

**Discover Cosmic Rays**

# **INTERNATIONAL COSMIC DAY**

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**21 novembre 2023**

# International Cosmic Day



## Welcome

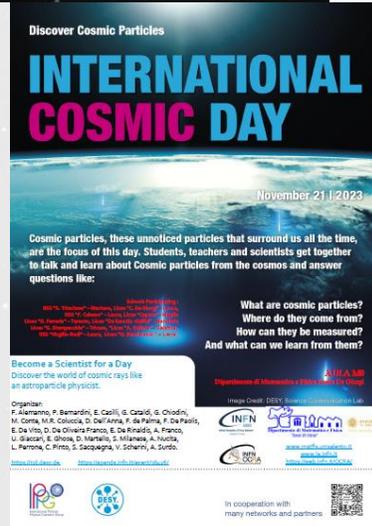
The 11th International Cosmic Day takes place on **November 22, 2022**.

International Cosmic Day (ICD) is dedicated to cosmic rays, which constantly surround us but always go unnoticed. So let's spend a day exploring the world of cosmic rays and discovering what secrets they hold.

On this day, students, teachers and scientists around the world will come together to talk and learn about cosmic rays. Questions that can be discussed are:

- What are cosmic particles?
- Where do they come from?
- How can they be measured and what can we learn from them?

Curious about what the ICD is all about? Watch this video about the ICD's 10th anniversary!



- Progetto internazionale per gli Istituti Superiori organizzato da DESY Accelerator Laboratory (Amburgo), FERMI National Laboratory (Chicago) e CERN (Ginevra)
- Gli studenti entrano in contatto con le attività di ricerca:
  - Portano a termine un piccolo esperimento sui raggi cosmici
  - Analizzano i dati
  - Confrontano i propri risultati con gli altri gruppi collegati da altre università o centri di ricerca nel mondo
  - Lavorano per un giorno come in una collaborazione internazionale

<https://icd.desy.de/>

# Mappa ICD 2023



# Mappa ICD 2023 - Europa



# ICD 2023 @ INFN Lecce

- **Seminario Prof. Daniele Martello**
- **Introduzione al Rivelatore Matteo Conte**
- **ICD**
- **Presi dati e analisi dati - Francesco de Palma**
- **Visita Control Room - Auger Ugo Giaccari**
- **Visita Planetario - Achille Nucita, Antonio Franco, Simone Sacquegna**
- **Visita Camera a Nebbia – Gabriele Chiodini, Carlo Pinto**
- **Collegamento esterno 12.30**
- **Collegamento zoom con Desy ore 13.00**
  - **CERCASI VOLONTARI!!!**

**Le visite ai laboratori devono durare circa 40 min in tutto  
In modo che si possa tornare in aula per la presa dati e  
l'analisi!**



Sondaggio studenti da compilare prima della fine dell'evento

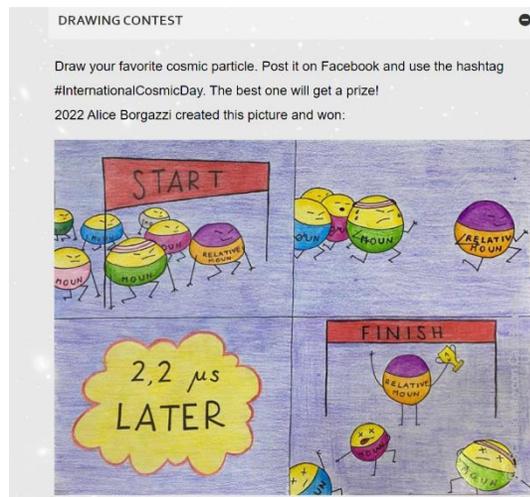
**IMPORTANTE!!!**  
**Fatelo prima di andare via!!!**

Sito web con:

- tutte le presentazioni
- i dati
- Il template per il contributo ( 1 SOLA PAGINA PER ISTITUTO)

<https://agenda.infn.it/event/38426/>

**Publicazione sui social:**  
**#InternationalCosmicDay**  
**#ocrainfn #INFNLecce**



# Pagina per Pubblicazione su Booklet



Who are you?

What have you done?

What did you find out?

What's your take-home message?

**International Cosmic Day 2020**  
Leonardo da Vinci - Maglie - Italy

**Abstract** International Cosmic Day is a great opportunity for students like us to approach to the particle physics world with real time measurements of the cosmic rays flux. These measurements, performed with CoSiAM setup developed at INFN Lecce laboratory, have been carried out together with scientists who also guided us in the analysis of the collected data and the discussion of the results. The main goal has been to verify the cosmic ray flux dependence on the zenith angle. In this poster, after a brief introduction to the history of the discovery of cosmic rays, we focused on the experimental setup description and on the measurements performed with the latter. The obtained results are then succinctly discussed.

**Cosmic Rays** Cosmic rays are high energy particles that come from outer space and reach the planet Earth. They originate from the Sun, but most of the cosmic rays are produced by astrophysical processes. Cosmic rays are composed of about 90% protons and 10% alpha particles, with a small fraction of heavier nuclei and electrons. Cosmic rays are ionizing radiation and can be harmful to living organisms. Cosmic rays are also a source of background noise for many scientific experiments.

**Analysis** The flux of cosmic rays is measured as a function of the zenith angle. The zenith angle is the angle between the direction of the cosmic ray and the vertical direction. The flux of cosmic rays is expected to decrease as the zenith angle increases. This is because the cosmic rays have to travel a longer path through the atmosphere before reaching the Earth's surface. The flux of cosmic rays is also expected to increase with the altitude. This is because the atmosphere is thinner at higher altitudes, so there is less material to absorb the cosmic rays.

**Experimental Setup** The CoSiAM setup consists of a silicon detector, a scintillator detector, and a photomultiplier tube. The silicon detector is used to measure the energy of the cosmic rays. The scintillator detector is used to measure the direction of the cosmic rays. The photomultiplier tube is used to measure the time of arrival of the cosmic rays. The CoSiAM setup is connected to a computer, which records the data and performs the analysis.

**Conclusions** The flux of cosmic rays decreases as the zenith angle increases. This is in agreement with the expected behavior of cosmic rays. The flux of cosmic rays also increases with the altitude. This is also in agreement with the expected behavior of cosmic rays. The CoSiAM setup is a good tool for measuring the flux of cosmic rays.

**Acknowledgements** We are grateful to the organizers of International Cosmic Day 2020, and to the INFN Lecce laboratory for providing the CoSiAM setup. We also thank the scientists who guided us in the analysis of the collected data.

**INTERNATIONAL COSMIC DAY** NOVEMBER 4 | 2020

**INTERNATIONAL COSMIC DAY**  
Liceo "Galileo Ferraris", Taranto

**Abstract** Cosmic Rays, discovered by Hess in 1912, are charged particles and atoms nuclei that hit the Earth every day (rain almost uniform way). They are high-energy particles originating from astrophysical objects, both galactic and extragalactic, through extremely violent processes, like the explosion of a star in a supernova or like the collisions of galaxies. When a cosmic ray enters the terrestrial atmosphere, it interacts with its nuclei. In these collisions are produced new particles that in turn interact or decay creating new others. The result is a kind of shower of particles called "Extensive Air Shower". The most energetic secondary particles can reach Earth's surface: they are very abundant in nature (about 300 particles/cm<sup>2</sup> and they make up about 20% of natural radioactivity).

**Experimental setup** We used a device called CoSiAM (Cosmic Ray Mission). CoSiAM is composed by four layers of scintillation detectors capable of emitting pulses of light during the passage of a particle. The pulses of light are converted into electrical signals by two photo-detectors. The scintillators are alternated to sheets of iron, called absorber, used to select the most penetrating particles: usually muons. The device records the signals of the scintillators at regular intervals of time, and shows the rate of single double, triple and quadruple coincidences coming respectively from only one layer or two, three and four adjacent layers. The rate is the ratio of the number of cosmic ray incidents in the detector in a time interval  $\Delta t$  and  $\Delta A$ . The device measures the rate of cosmic rays that pass through the detector in function of the zenith angle. We changed the measurement angle, from 0° to 90° rotating the detector every thirty minutes. The distribution of coincidences is shown through a graphic interface in the form of histograms. We reported the rate of double, triple and quadruple coincidences in a table, we divided the arithmetic averages by 3 to have the rate of counts in Hz and we represented the data in a graph to show the relationship between the rate of cosmic rays and the zenith angle. Finally through another graph we saw how the rate of counts in Hz changes in function of  $\cos^2 \theta$ .

**Analysis** The flux of cosmic rays is measured as a function of the zenith angle. The zenith angle is the angle between the direction of the cosmic ray and the vertical direction. The flux of cosmic rays is expected to decrease as the zenith angle increases. This is because the cosmic rays have to travel a longer path through the atmosphere before reaching the Earth's surface. The flux of cosmic rays is also expected to increase with the altitude. This is because the atmosphere is thinner at higher altitudes, so there is less material to absorb the cosmic rays.

**Participants** Student: Giulia Compagnone, Cristiano Celesia, Aurora Di Donno, Cristiano De Pasquale, Sara Marchionni, Iuli Vassilova, Greta Papaneri, Sara Pomas, Davide Santo, Denise Sgrignola, Teacher: Salvatore Spinelli.

**Conclusion** Observing the first graph, it is possible to notice that the cosmic ray flux decreases as the zenith angle increases. The flux is maximum when the angle measures 0° and the direction of particles is perpendicular to the Earth's surface. While the flux is minimum when the angle measures 90°. This happens because a greater angle corresponds to greater distance traveled by the particles and to higher possibility that they are absorbed in the atmosphere before reaching the Earth's surface. Observing the second graph, it is possible to notice that the data is arranged approximately along a straight line: the rate of cosmic rays is directly proportional to the cosine squared of the zenith angle.

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**INTERNATIONAL COSMIC DAY**  
Liceo Statale « Tito Livio » - Martina Franca  
ITALY

**Abstract** On November 4<sup>th</sup>, 2020 we participated to the International Cosmic Day together with the researchers of INFN Lecce and University of Salento. We learned about cosmic rays and we performed an experiment to measure the cosmic rays flux as a function of the zenith angle. We analysed the data and here we present the results.

**Experimental Setup** To perform the measurements of the cosmic rays flux we used a detector named CoSiAM (Cosmic Ray Mission) made with 4 scintillator layers interposed with iron absorbers. The plastic scintillators emit light when a particle pass through the light is collected by optical fiber (WLS) and is sent to 2 "photo-detectors" (PMT). The iron absorbers allow to select the most energetic particle.

**Analysis** We recorded the single counts from every detector layers named X, Y, Z, W starting from the top. We also recorded the twofold, threefold and fourfold coincidences that is the signals due to the fact that two, three and four layers detect an event at the same time.

**Conclusion** We measured the cosmic ray flux versus the Zenith angle. We saw from the data that the flux decreases as the angle increases as expected because for bigger angles the cosmic rays pass through a wider atmospheric layer and are absorbed.

**INTERNATIONAL COSMIC DAY** NOVEMBER 4 | 2020

**Termine ultimo per la consegna 15 Dicembre 2023**  
**Deadline Desy 15 Dicembre 2023**

# Buon Lavoro!!!!

