Physics Education & Outreach

US Muon Collider Community Meeting
August 7, 2025

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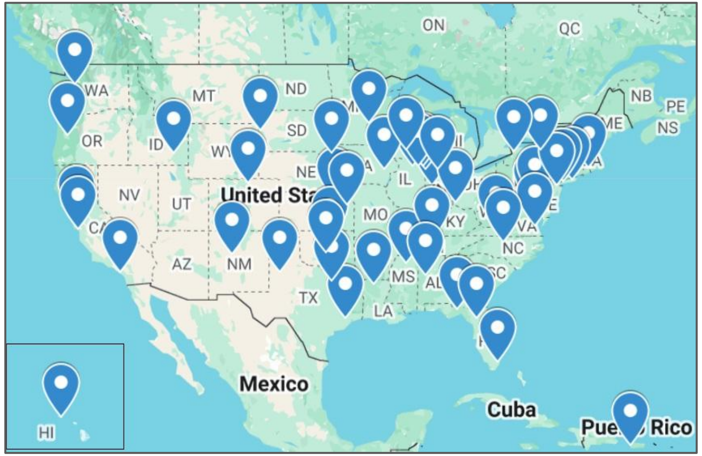
What is QuarkNet?

NSF-funded **physics teacher professional development** program since 1999.

- quarknet.org
- 50+ centers across US, 500+ teachers
- Partnership between HEP physics and high school physics/science teacher communities
- Connects current physics and physics research to high school classroom
- Tevatron → LHC → Neutrino → new physics

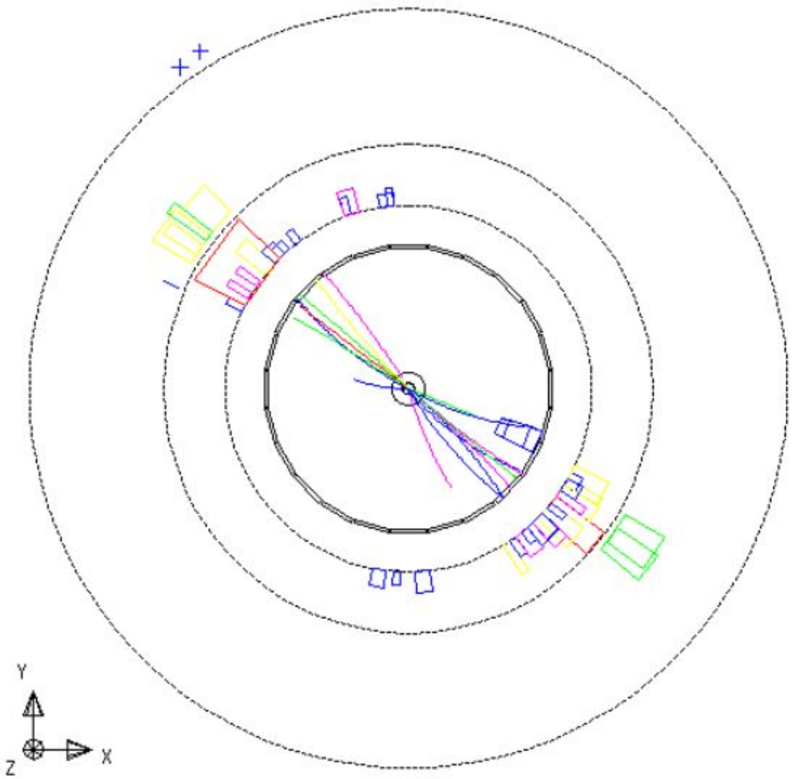


We're excited!

- New bleeding edge tech
- Compelling physics
- Compelling physics education

From great to small…

- Muon lifetime in lab frame
- Accelerator size in muon frame!



QuarkNet Events

Center workshops

Data Camp @ FNAL

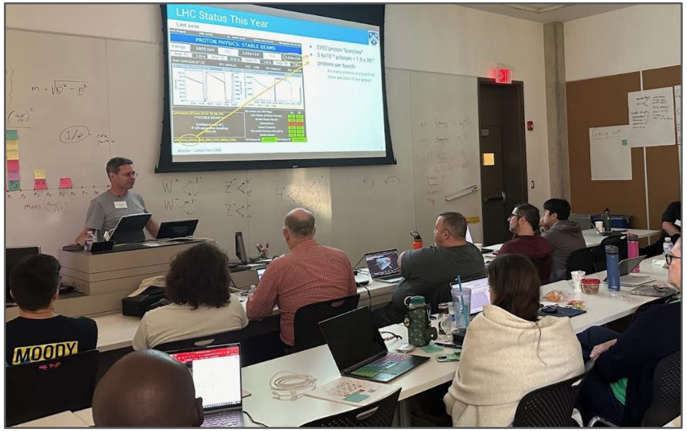
Coding Camp 1 (virtual)

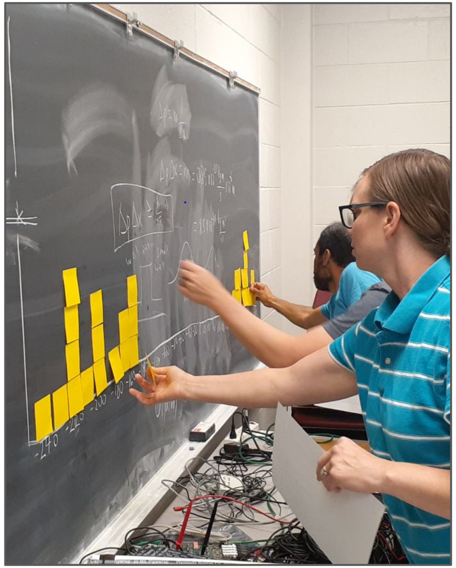
Coding Camp 2 @ FNAL

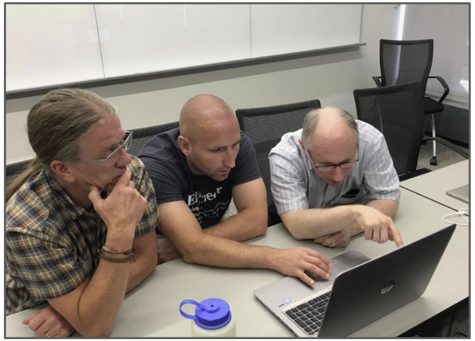
Particle Physics Masterclasses

(CMS, ATLAS,
MINERvA, NOvA, .

Others…

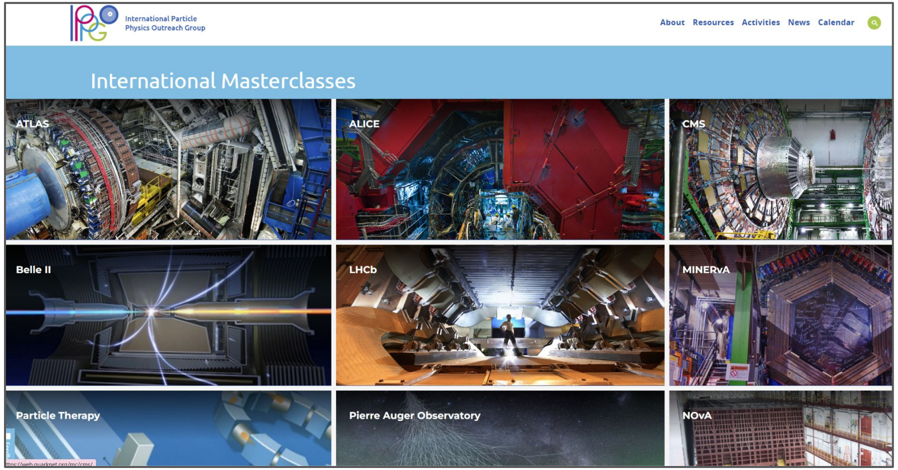


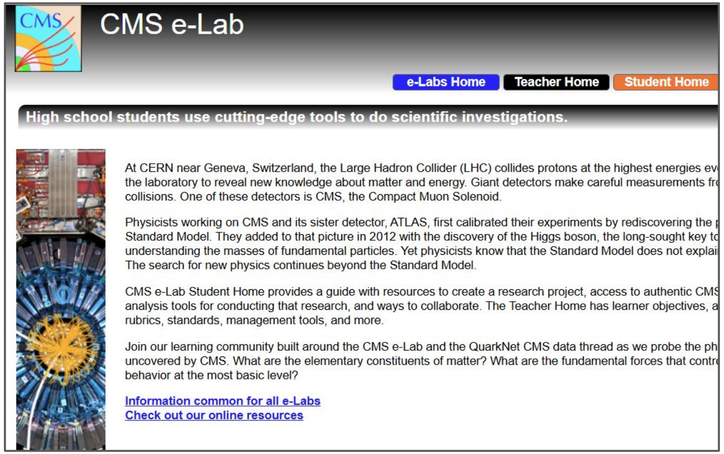




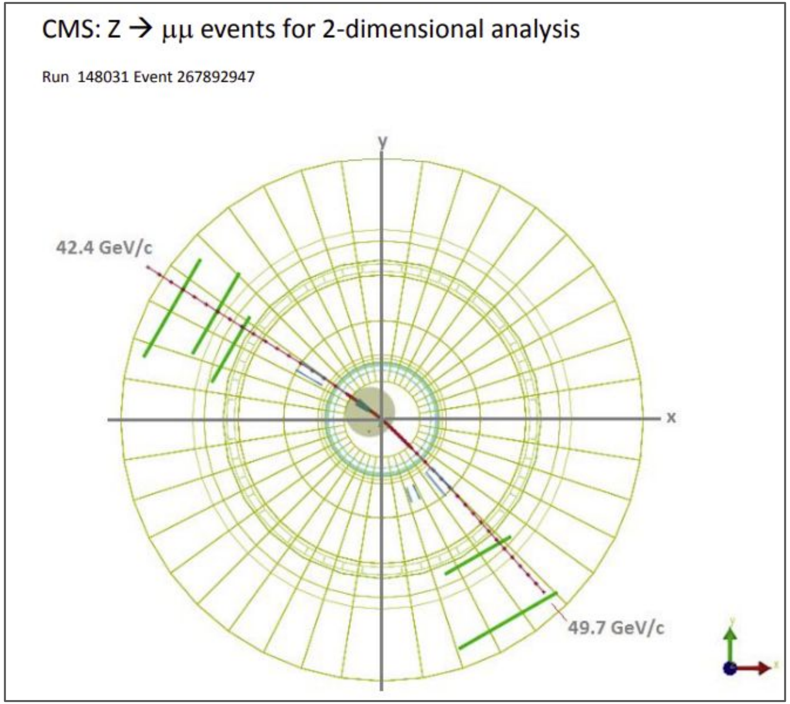
QuarkNet Resources

- quarknet.org
- Cosmic ray detectors & cosmic watches
- Data Activities Portfolio
- CMS & Cosmic Ray e-Labs
- *Friday Flyer* newsletter
- Coding support
- Particle physics masterclasses
- Others…





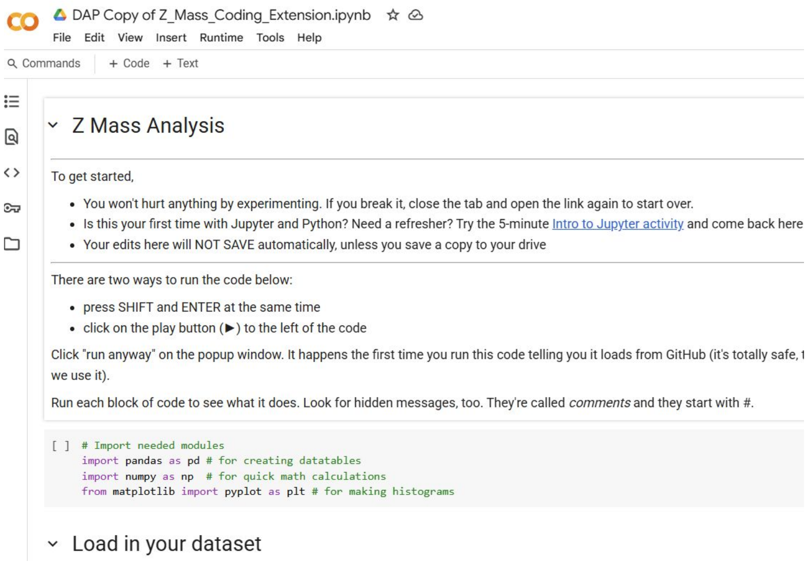
Data Activities Portfolio - Mass of the Z



$$E^2 = p^2c^2 + m^2c^4$$

Solve for m

$$m = \sqrt{\frac{E^2 - p^2c^2}{c^4}}$$

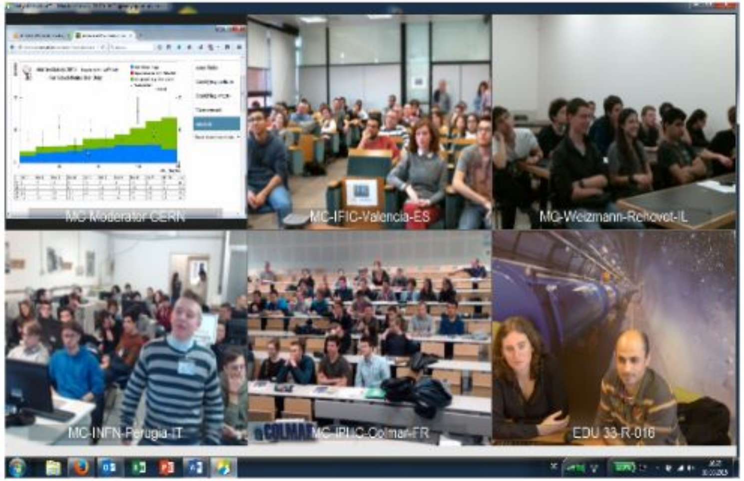


Particle Physics Masterclasses

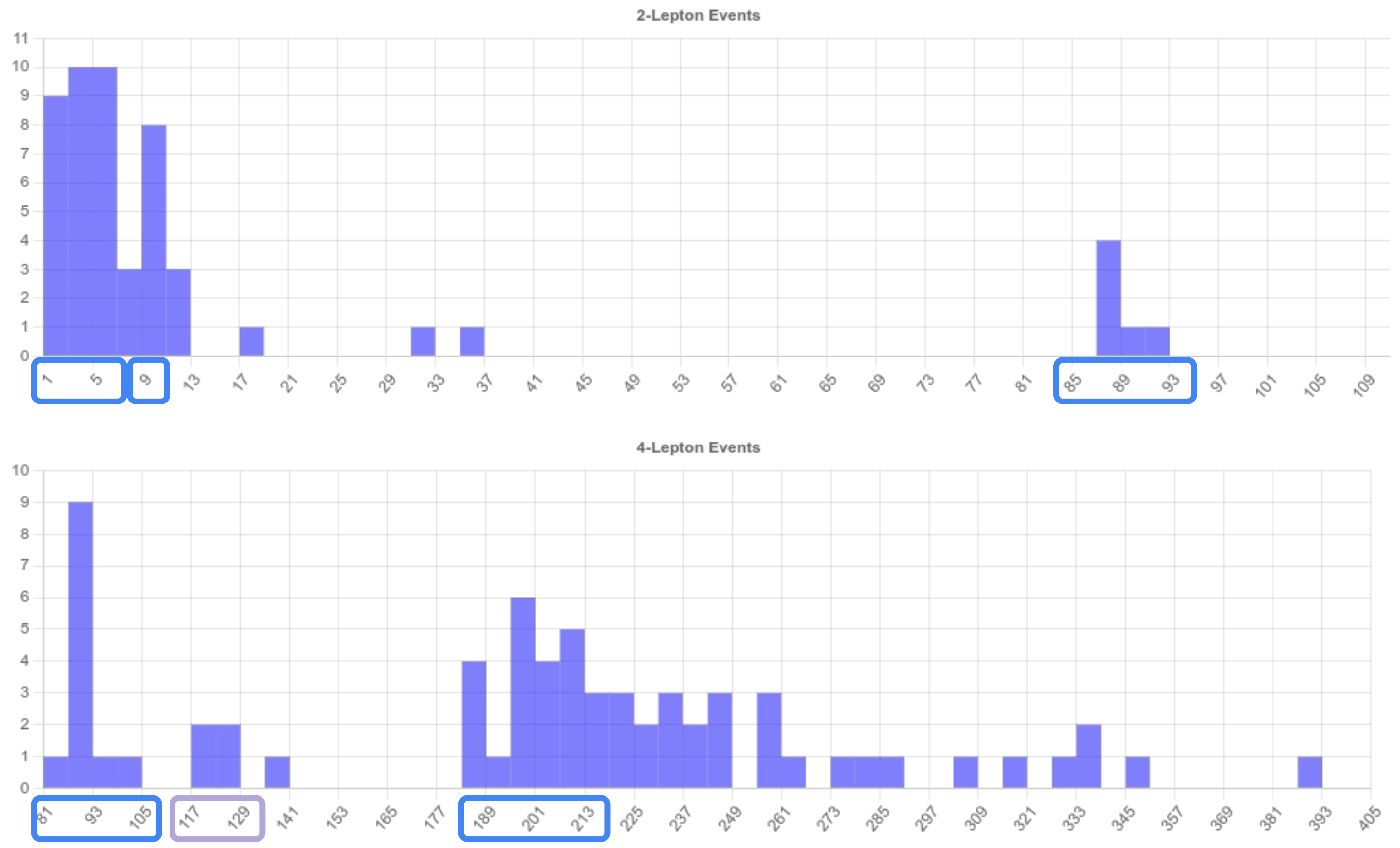
High school students **(13k+/year)** come to a research lab to be *“scientists for one day”*

- Intro to particle physics
- Analyze authentic data from experiments
- International video conference with other groups + CERN / Fermilab / KEK / GSI…

Like a masterclass in the arts but in particle physics!



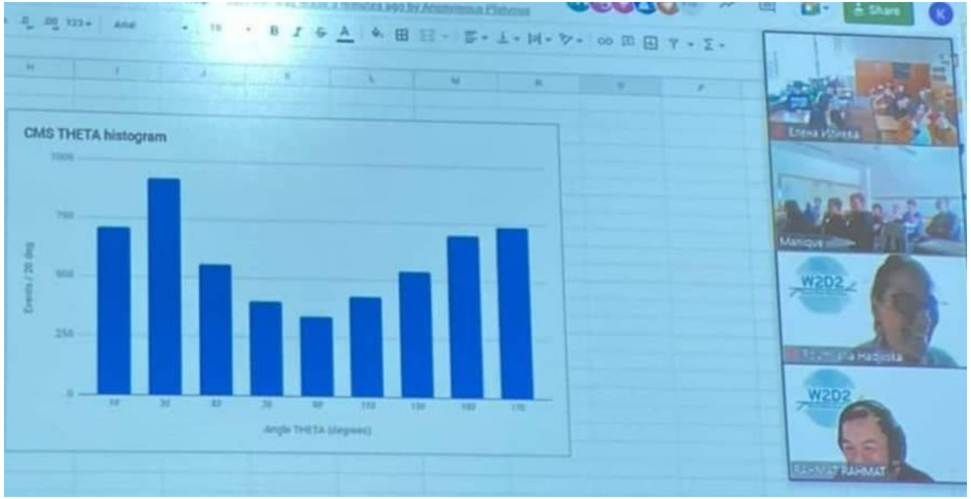
Particle Physics Masterclasses @ Rice - 03/29/2025



World Wide Data Day

High school teachers and students make simple measurements of dimuon events in LHC

- All done in school
- Combination of results and videocons all on one day each autumn
- About 2 hr, soup to nuts!



Let’s explore some more…

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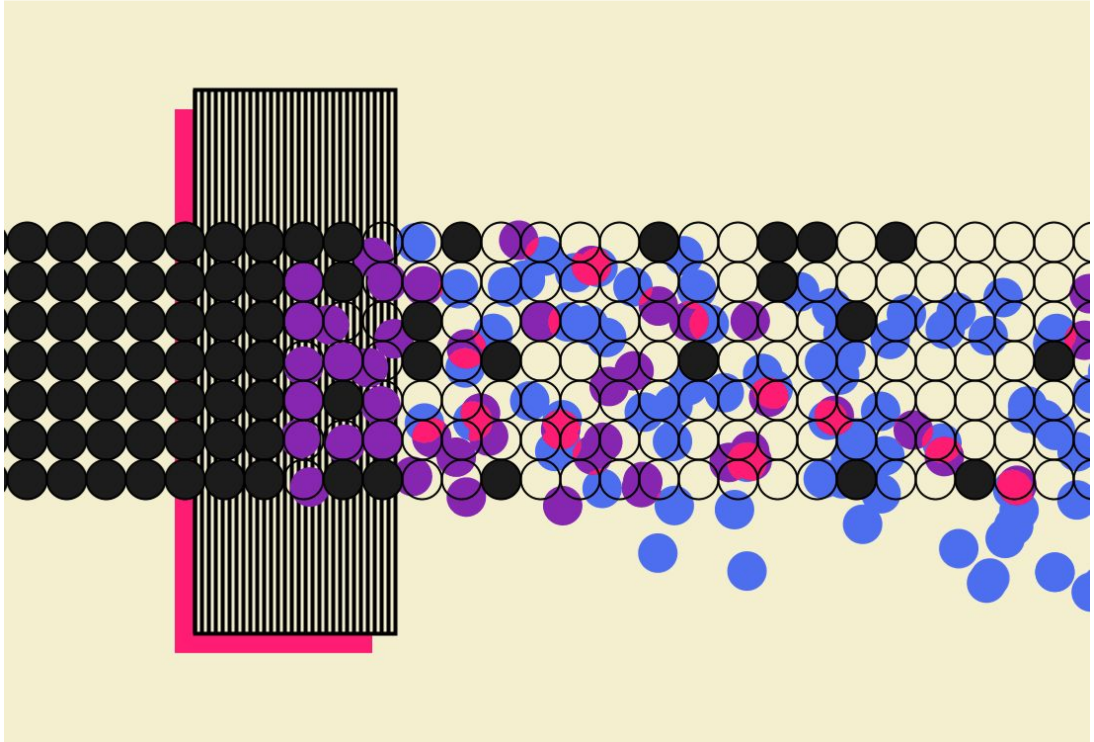
We want to learn more about the Muon Collider and hope we can help the effort.

Extra slides…



Particle Physics Masterclasses @ Rice - 03/29/2025

https://star.rice.edu/outreach/quarknet/masterclass2025/

Local organizers: Frank Geurts, Darin Acosta
(in collaboration with QuarkNet teachers)

Agenda:

- Lecture on Introduction to Particle Physics
- Lecture on Introduction to detectors, accelerators and how to detect particles
- Lecture on Instructions on how to use CIMA and iSpy
- Physics demonstrations
    - Including cloud chamber

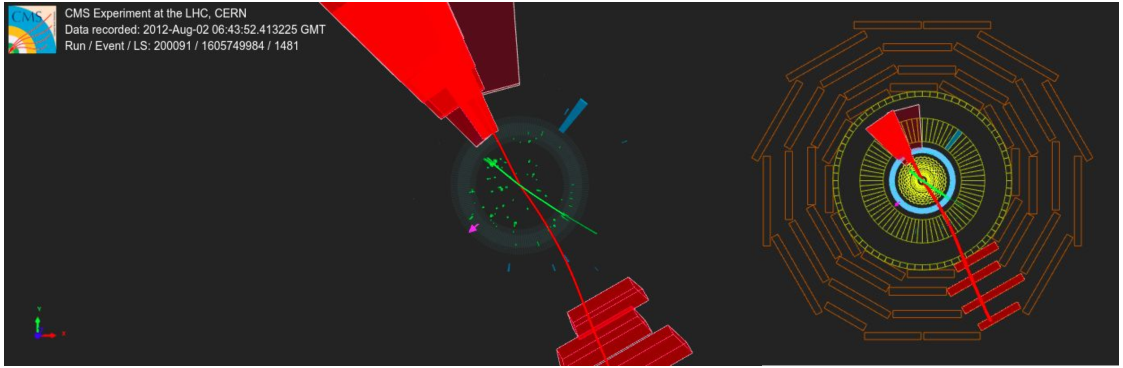
A day as a particle physicist!!!

Particle Physics Masterclasses

How is simplified analysis performed by the high school students?

iSpy: Event Display

(Link)



CIMA: CMS Instrument for Masterclass Analysis

(Link)