

INTERNATIONAL MASTERCLASSES HANDS ON PARTICLE PHYSICS

Moderators' orientation

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Inspiring the next generation

“

I did this masterclass in 2012 when in high school and that's why I decided to study physics so I would love to encourage people to join our community.

”



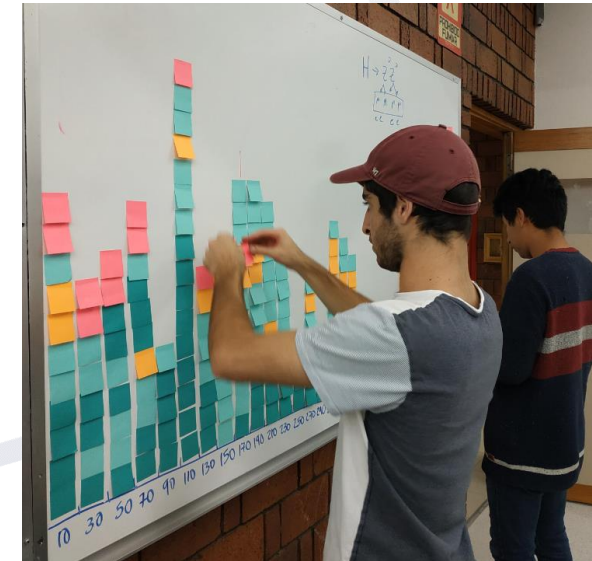
Moderator since 2021

The idea behind Masterclasses

High school students (16-19y) at a university or research lab

Act as a „scientists for one day“

- Close to current research
- Hands-on activity
- Real scientific data
- Relevant methods and tools
- Nature of science
- Organisation of HEP research
- Meeting and discussion with scientists



Sample agenda

08:30 - 09:00 registration & welcome

09:00 - 10:00 introduction to Particle Physics
(standard model, experiment)

10:30 - 11:30 second talk or tour

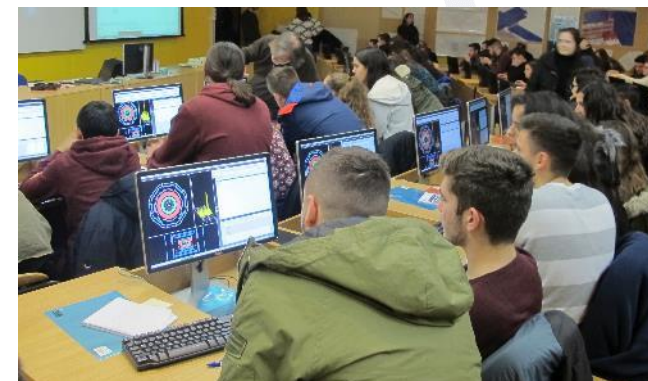
12:00 - 13:00 lunch break

13:00 - 15:00 data analysis: measurement with
authentic HEP data

15:00 - 16:00 local combination + discussion

16:00 - 17:00 videoconference with Fermilab
or other institution

You might be sitting here!



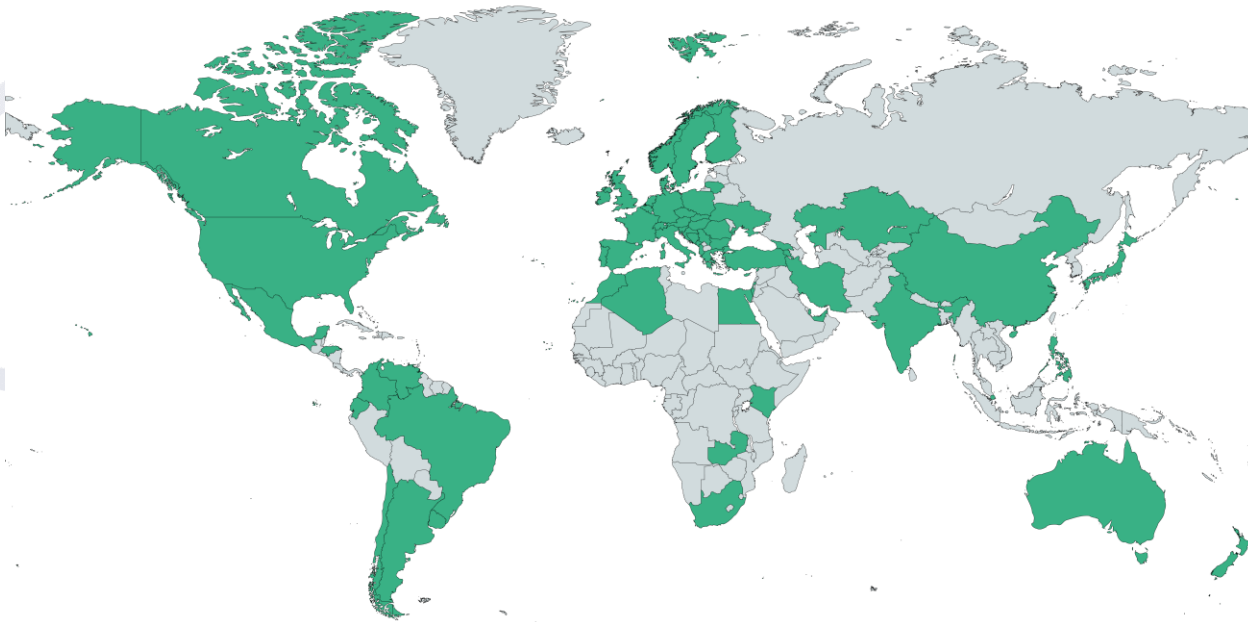
Schedule

- Schedule at quarknet.org/mc-comm
- International Masterclasses period for Fermilab: 10 Mar – 10 Apr 2025 (5 weeks)
- 4 different measurements
 - (ATLAS, CMS, MINERvA, NOvA)
- Each institute picks their favorite date
- 1-2 moderators chair each session with QuarkNet assistant
- Assignment according to your availability

- Also: TRIUMF 26 Apr 2025 (ATLAS)

International Masterclasses

- >60 countries, >220 institutes
- key activity of IPPOG (International Particle Physics Outreach Group)
- Masterclasses: LHC, Belle II, Neutrinos experiments, Auger, Particle Therapy, ...
- Moderation centers: CERN, Fermilab, KEK, GSI, Malargue
- More at <https://ippog.org/imc-international-masterclasses>



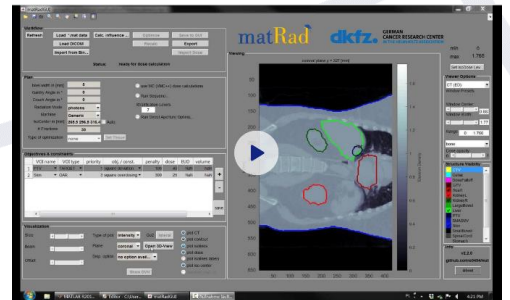
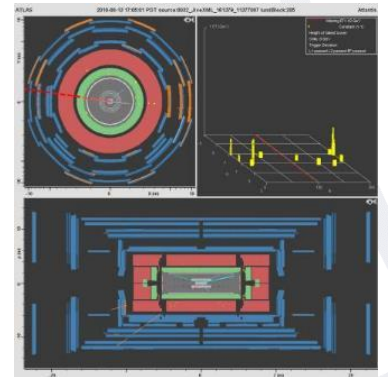
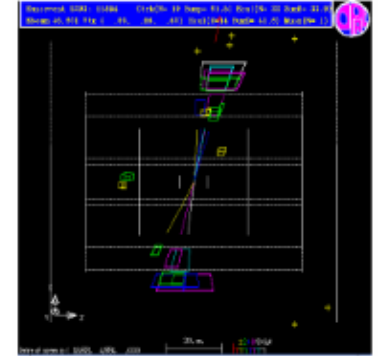
Created with mapchart.net

Brief history of IMC

- Idea from UK, 1996 (R. Barlow et al.)
- 1997: 1. Masterclass with 7 institutes (LEP data)
- 1998: nationwide uptake in UK
- 2005: Adopted by (E)IPPOG for all Europe
- 2006: U.S. joined program (QuarkNet)
- 2011: LHC-based Masterclasses
- 2014: all 4 LHC experiments involved
- 2019: MINERvA Neutrino Masterclass
- 2020: Belle II Masterclass and Particle Therapy Masterclass

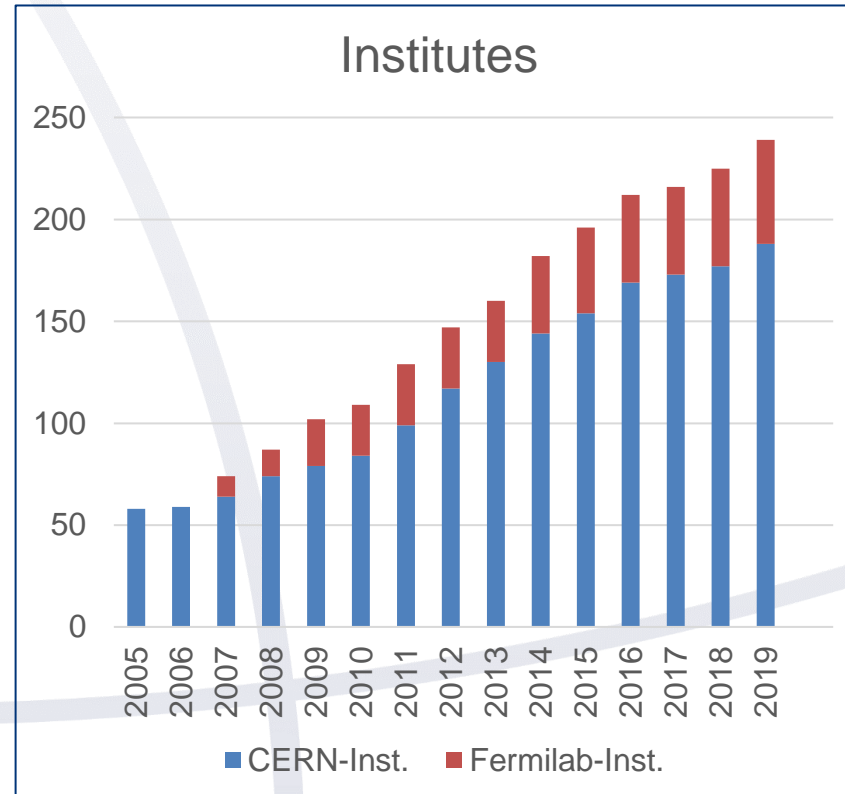
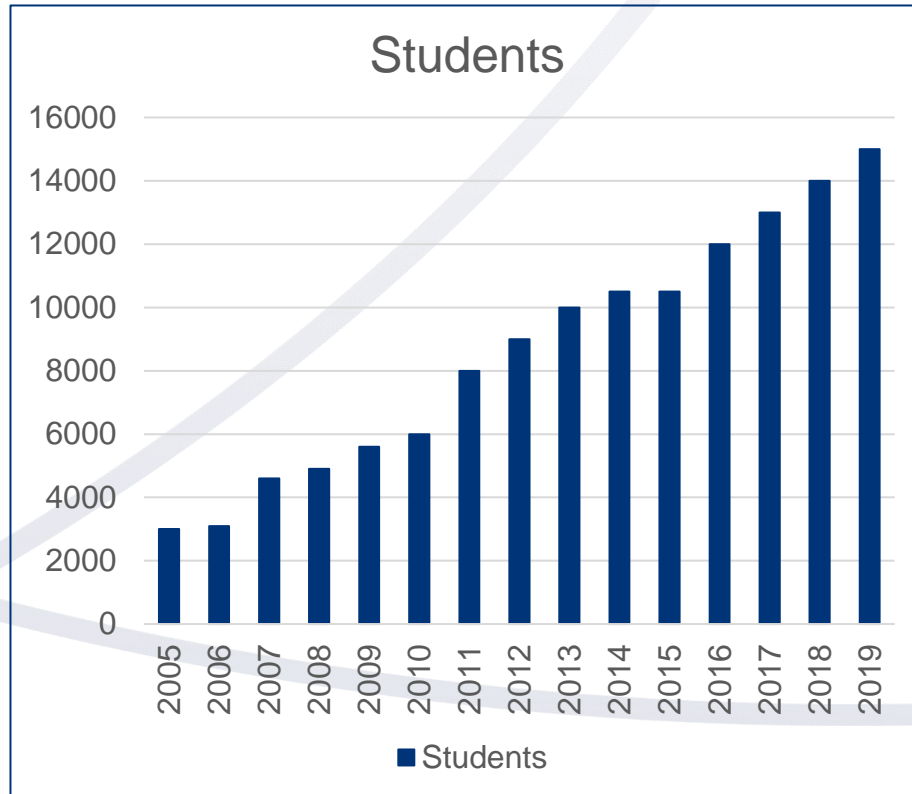
CERN courier 2005: [MC spreads the word for physics](#)

CERN courier 2014: [MC in the LHC era](#)



IMC: a growing program

2005: 18 countries → 2025: 64 countries



Videoconference

- You are going to be the face of Fermilab and particle physics to students around the U.S. and the world!
- You will hold a videoconference via Zoom.
- The videoconference (VC) allows the students to come together to combine and discuss their results under your guidance in a light hearted and fun way.



Videoconference aims

- Convey the internationality of masterclasses and the event.
- Demonstrate how physicists work together internationally.
- Encourage students to exchange experiences between masterclasses.
- Demonstrate improvement in accuracy by combination of different data sets.
- Be a FUN end to a long day!



Videoconference General information

- Short: aim for 30 min
- Three (four) main elements:
 - Introduction
 - Combination/discussion of results
 - (Optional mini virtual visit)
 - Q&A
- Zoom links at quarknet.org/mc-comm;
passcode will be sent by email (but maybe you can guess it)



Mini virtual visit videos:

- Do your own, live, or
- Use pre-recorded from <https://web.quarknet.org/mc/videos/moderators/>

Videoconference timeline

General Videoconference Plan

Revised Feb 2024.

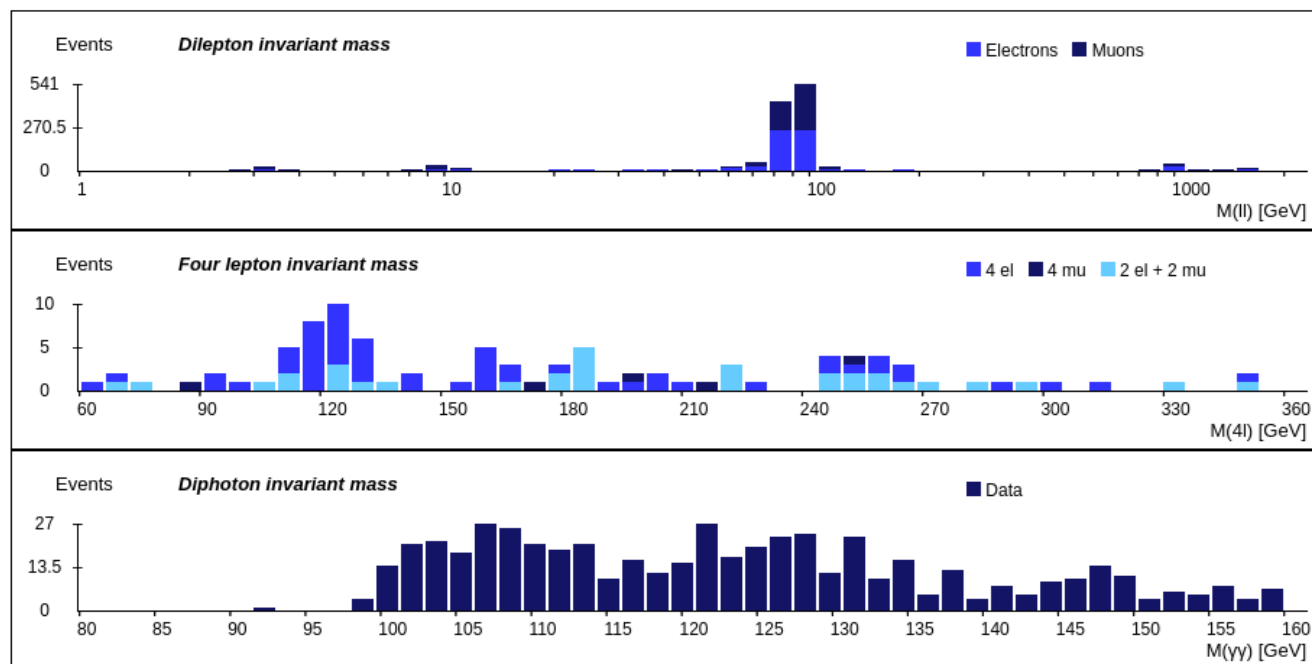
Time from start	Item	Remarks
-00:10	Moderators arrive; institutes log in	<ul style="list-style-type: none">• test and establish video and audio connections
+00:00	Start	<ul style="list-style-type: none">• introductions of moderators, institutes, map; warm-up questions, if any
+00:05	Discuss results	<ul style="list-style-type: none">• show combined result from that day• for LHC masterclasses, show ATLAS or CMS "pro" results• Let students ask questions if they have them. Answer succinctly. Do not try to draw them into a socratic lesson.
+00:10	Mini Virtual Visit <i>Optional: If not doing this, go to Q&A.</i>	<ul style="list-style-type: none">• Live or video tour of some aspect of Fermilab or another site• If there is time, add a Fermilab story or personal observation.
+00:15	Q&A	<ul style="list-style-type: none">• moderators take questions from students
+00:30	Videoconference ends	<ul style="list-style-type: none">• students may leave or stay for more questions if they are inclined

Videoconference discussion of measurements & combination

- Share the combination results on Zoom. (QN staff will help.)
- Summarize and comment on the combination.
 - Note that all groups in the VC have done the same measurement, but using different datasets.
 - Don't comment on results from individual institutes.
- Stress why using different data from different sources is beneficial (stats and reduces bias).
- Universal answer: more data

OPlot – MasterClass – Combination for all institutes on 2022-03-12

Start Student Moderator Tutor Administrator



Videoconference Q&A

- Discussion expands to more open and general questions. They can be on anything from...
 - Life at CERN or Fermilab.
 - Experiment size/magnets/cost/power consumption.
 - The Big Bang, dark matter, black holes, time travel...
 - How to become a particle physicist.
- Ask the institutes to come up with more general questions.
 - One question per institute per round.
- Repeat/rephrase the question to:
 - Make sure you understood correctly.
 - Help other groups understand.
- Give a **short** concise answer. (If you think your answer was too short, it wasn't.)
- It is okay if you cannot answer a question!

Videoconference end

There must be a clear and common end to the VC after 30 min.

- Say goodbye to everyone and thank them for taking part.
- Do not keep discussion going even if the students are still asking questions.
 - If they and you want some discussion can continue after the goodbye on a voluntary basis.
 - "The videoconference is over – you are free to leave! – but we will stay a few more minutes for additional questions."

