



# Developments in International Masterclasses

APS-DPF 2019

Richard Dower, Roxbury Latin School (ret.), [rickdower@gmail.com](mailto:rickdower@gmail.com)

K. Cecire, University of Notre Dame, [kcecire@nd.edu](mailto:kcecire@nd.edu)



U.S. DEPARTMENT OF  
**ENERGY**

Office of  
Science



 **Fermilab**

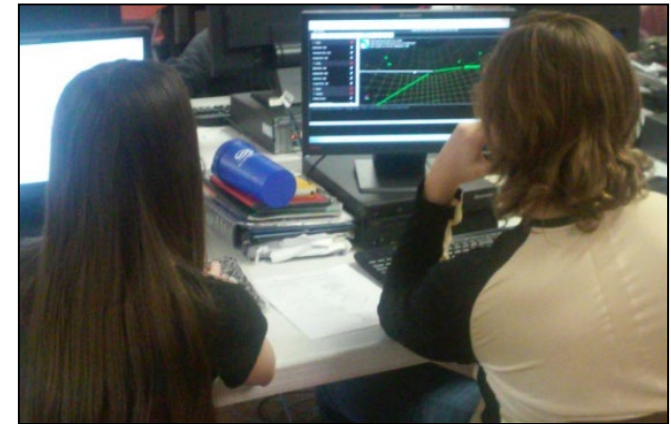
# Overview



## What is a masterclass?

“Particle physicist for a day”

- Intro
- Tour
- Analyze authentic HEP data.
- Videoconference



## International Masterclasses 2019 and beyond

- > 50 Countries
- > 10<sup>4</sup> Students
- 4 LHC experiments
- 1 new Neutrino experiment
- More on the way



# Masterclasses Expand



## New opportunities

- World Wide Data Day (W2D2)
- Masterclasses for International Day of Women and Girls in Science (IDWGS)

## New measurements

- MINERvA
- More neutrino masterclasses
- CMS upgrade
- Belle II
- Masterclasses from GSI
- More on the way



# W2D2

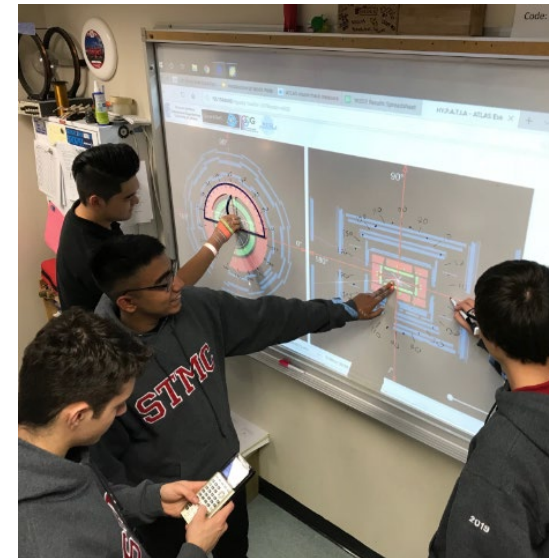
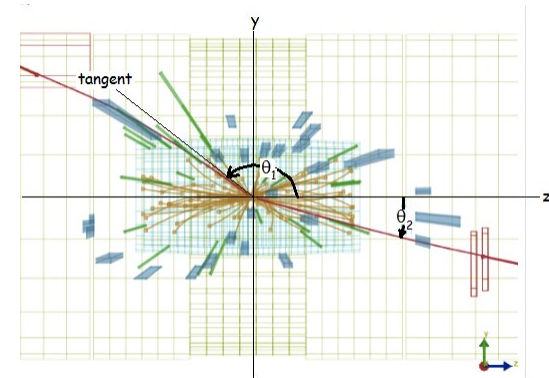


## What it is

- Simple measurement:  $\phi$  and  $\theta$  of muons in events
- Can be done by teachers and students in school
- Worldwide combination of data
- 24-hour shift of videoconferences

## Get involved

- Takes place in Oct or Nov each year (next: Oct 16, 2019)
- Inform physics teachers
- Contact Ken



# IDWGS



## What it is

- LHC masterclass measurements
- By and for girls
- Learn about particle physics
- Discuss women in science

## Get involved

- Takes place in Feb each year
- Recruit students, teachers, tutors
- Women as role models
- Encourage young women with a friendly physics environment
- Contact Uta Bilow, [uta.bilow@tu-dresden.de](mailto:uta.bilow@tu-dresden.de)

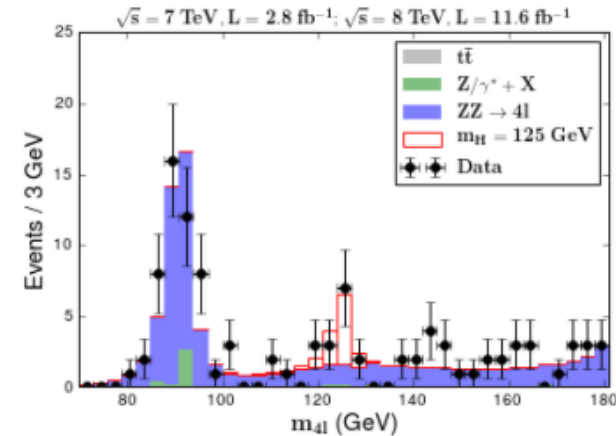


# CMS upgrade, Belle II



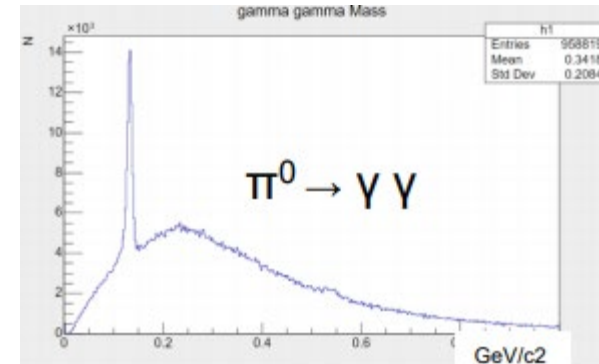
## What they are

- CMS measurement adds a 4-lepton mass plot
  - Test this summer
  - Use in IMC 2020
- Belle II shows students how to code B-physics analysis
  - Tested in IMC 2019
  - Ready for IMC 2020



## Get involved

- Take place in IMC
- Contact Zdenek Dolezal, [zdenek.dolezal@cern.ch](mailto:zdenek.dolezal@cern.ch)





# Neutrino masterclasses



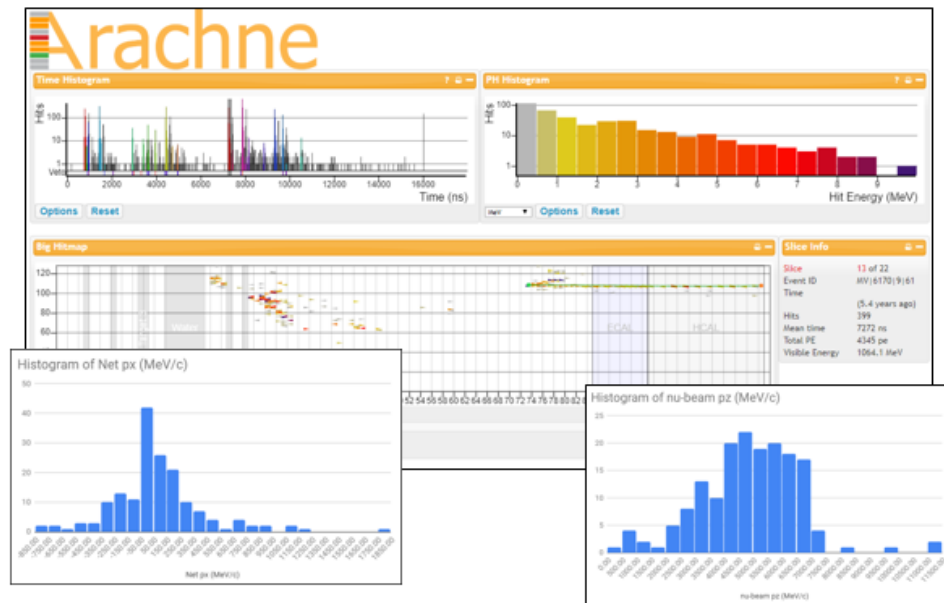
## What it is

- First, MINERvA
  - Muon neutrinos interact with carbon target
  - Discover Fermi motion
  - Measure carbon nucleus to test interaction model
- Coming:
  - MicroBoone, more



## Get involved

- Take place in IMC
- Contact Ken



# GSI/FAIR

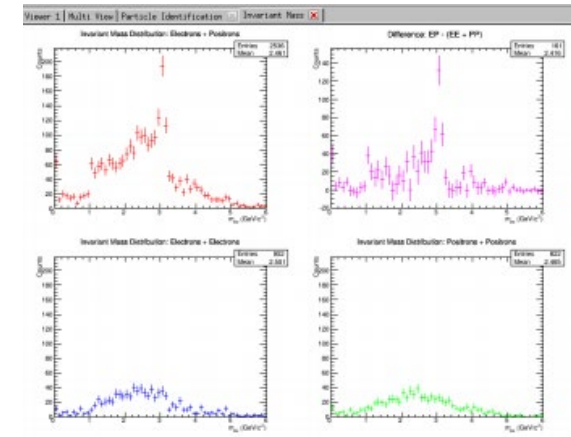
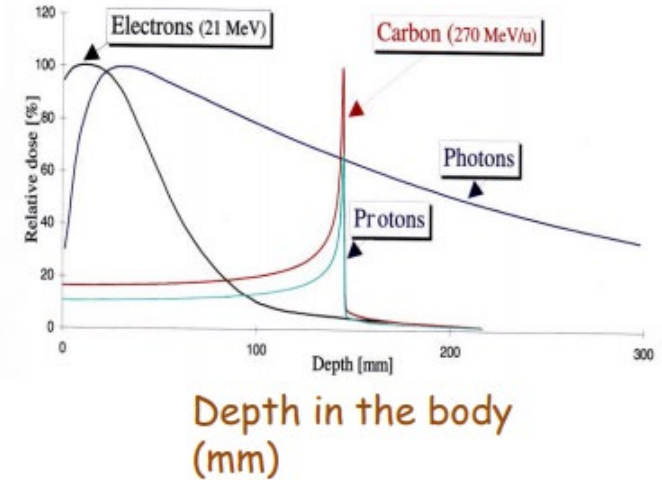


## What they are

- Medical Imaging (HIT)
- $J/\psi$  (ALICE)
- GSI
  - videoconferences
  - innovations

## Get involved

- Take place in IMC
- Contact Uta, Ken, or Yiota Fokka, [yiota.fokka@cern.ch](mailto:yiota.fokka@cern.ch)





# Interesting future



## Challenges

- 4 centers for videoconferences and growing
  - CERN
  - Fermilab
  - TRIUMF
  - GSI
- Organization and Coordination
- Structure will expand



## Opportunities

- Rich offerings develop all involved
- New offerings yield new methods
- Multiplying pathways to reach students and teachers