

# IPPOG Visualization Application

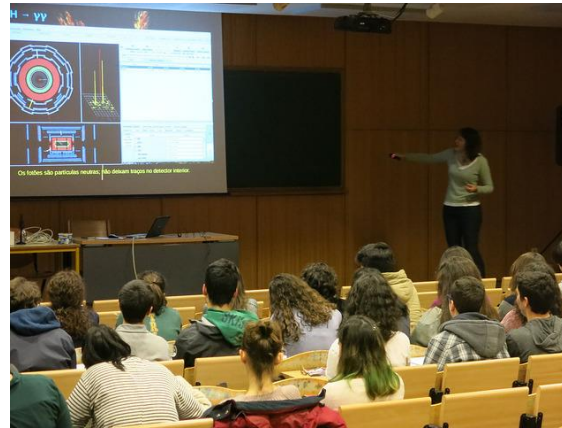
CERN-GTU Agreements, 21 December 2022

ZURASHVILI NINO  
Georgian Technical University

# ATLAS Masterclasses

## Popularization of particle physics

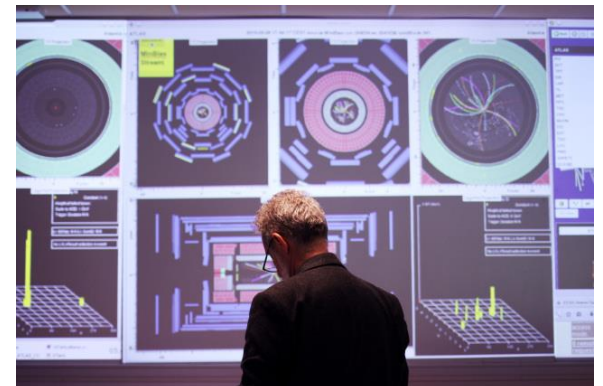
Masterclass involves 60 countries and more than 200 universities or research centers and gives opportunity to youth (aged 15-19) to unravel the mysteries of particle physics.



Lectures from active scientists give insight in topics and methods of basic research at the fundamentals of matter and forces, enabling the students to perform measurements on real data from particle physics experiments themselves.



At the end of each day, like in an international research collaboration, the participants join in a video conference for discussion and combination of their results.



# Important Requirements



## Web-based

Your text has been concise and beautiful,  
but the information is inextricably  
inextricable



## 3-Dimensional visualisation

Your text has been concise and beautiful,  
but the information is inextricably  
inextricable



## High Performance

Your text has been concise and beautiful,  
but the information is inextricably  
inextricable

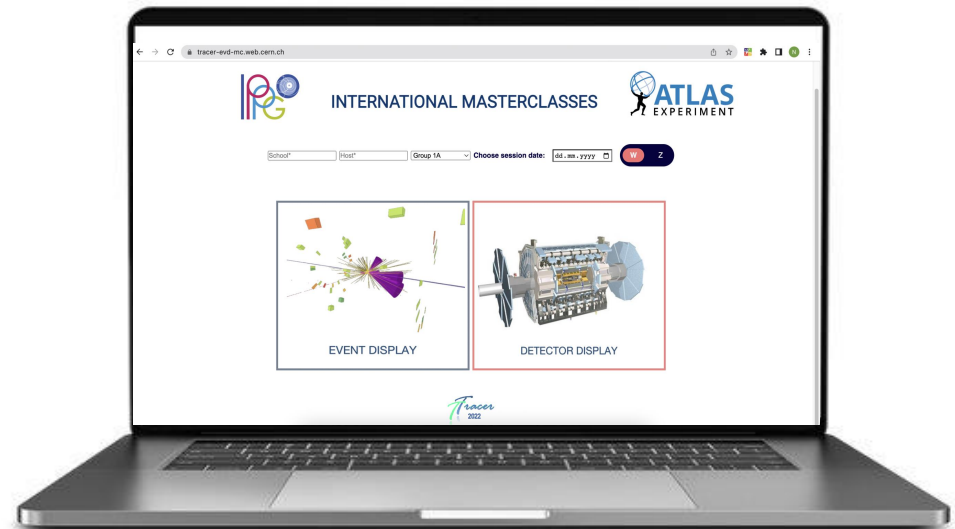


## Intuitive & Simple to use

Your text has been concise and beautiful,  
but the information is inextricably  
inextricable

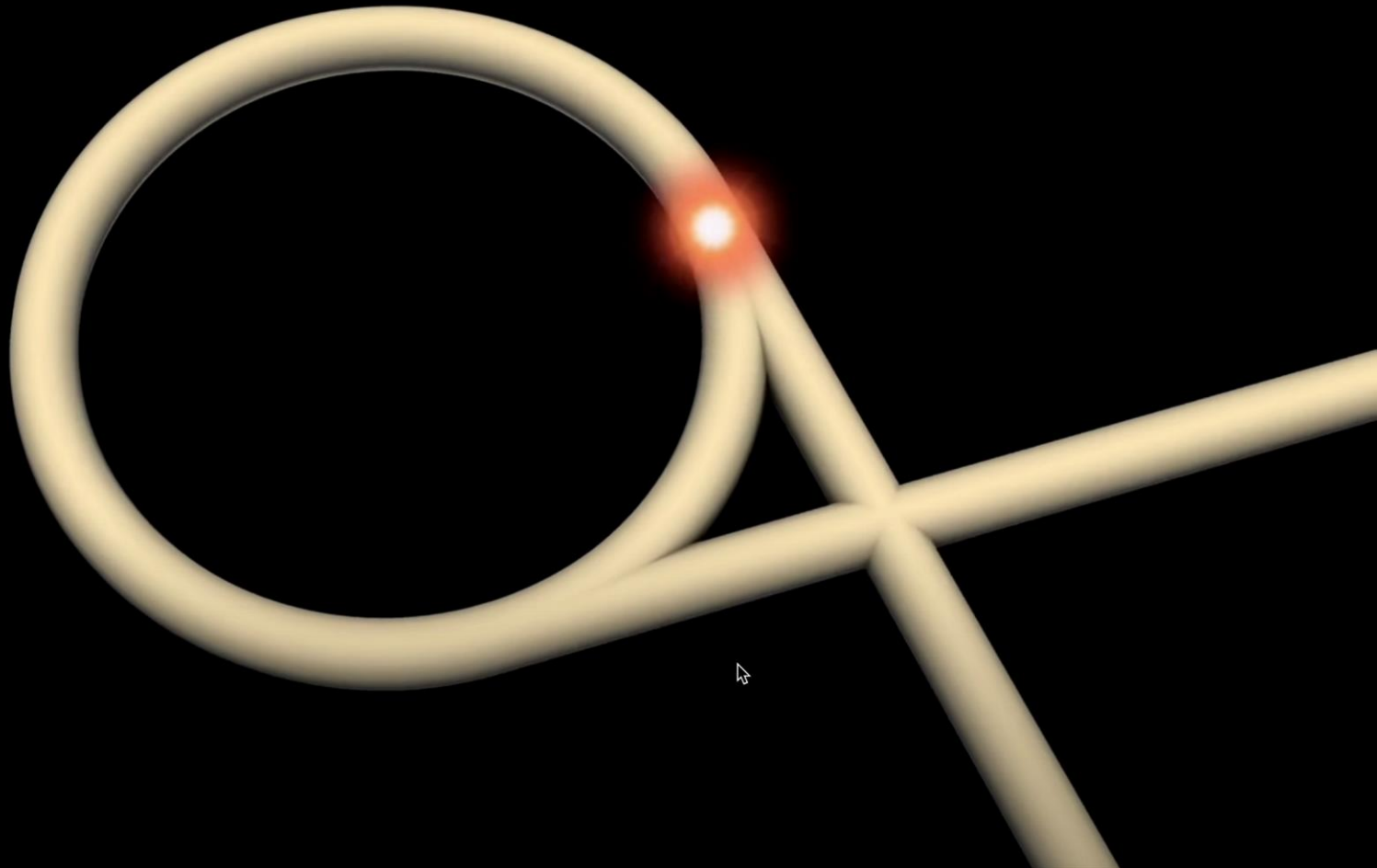


<https://tracer-evd-mc.web.cern.ch>





# Proton Collision Event



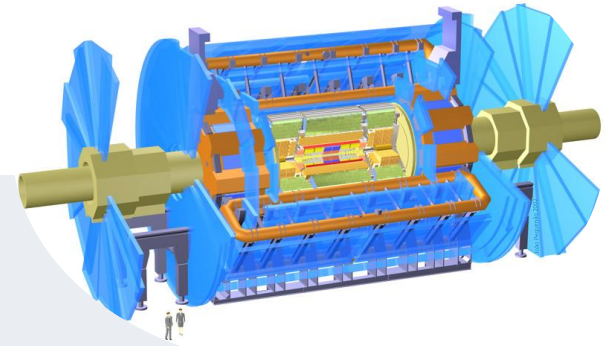
# Tracer EVD for ATLAS Masterclasses



## Event Analysis

Your text has been concise and beautiful,  
but the information is inextricably  
inextricable

Event Display



## Detector Tour

Detector Display can be used in almost any  
topic where visually representing Detector or  
Event is needed, like Outreach, Education and  
Analytics

Detector Display

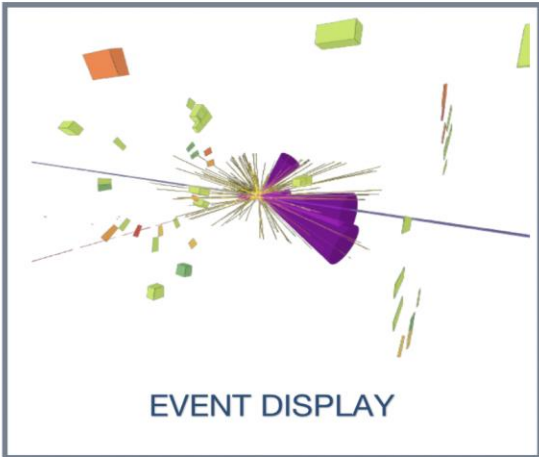
# Tracer EVD for International Masterclasses



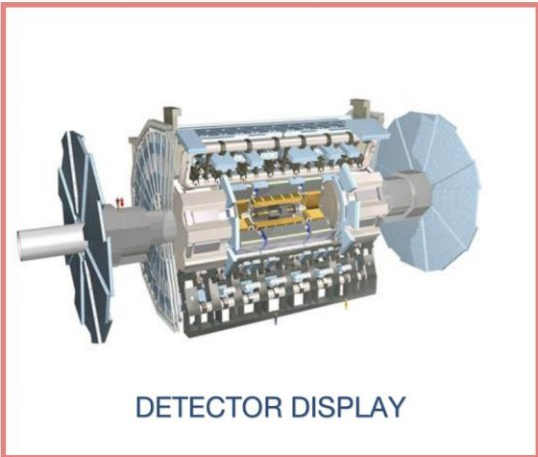
## INTERNATIONAL MASTERCLASSES



School\*  Host\*  Group 1A  Choose session date:



EVENT DISPLAY



DETECTOR DISPLAY

# Event XML list for Student Groups

The screenshot shows the ATLAS International Masterclasses website. At the top, there are logos for 'INTERNATIONAL MASTERCLASSES' and 'ATLAS EXPERIMENT'. Below the logos, there are input fields for 'School\*' and 'Host\*', a 'Choose session date:' field with a date format 'dd.mm.yyyy', and a 'W Z' button. A dropdown menu is open, listing groups from Group 1A to Group 1I, with 'Group 1D' selected. In the background, there is a window titled 'EVENT DISPLAY' showing a particle event visualization. In the foreground, there is a window titled 'Data 2022' showing a table of data samples assigned to various groups. To the right of the table is a 'W-Path' sidebar with a menu containing 'Aims/Tasks', 'Identifying Particles', 'Identifying Events', 'Measurement', 'Data', 'Structure of the Proton', 'Search for the Higgs', and 'Analysis'.

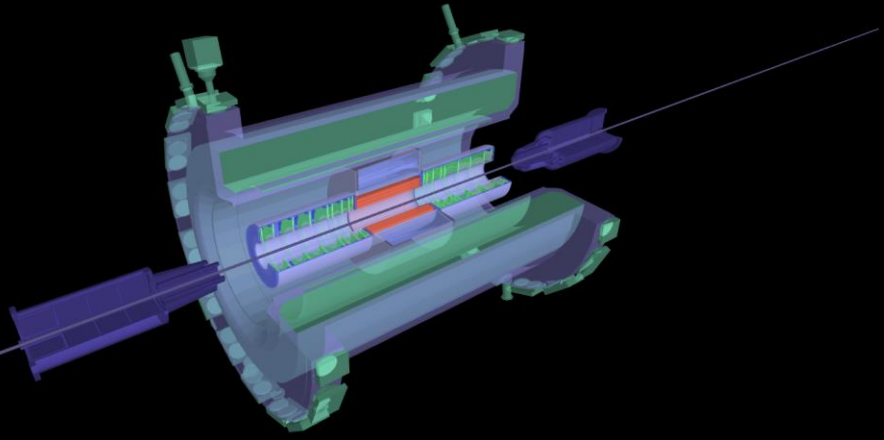
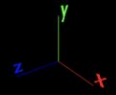
# Data Sample	assigned to	Sub Sample
1 & 2	Cosenza, Alexandria, Sao Tomé and Príncipe, Prague CTU, Bonn	1A 1B 1C 1D 1E 1F 1G 1H 1I 1J
		1K 1L 1M 1N 1O 1P 1Q 1R 1S 1T
		2A 2B 2C 2D 2E 2F 2G 2H 2I 2J
		2K 2L 2M 2N 2O 2P 2Q 2R 2S 2T
		3A 3B 3C 3D 3E 3F 3G 3H 3I 3J
		3K 3L 3M 3N 3O 3P 3Q 3R 3S 3T
3 & 4	Bern, Rome Tre, Dresden, Regensburg	4A 4B 4C 4D 4E 4F 4G 4H 4I 4J
		4K 4L 4M 4N 4O 4P 4Q 4R 4S 4T
		5A 5B 5C 5D 5E 5F 5G 5H 5I 5J



# DETECTOR DISPLAY

- ⊖ ATLAS DETECTOR
  - ⊖ MAIN COMPONENTS
    - + MAGNET SYSTEMS
    - + INNER DETECTOR
    - + CALORIMETRY
    - + MUON SPECTROMETER
    - + FORWARD SHIELDING
  - BEAM PIPE
  - + SUPPORT STRUCTURE
  - + CAVERN

No tools for  
Event analysis



More Detailed  
Geometry tree!



# Drone Animations

tracer-evd-mc.web.cern.ch/dtd/#

TDTD

- ATLAS DETECTOR
  - MAIN COMPONENTS
    - + MAGNET SYSTEMS
    - + INNER DETECTOR
    - + CALORIMETRY
    - + MUON SPECTROMETER
    - + FORWARD SHIELDING
  - BEAM PIPE
  - + SUPPORT STRUCTURE
  - + CAVERN

Group 1F  
Host : GTU  
Date : 20/12/2022

FPS: 60 TRIANGLES: 188063



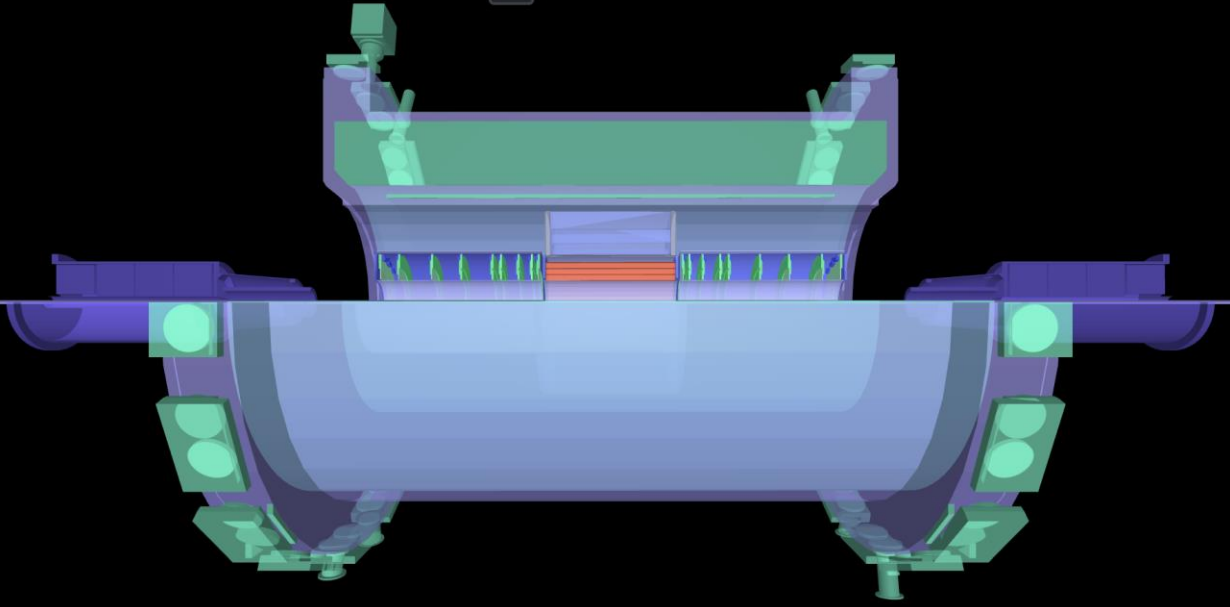
# Camera views

← → ↻ [tracer-evd-mc.web.cern.ch/dtd/#](https://tracer-evd-mc.web.cern.ch/dtd/#) 📄 ☆ 🌐 ⚙️ 📏 📐

TDTD ☰ 📷 📷 📷 ☒ ⏏️ ⓘ 🏠 🗄️

Camera Views

- ATLAS DETECTOR
  - MAIN COMPONENTS
    - + MAGNET SYSTEMS
    - + INNER DETECTOR
    - + CALORIMETRY
    - + MUON SPECTROMETER
    - + FORWARD SHIELDING
  - BEAM PIPE
  - + SUPPORT STRUCTURE
  - + CAVERN



Group 1F  
Host : GTU  
Date : 20/12/2022

FPS: 60 TRIANGLES: 188063

*Tracer*  
2022

# Geometry pre-defined cuts & cuts slider

1  
1

tracer-evd-mc.web.cern.ch/dtd/#

TDTD

Geometry Cuts

- ATLAS DETECTOR
  - MAIN COMPONENTS
    - MAGNET SYSTEMS
    - INNER DETECTOR
    - CALORIMETRY
    - MUON SPECTROMETER
    - FORWARD SHIELDING
  - BEAM PIPE
  - SUPPORT STRUCTURE
  - CAVERN

Group 1F  
Host : GTU  
Date : 20/12/2022

Tracer 2022

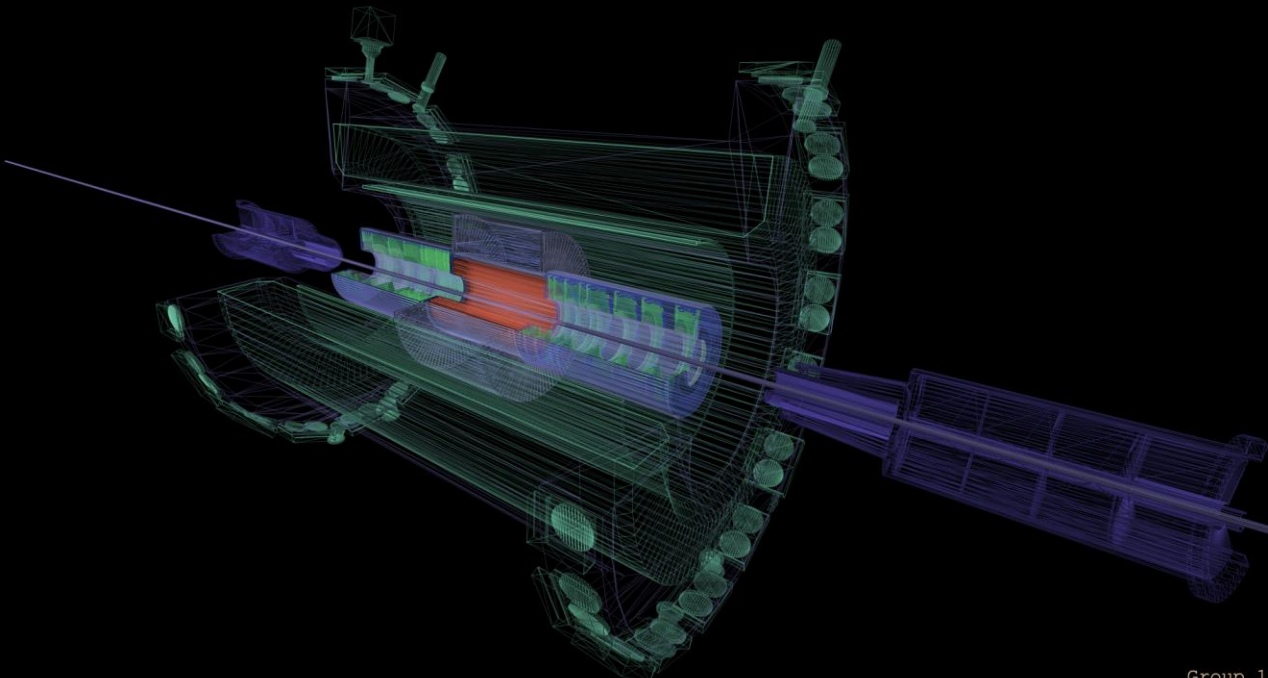
FPS: 61 TRIANGLES: 179054

# Opacity slider & Wireframe

← → ↻ [tracer-evd-mc.web.cern.ch/dtd/#](https://tracer-evd-mc.web.cern.ch/dtd/#) 📄 ☆ 🌐 ⚙️ 🏠 N ⋮


TDTD ☰ 🗨️ 📦 📐 📏 📐 📏 📏 🏠 🗨️

- ⊖ ATLAS DETECTOR
  - ⊖ MAIN COMPONENTS
    - + MAGNET SYSTEMS
    - + INNER DETECTOR
    - + CALORIMETRY
    - + MUON SPECTROMETER
    - + FORWARD SHIELDING
  - BEAM PIPE
  - + SUPPORT STRUCTURE
  - + CAVERN



Group 1F  
Host : GTU  
Date : 20/12/2022

FPS: 61 TRIANGLES: 0



# Settings Tools

13

← → ↻ [tracer-evd-mc.web.cern.ch/dtd/#](https://tracer-evd-mc.web.cern.ch/dtd/#)

TDTD

- ⊖ ATLAS DETECTOR
  - ⊖ MAIN COMPONENTS
    - + MAGNET SYSTEMS
    - + INNER DETECTOR
    - + CALORIMETRY
    - + MUON SPECTROMETER
    - + FORWARD SHIELDING
  - BEAM PIPE
  - + SUPPORT STRUCTURE
  - + CAVERN

**SETTINGS** ×

SCENE —

Camera mode  
Perspective ▾

Brightness: 60%

Contrast: 45%

Object speed: 0.8

ADVANCED —

Ground

Geometry pre-load

USER INTERFACE —

Axis

Stats

Font: 'Roboto'  Font: 'Jura'

Dark mode  Light mode

Group 1F  
Host : GTU  
Date : 20/12/2022

FPS: 61 TRIANGLES: 115773

The screenshot shows the Tracer EVD web application interface. At the top, the browser address bar displays `tracer-evd-mc.web.cern.ch/evd/#`. Below the browser, a toolbar contains various icons for navigation and interaction. On the left, a 'Simplified Geometry tree' lists detector components: ATLAS DETECTOR, MAGNET SYSTEMS, INNER DETECTOR (PIXEL, SCT, TRT), CALORIMETRY (LAR, TILE), MUON SPECTROMETER (BARREL, ENDCAP), and BEAM PIPE. A red arrow points to this tree with the label 'Simplified Geometry tree!'. The central 3D view shows a detector model with a yellow and orange event display. A red arrow points to this display with the label 'Event analysis Tools'. An 'EVENTS' panel is open, showing 'Upload XML' and toggle switches for TRACKS, CELLS, JETS, MET, and VERTICES. Below these are tabs for FILTER, ALGORITHMS, and INFO. The INFO tab is active, displaying event details: Event 1F 01/50, Num: 29589421, LumiB: 229, RunN: 189598, Date: 2011-09-21, Time: 13:07:43, and 'Loaded Events(1)'. A red arrow points to this panel. To the right, a 'W PATH TABLE' panel is visible, containing a table with columns: Event, e+, e-, M+, M-, Background, WW, and Angle. The table has one row with values: 01, and several colored circles. Below the table are 'Submit result' and 'Next' buttons. A red arrow points to this table with the label 'Analysis results table for students'. The bottom left corner features the 'Tracer 2022' logo. The bottom right corner displays system information: 'Group 1F', 'Host : GTU', 'Date : 20/12/2022', and 'FPS: 61 TRIANGLES: 121747'.

Simplified Geometry tree!

Event analysis Tools

Analysis results table for students



# Event Filtering

The screenshot shows the Tracer EVD web interface. On the left is a tree view of the ATLAS detector components: ATLAS DETECTOR, MAGNET SYSTEMS, INNER DETECTOR (PIXEL, SCT, TRT), CALORIMETRY (LAR, TILE), MUON SPECTROMETER (BARREL, ENDCAP), and BEAM PIPE. The main area displays a 3D visualization of the detector with particle tracks. A red arrow points to a track with the text "Filtering with energy and angles." The interface includes several panels: "EVENTS" with an "Upload XML" button and toggle switches for TRACKS, CELLS, JETS, MET, and VERTICES; a "FILTER" panel with tabs for FILTER, ALGORITHMS, and INFO, and a table for "Track values" with fields for  $\phi$ ,  $\eta$ , Pt (set to 10), and  $\theta$ ; and a "W PATH TABLE" panel with a table of event data and "Submit result" and "Next" buttons.

Event	e+	e-	M+	M-	Background	WW	Angle
01	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="text"/>

Track values	
$\phi$	
$\eta$	
Pt	10
$\theta$	





# Selecting Event Objects

The screenshot displays the Tracer EVD web interface. On the left, a tree view lists detector components: ATLAS DETECTOR, MAGNET SYSTEMS, INNER DETECTOR (PIXEL, SCT, TRT), CALORIMETRY (LAR, TILE), MUON SPECTROMETER (BARREL, ENDCAP), and BEAM PIPE. The main 3D view shows a detector cross-section with tracks. A red arrow points to a track with the text "Select tracks by clicking".

The "EVENTS" panel includes an "Upload XML" button, toggle switches for TRACKS, CELLS, JETS, VERTICES, and MET, and tabs for FILTER, ALGORITHMS, and INFO. The "Track values" table is shown below:

Track values	
$\phi$	
$\eta$	
Pt	10
$\theta$	




Legend:  Muons,  Electrons

The "W PATH TABLE" panel shows a table with columns: Event, e+, e-, M+, M-, Background, WW, and Angle. The first row contains the value "01" and a series of colored circles. Below the table are "Submit result" and "Next" buttons.

At the bottom center, a tooltip displays track information: "Object: Track  $\phi: 160.135^\circ$   $\eta: 1.014$  pT: 27.459  $\theta: 39.880^\circ$  Charge: -1".

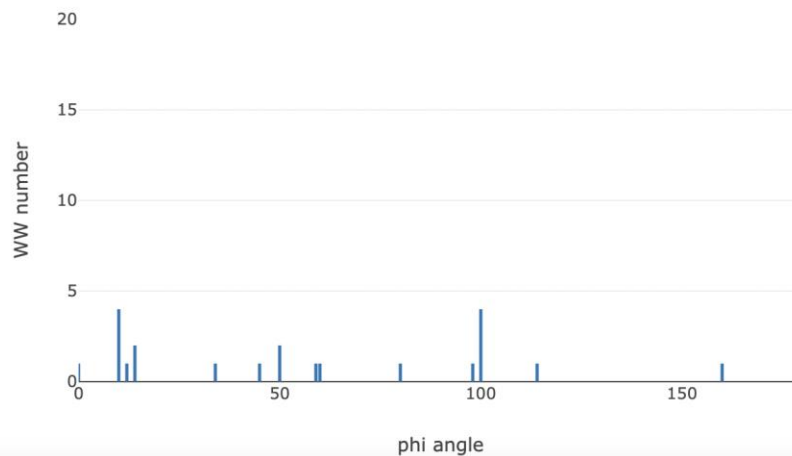
Bottom right corner: Group 1F, Host : GTU, Date : 20/12/2022, FPS: 61 TRIANGLES: 121747

# Finishing analysis & Results Table

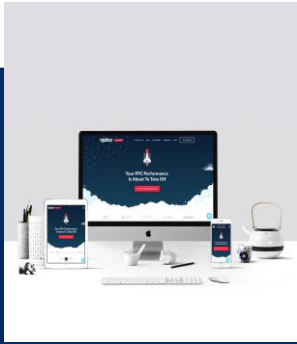
← → ↻ [tracer-evd-mc.web.cern.ch/evd/create-table.php](https://tracer-evd-mc.web.cern.ch/evd/create-table.php)       ⋮

3Q	1	2	1	1	3	4	160; 12; 14; 114;
3R	0	0	0	0	0	0	
3S	0	0	0	0	0	0	
3T	0	0	0	0	0	0	
4A	0	0	0	0	0	0	
Total	42	10	30	29	67	47	

WW events angle distribution



# Future Goals & Development



## Responsive Application

Design application for all device types, especially for mobile users.

It will create possibility for students to do analysis simply using mobile devices



## Add Z path analysis

Currently results table is developed only for W path problems.

It is important to implement table for Z path analysis.

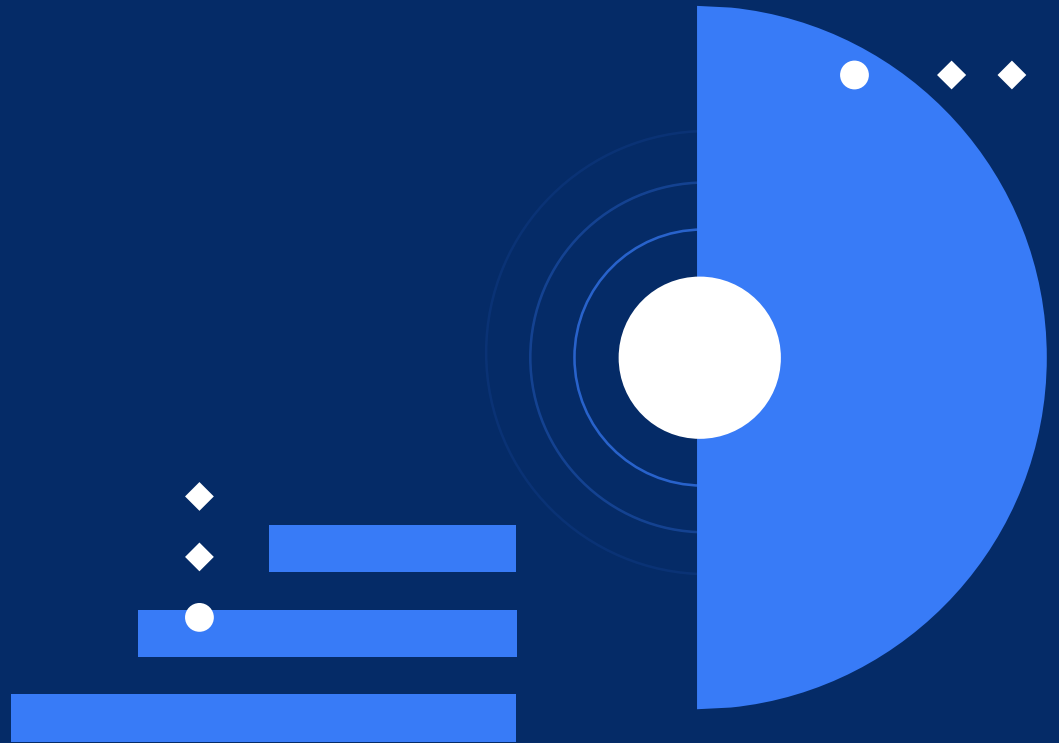


## Testing Application for 2023 Masterclasses

Application is ready to be tested for ATLAS Masterclasses W path. Feedback will help us to finish development of TracerEVD to become official tool for Masterclasses.

# Thank you for your attention!

Comments are Welcome



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