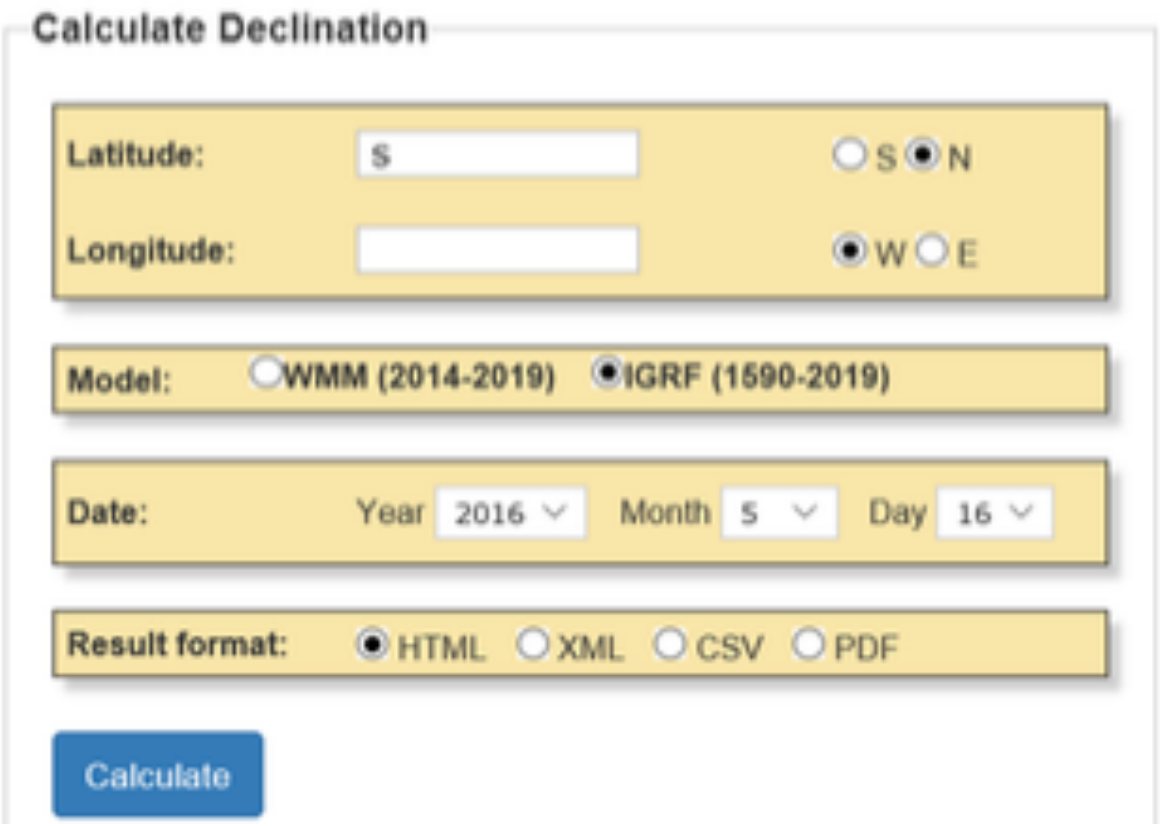

Efficiency Bottom Chamber
Efficiency Values (%)
1,1
1
0,9
0,8
0,7
0,6
0,5
0,4
Working voltage = 17.3 kV
Efficiency = 97%
Potential Difference (V)
13000
14000
15000
16000
17000
18000
19000


Efficiency Middle Chamber
1,100
1,000
0,900
0,800
0,700
0,600
0,500
0,400
Efficiency Values (%)
13000
14000
15000
16000
17000
18000
19000
Potential Difference (V)
Working voltage = 17.4 kV
Efficiency = 98%


Efficiency Top Chamber
1,1
1,0
0,9
0,8
0,7
0,6
0,5
0,4
Efficiency Values (%)
Working voltage = 17.6 kV
Efficiency = 96 %
Potential Difference (V)
13000
14000
15000
16000
17000
18000
19000

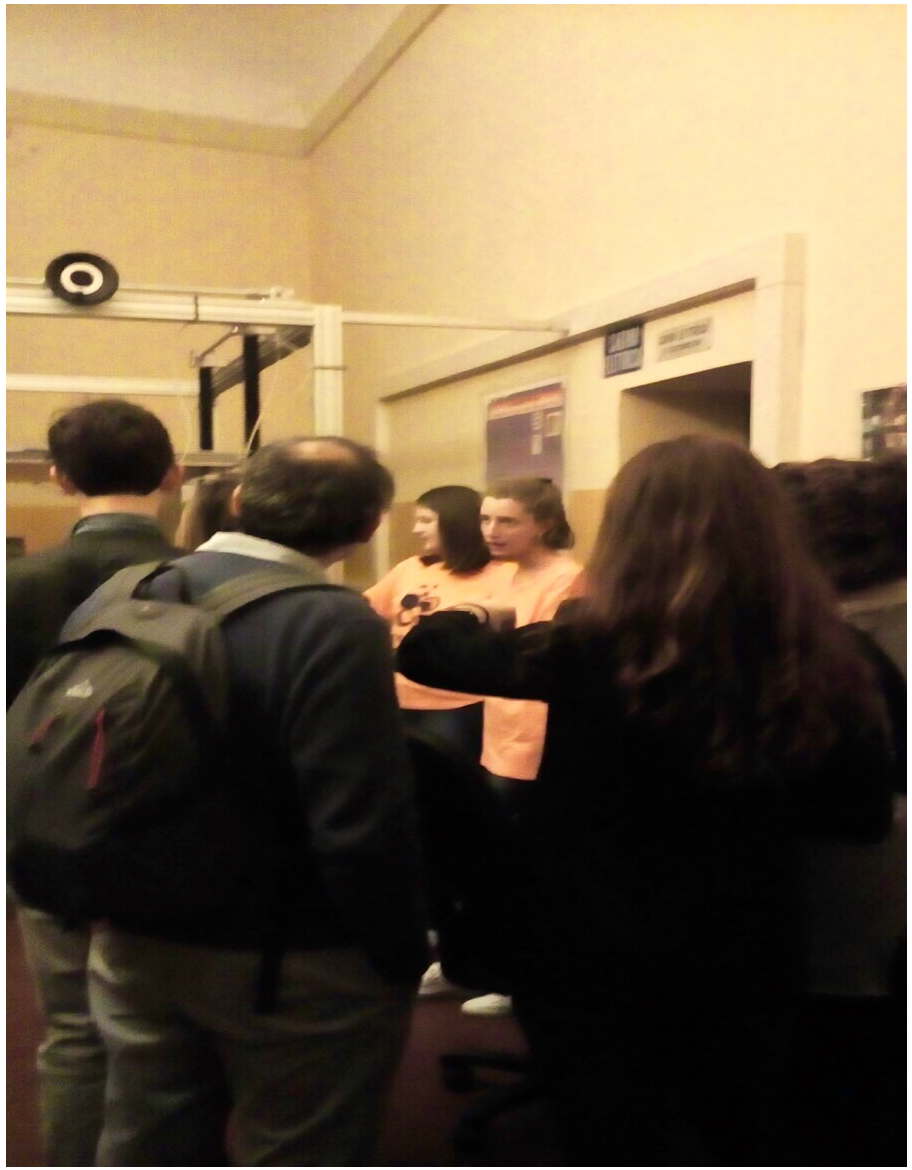
Orientation towards the geographical North

- Before the run begins
- We measure the angle compared to magnetic north with the aid of a compass
- We determine the Magnetic declination, which is the angle between true north and the horizontal trace of the local magnetic field



- **Date** 2017-11-18
- **Latitude** 44.30270° N
- **Longitude** 11.21504° E
- **Elevation** 0.0 km GPS
- **Model used** IGRF12
- **Declination** 2.92° E changing by
- 0.12° E per year

Notte dei ricercatori



- **General presentation**
- **Guided tour to detector**
- Teaching physics to children was a very exciting experience
- **People were extremely involved!**

Discover Cosmic Rays

INTERNATIONAL COSMIC DAY

November 30 | 2017

Liceo L. Galvani

Via Castiglione 38 - Bologna

09:00 Registration

09:45 Greetings from School Director of Liceo L. Galvani Prof. Giovanna Cantile

10:00 Vidyo connection between EEE headquarters

10:15 Greetings from Prof. A.Zichichi

10:30 Dott. P.La Rocca & Dott. M.Trimarchi

"Introduction to cosmic rays: measuring the zenith angle distribution of air shower particles"

11:00 Data Analysis

12:00: General discussion of results with other groups worldwide

Image Credit: NASA, ESA, Hubble, HLA; Processing & Copyright: Domingo Pestana

Become a Scientist for a Day

Discover the world of cosmic rays like an astroparticle physicist.

Organizer:
Progetto EEE - La Scienza nelle Scuole
Centro Studi E. Fermi, Roma
Liceo L. Galvani, Bologna

More Information and Registration:
http://icd.desy.de
http://eee.centrofermi.it
http://www.liceogalvani.it

CENTRO FERMI Museo Storico della Fisica e Centro Studi e Ricerche Enrico Fermi

Extreme Energy Events Science inside Schools

LICEO CLASSICO "Luigi Galvani"

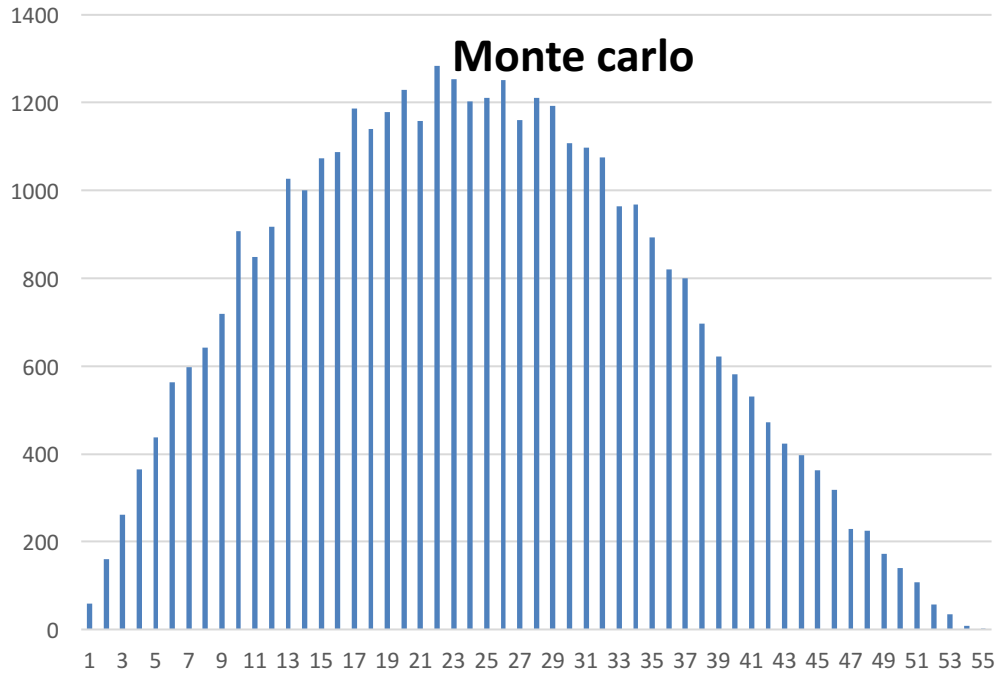
International Particle Physics Outreach Group

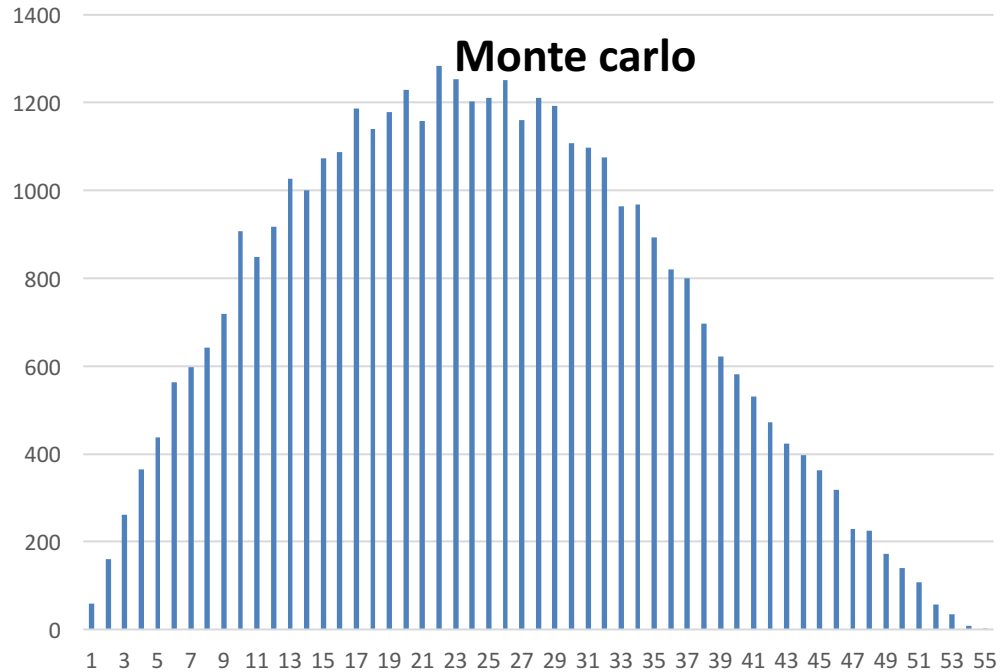
Netzwerk Teilchenwelt

DESY

Fermilab

QuarkNet


Monte carlo
1400
1200
1000
800
600
400
200
0
1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31 33 35 37 39 41 43 45 47 49 51 53 55


Monte carlo
1400
1200
1000
800
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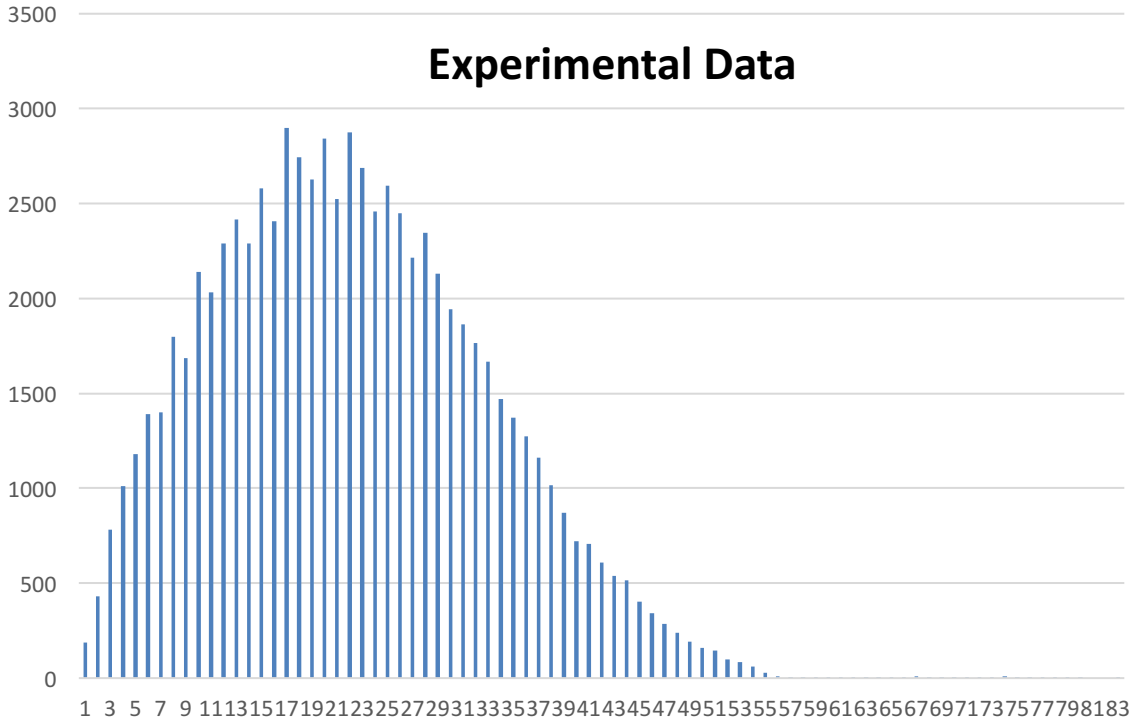
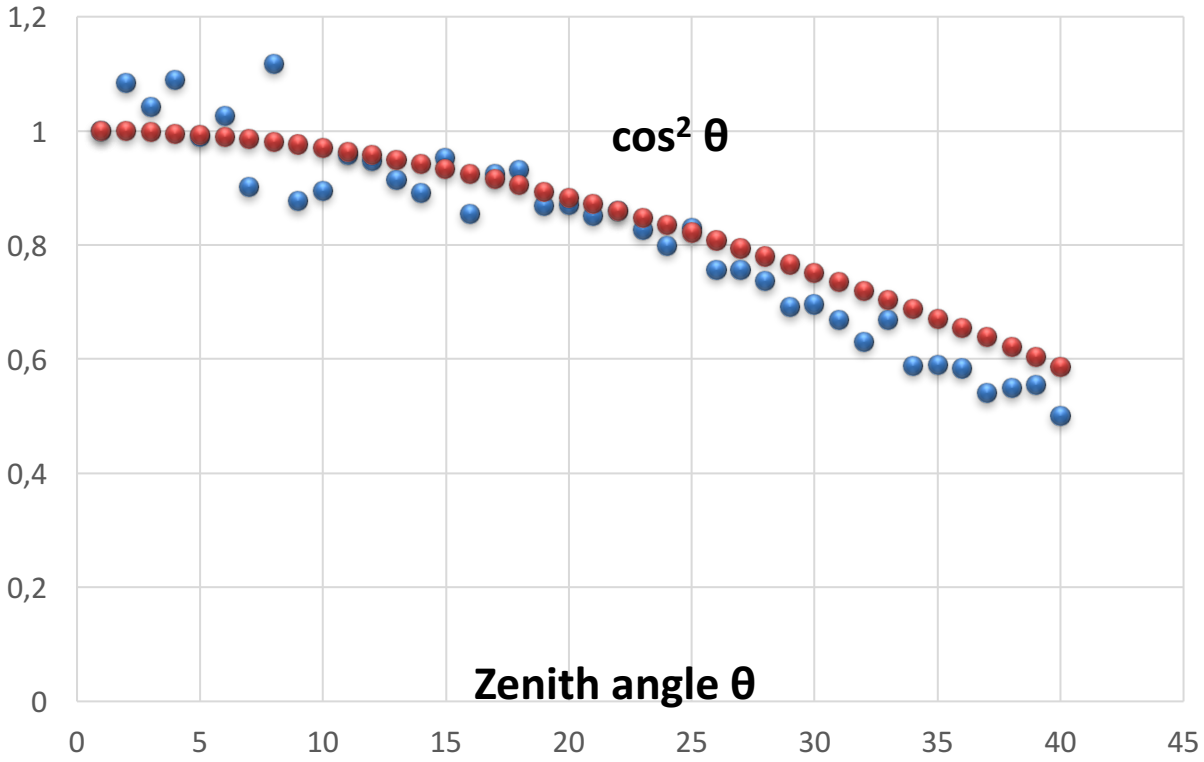
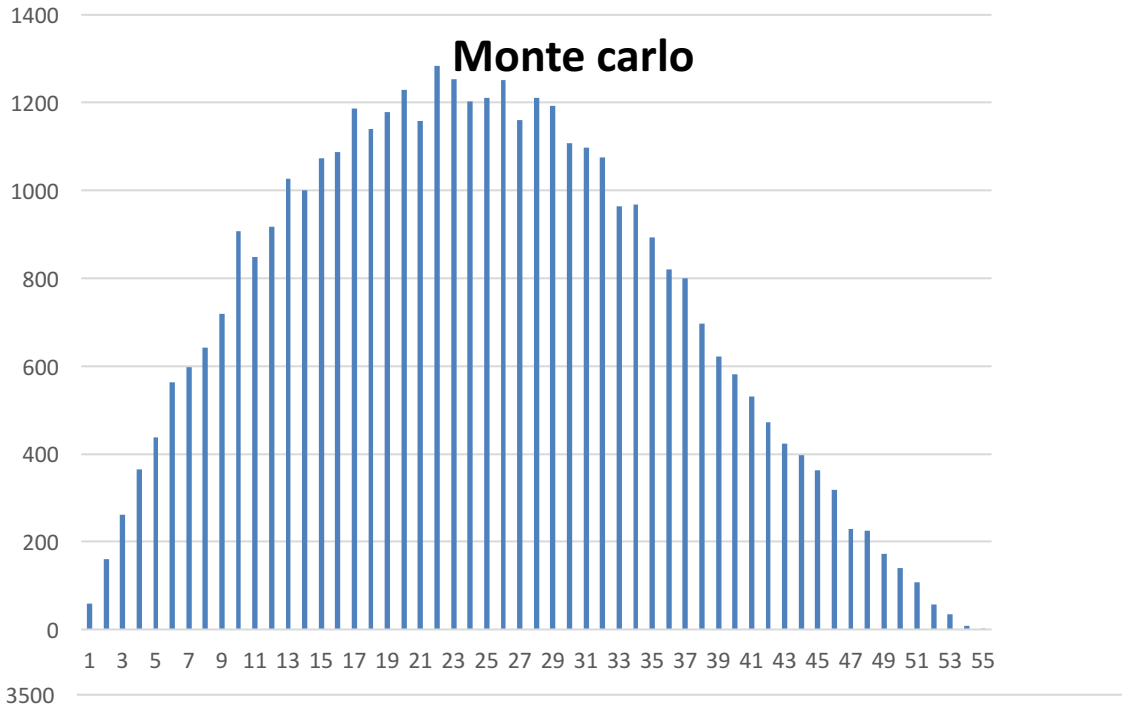
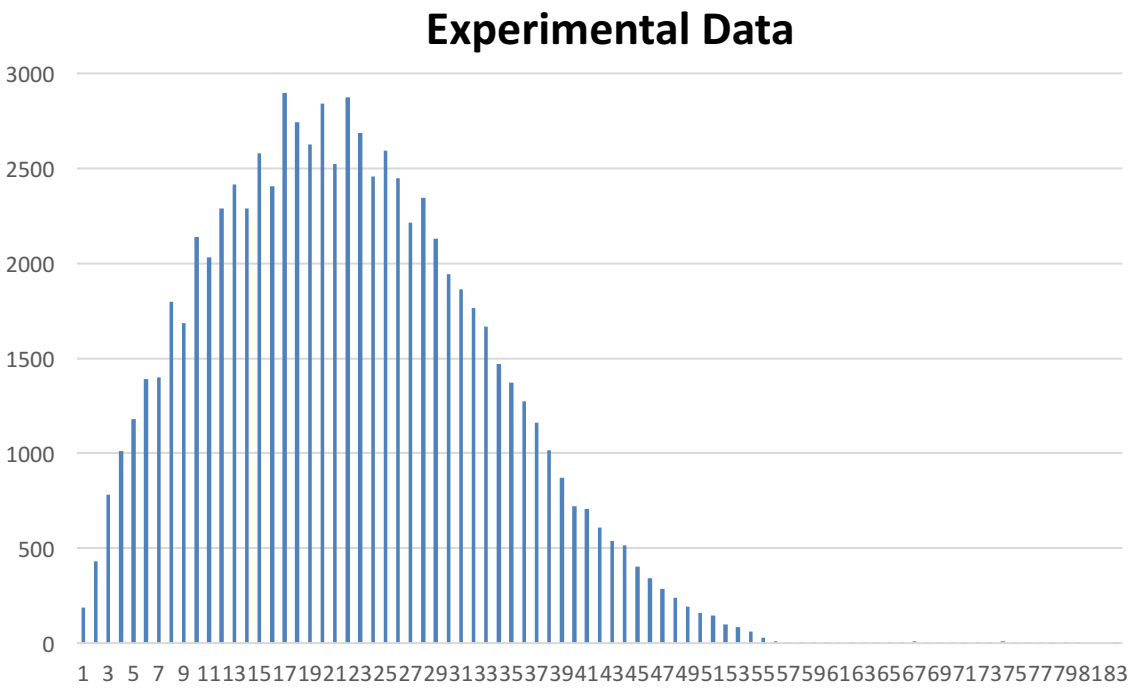
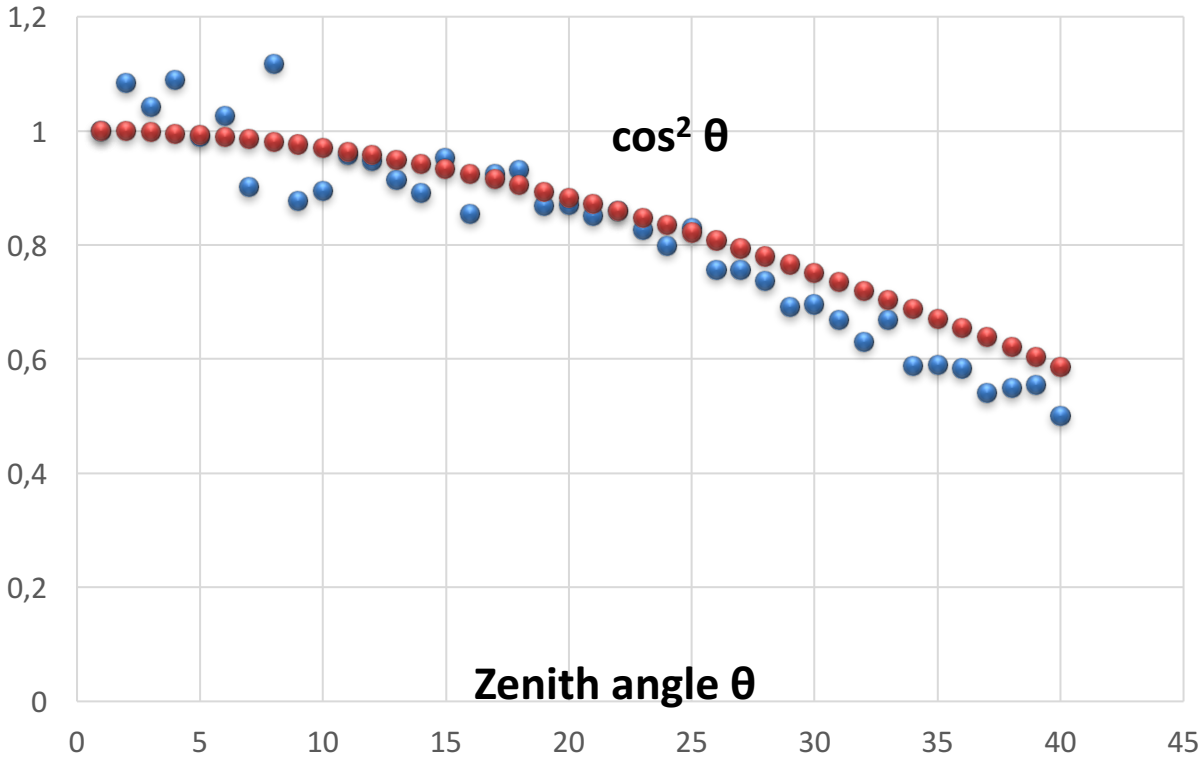
200
0
1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31 33 35 37 39 41 43 45 47 49 51 53 55

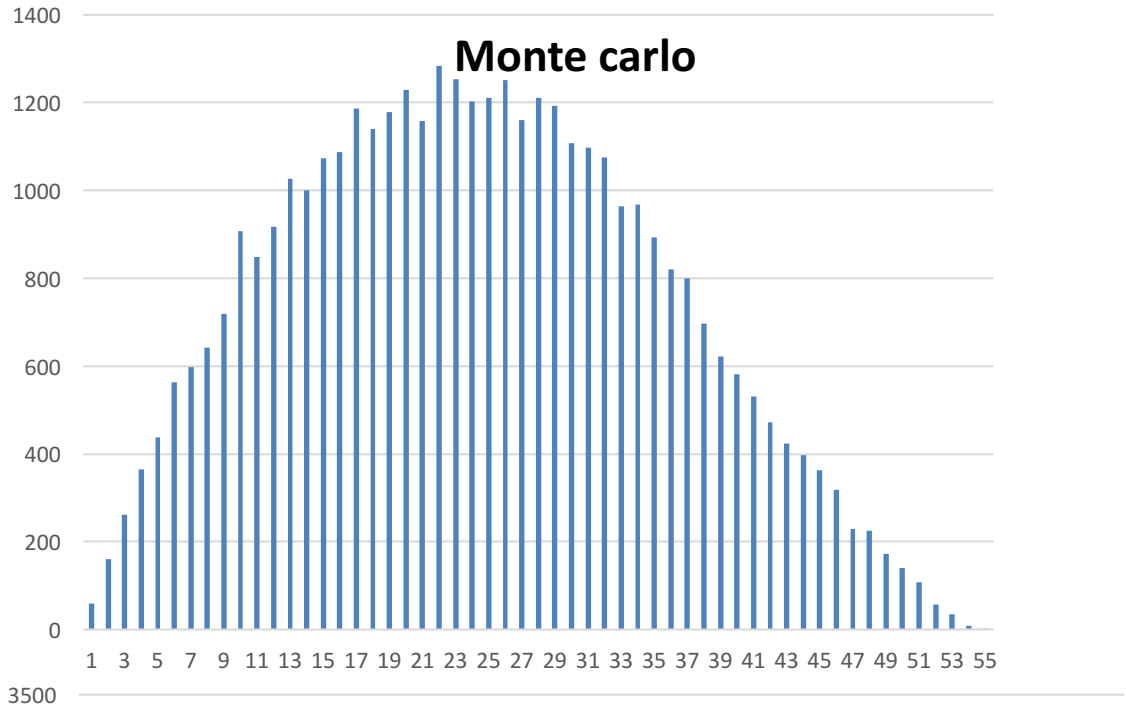

Experimental Data
3500
3000
2500
2000
1500
1000
500
0
1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31 33 35 37 39 41 43 45 47 49 51 53 55 57 59 61 63 65 67 69 71 73 75 77 79 81 83


cos² θ
Zenith angle θ
1,2
1
0,8
0,6
0,4
0,2
0
0 5 10 15 20 25 30 35 40 45

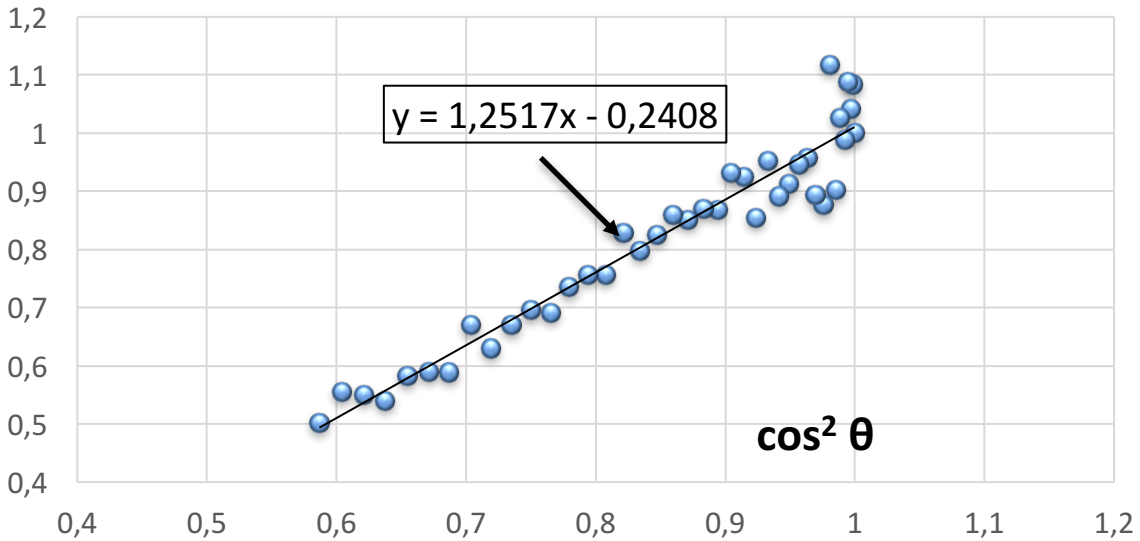

Monte carlo
1400
1200
1000
800
600
400
200
0
1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31 33 35 37 39 41 43 45 47 49 51 53 55


Experimental Data
3500
3000
2500
2000
1500
1000
500
0

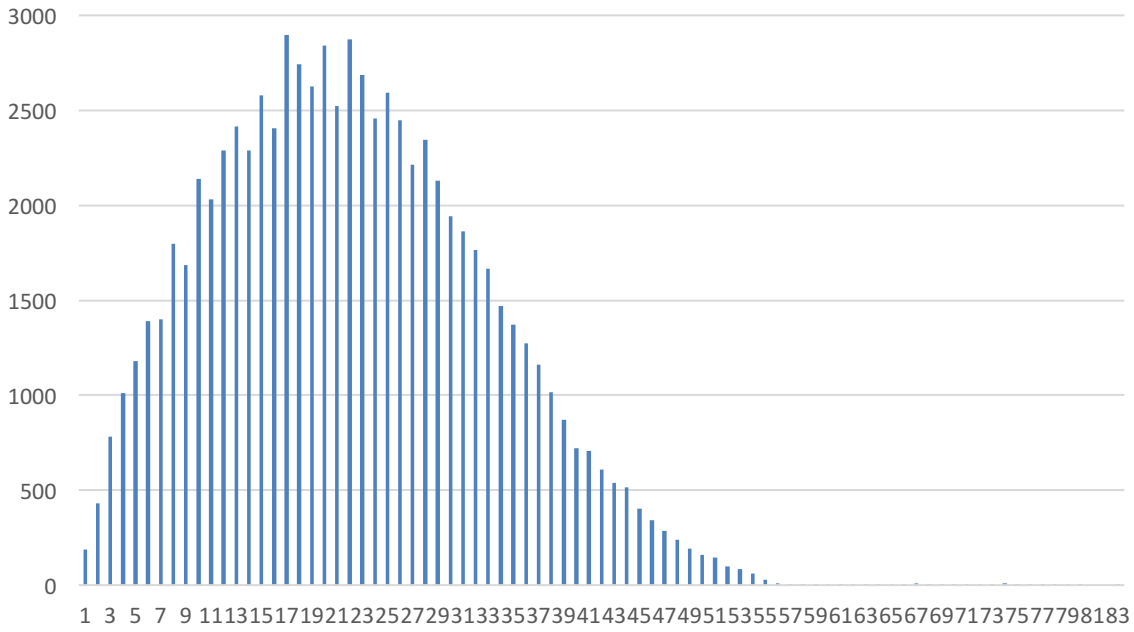




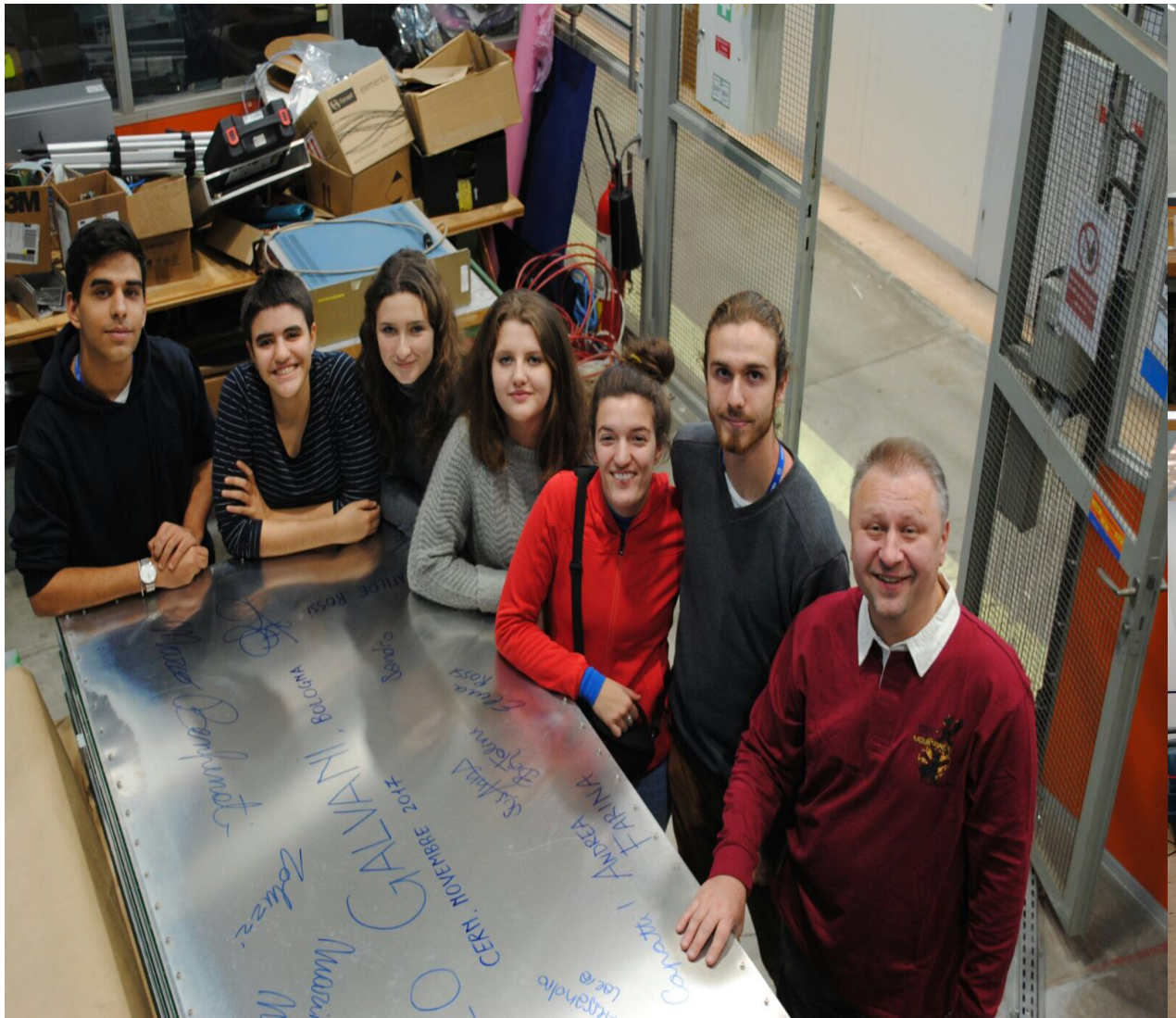
Linearized Data



Experimental Data



Our experience at CERN laboratories



The project and us

- We met other people sharing the same interests
- The afternoon lessons were very interesting and challenging, providing further information and feedback aimed to broaden our perspectives
- We understood what **being a researcher** really means
- We appreciated the introduction of run-meetings
- **We would like** to better understand the actual contribution of our work, the scientific results until now as well as future projects.

Thanks for your attention!