

TracerEVD for the IPPOG International Masterclasses (ATLAS W exercise)

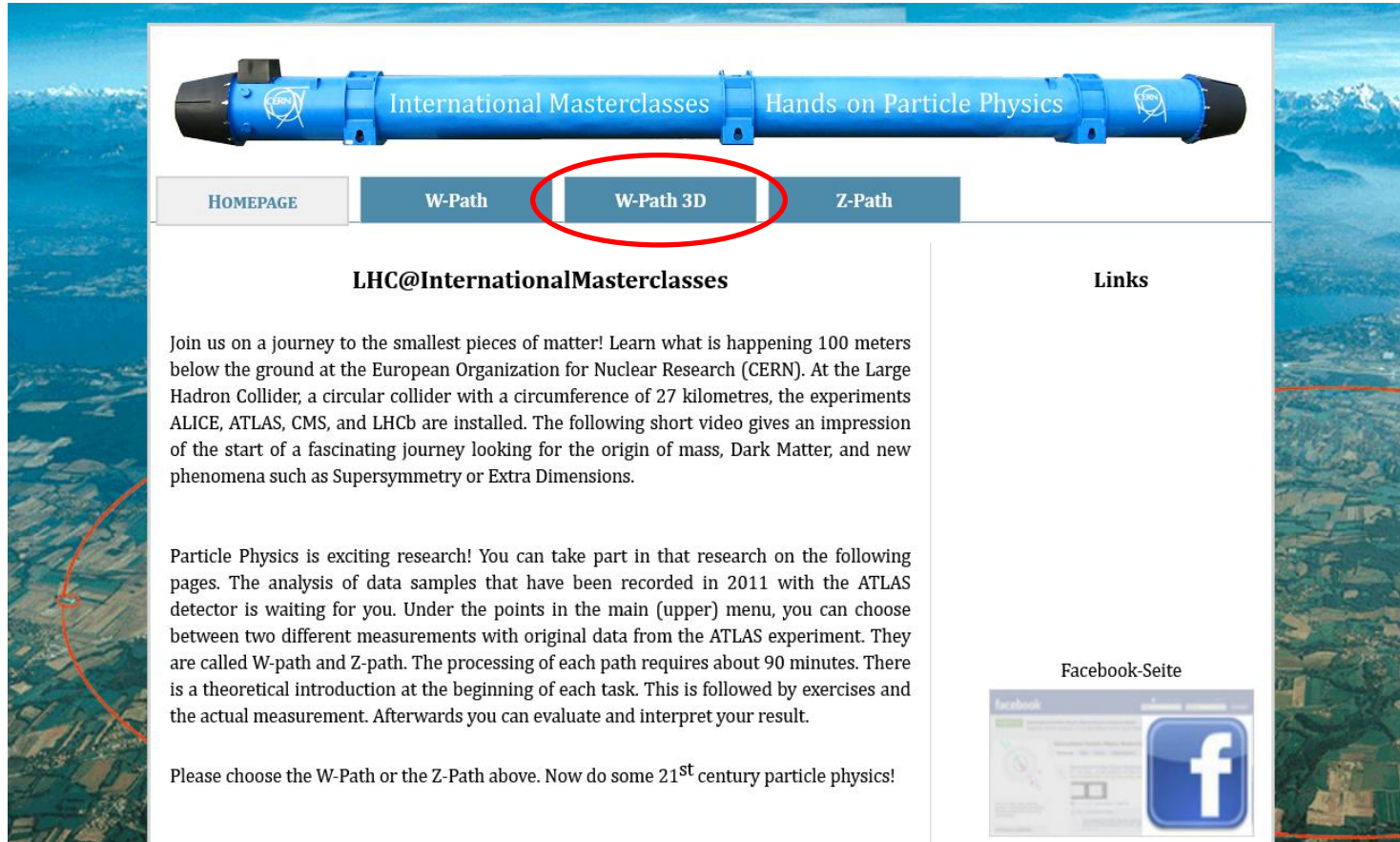


SHARMAZANASHVILI Alexander
Georgian Technical University

- Tracer EVD-MC is the browser-based 3-Dimensional event display for the ATLAS WW International masterclasses
- The application doesn't require installation and is compatible with most platforms, including portable devices



- Application is available through the official IPPOG Masterclasses website standalone additional tab (Thanks to Uta & Tim)
- The link is <https://ippog-masterclasses-website.web.cern.ch>



International Masterclasses Hands on Particle Physics

HOME PAGE W-Path **W-Path 3D** Z-Path

LHC@InternationalMasterclasses


Join us on a journey to the smallest pieces of matter! Learn what is happening 100 meters below the ground at the European Organization for Nuclear Research (CERN). At the Large Hadron Collider, a circular collider with a circumference of 27 kilometres, the experiments ALICE, ATLAS, CMS, and LHCb are installed. The following short video gives an impression of the start of a fascinating journey looking for the origin of mass, Dark Matter, and new phenomena such as Supersymmetry or Extra Dimensions.

Particle Physics is exciting research! You can take part in that research on the following pages. The analysis of data samples that have been recorded in 2011 with the ATLAS detector is waiting for you. Under the points in the main (upper) menu, you can choose between two different measurements with original data from the ATLAS experiment. They are called W-path and Z-path. The processing of each path requires about 90 minutes. There is a theoretical introduction at the beginning of each task. This is followed by exercises and the actual measurement. Afterwards you can evaluate and interpret your result.


Please choose the W-Path or the Z-Path above. Now do some 21st century particle physics!

Links

Facebook-Seite



- We added Tracer 3D event Display functionalities and Screenshots
- The new ATLAS interactive 3D viewer is also available <https://ippog-masterclasses-website.web.cern.ch>



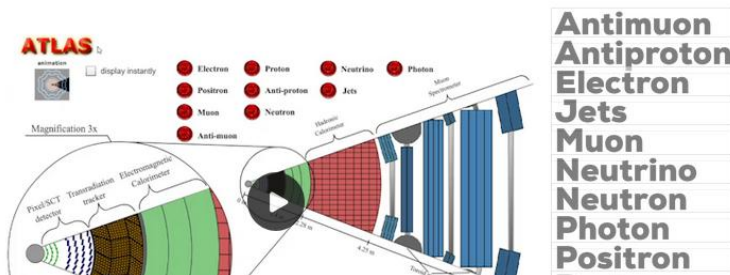
Identifying Particles

Here you can review how the detector is built. You will learn how elementary particles can be identified and how you can recognize them with our program. In a concluding exercise you may test your newly acquired knowledge.

Time for active playing! Discover the signals elementary particles leave in the detector with the help of the interactive animation of ATLAS below. Choose a specific particle from the upper menu and follow its way through the detector. Keep in mind that a dotted line represents the path of a neutral particle, which is not seen by the detector until it showers in a calorimeter, if at all.

The program that we will use is introduced on the [next page](#). It illustrates events of proton-proton collisions in cross-sectional view similar to the picture you see at the bottom of the page.

If you do not yet understand the structure of the ATLAS detector, you can find more information under the menu item [ATLAS detector](#).



Antimuon	Electron	Proton	Neutrino	Photon
Antiproton	Positron	Anti-proton	Jets	
Electron	Muon	Neutron		
Antimuon				

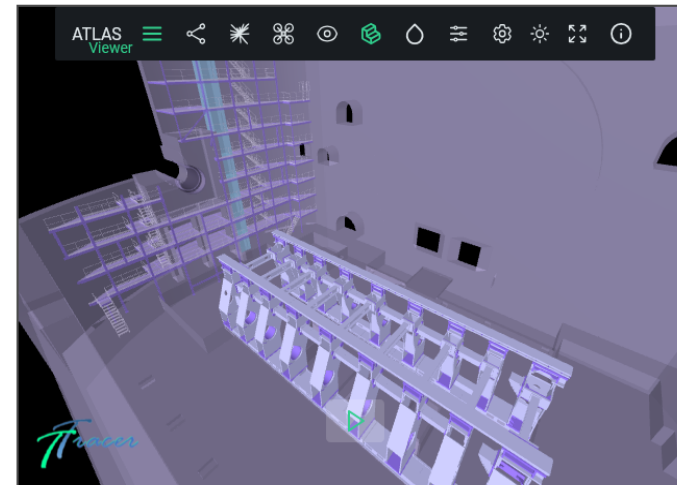
W-path 3D

- Aims/Tasks
- Identifying Particles
- ATLAS Detector**
- The Event Display Tracer
- Identifying Particles
- Exercise 1
- Identifying Events
- Measurement
- Analysis

Here, you'll learn about the structure of the ATLAS detector and how particles interact with the detector material. You can learn using videos, texts, and interactive resources, including the ATLAS Viewer tool developed by Tracer.

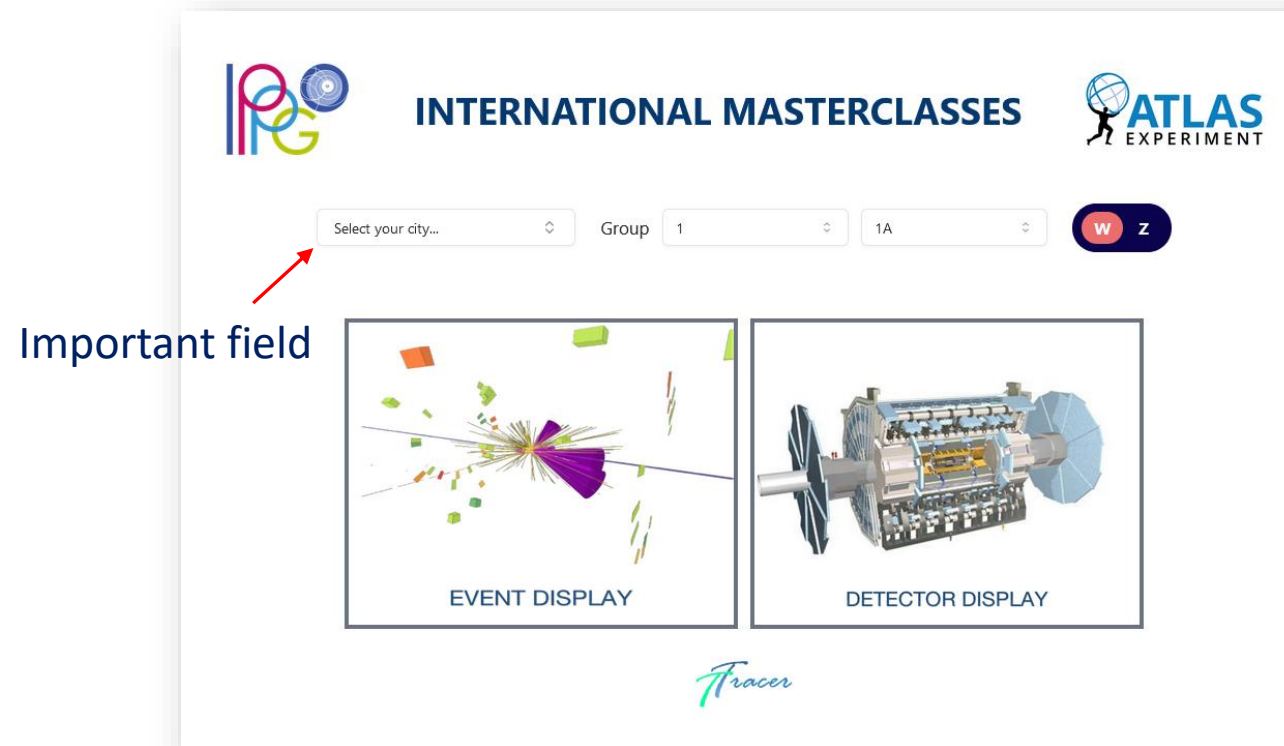
Products of proton-proton collisions are detected by the ATLAS detector (ATLAS stands for A Toroidal LHC Apparatus). In the middle of ATLAS, two particle bunches (each with 100 billion protons) collide with each other after they have been accelerated in opposite directions in the LHC. It is therefore not possible to predict which parts of one proton will collide with which parts of another one nor can we tell which protons collide at all. When protons collide they may simply scatter off each other but stay whole or they will interact more violently and disintegrate. In the latter case, new particles are formed. From the data, physicists are able to say which physical processes may have taken place during the collisions. To do this, they need a good understanding of the detector and its function. So let's take a look at these points, below.

ATLAS Detector Viewer by Tracer

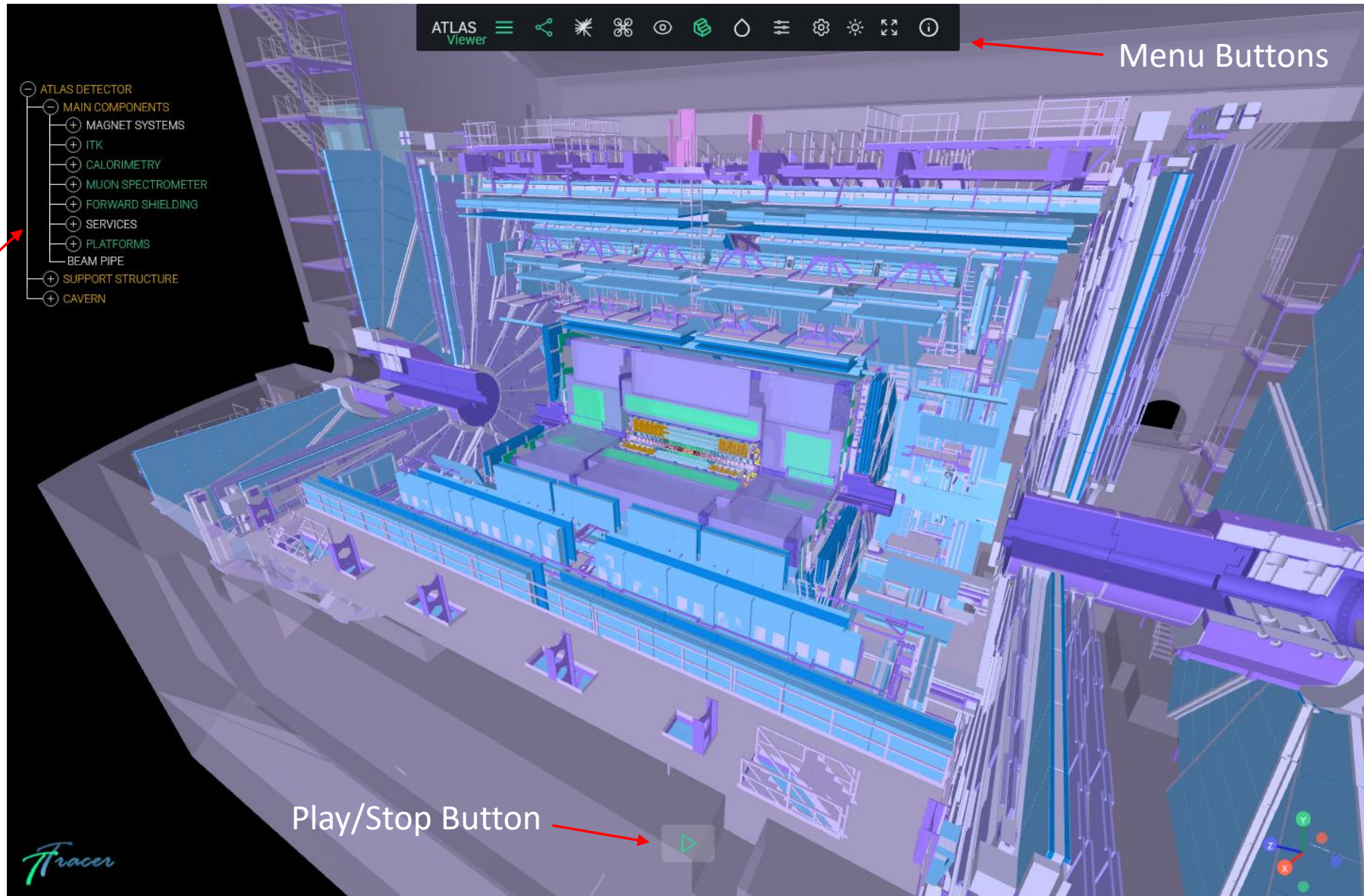


Aims/Tasks
Identifying Particles
ATLAS Detector
The Event Display Tracer
Identifying Particles
Exercise 1
Identifying Events
Measurement
Analysis

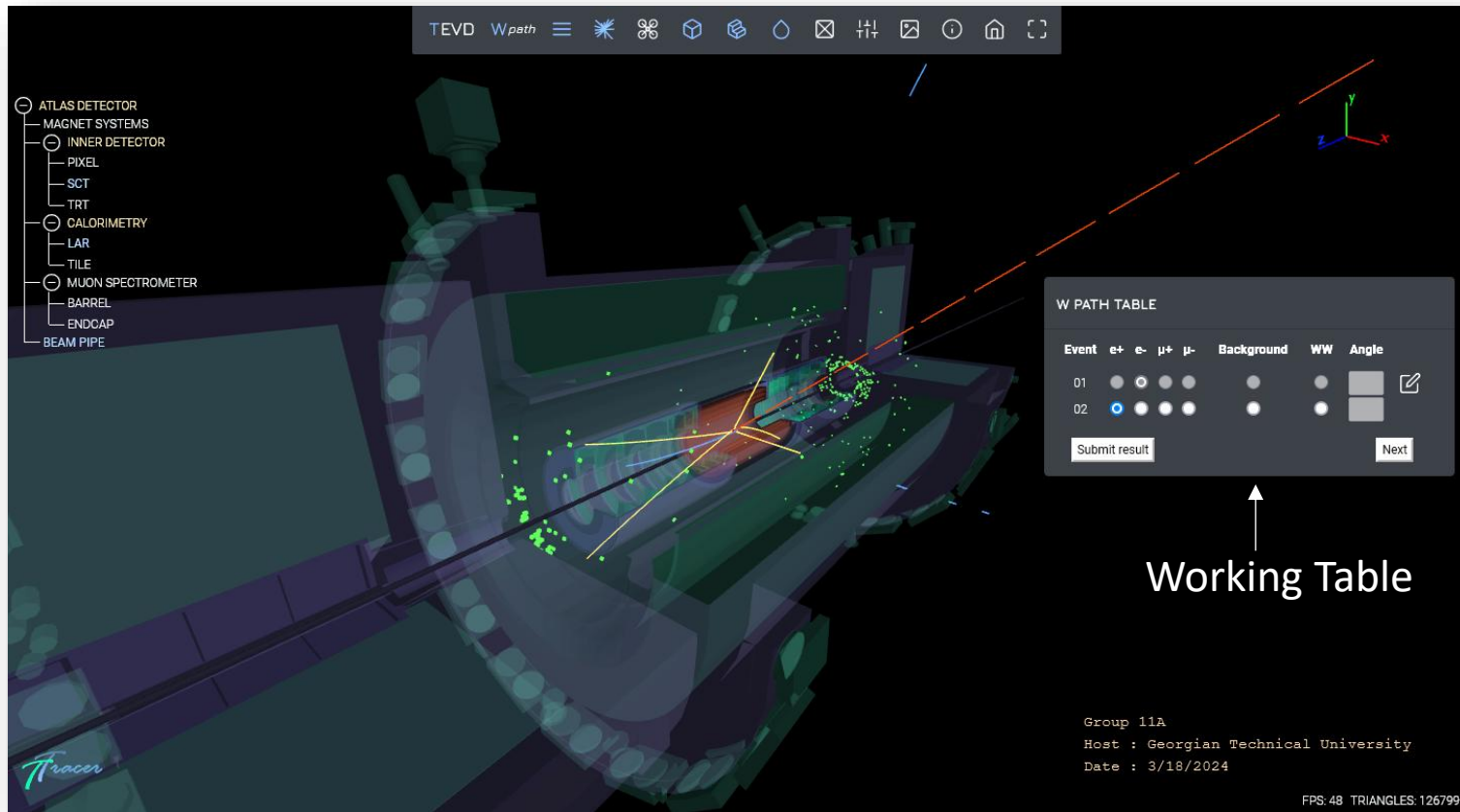
- On the Masterclass session **Tracer-EVD**, the event display application should run by the link <https://tracer-mc.web.cern.ch/>
- After filling out all-important fields students can go to ATLAS viewer to learn the detector hardware or call the 3D event display to start analysing the events



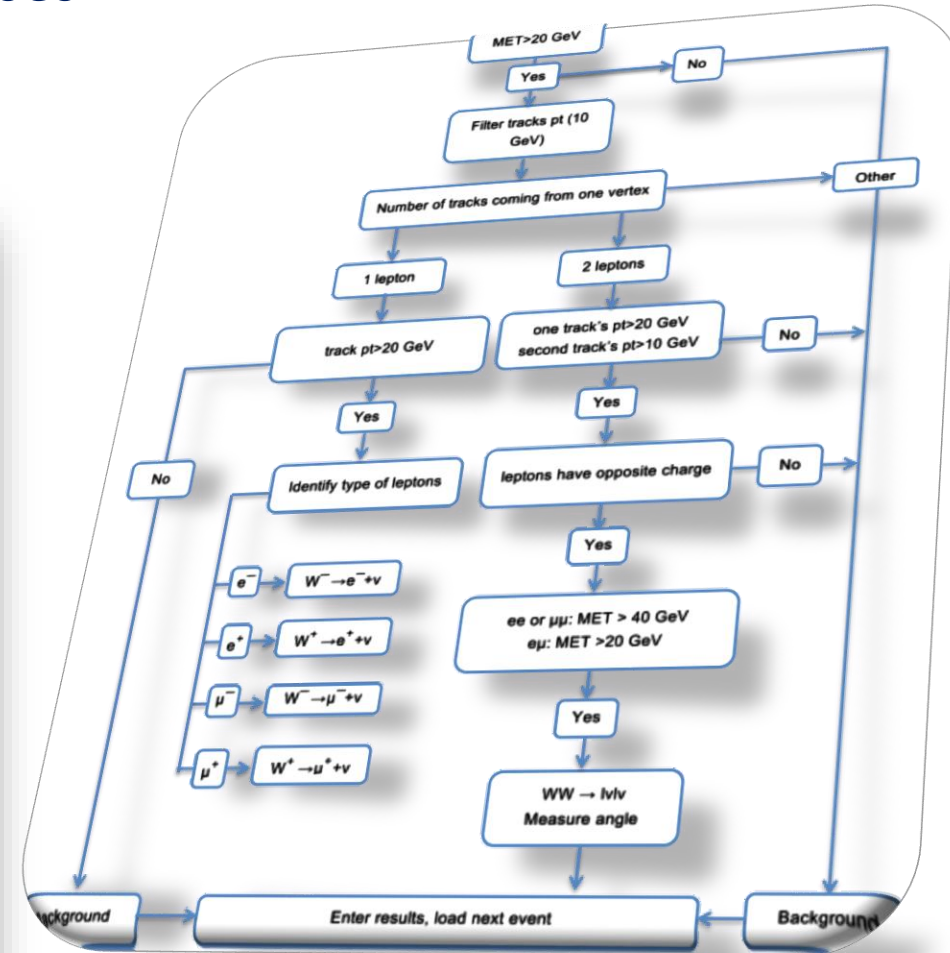
Geometry Tree



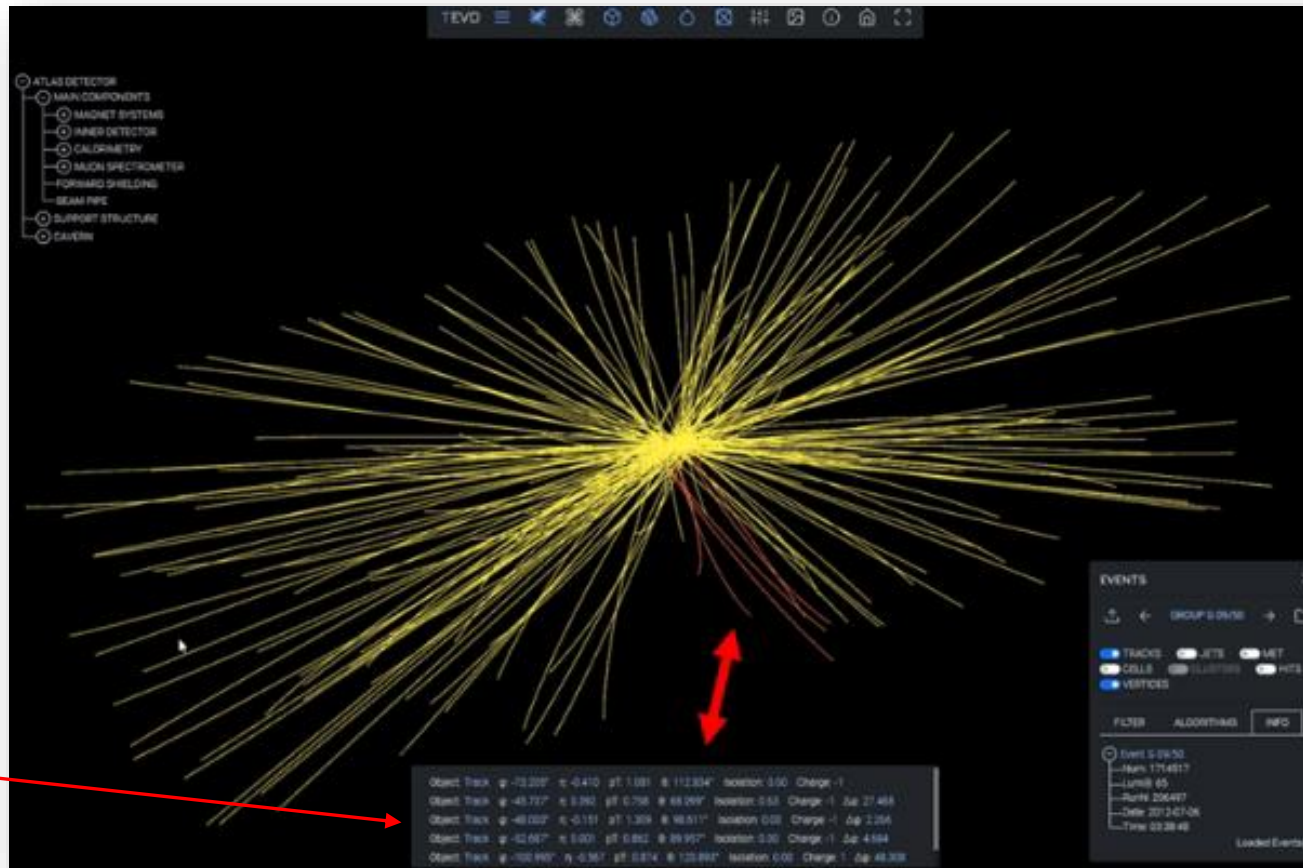
- Students follow the standard algorithm for event analyses and fill strings in the Working table



Working Table

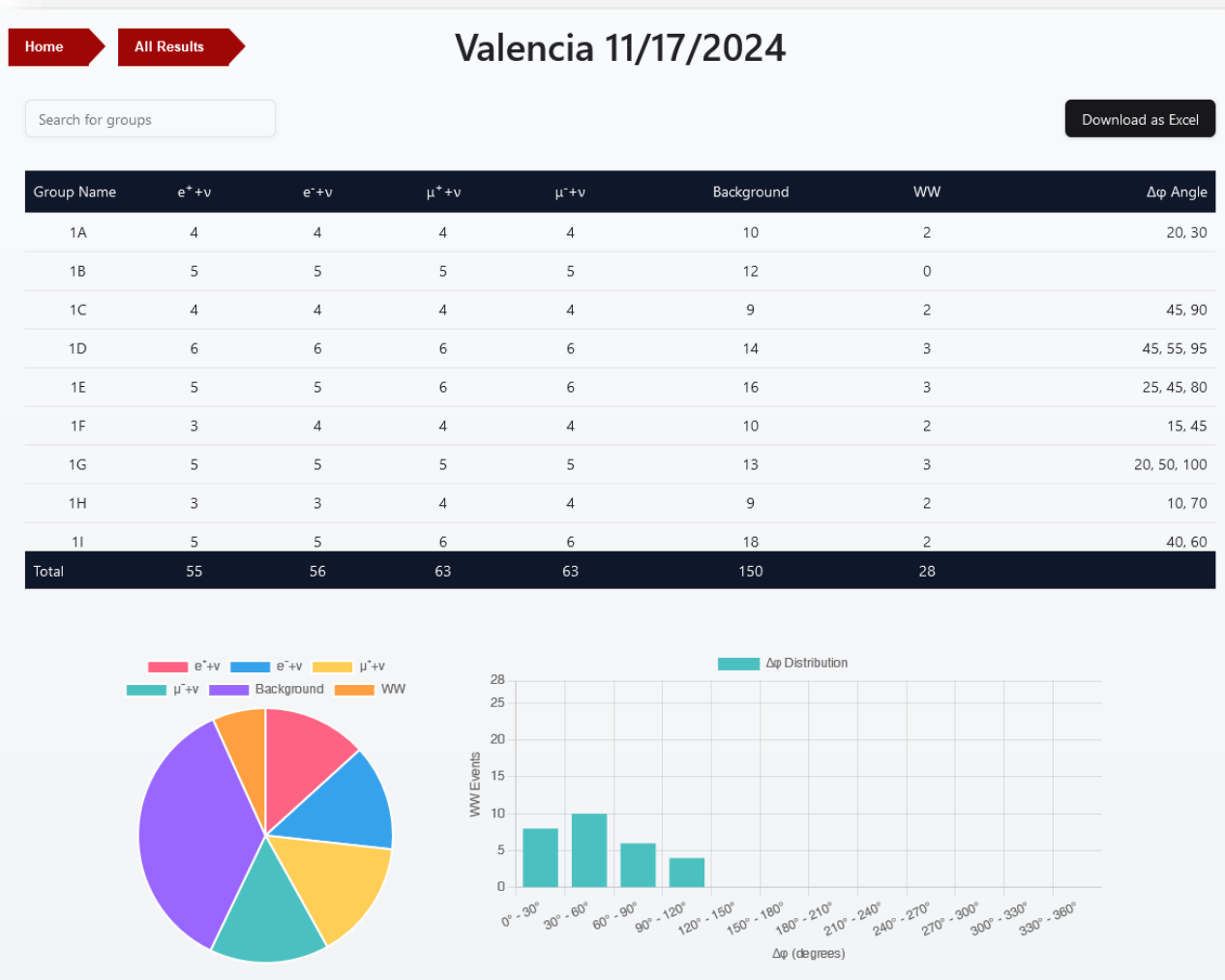


- Tracks-Jets-MET are selectable
- Detailed parameters are available in the status bar
- Cuts and event-sensitive parameters are available in the Events window



Status Bar

Events Window



International Masterclasses

Total #	W → ... + v				Background	WW
914	e ⁺	e ⁻	μ ⁺	μ ⁻		
group A	8	2	6	5	29	0
group B	4	2	5	3	36	0
group C	9	12	0	0	28	6
group D	12	6	2	0	29	1
group E	8	6	2	0	30	4
group F	6	2	5	5	29	3
group G	10	6	5	4	24	1
group H	3	0	7	6	28	6
group I	2	2	1	3	2	0
group J	5	6	4	3	32	0
group K	4	6	7	3	30	0
group L	6	5	8	1	29	1
group M	8	4	5	7	26	0
group N	6	6	6	3	28	1
group O	3	2	3	4	34	4
group P	6	3	6	6	28	1
group Q	5	1	6	5	31	2
group R	5	4	3	3	31	3
group S	9	3	7	2	27	2
group T						
Total	119	78	88	63	531	35
Σ W ⁺ , Σ W ⁻	W ⁺	207	W ⁻	141	W ⁺ + W ⁻	348
Ratio	W ⁺ / W ⁻		1.47		±	0.16

- **Tracer Implementation in the Masterclasses**

- Georgian Technical University, 1st of March 2024

IPPOG International Masterclasses
Organized by International Particle Physics Outreach Group

CERN

Participant Universities:
AGH UST Krakow Poland
UAM/CSIC Madrid Spain
GTU Tbilisi Georgia

Organized by:
MINISTRY OF EDUCATION,
SCIENCE AND YOUTH OF GEORGIA
Georgian Technical University
Faculty of Informatics and
Control Systems
Nuclear Engineering Center

Friday 1 March 2024

TimeTable

10:30-11:00	Registration	
11:00-12:00	Open Ceremony	
12:00-12:50	<u>Lecture 1:</u>	About the CERN and IPPOG Prof Alexander Sharmazanashvili Georgia
13:00-14:00	<u>Lecture 2:</u>	High Energy Physics and LHC experiments Prof Hans-Peter Beck Switzerland
14:15-15:00	<u>Lecture 3:</u>	Detector Technologies Prof Alexander Sharmazanashvili Georgia
15:00-16:00	Lunch	
16:00-16:55	<u>Lecture 4:</u>	Tracer Application Dr Niko Tsutskiridze Georgia
17:00-17:55	<u>Practical Session</u>	IPPOG Exercises M.Nozadze, S. Vashakidze, V. Dolinski, A. Alikhanov
18:00-18:30	<u>Practical Session</u>	Quiz
18:30-19:00	<u>Practical Session</u>	Webinar training Salome Vashakidze
19:00-20:00	CERN Videoconference	Dr Tadej Novak CERN Switzerland
20:00	Award of the Certificates	

Address:
77, Kostava Street
Georgian Technical University
Conference hall
IX Building 4th floor

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Partner Universities:



Krakov University AGH UST, Poland

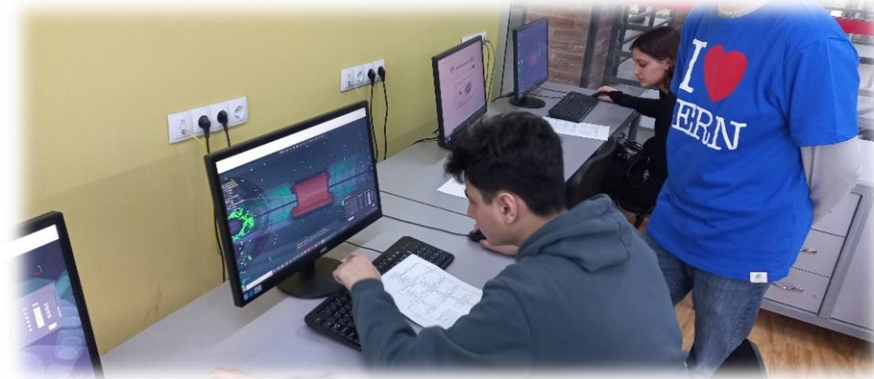
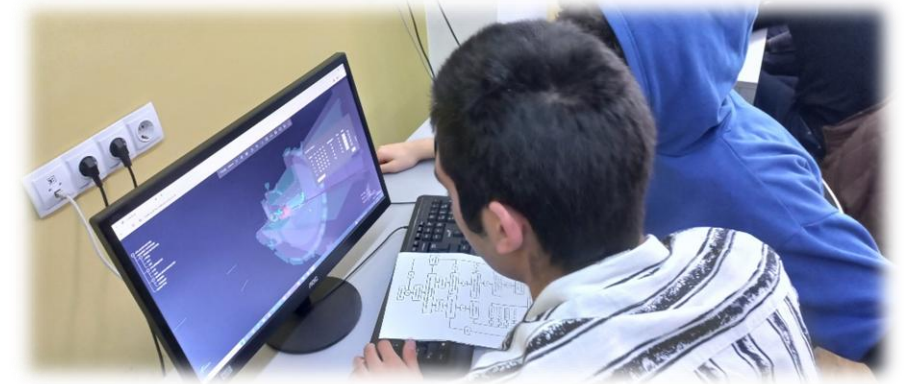


Madrid University UAM/CSIC, Spain

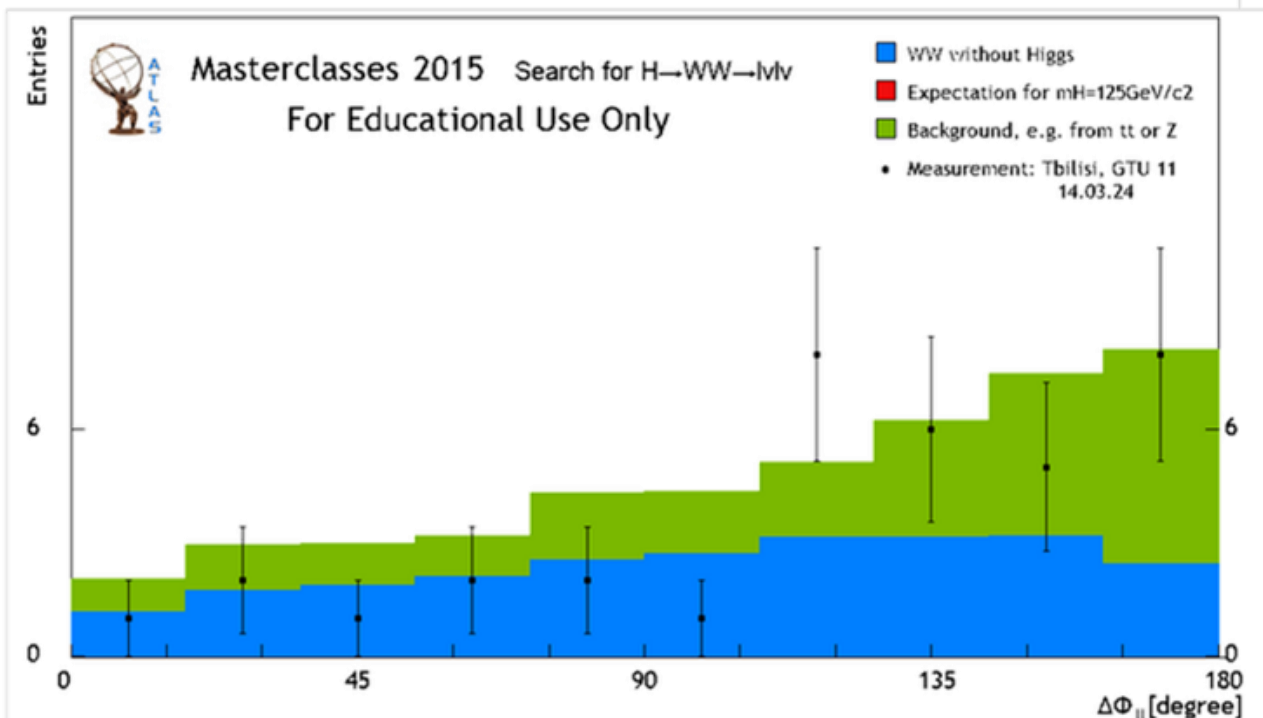
Participants: 36 students from 24 schools of Tbilisi region



- Done on the 30 Workstations



WW-Histogramme



Masterclass activities:



Krakow - 1'109 events



Madrid - 2'208 events



Tbilisi - 914 events

	bin 1	bin 2	bin 3	bin 4	bin 5	bin 6	bin 7	bin 8	bin 9	bin 10	SUM
N	1	2	1	2	2	1	8	6	5	8	36
B	2	2.9	3	3.2	4.3	4.3	5.1	6.3	7.5	8.1	46.7
S	-1	-0.9	-2	-1.2	-2.3	-3.3	2.9	-0.3	-2.5	-0.1	-10.7
Z	-0.7	-0.6	-1.1	-0.7	-1.1	-1.6	1.3	-0.1	-0.9	-0	-1.6

- Kutaisi International University, 6th of March 2024

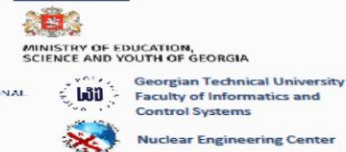


Participant Universities:



Wednesday 6 March 2024

Organized by:



TimeTable

10:30-11:00	Registration	
11:00-12:00	Open Ceremony	
12:00-12:50	<u>Lecture 1:</u>	About the CERN and IPPOG Prof Alexander Sharmazanashvili Georgia
13:00-14:00	<u>Lecture 2:</u>	High Energy Physics and LHC experiments Prof Dario Barberis Switzerland
14:15-15:00	<u>Lecture 3:</u>	Detector Technologies Prof Alexander Sharmazanashvili Georgia
15:00-16:00	Lunch	
16:00-16:55	<u>Lecture 4:</u>	Tracer Application MSc Nino Zurashvili Georgia
17:00-17:55	<u>Practical Session</u>	IPPOG Exercises G. Mirziashvili, N.Zurashvili, B.Kekelia, N.Tsutskiridze
18:00-18:30	<u>Practical Session</u>	Quiz
18:30-19:00	<u>Practical Session</u>	Webinar training MSc Nino Zurashvili Georgia
19:00-20:00	CERN Videoconference	Dr Tadej Novak CERN Switzerland
20:00	Award of the Certificates	

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Kutaisi International University

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Partner Universities:



Brookhaven National Laboratory, USA

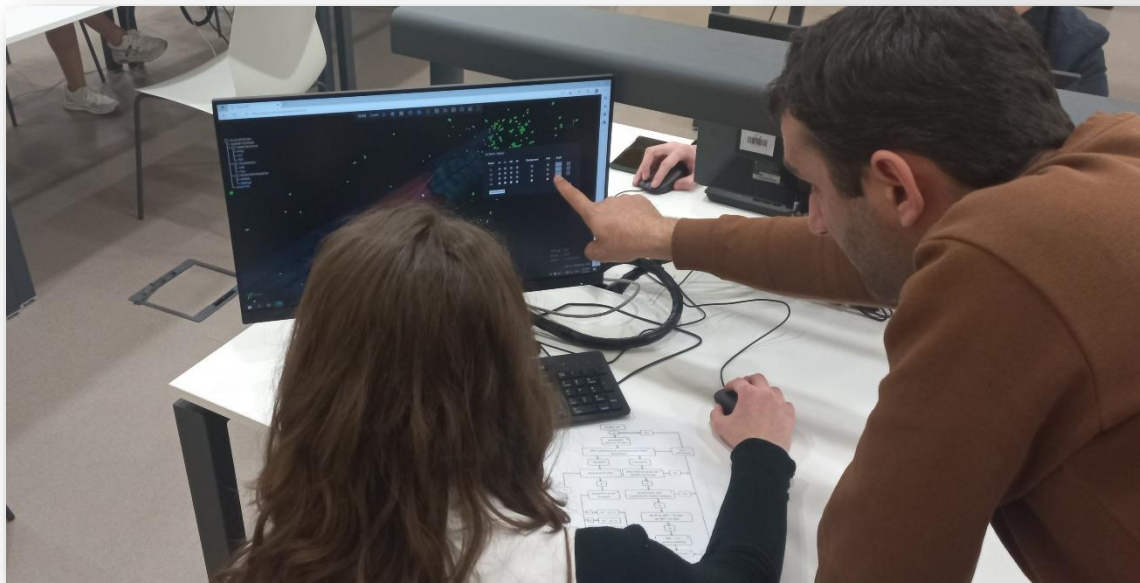
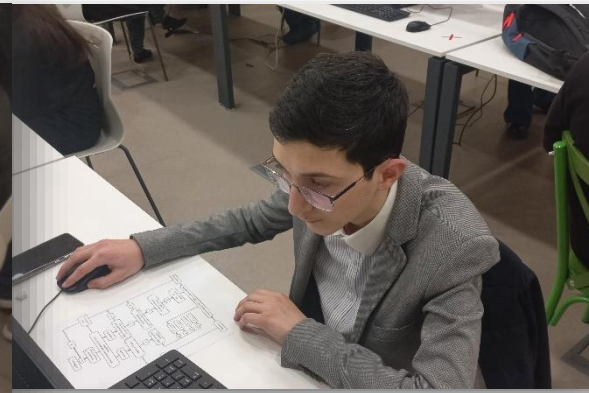
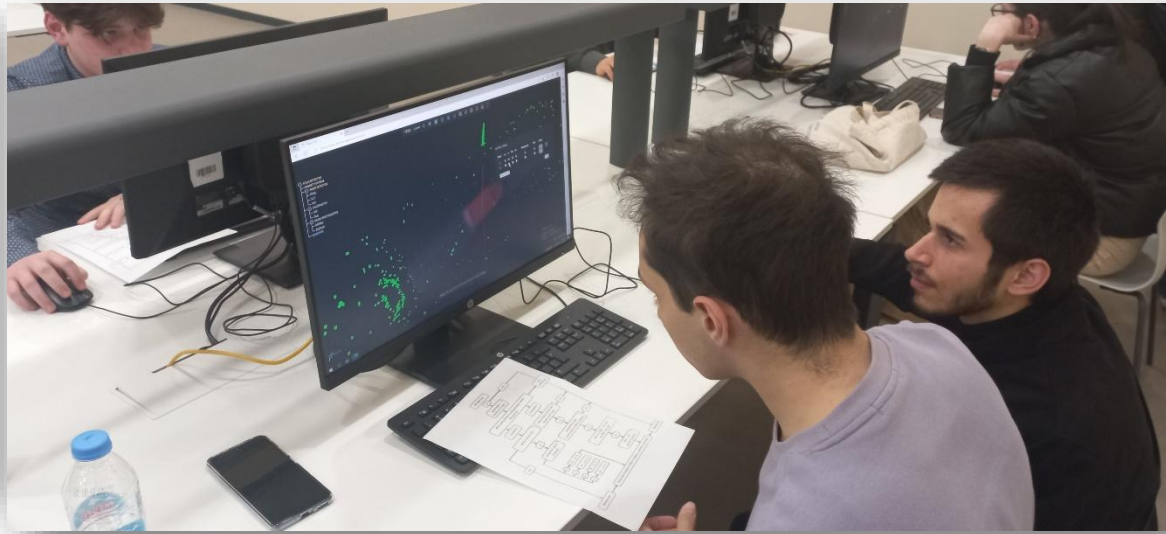


University of Valencia, Spain



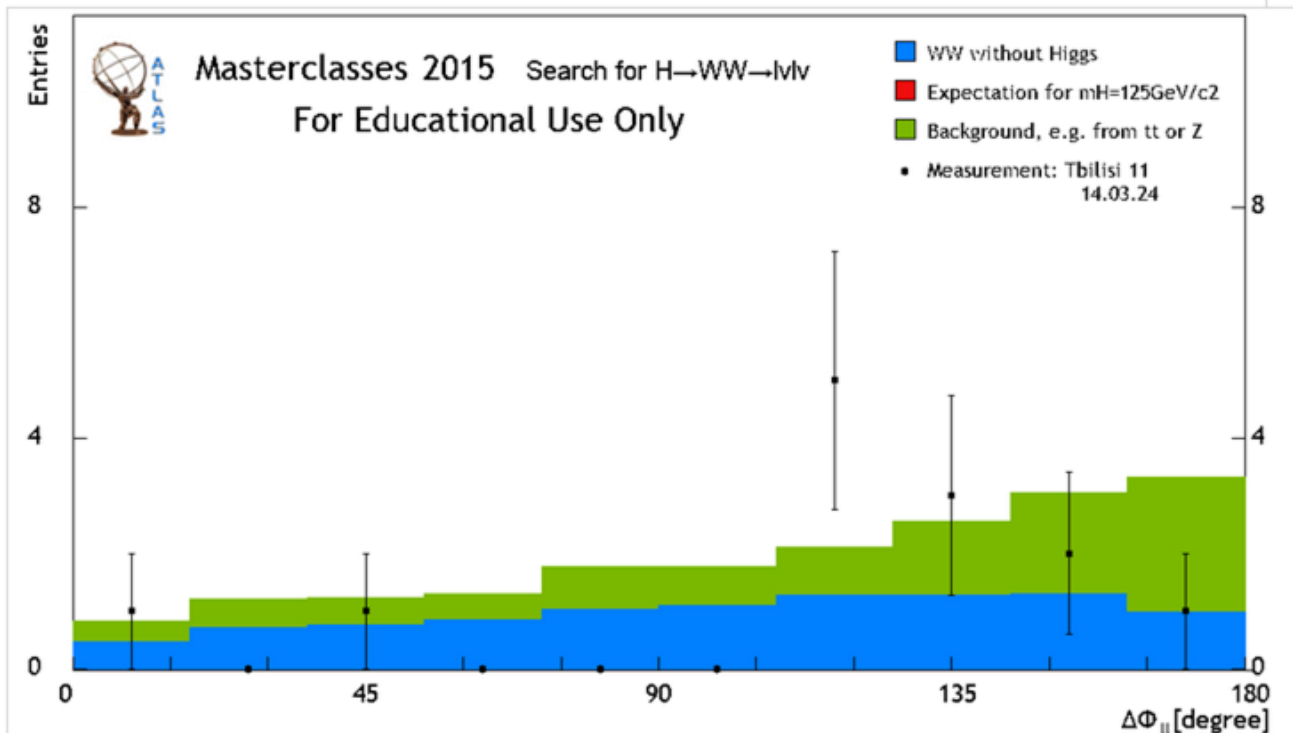
Yerevan National Laboratory, Armenia

Participants: 29 students from 11 Schools of the Kutaisi region, West Georgia







- Done on the 45 Workstations

WW-Histogramme



Masterclass Activity:

-  Brookhaven - 346 events
-  Valencia - 1'920 events
-  Yerevan - 0 events
-  Kutaisi - 876 events

	bin 1	bin 2	bin 3	bin 4	bin 5	bin 6	bin 7	bin 8	bin 9	bin 10	SUM
N	1	0	1	0	0	0	5	3	2	1	13
B	0.8	1.2	1.2	1.3	1.8	1.8	2.1	2.5	3	3.3	19
S	0.2	-1.2	-0.2	-1.3	-1.8	-1.8	2.9	0.5	-1	-2.3	-6
Z	0.2	-1.1	-0.2	-1.1	-1.3	-1.3	2	0.3	-0.6	-1.3	-1.4

- Telavi State University, 18th of March 2024

International Masterclasses
Organized by International Particle Physics Outreach Group

Participant Universities:

- University of Roma, Rome Italy
- TU Dresden, Dresden Germany
- University of Bonn, Bonn Germany
- Telavi State University, Telavi Georgia

Organized by:

- MINISTRY OF EDUCATION, SCIENCE AND YOUTH OF GEORGIA
- Telavi State University
- Georgian Technical University Faculty of Informatics and Control Systems
- Nuclear Engineering Center

Monday 18 March 2024



TimeTable

10:30-11:00	Registration
11:00-12:00	Open Ceremony
12:00-12:50	Lecture 1: About the CERN and IPPOG Prof Alexander Sharmazanashvili Georgia
13:00-14:00	Lecture 2: High Energy Physics and LHC experiments Prof Hans-Peter Beck Switzerland
14:15-15:00	Lecture 3: Detector Technologies Prof Alexander Sharmazanashvili Georgia
15:00-16:00	Lunch
16:00-16:55	Lecture 4: Tracer Application Dr Niko Tsutskiridze Georgia
17:00-17:55	Practical Session: IPPOG Exercises M.No zadze, S. Vashakidze, V. Dolinski, A. Alikhanov
18:00-18:30	Practical Session: Quiz
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19:00-20:00	CERN Videoconference Dr Tadej Novak CERN Switzerland
20:00	Award of the Certificates

Address:
#1 Kartuli Universiteti Str.
2200 Telavi
TeSaU Bld. I

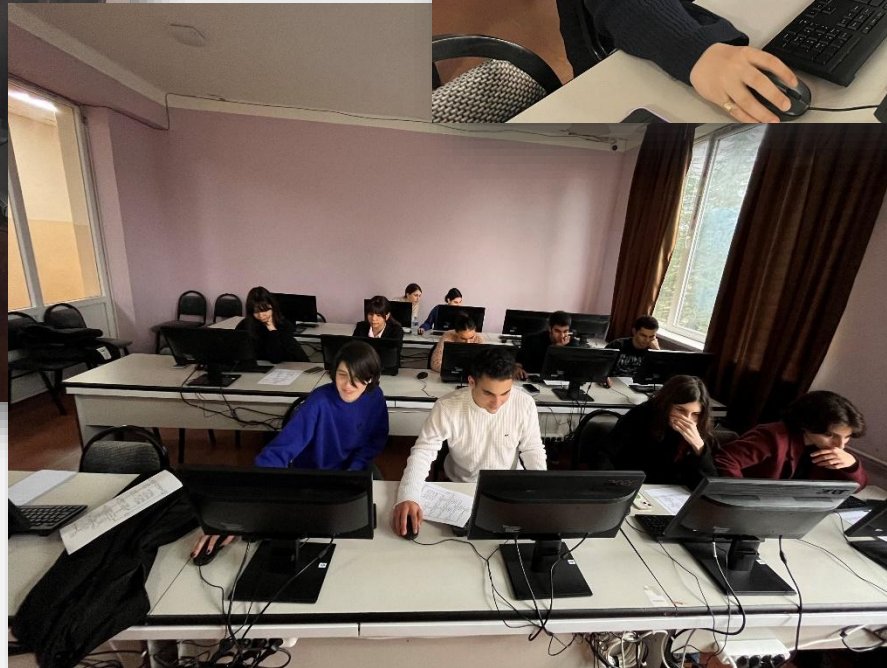
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Partner Universities:

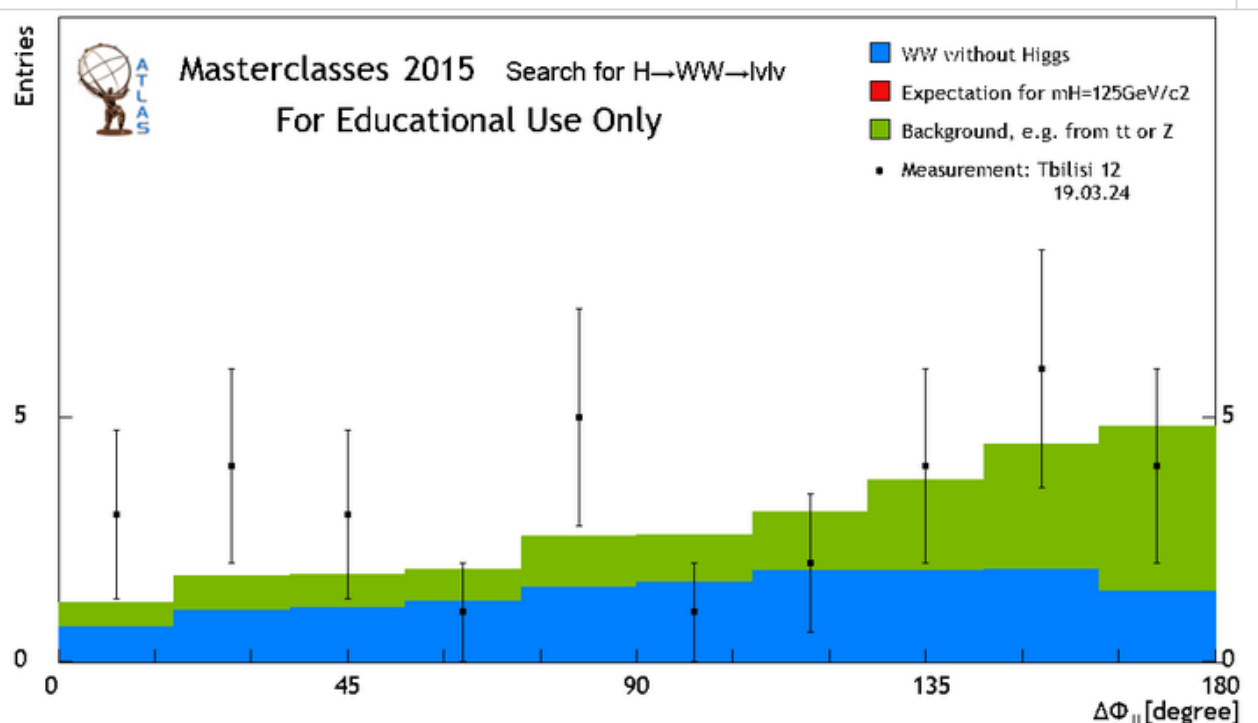
-  Rome University, Italy
-  Technical University of Dresden, Germany
-  Bonn University, Germany

Participants: 40 students from 16 schools of the Telavi region, East of Georgia

- Done on the 40 Workstations



WW-Histogramme



	bin 1	bin 2	bin 3	bin 4	bin 5	bin 6	bin 7	bin 8	bin 9	bin 10	SUM
N	3	4	3	1	5	1	2	4	6	4	33
B	1.2	1.7	1.8	1.9	2.6	2.6	3	3.7	4.4	4.8	27.7
S	1.8	2.3	1.2	-0.9	2.4	-1.6	-1	0.3	1.6	-0.8	5.3
Z	1.6	1.7	0.9	-0.6	1.5	-1	-0.6	0.2	0.7	-0.4	1

Masterclass Activity:

-  Rome - 1'421 events
-  Dresden - 716 events
-  Bonn - 131 events
-  Telavi - 1'956 events

- What we learned from Masterclasses

II. Hardware issue

- Host university accommodate masterclass sessions in the library computers.
- Those computers were moderate with CPU/GPU parameters but were weak with amount of the RAM, about 2Mb
- As a result, Tracer was halted after the analyses about 22 events, and students were restarting the session from the beginning
- Slightly numbers were improving after the hidden geometries in the scenes

III. Manual work at the end

- Final results should be filled in the Physics analyses manually from the tables generated by the Tracer.

Important Advantages of the Tracer

1. Events analyses are easy and fast. About 20 minutes are needed to proceed with all 50 events in the group. Therefore, in the future, with Tracer it is possible to proceed with more events in the masterclass sessions
2. With 3D scenes events are more visible and understandable for the students
3. Realistic representation of the detector components increases the cognitive ability of the application and makes it more enjoyable for the students
4. Compatibility with the majority of the platforms makes Tracer as a universal event display tool
5. No requirements in installation make Tracer an easy and reliable tool for use
6. Compatibility with portable devices makes it possible to extend the participant list in the classes without the involvement of extra workstations
7. A number of reliable parallel working sessions testified in the masterclasses is 50

Check more Applications here <https://tracer.web.cern.ch>

Comments are welcome
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Thanks!