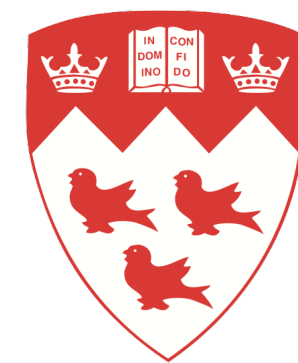


International Physics Masterclasses



Brigitte Vachon
McGill University

<https://physicsmasterclasses.org/>

International Physics Masterclasses

- Outreach project centrally coordinated by the “International Particle Physics Outreach Group” (<https://ippog.web.cern.ch/>)
 - The project started in 2005 with the analysis of real data from the DELPHI and OPAL experiments at the LEP collider at CERN.



- A Physics Masterclass provides the opportunity for high-school students to experience what it's like to be a “particle physicist for a day”.
- Goal: To bring the excitement of cutting-edge particle physics research into the classroom.

International Physics Masterclasses

Learning objectives:

- Become familiar with methods of basic research
- Learn about fundamental laws of matter and forces
- Become acquainted with particle detection techniques.
- Learn basic concepts of data analysis, modelling, and statistics.
- Gain experience in collaborative work.

International Physics Masterclasses

One-day event held in March at different universities and institutes in ~ 60 countries.



International Physics Masterclasses

Key elements:

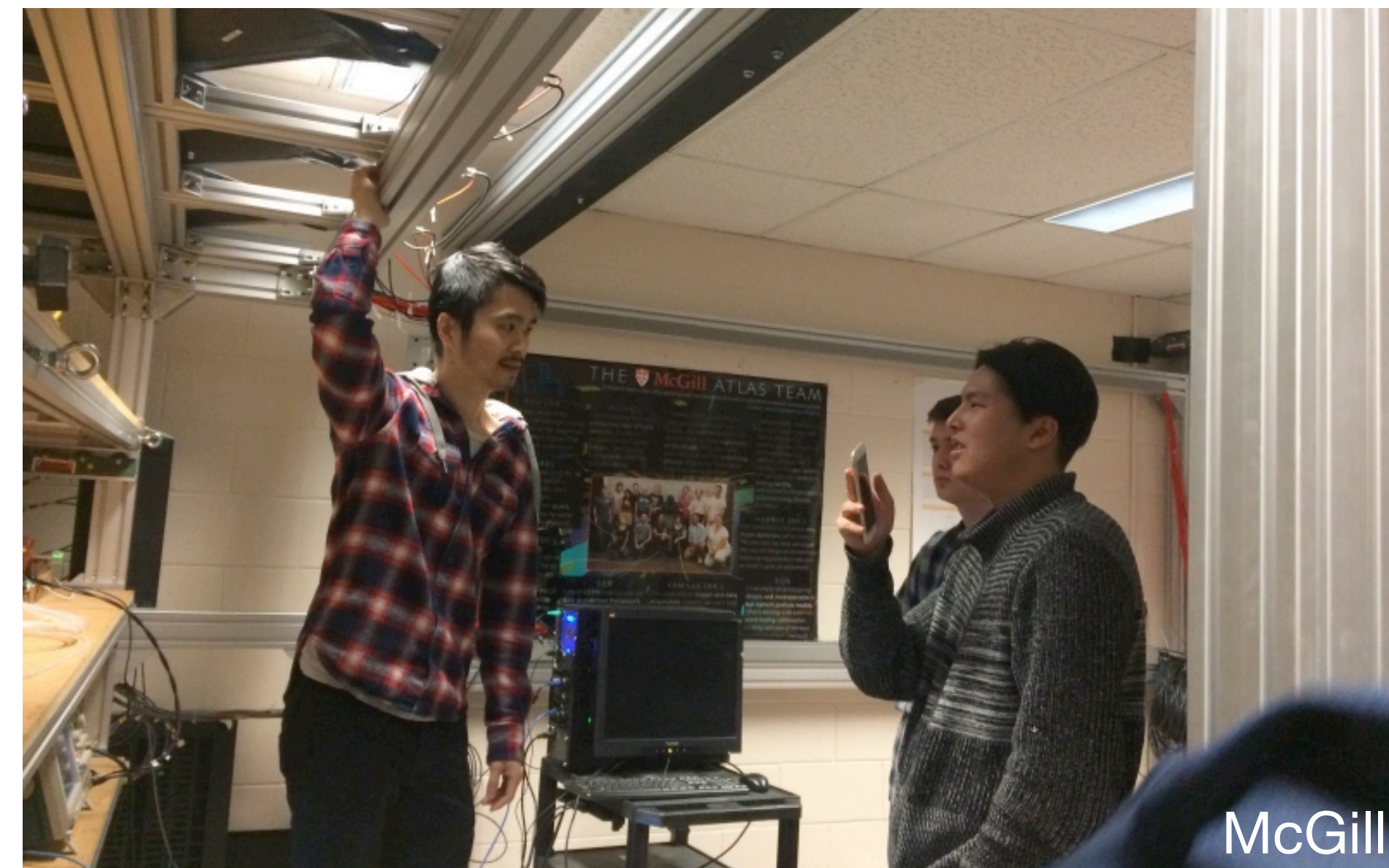
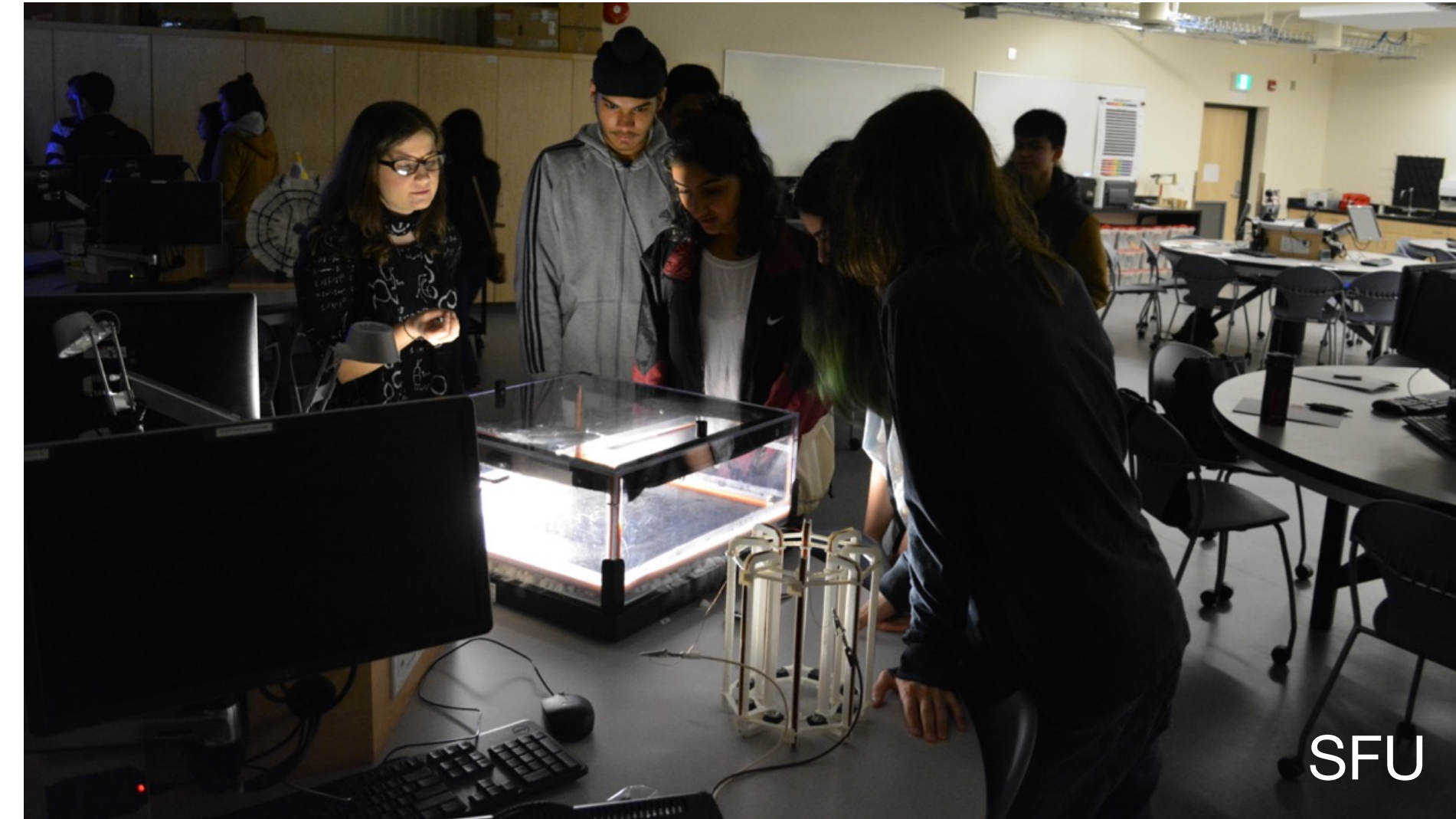
- **Introductory presentation on the Standard Model and current research.**



International Physics Masterclasses

Key elements:

- Introductory presentation on the Standard Model and current research
- **Facilities or laboratory tour**



International Physics Masterclasses

Key elements:

- Introductory presentation on the Standard Model and current research
- Facilities or laboratory tour
- **“Hands-on” analysis of authentic experimental high-energy physics data**



International Physics Masterclasses

Key elements:

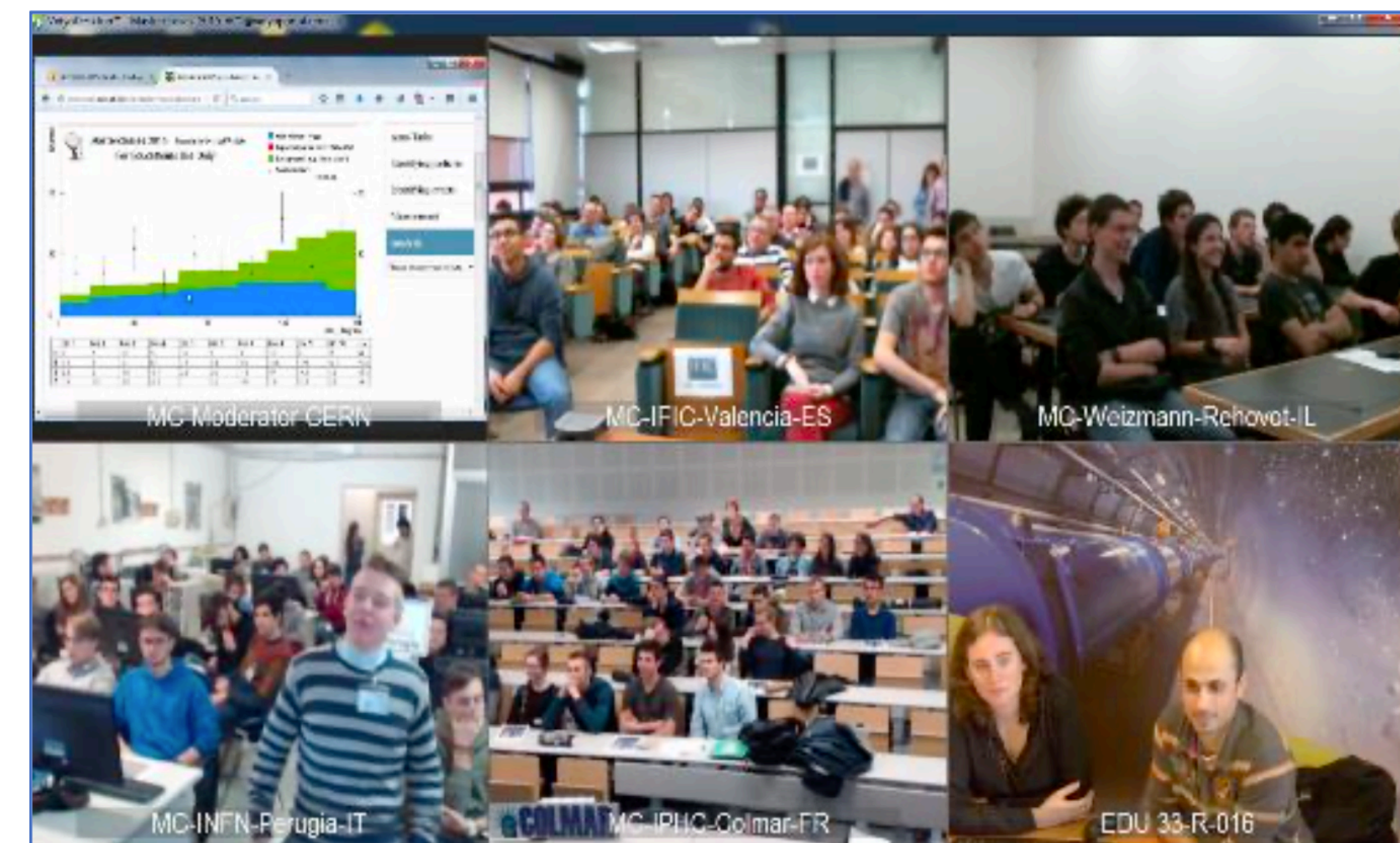
- Introductory presentation on the Standard Model and current research
- Facilities or laboratory tour
- “Hands-on” analysis of authentic experimental high-energy physics data
- **Discussion of results**



International Physics Masterclasses

Key elements:

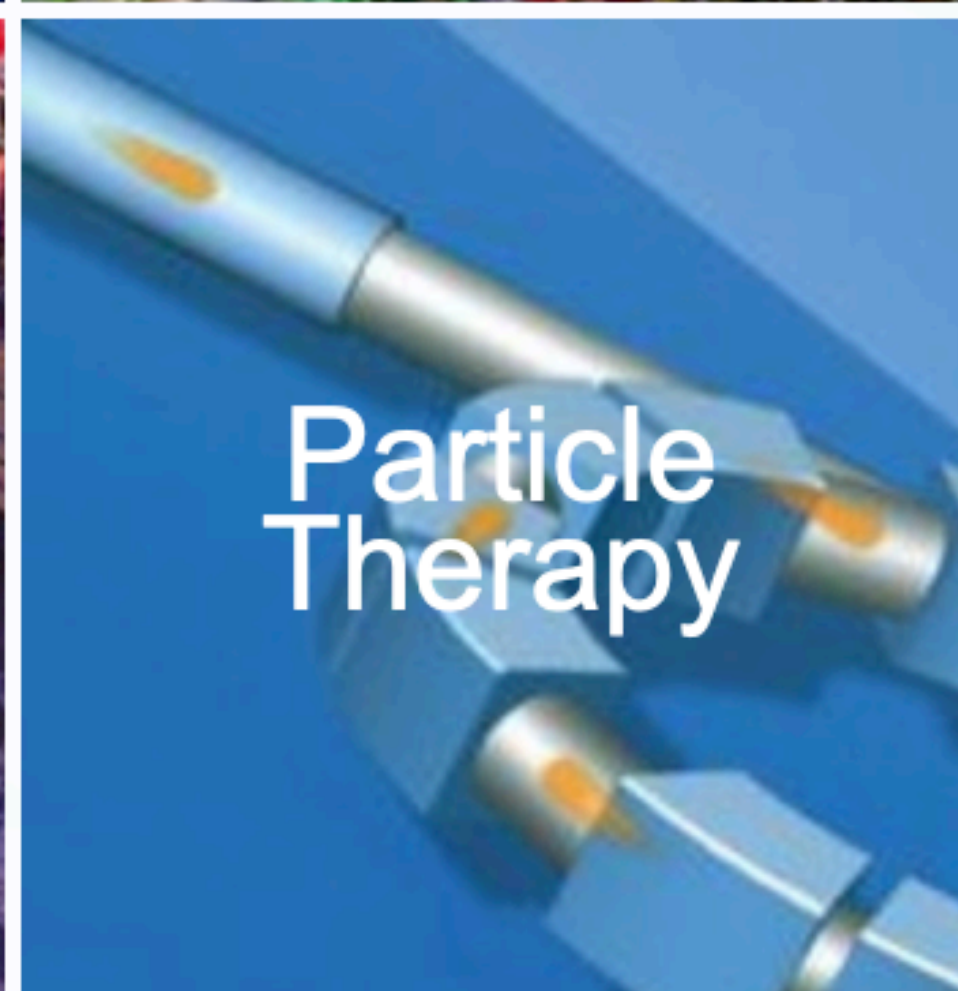
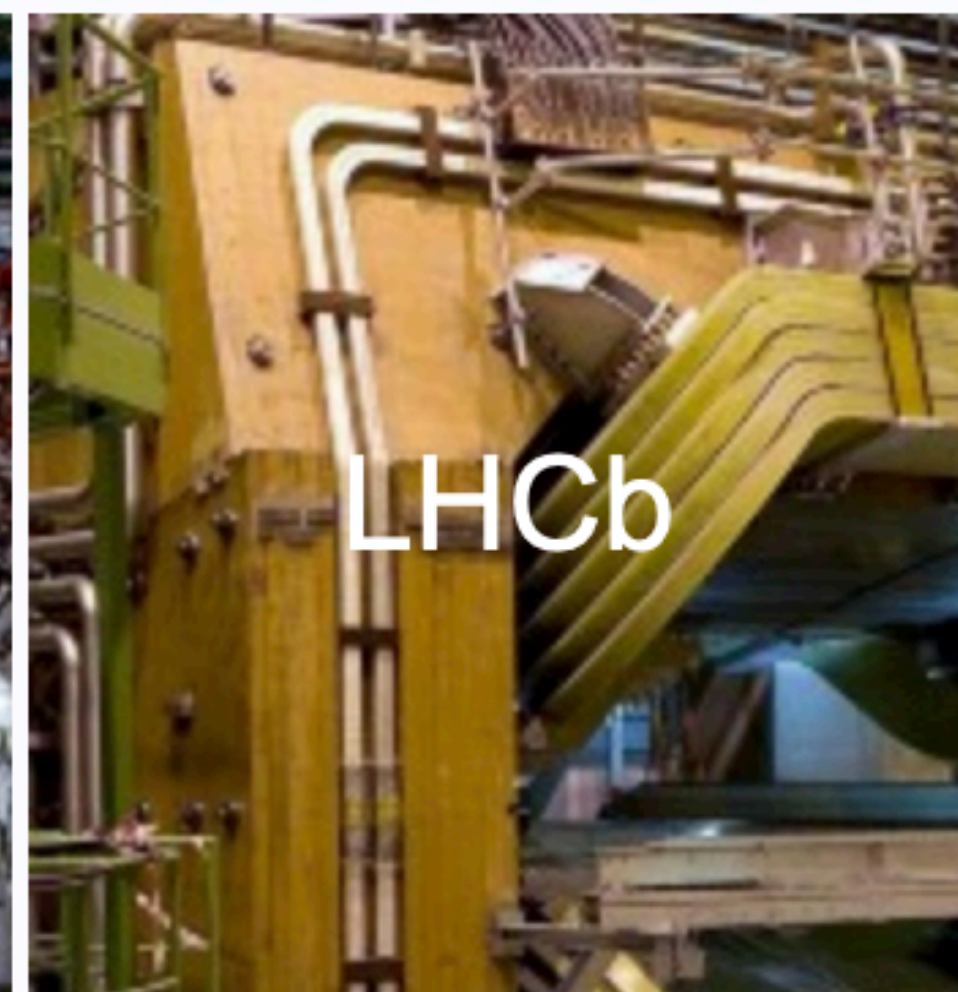
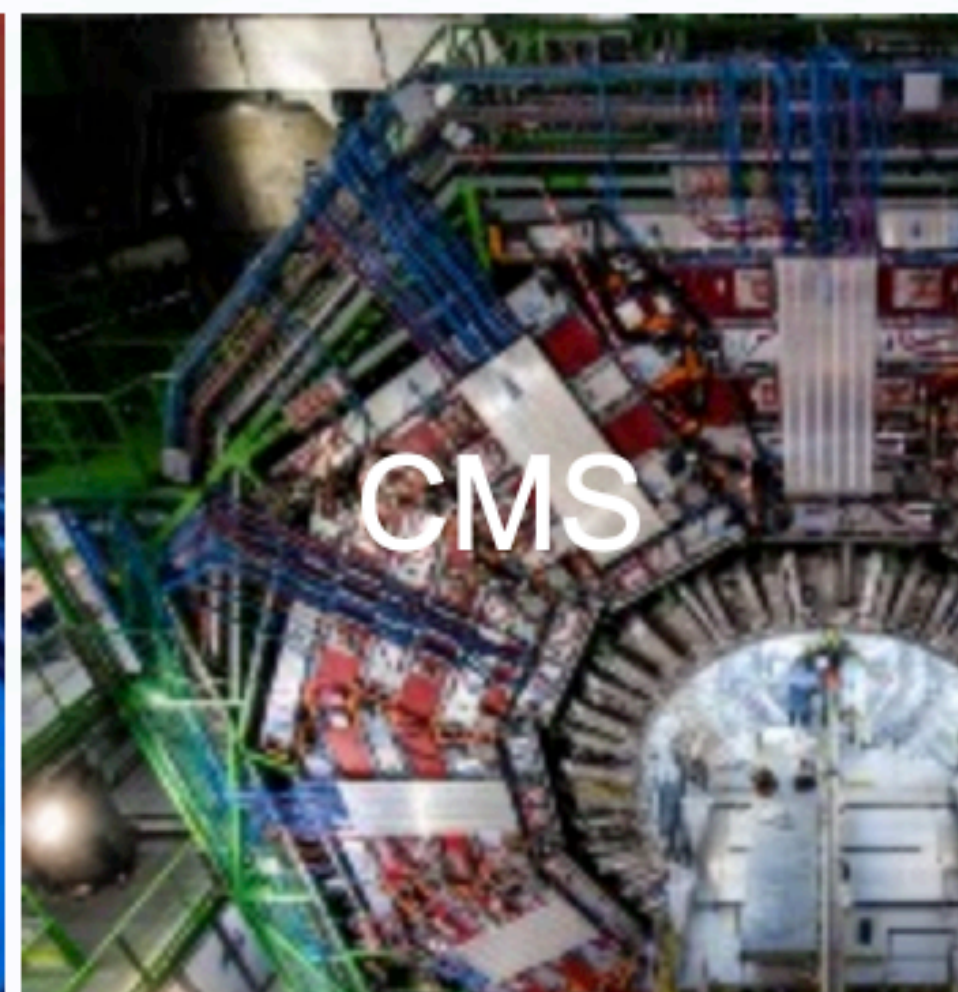
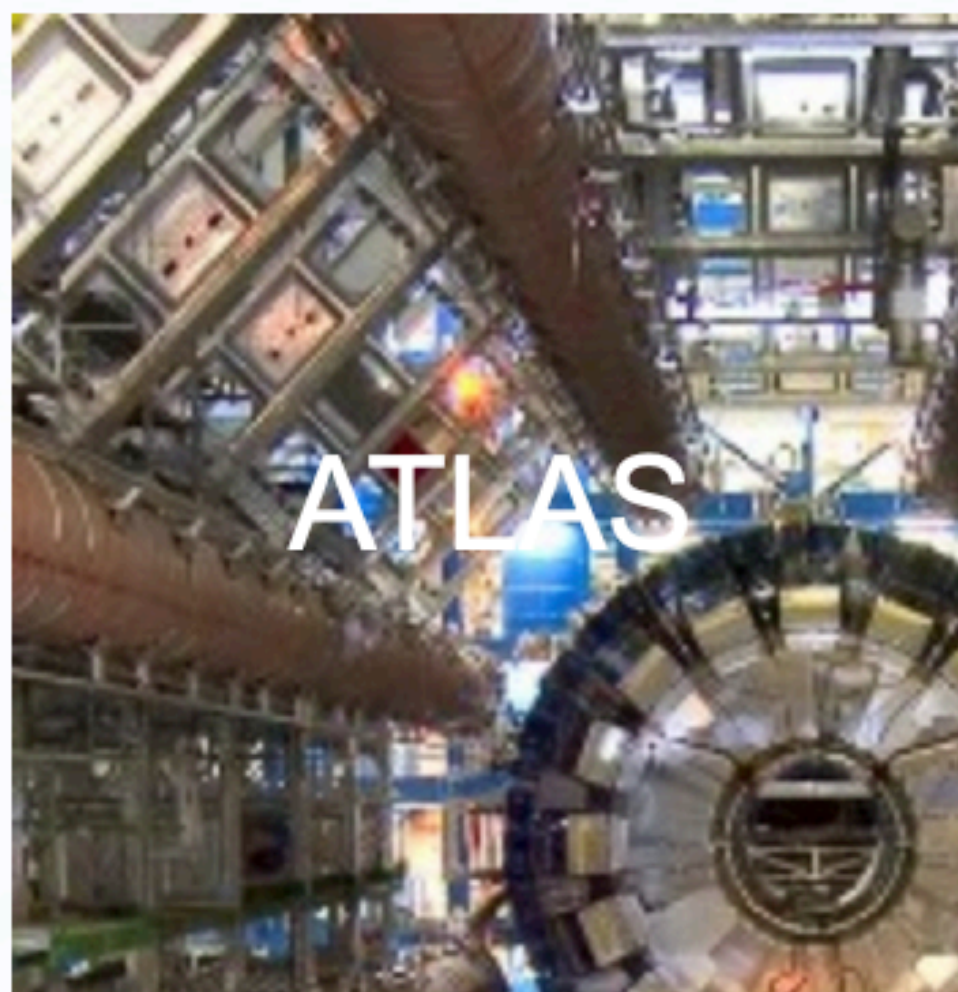
- **Introductory presentation on the Standard Model and current research**
- Facilities or laboratory tour
- “Hands-on” analysis of authentic experimental high-energy physics data
- Discussion of results
- **Scheduled videoconference with other masterclass institutions analyzing data from the same experiment, moderated by physicists at CERN, Fermilab, KEK, GSI, or TRIUMF.**





International Masterclasses

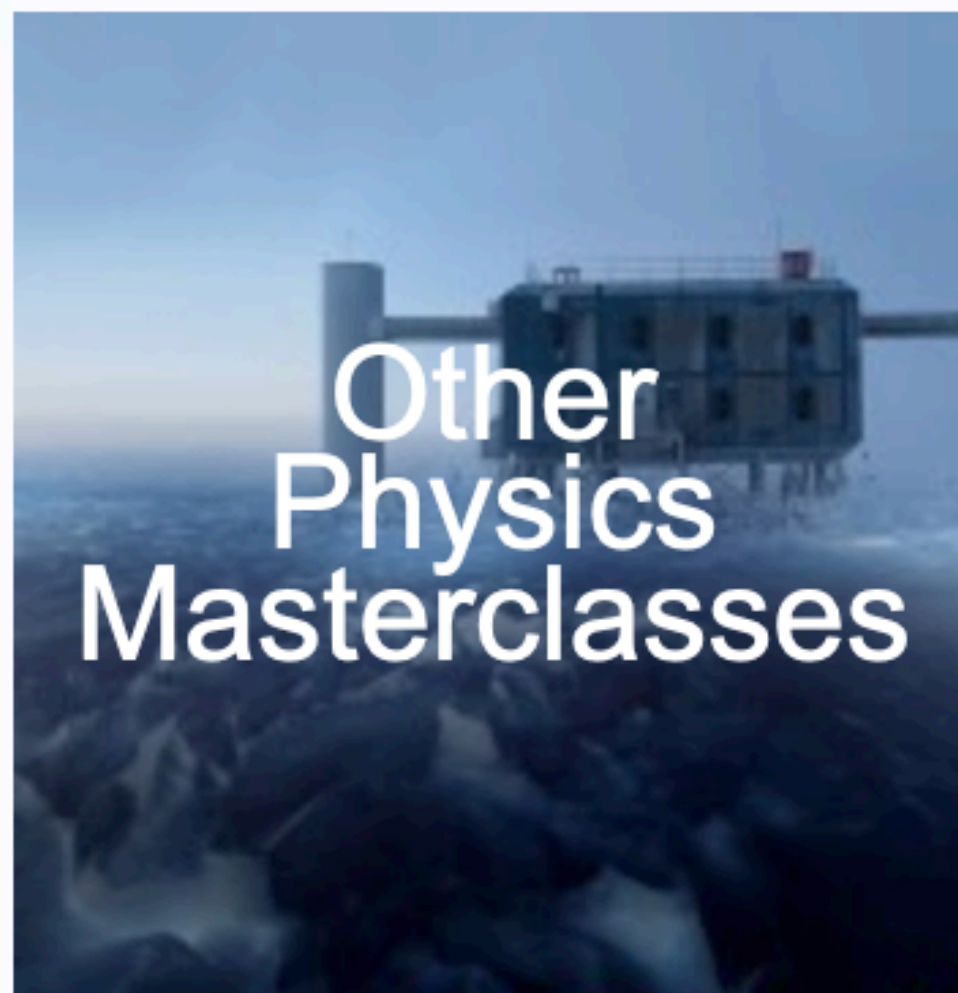
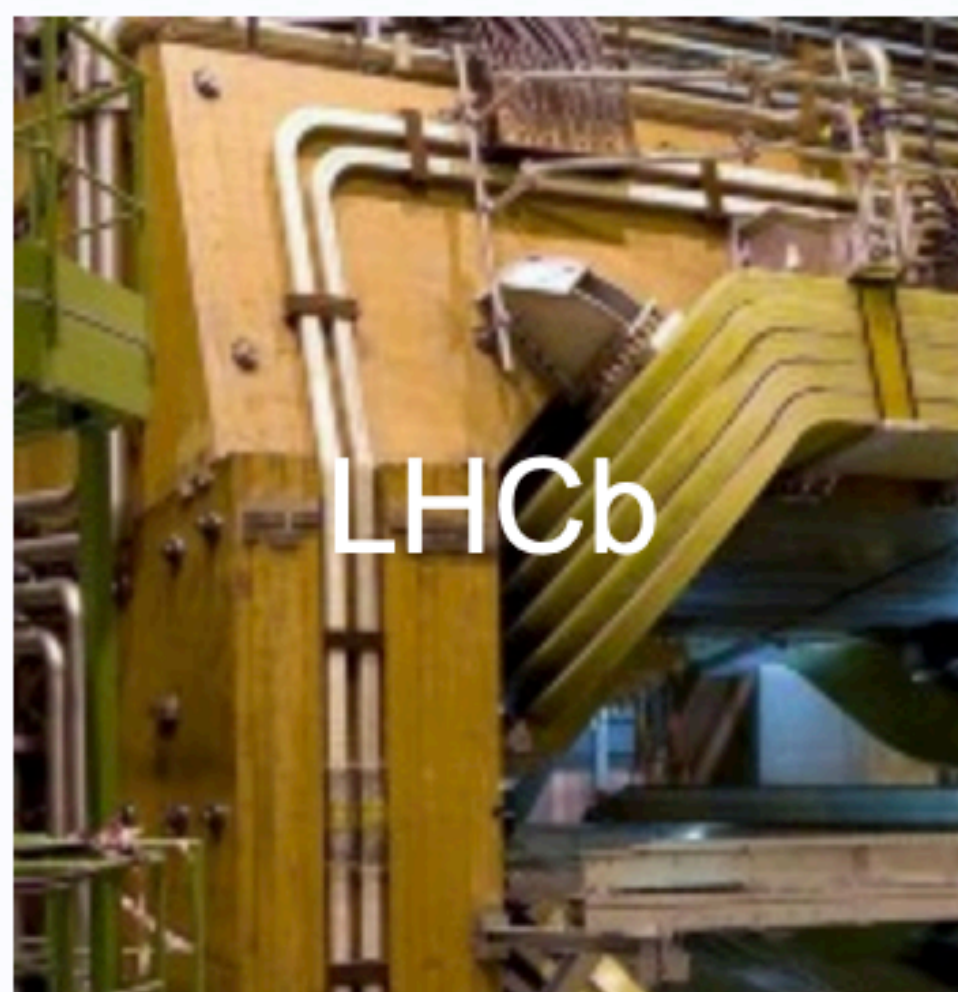
18th International Masterclasses 2022





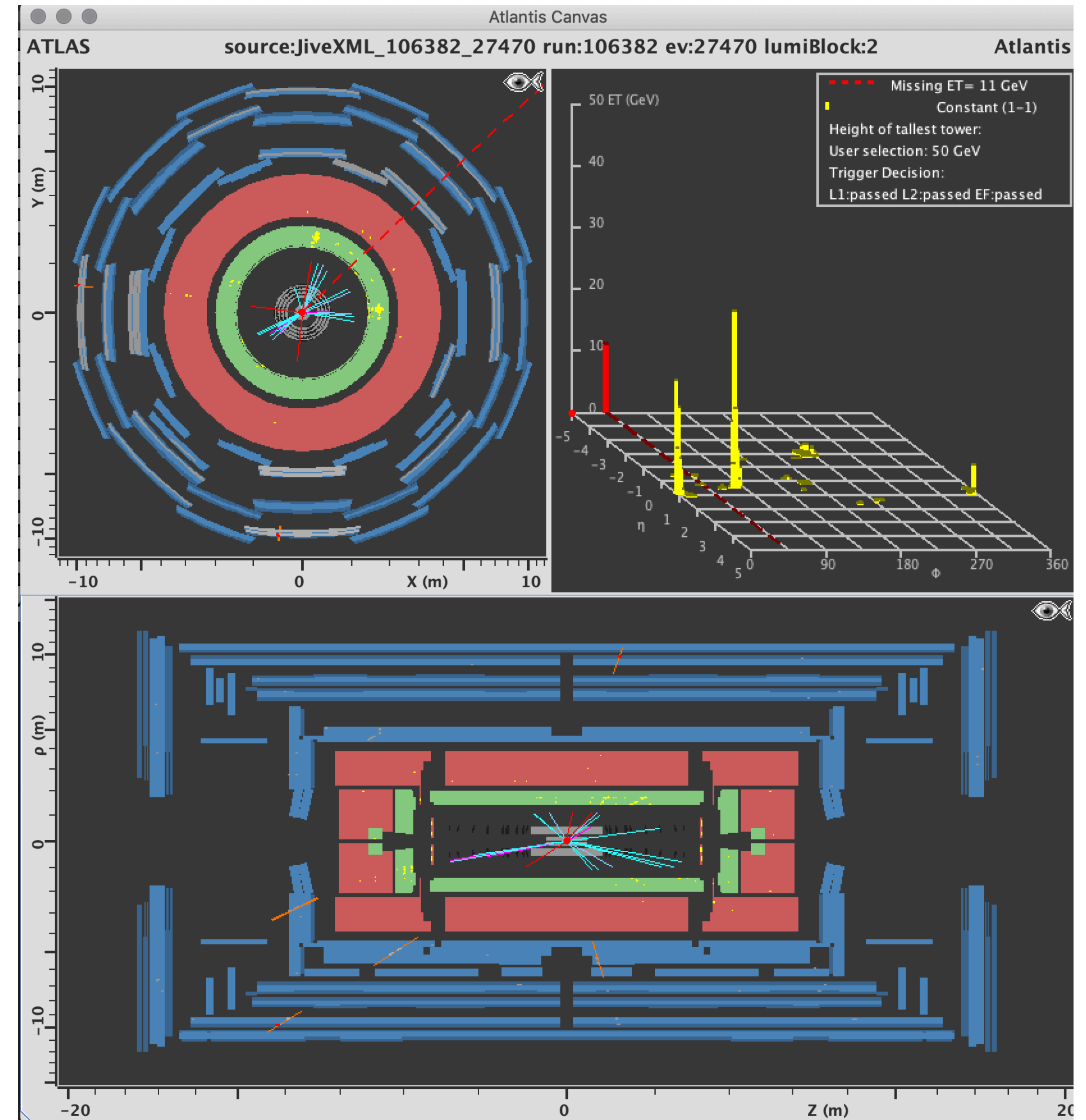
International Masterclasses

18th International Masterclasses 2022



ATLAS : Physics Masterclasses

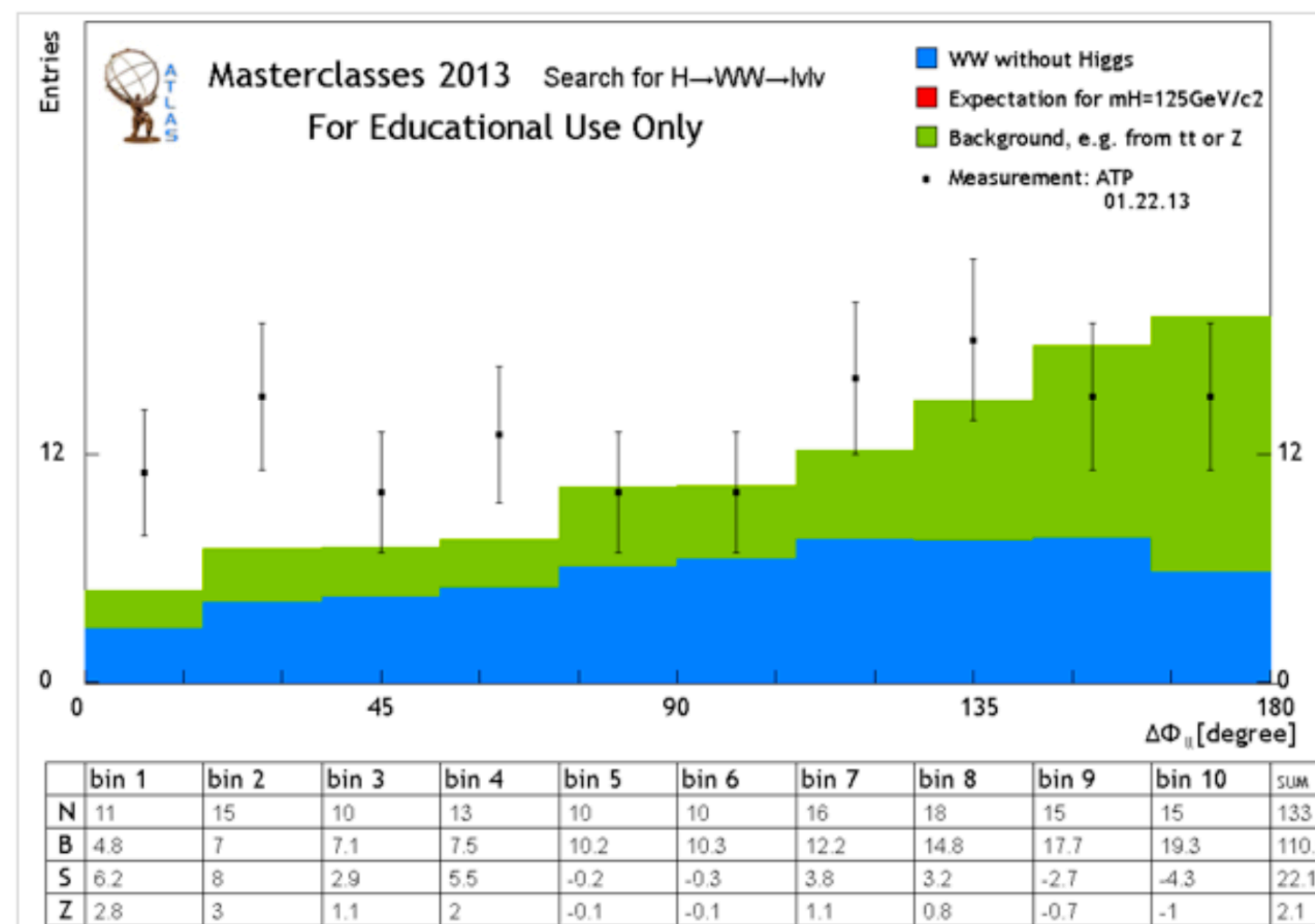
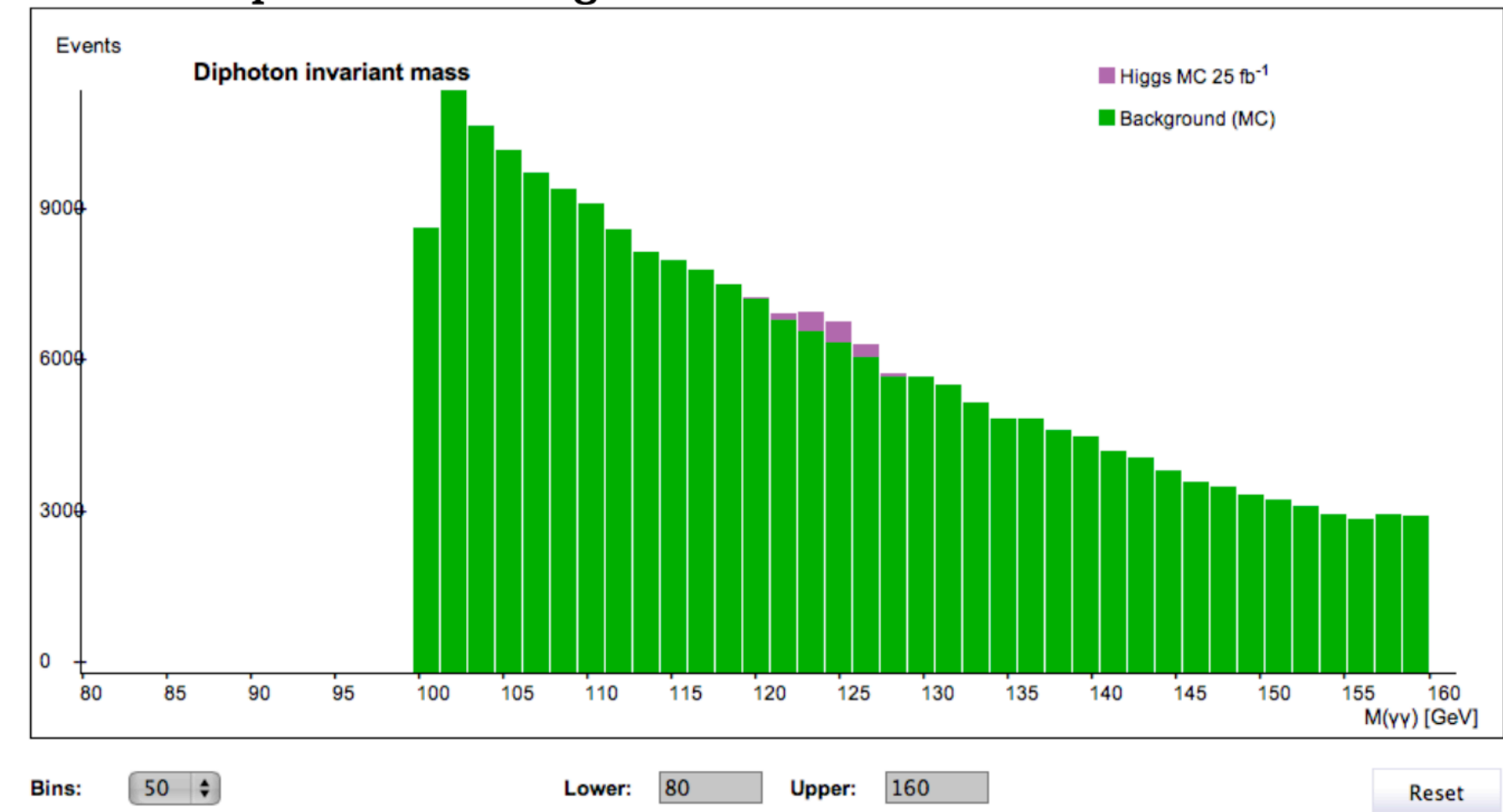
- Students work in pairs to analyze a fixed set of 50-100 collision events.
- Data analysis carried out using Java-based visualization tool.



ATLAS : Physics Masterclasses



- Students work in pairs to analyze a fixed set of 50-100 collision events.
- Data analysis carried out using Java-based visualization tool.
- Two distinct ATLAS Masterclass measurements
 - "Z-path"
 - Exploit the invariant mass concept as a tool for identifying known short-lived particles and to search for and discover new ones.
 - Find Higgs boson events ($H \rightarrow \gamma\gamma$ and $H \rightarrow ZZ \rightarrow 4\ell$)
 - "W-path"
 - Determine the ratio W^+/W^- to reveal the inner structure of the proton.
 - Find Higgs boson events ($H \rightarrow WW \rightarrow \ell\nu\ell\nu$)



Physics Masterclasses in **Canada**

- Events organized and run by volunteers faculty, postdocs and grads.
- Number of participants limited by physical space at each location.
 - For 2021 virtual events, participation limited by the number of tutor volunteers available.
- Over 1000 participants in the past 10 years.

	TRIUMF, UBC, SFU	UVic	McGill	
2011	38	---	40	
2012	14	15	40	
2013	83	18	40	
2014	24	15	40	
2015	38	24	45	
2016	39	23	40	
2017	47	18	30	
2018	46	24	32	
2019	47	25	42	
2020	---	---	39	
2021	44	38	80 (virtual)] Covid
2022	---	---	---	
Total	420	200	468	

Summary

- International Physics Masterclasses provide the opportunity for high-school students to experience what it's like to be a "particle physicist for a day".
- Annual event held over one-day in 60 different countries.
- Physics Masterclasses taking place at different institutes in Canada for the past 10 years.

- Organize a Masterclass at your institute!

<https://physicsmasterclasses.org/>



Hands on Particle Physics Masterclasses ORGANISATION

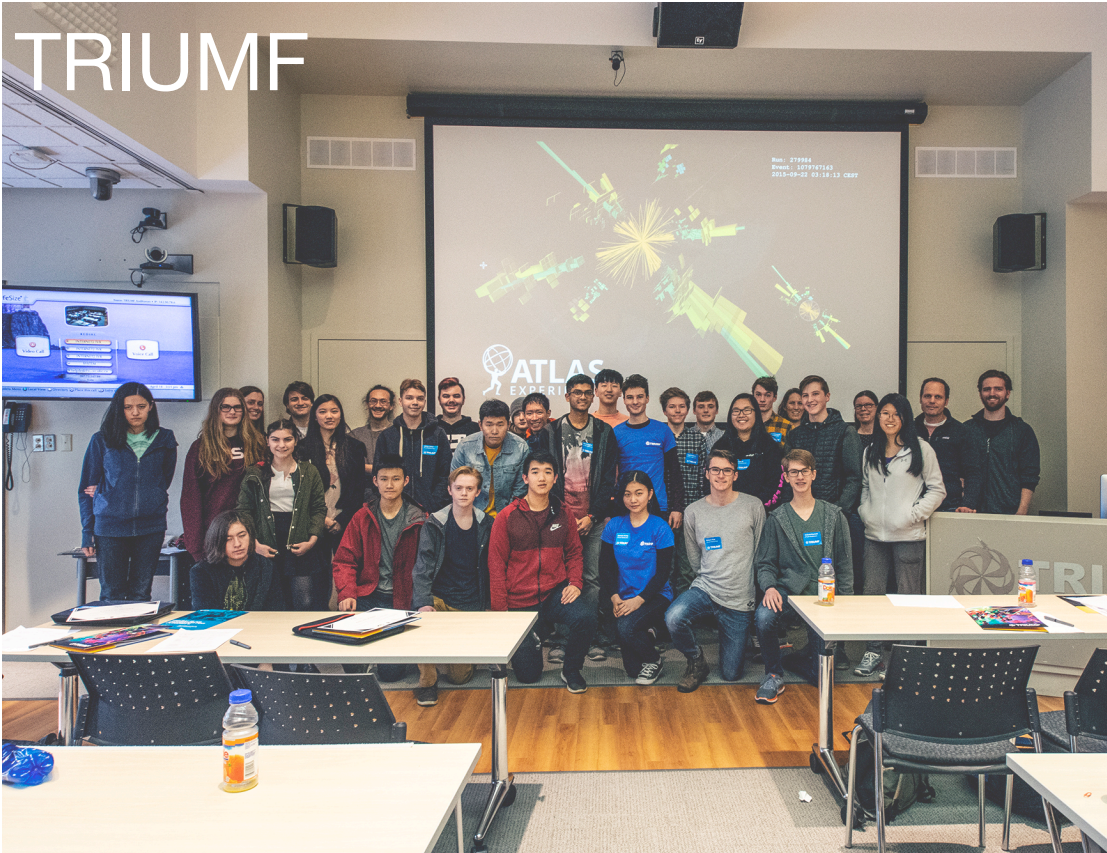
Welcome to the organisation section of International Masterclasses! We will provide you with all that you'll need in order to organise your event. Here, you can find:

- **introduction** to the overall organising scheme including a **step-by-step list** for preparation
- **recommendations** for **online Masterclasses**
- **manual** for the **videoconference**
- **information on the measurements**
- **corporate material** (logos, poster, invitation letters, participation certificates)
- **a form** to request data and tables for a Masterclass outside the official IMC period

We also provide information

- how we would like to **present your institute on our website**
- or how you can **contribute in translating the measurement tasks**.
- or some **guidelines** if you plan to develop a new Masterclass measurement.

Special thanks to all volunteers over the years!



And the following individuals who helped in the preparation of this presentation:
Jesse Abney, Justin Albert, Auriane Canesse, Ken Cecire, Andrea Fodor, Colin Gay, Peter Krieger, Rob McPherson, Dugan O’Neil, Marcello Pavan, Shreya Saha, Oliver Stelzer-Chilton, Isabel Trigger, Mike Vetterli, Andreas Warburton.