International Masterclasses on Particle Physics

IMC 2024

Question Time with authors of Auger Masterclass

February 9, 2024

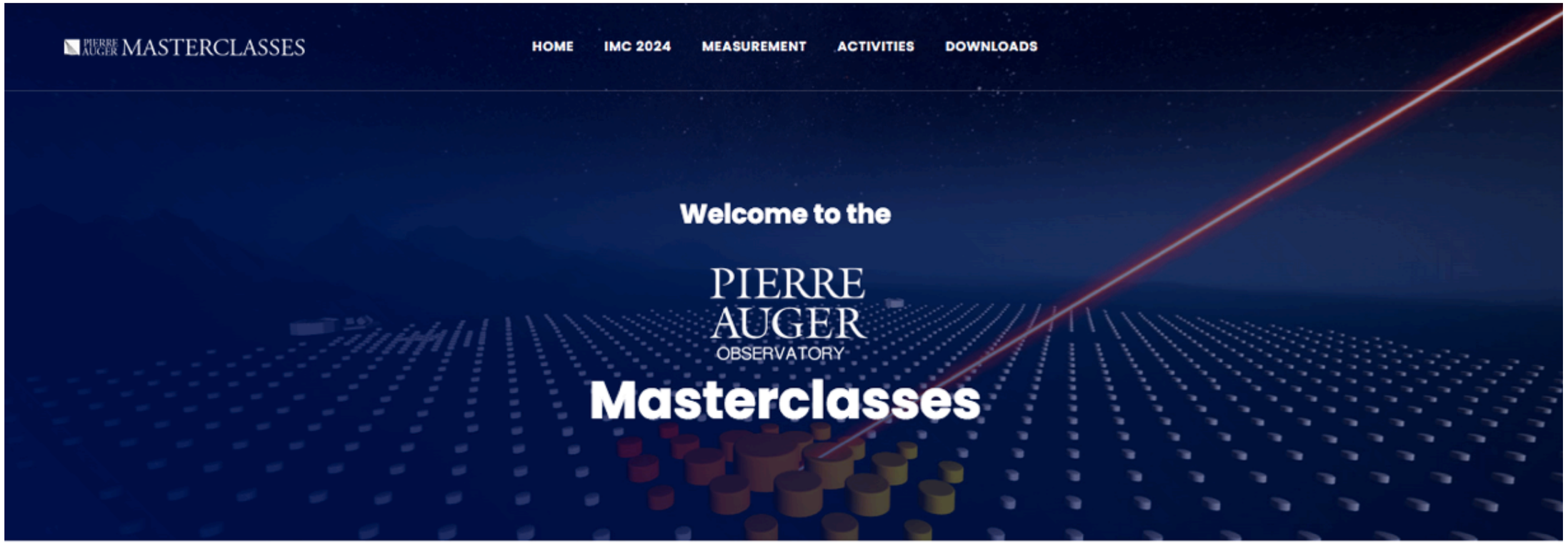
Agenda

- Welcome
- Auger @ IMC2024: overview and general instructions
- Experimental activity demonstration
- Additional questions time
- Other items

Auger @ IMC2024

overview and general instructions

- All the required information and materials are at the webpage!



INTERNATIONAL MASTERCLASSES 2024

https://augermasterclasses.lip.pt/

Afr/Eur **March 01, 2024**	Kenyatta University	Nairobi, Kenya
	INFN - Sezione di Napoli | University Federico II	Naples, Italy
	University of L'Aquila | GSSI | Laboratori Nazionali del Gran Sasso	L'Aquila, Italy
March 08, 2024	Czech Technical University and Institute of Physics | Czech Academy of Science	Prague, Czech Republic
	University Of Minho	Braga, Portugal
Asi/Oce **March 12, 2024**	Accel Kitchen | Waseda Research Institute for Science and Engineering	Japan
	Institute of High Energy Physics, Chinese Academy of Sciences	Beijing, China
Afr/Eur **March 16, 2024**	Instituto Superior Técnico	Lisboa, Potugal
	Universidade da Madeira	Funchal, Portugal
	Institute of Space Science	Bucharest, Romania
	Universidade de Coimbra	Coimbra, Portugal
	Universidade de Évora	Évora, Portugal
March 19, 2024	University of Debrecen	Debrecen, Hungary
	El Houria High School	Constantine, Algeria
	Università del Salento | INFN Lecce	Lecce, Italy
	Università degli Studi di Milano | INFN Milano	Milan, Italy

Auger @ IMC 2024

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

Important notes:

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

Auger @ IMC 2024

video conferences

March 1, 16h30 UTC:

- Kenya 17h30
- Italy 15h30

March 8, 16h00 UTC+1:

- Czech Republic 16h00
- Portugal 15h00

March 12, 16h00 UTC+9:

- China 15h00
- Japan 16h00

March 16, 16h00 UTC+1:

- Portugal 15h00
- Romania 16h00

March 19, 16h00 UTC+1:

- Algeria 16h00
- Hungary 16h00
- Italy 16h00

Auger @ IMC 2024

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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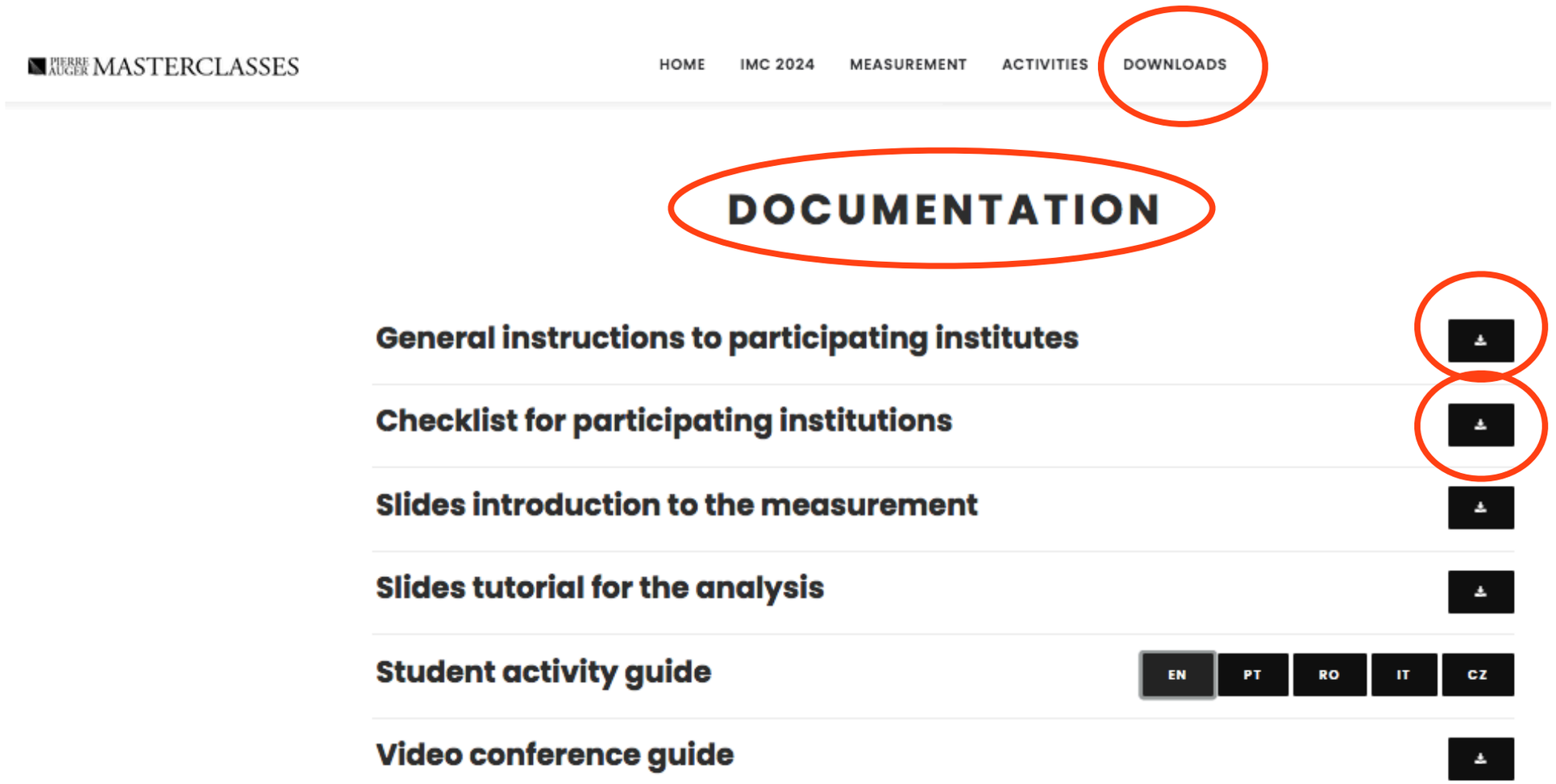
logistics

<u>Video conferences:</u>

- please test in advance your speakers, micro, camera and projection system
- 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

Auger @ IMC 2024
logistics

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



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materials

All materials made available at the downloads tab of the webpage:

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

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datasets

<u>Downloads tab:</u>

- The datasets will be indicated to each participating institution a few days in advance, according to the number of students
- Please write the number of each dataset to be used in the student activity guide (there is an empty field for that), so that the student nows what is the dataset that he/she/they must download

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materials

Measurement tab describes the measurement and has hyperlinks to further information about the Pierre Auger Observatory

Activities tab contains the platform for uploading and discussing the results

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student activity guide

PIERRE AUGER OBSERVATORY

International Particle Physics Outreach Group

INTERNATIONAL MASTERCLASSES
hands on particle physics

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 2024 MEASUREMENT ACTIVITIES DOWNLOADS

DOCUMENTATION

General instructions to participating institutes

Checklist for participating institutions

Slides introduction to the measurement

Slides tutorial for the analysis

Student activity guide EN PT RO IT CZ

Video conference guide

Experimental activity

demonstration

Experimental activity
demonstration

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

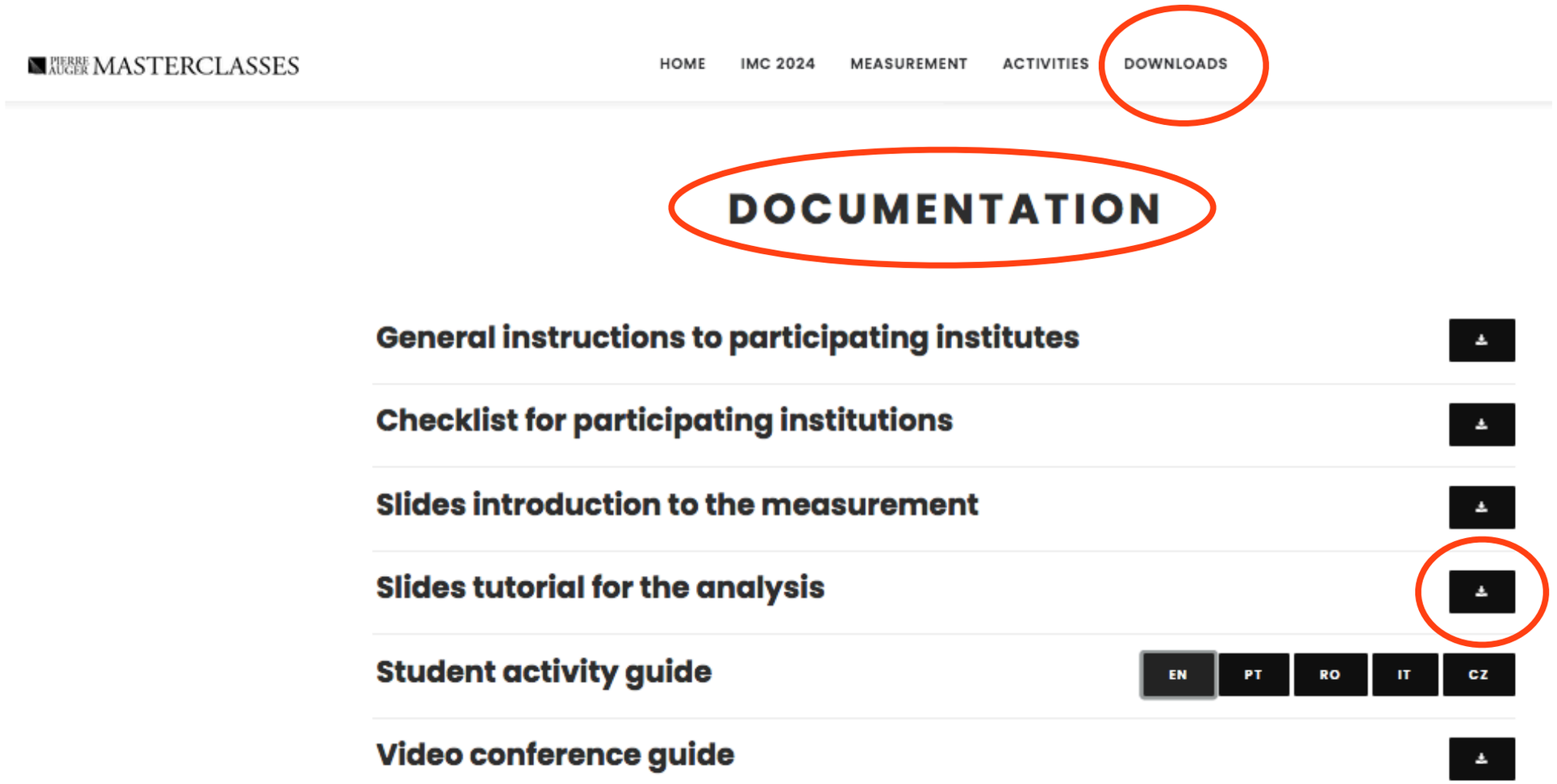
Procedure:

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

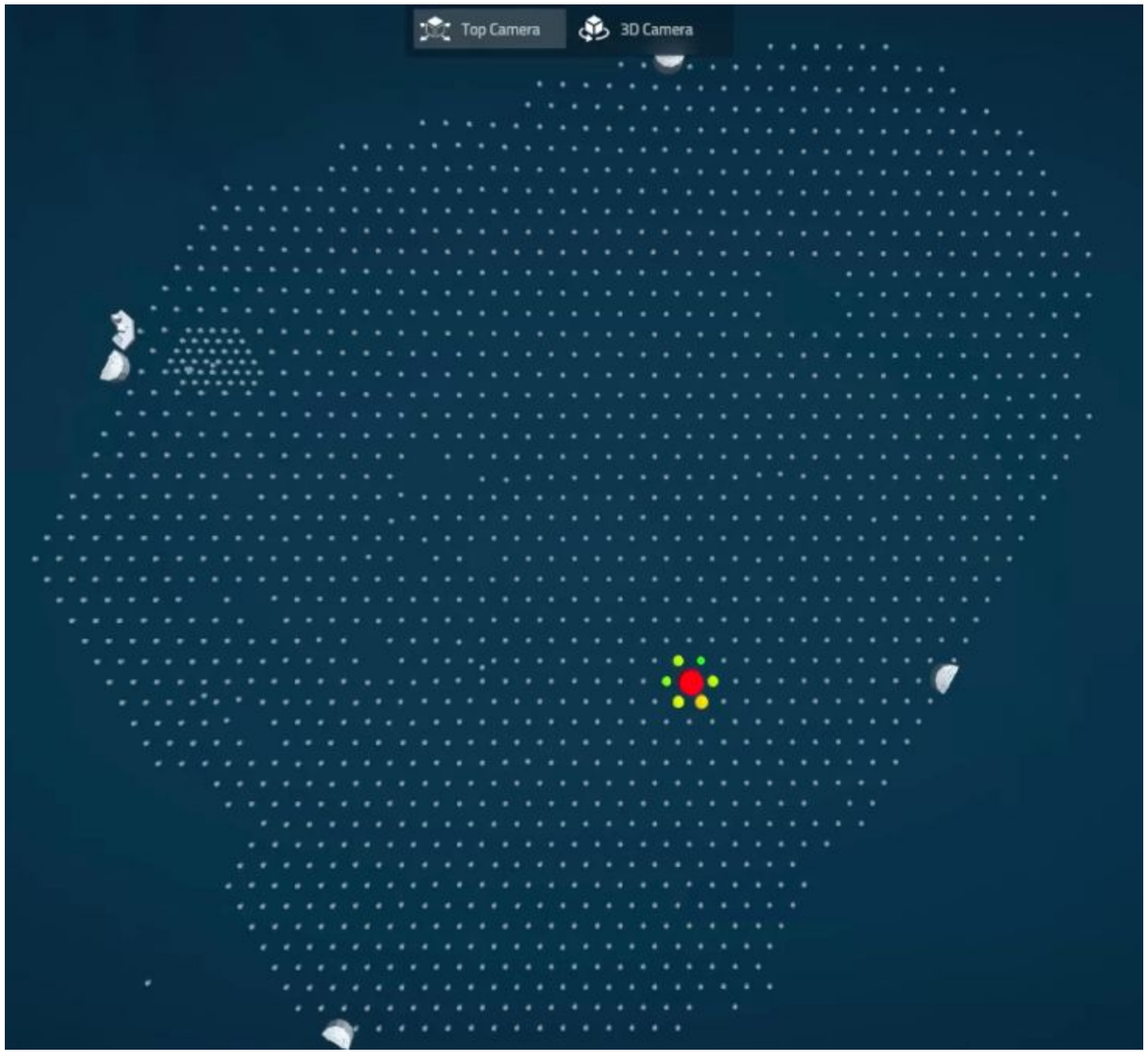
Experimental activity
demonstration

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



Experimental activity
demonstration

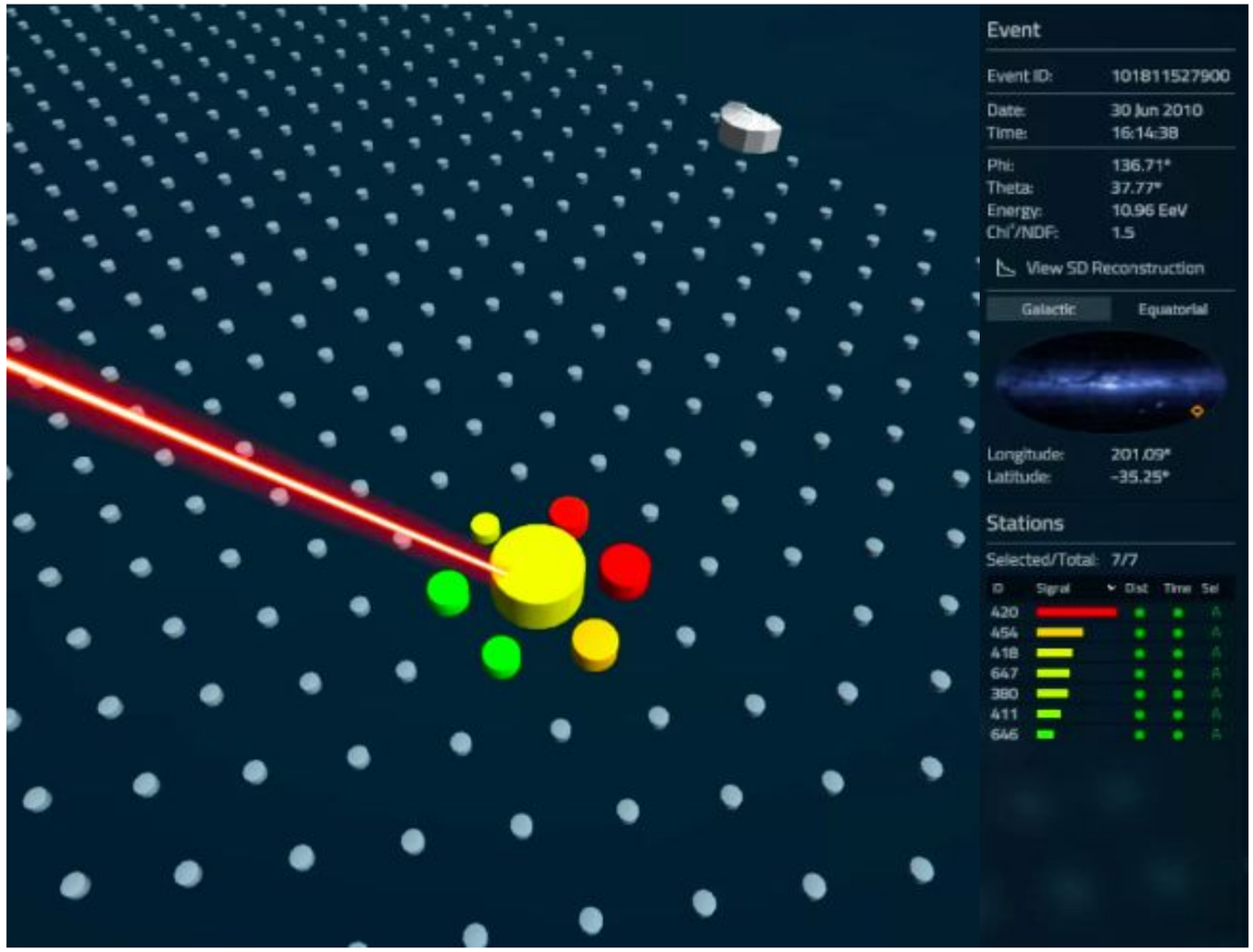
Student starting point



Surface Detector stations time and signal only

Experimental activity
demonstration

Reconstructed event



energy

arrival direction

Experimental activity
demonstration

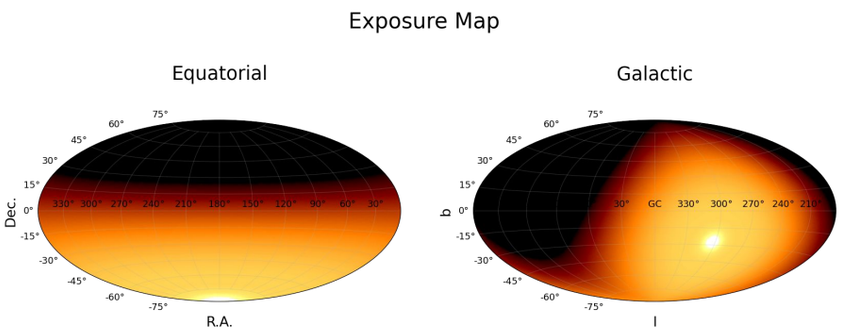
Quick tour through the activity

Experimental activity
demonstration

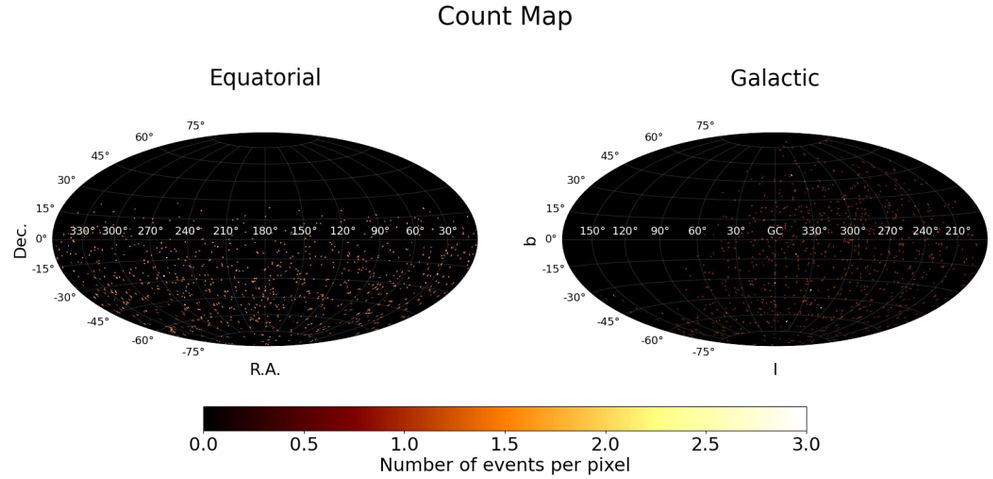
- **topics of the final discussion, combining the statistics from all students**

1) sky-map coordinates

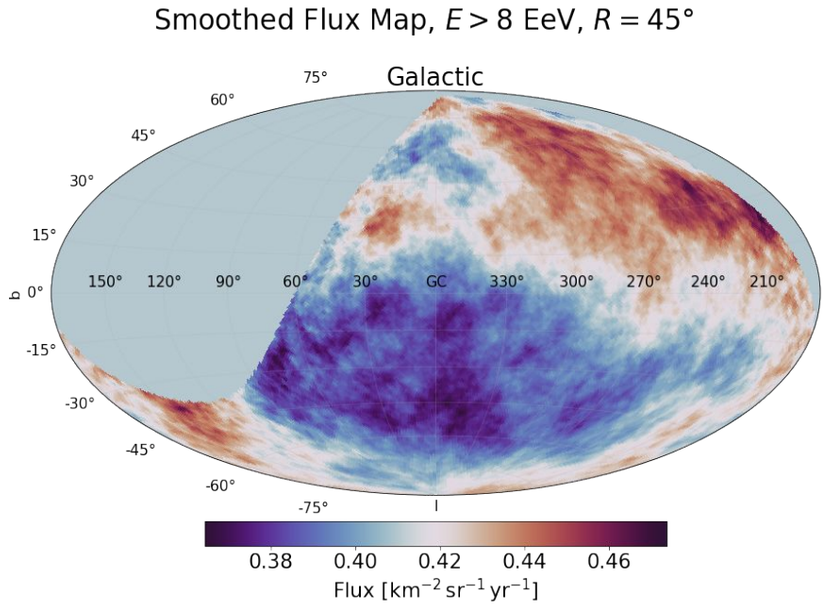
2) observatory exposure to the sky



3) count maps of arrival directions



4) smoothed flux map



Experimental activity
demonstration

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

- 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

- 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

Other items

- need to schedule another meeting, for final questions, on February ?