International Masterclasses on Particle Physics

IMC 2025

Question Time with authors of the Auger Masterclass

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February 14, 2025

Agenda

- Welcome
- Auger @ IMC2025: overview and general instructions
- Experimental activity demonstration
- Additional questions time
- Other items

Auger @ IMC2025

overview and general instructions

- **All information/materials** required are at the webpage!

https://augermasterclasses.lip.pt/

Auger @ IMC 2025

sessions

February 28, 2025 Afr/Eur	University Of Minho	Braga, Portugal	David Schmidt (KIT, Germany)
	Czech Technical University and Institute of Physics | Czech Academy of Science	Prague, Czechia	
	Ahmed Nouacer High School	Bab Ezzouar, Algeria	Beatriz Garcia (ITeDA, Argentina)
	University of Tuzla	Tuzla, Bosnia and Herzegovina	Fabio Convenga (UnivAQ, Italy)
	University of L'Aquila | GSSI | Laboratori Nazionali del Gran Sasso	L'Aquila, Italy	
March 6, 2025 Afr/Eur	University of Debrecen	Debrecen, Hungary	Gina Isar (ISS, Romania)
	INFN - Sezione di Napoli | University Federico II	Naples, Italy	
	Ibn Sahnoun Er-Rachidi High School	Saida, Algeria	Nicolas Leal (ITeDA, Argentina)
	INFN - Sezione di Milano	Milan, Italy	
	Kenyatta University	Nairobi, Kenya	
March 14, 2025 Asia/Oce	Hebei Normal University	Shijiazhuang, China	Karen Caballero (UNACH, Mexico)
	Accel Kitchen	Tokyo, Japan	
March 18, 2025 Afr/Eur	Hellenic Open University	Patra, Greece	Gina Isar (ISS, Romania)
	Silesian University - Institute of Physics	Opava, Czechia	
	University of Zian Achor	Djelfa, Algeria	
	Universita' del Salento and INFN-Lecce	Lecce, Italy	
	August 20, 1956 High School & Saint-Augustin High School	Tizi-Ouzou & Annaba, Algeria	
March 26, 2025 America	Instituto Lux	León, Mexico	Raul Sarmento (LIP, Portugal)
	Escuelas Técnicas Raggio & Colegio Nacional de Buenos Aires	Buenos Aires, Argentina	
	Escuela Cumelén & Instituto Sagrado Corazón de Jesús (de Merlo)	Buenos Aires, Argentina	Beatriz Garcia (ITeDA, Argentina)
April 5, 2025 Afr/Eur	Institute of Space Science	Bucharest, Romania	Karen Caballero (UNACH, Mexico)
	Instituto Superior Técnico	Lisboa, Portugal	
	Faculty of Sciences - University of Porto	Porto, Portugal	Katarina Simkova (VUB, Belgium)
	University of Constantine	Constantine, Algeria	
	University of Évora	Évora, Portugal	

Auger @ IMC 2025

timetable

10:00 – 10:15	Registration and welcome
10:15 – 10:30	Introduction
10:30 – 11:45	Particle and astroparticle physics
11:45 – 12:15	Coffee break
12:15 – 13:00	Experiments in astroparticle physics
13:00 – 14:00	Lunch
14:00 – 16:00	Data analysis
16:00 – 17:00	Video conference with the Pierre Auger Observatory*
17:00 – 17:15	Farewell

introductory talks given by local scientists

experimental activity by the students

<u>Important notes:</u>

- The joint video conferences **start sharp at fixed time**
- The remaining schedule may be adapted locally

Auger @ IMC 2025

time of the video conferences

Feb 28
Afr/Eur

Location	Local Time	Time Zone	UTC Offset
Lisbon (Portugal – Lisbon)	Friday, 28 February 2025, 15:00:00	WET	UTC
Prague (Czechia)	Friday, 28 February 2025, 16:00:00	CET	UTC+1 hour
Algiers (Algeria)	Friday, 28 February 2025, 16:00:00	CET	UTC+1 hour
Sarajevo (Bosnia-Herzegovina)	Friday, 28 February 2025, 16:00:00	CET	UTC+1 hour
Rome (Italy)	Friday, 28 February 2025, 16:00:00	CET	UTC+1 hour
Buenos Aires (Argentina)	Friday, 28 February 2025, 12:00:00	ART	UTC-3 hours
Corresponding UTC (GMT)	Friday, 28 February 2025, 15:00:00		

Mar 6
Afr/Eur

Location	Local Time	Time Zone	UTC Offset
Budapest (Hungary)	Thursday, 6 March 2025, 15:30:00	CET	UTC+1 hour
Rome (Italy)	Thursday, 6 March 2025, 15:30:00	CET	UTC+1 hour
Algiers (Algeria)	Thursday, 6 March 2025, 15:30:00	CET	UTC+1 hour
Nairobi (Kenya)	Thursday, 6 March 2025, 17:30:00	EAT	UTC+3 hours
Buenos Aires (Argentina)	Thursday, 6 March 2025, 11:30:00	ART	UTC-3 hours
Corresponding UTC (GMT)	Thursday, 6 March 2025, 14:30:00		

Mar 14
Asia/Oce

Location	Local Time	Time Zone	UTC Offset
Beijing (China – Beijing Municipality)	Friday, 14 March 2025, 15:00:00	CST	UTC+8 hours
Tokyo (Japan)	Friday, 14 March 2025, 16:00:00	JST	UTC+9 hours
Buenos Aires (Argentina)	Friday, 14 March 2025, 04:00:00	ART	UTC-3 hours
Corresponding UTC (GMT)	Friday, 14 March 2025, 07:00:00		

Auger @ IMC 2025

time of the video conferences

Mar 18
Afr/Eur

Location	Local Time	Time Zone	UTC Offset
Athens (Greece)	Tuesday, 18 March 2025, 17:00:00	EET	UTC+2 hours
Prague (Czechia)	Tuesday, 18 March 2025, 16:00:00	CET	UTC+1 hour
Algiers (Algeria)	Tuesday, 18 March 2025, 16:00:00	CET	UTC+1 hour
Rome (Italy)	Tuesday, 18 March 2025, 16:00:00	CET	UTC+1 hour
Buenos Aires (Argentina)	Tuesday, 18 March 2025, 12:00:00	ART	UTC-3 hours
Corresponding UTC (GMT)	Tuesday, 18 March 2025, 15:00:00		

Mar 26
America

Location	Local Time	Time Zone	UTC Offset
Mexico City (Mexico – Ciudad de México)	Wednesday, 26 March 2025, 14:00:00	CST	UTC-6 hours
Buenos Aires (Argentina)	Wednesday, 26 March 2025, 17:00:00	ART	UTC-3 hours
Corresponding UTC (GMT)	Wednesday, 26 March 2025, 20:00:00		

Apr 5
Afr/Eur

Location	Local Time	Time Zone	UTC Offset
Bucharest (Romania)	Saturday, 5 April 2025, 17:00:00	EEST	UTC+3 hours
Lisbon (Portugal – Lisbon)	Saturday, 5 April 2025, 15:00:00	WEST	UTC+1 hour
Algiers (Algeria)	Saturday, 5 April 2025, 15:00:00	CET	UTC+1 hour
Buenos Aires (Argentina)	Saturday, 5 April 2025, 11:00:00	ART	UTC-3 hours
Corresponding UTC (GMT)	Saturday, 5 April 2025, 14:00:00		

Auger @ IMC 2025

logistics

Computers room:

- Machines with **internet connection required**
- Recommended that the software is installed **beforehand**
- Students work individually (suggested) or in groups of two
- Each group should have the **student activity guide** (printed version is suggested)

Requirements:

- Windows: Windows 7+
- Mac: MacOS 10.13+
- Linux: Ubuntu 18.04+, centos 7+
- Virtual machines should not be used (very low performance)
- Please test the software beforehand and contact us if needed

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logistics

<u>Video conferences:</u>

- via a **Zoom meeting**
- invitations to the Zoom meeting will be sent to the contact person of each institute a few days in advance
- meetings will be open one hour in advance for prior setting when needed
- please **test in advance** your speakers, micro, camera and projection system
- for an organized discussion, please ask **two volunteers** among your students to act as spokespersons of the group

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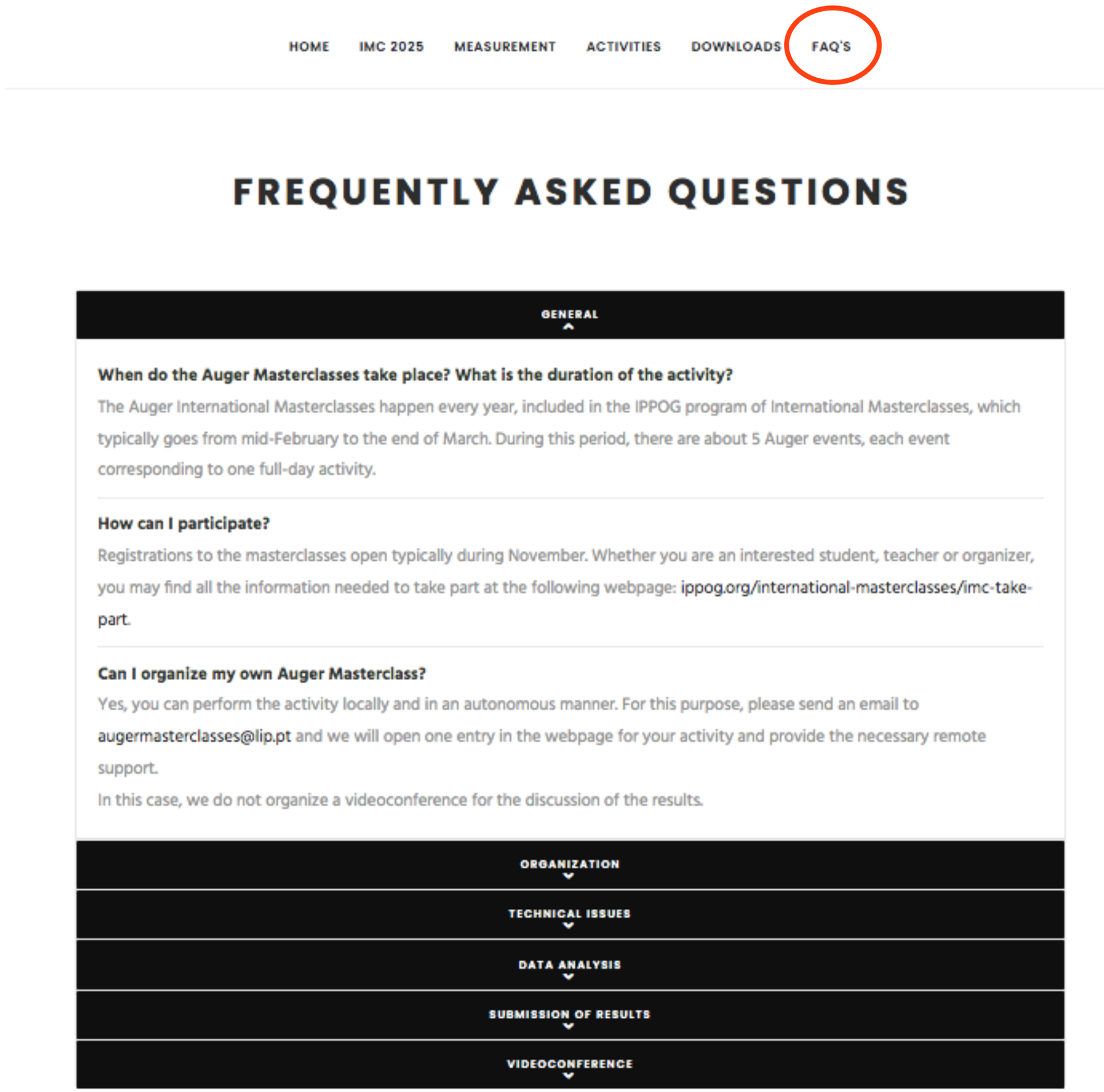
FAQs

https://augermasterclasses.lip.pt/

new this year

- A new tab with frequently asked questions: a good place for starters



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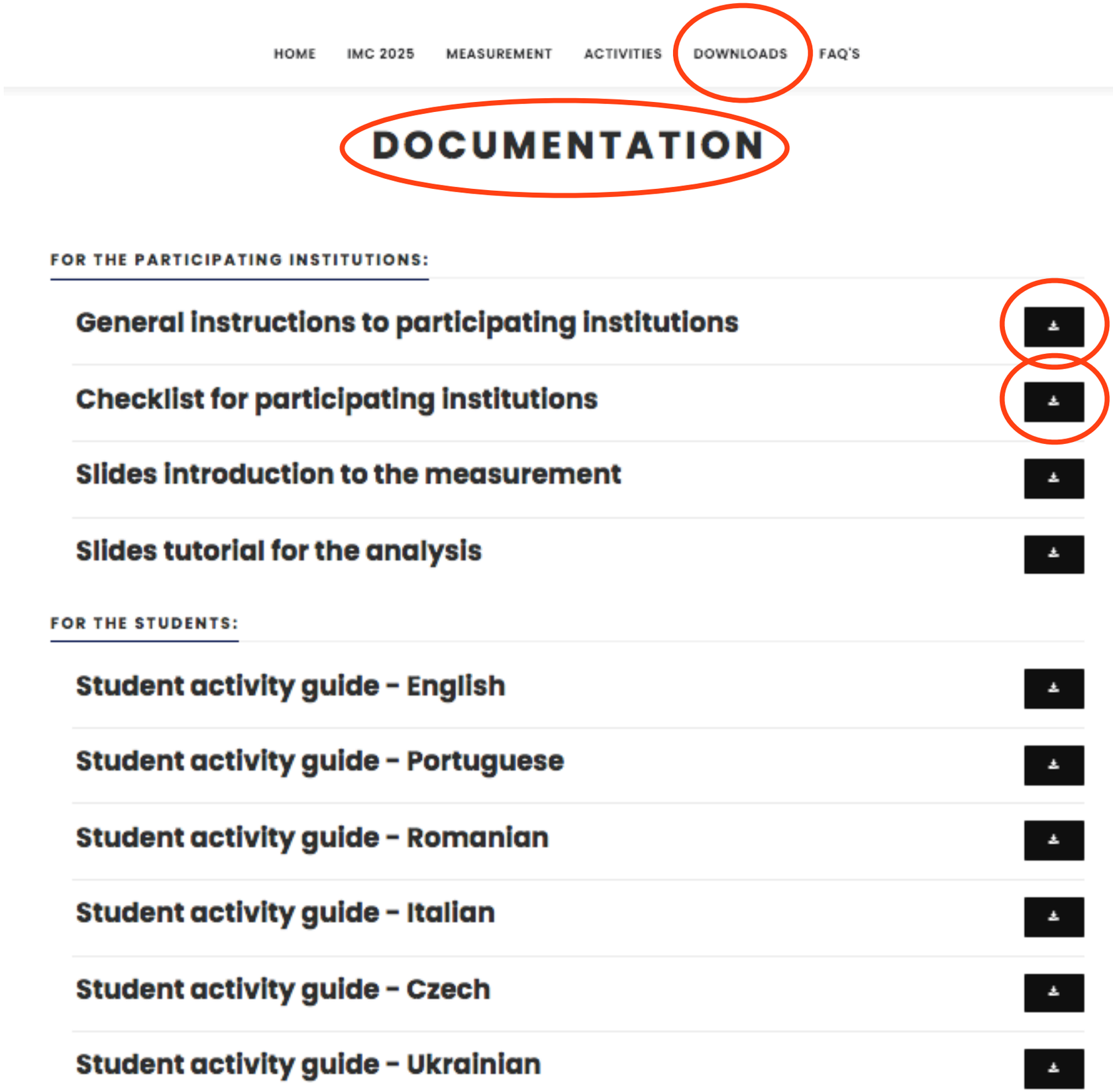
documentation

- A checklist was prepared and these slides are also available online



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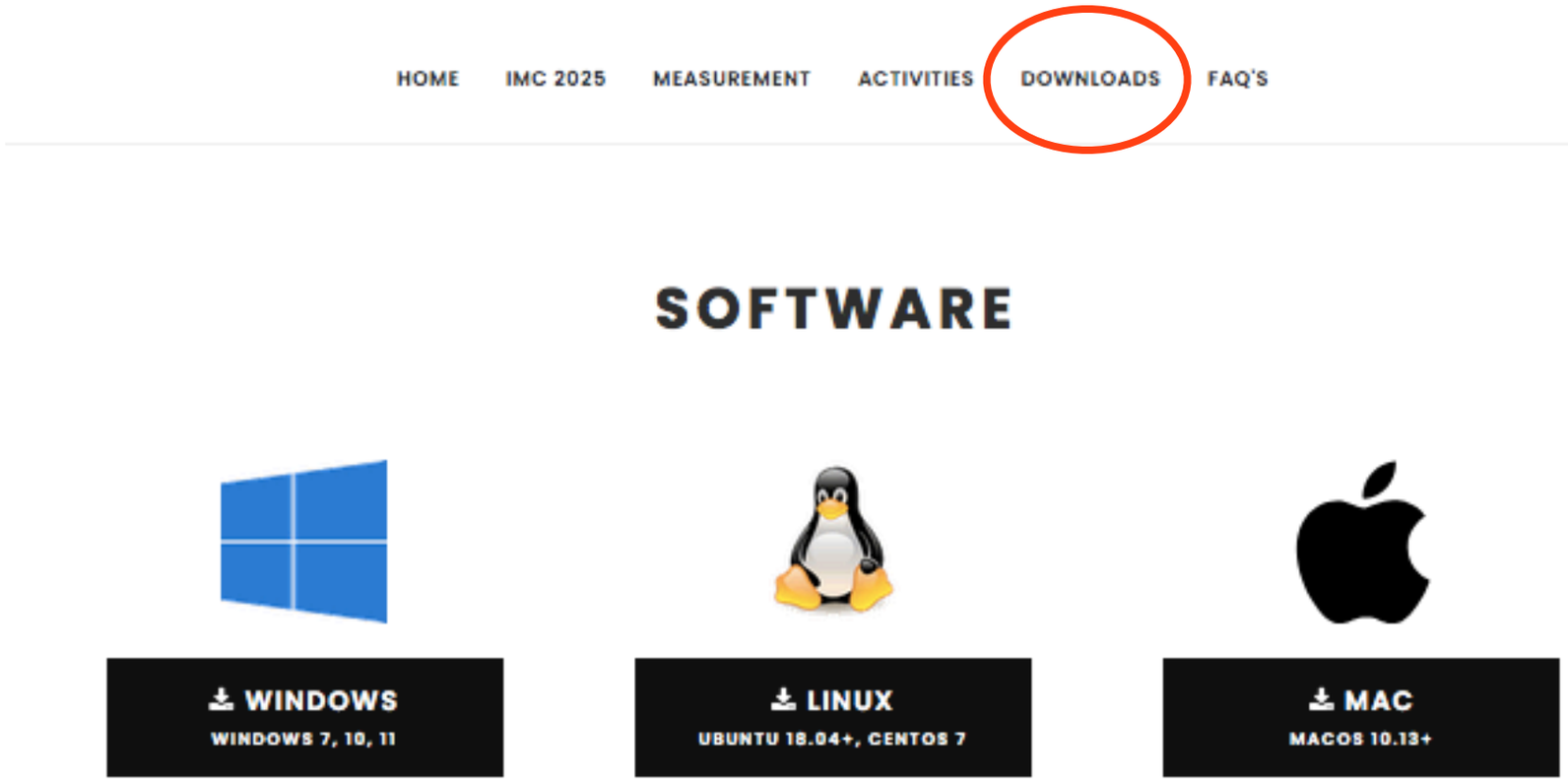
software, others



Additional materials are available at the downloads tab of the webpage:

- **Software**, a single application to download and execute
- **Student activity guide** (translations are available)
- **Slide suggestions** with summary of the steps of the activity and others

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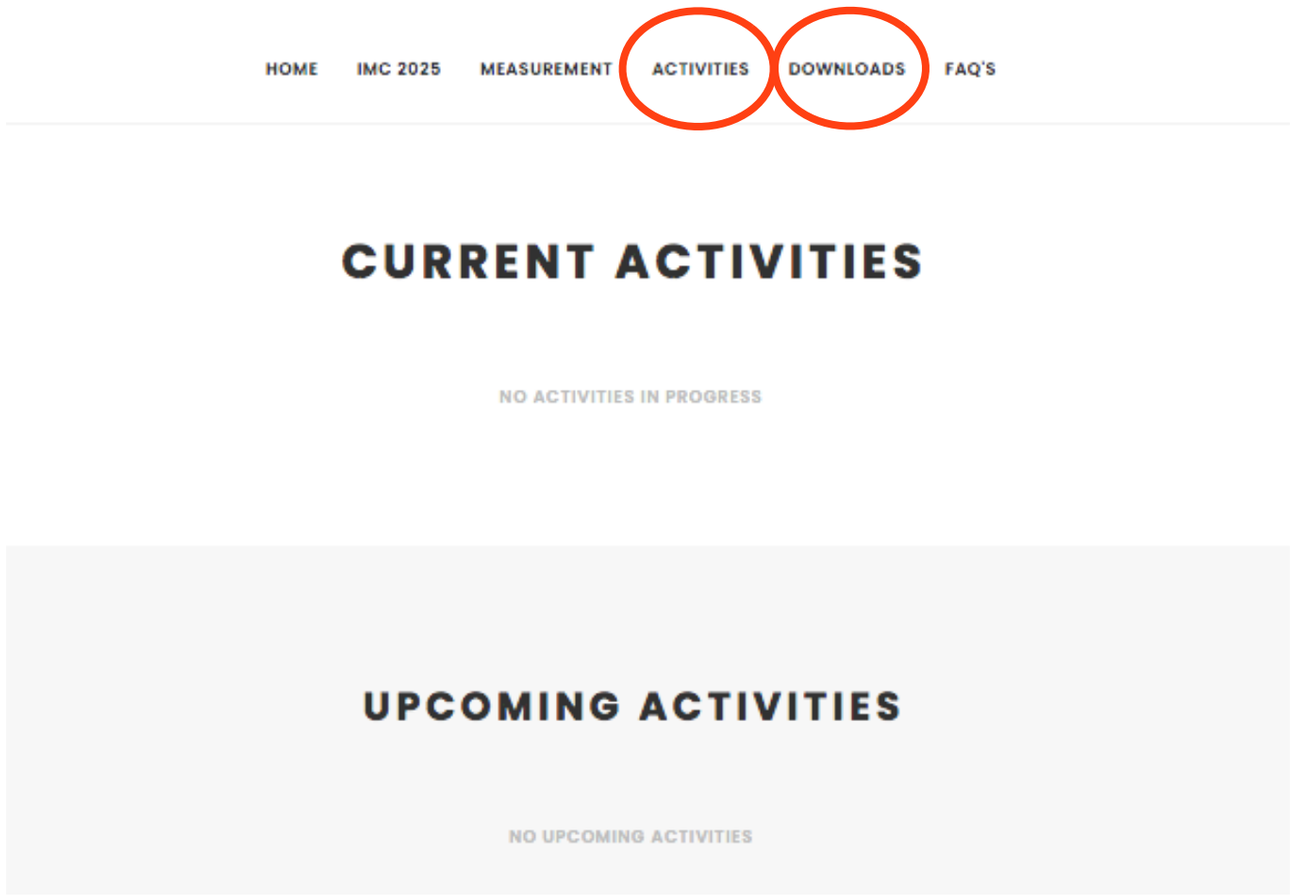
datasets

new this year: the datasets will be also available at the **"Activities" tab**



Downloads tab:

- The datasets will be generated according to the number of students at each institution, and will be indicated to each participating institution a few days in advance
- Please write the number of each dataset in the student **activity guide (there is an empty field for that), so that each** student (or group of two students) nows what is the dataset to download

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materials

<u>Measurement tab:</u> describes the measurement and has hyperlinks to further information about the Pierre Auger Observatory

<u>Activities tab:</u> contains the platform for downloading the datasets, and for uploading and discussing the results

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student activity guide

INTERNATIONAL MASTERCLASSES
Experimental activity at the Pierre Auger Observatory

// Origin of ultra-high-energy cosmic rays

Training Guide Person/Group _____

Goals:

- **Rebuild 50 events of the Pierre Auger Observatory**
- **Select the ones that contain directional information about their origin**
- **Discuss where in the Universe the cosmic rays of extreme energy are produced**

Before starting:

- Navigate to https://augermasterclasses.lip.pt/downloads and find *"NEXT ACTIVITIES DATASETS"*.
- Find you institution and download to your Downloads folder the dataset *AugerMasterClasse_X.augermc*, where *X* is the group number indicated above. Each person/group has their own unique dataset to use.
- In Auger's interactive event viewer, click on *"Read Events File"* in the upper left corner and select the data file in your Downloads folder with the extension *".augermc"*
- You are now ready to start analyzing events. Begin the process by selecting the first event from the left sidebar.

1

5-pages document

HOME IMC 2025 MEASUREMENT ACTIVITIES DOWNLOADS FAQ'S

DOCUMENTATION

FOR THE PARTICIPATING INSTITUTIONS:

- General instructions to participating institutions
- Checklist for participating institutions
- Slides introduction to the measurement
- Slides tutorial for the analysis

FOR THE STUDENTS:

- Student activity guide - English
- Student activity guide - Portuguese
- Student activity guide - Romanian
- Student activity guide - Italian
- Student activity guide - Czech
- Student activity guide - Ukrainian

Experimental activity

demonstration

Experimental activity
demonstration

Where in the Universe are ultra-high-energy cosmic rays being produced?

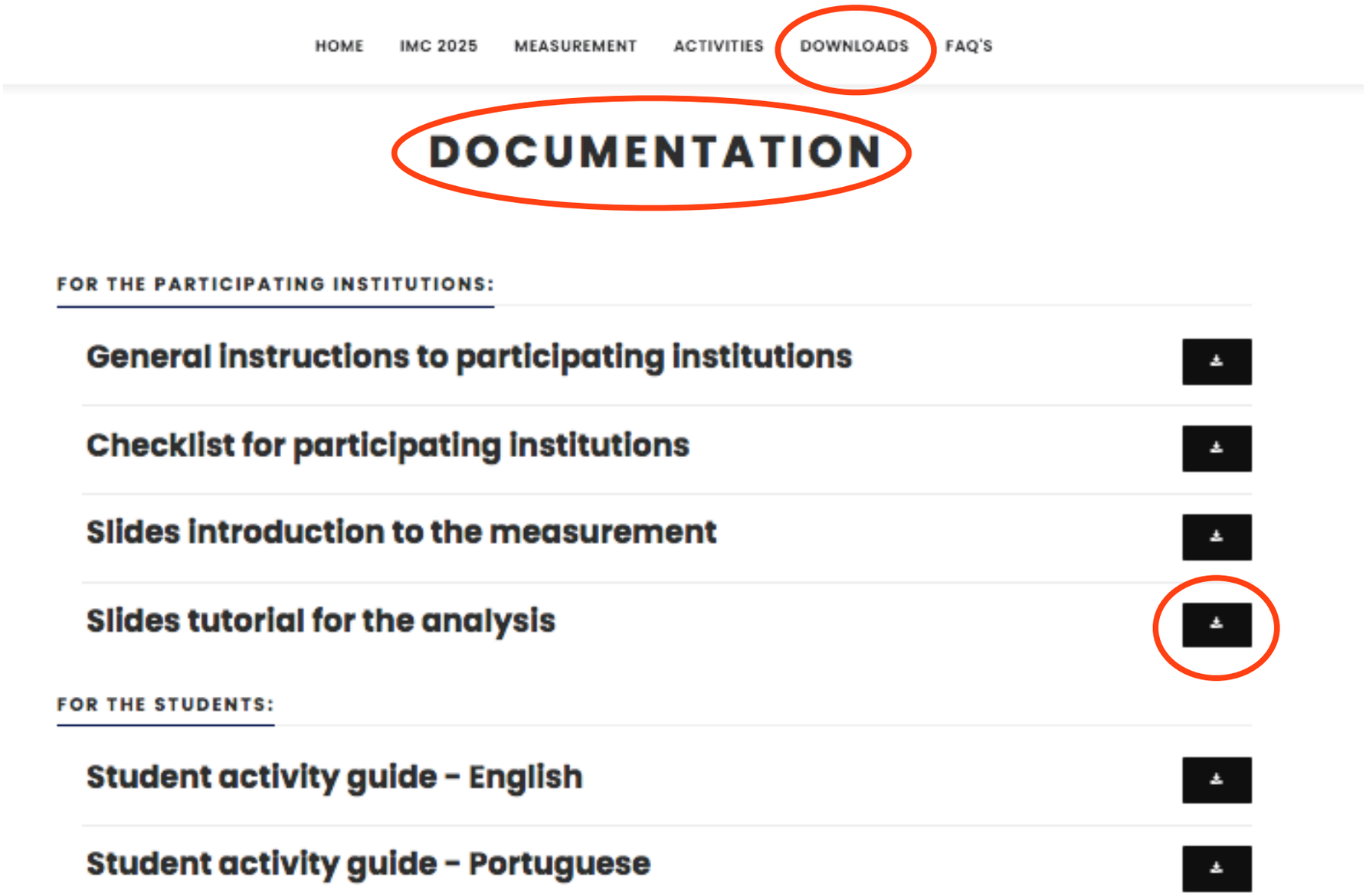
<u>Procedure:</u>

1. Reconstruct the arrival direction and energy of real Auger events + perform event selection

2. A sky map with the reconstructed arrival directions of selected events is produced and discussed

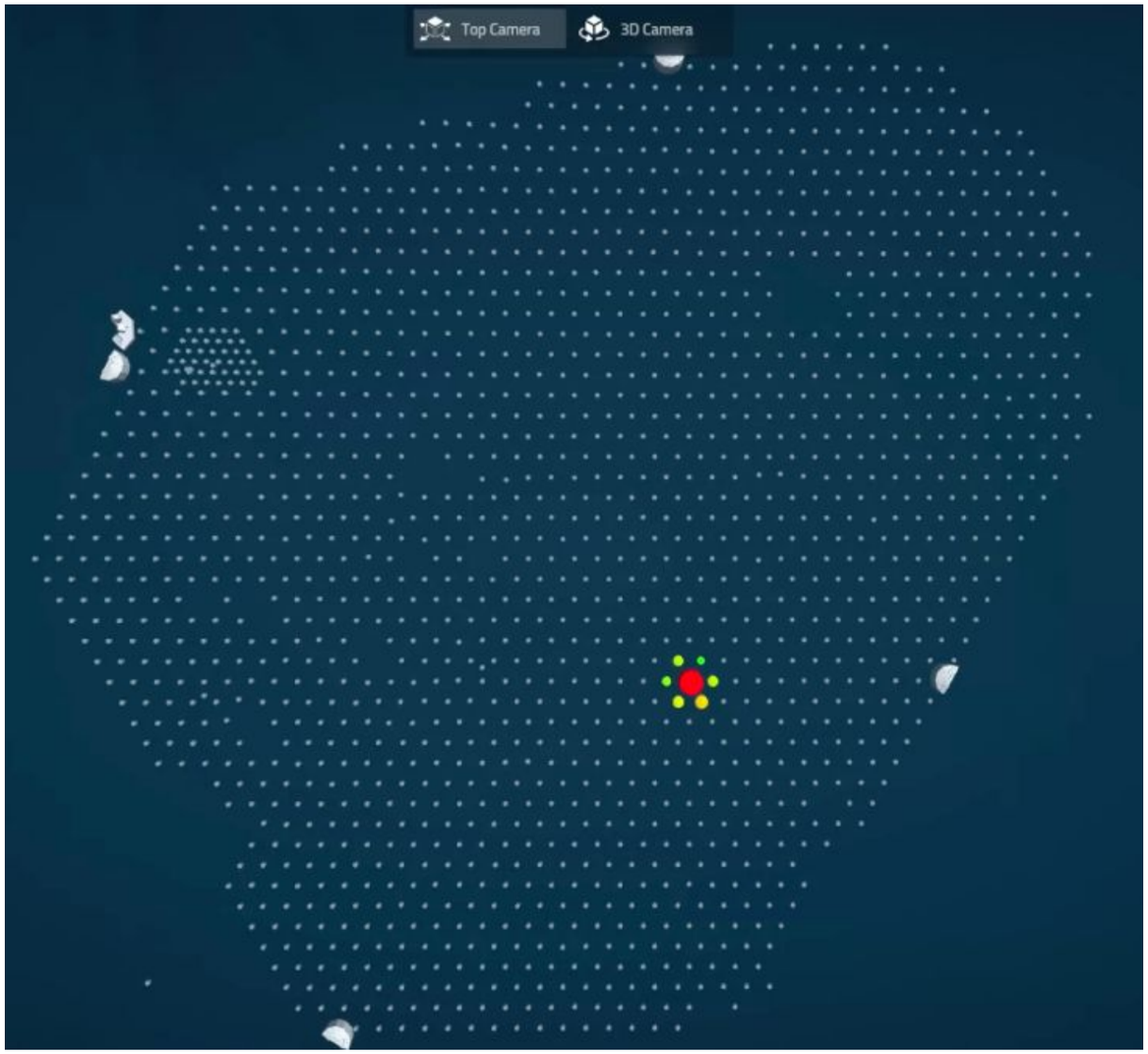
Experimental activity
demonstration

- A step-by-step tutorial is available for the organizers



Experimental activity
demonstration

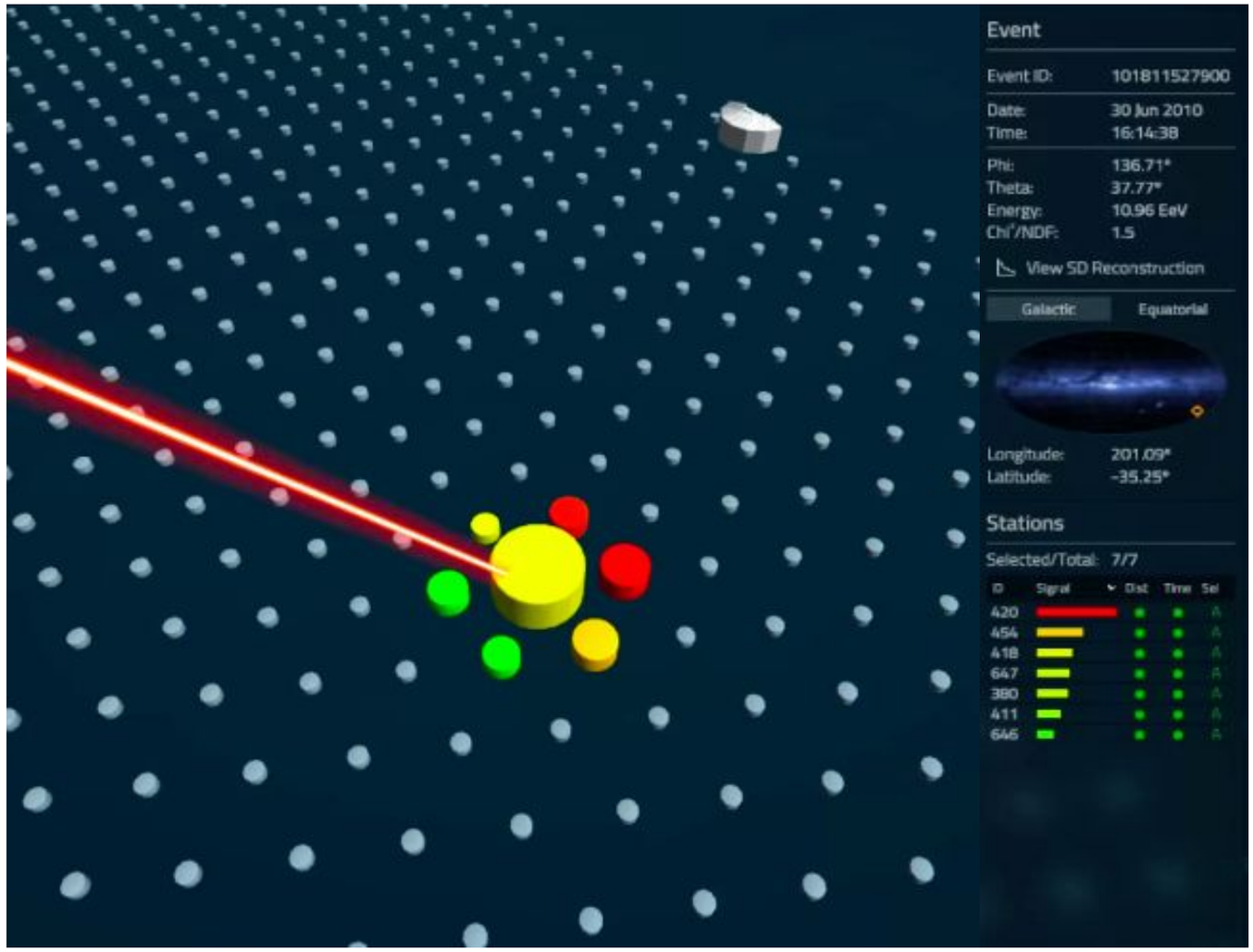
Student starting point



Surface Detector stations time and signal only

Experimental activity
demonstration

Reconstructed event



energy

arrival direction

Experimental activity
demonstration

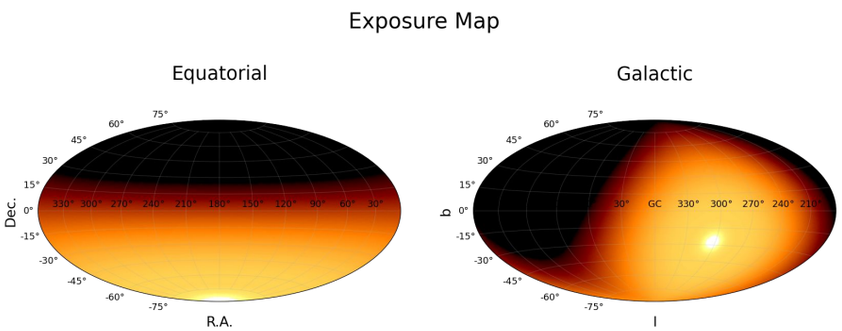
Quick tour through the activity

Experimental activity
demonstration

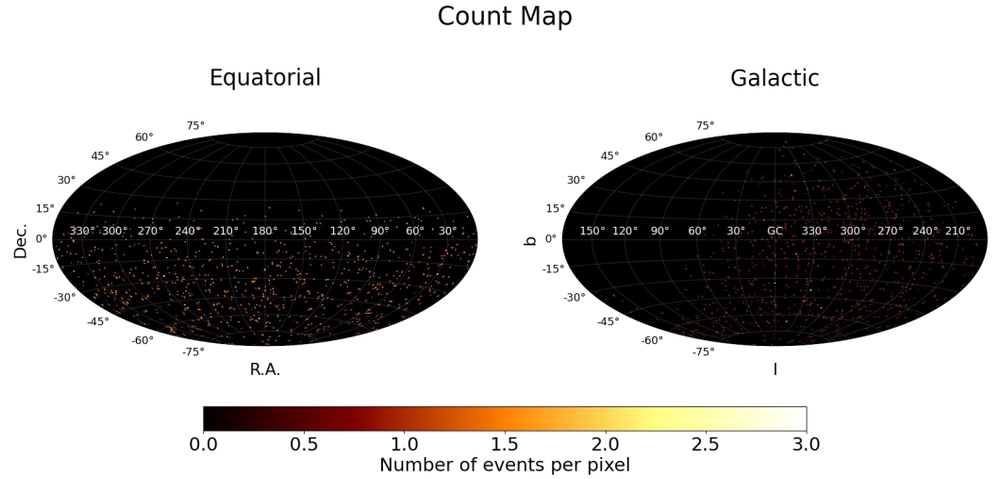
- **topics of the final discussion, combining the statistics from all students**

1) sky-map coordinates

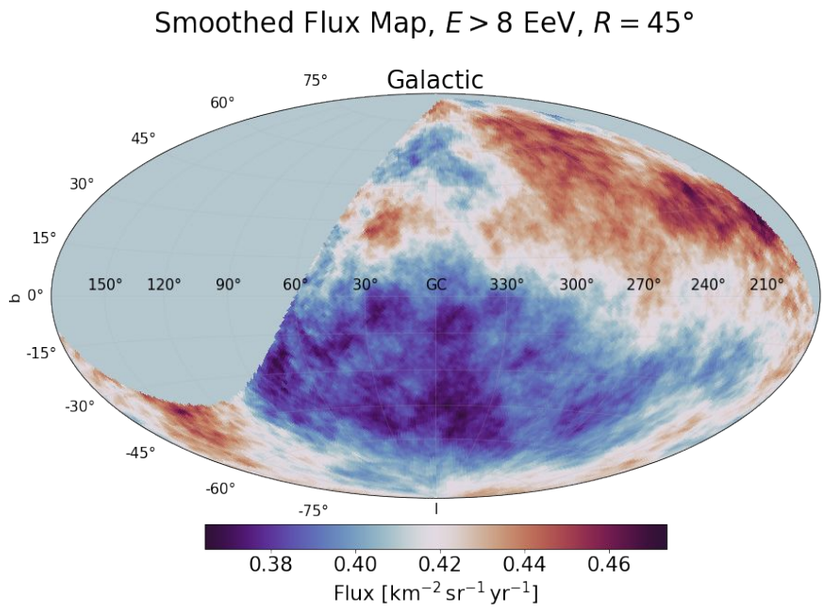
2) observatory exposure to the sky



3) count maps of arrival directions



4) smoothed flux map



Experimental activity
remarks

Some remarks from experience:

- it works very well to **challenge students to go through the guide by themselves**, instead of spending lots of time at the beginning of the activity trying to explain details

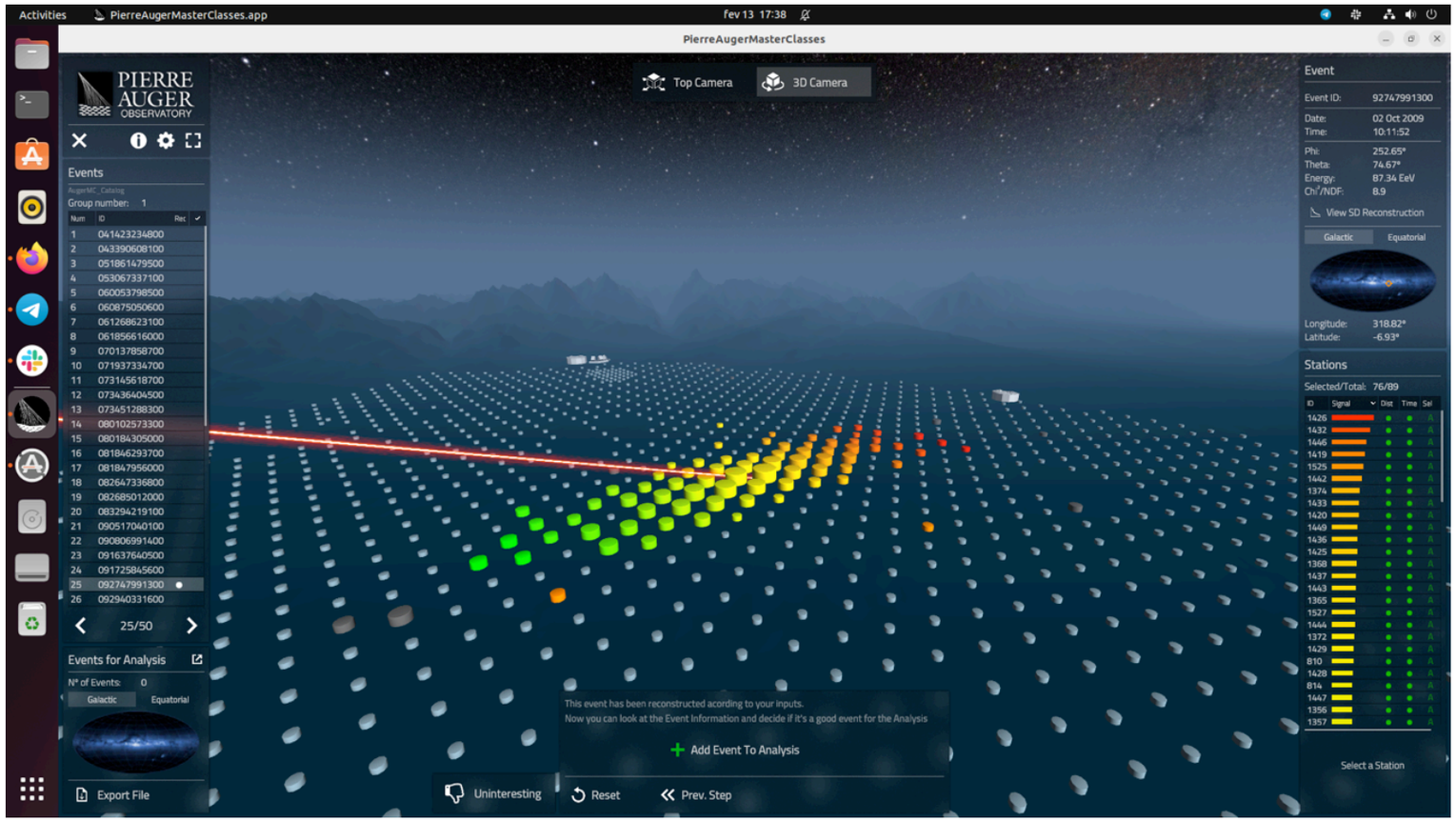
- students should go through as many events as they are able to, but **no problem if they do not analyze their full dataset**

Experimental activity
remarks

<u>Some remarks from experience:</u>

- you may **launch the challenge** for who gets "the most energetic event", or "the most inclined event", or "the event with the highest number of stations with signal", updating the current value on the board

new this year: we will randomly include in some datasets special events from the Top100 Auger catalogue



Experimental activity
remarks

<u>Some remarks from experience:</u>

- if there is time before the video conference to locally discuss the results, some discussion topics are:
  - Start with the result from one individual student
  - Any conclusion? Any pattern?
  - Is there a correlation with galactic plane?
  - How does it compare with another individual result?
  - Need for statistics...

Question time!

additional questions are welcome