

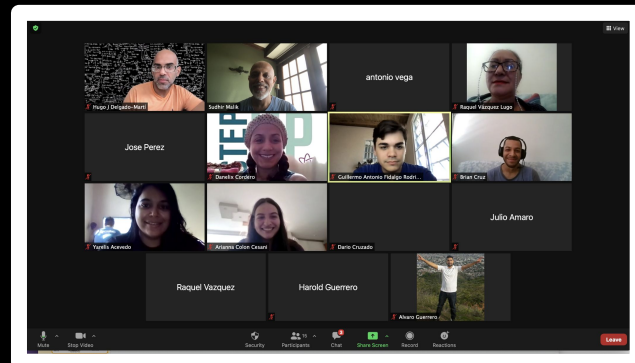
Software Training Outreach (in IRISHEP-QuarkNet)

26th International Conference on Computing in
High Energy & Nuclear Physics (CHEP 2023)

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LaMee (University of Central Florida) Cordero, Danelix (CROEM High School (Departamento
de Educación de Puerto Rico)) Dr. Gleyzer, Sergei (University of Alabama) Cecire,
Ken (QuarkNet National Staff at University of Notre Dame)



- IRIS-HEP workforce development activities contribute to the preparation of a highly qualified STEM workforce
- Several events organized
- Connect with Physics teachers
 - Growing partnership with QuarkNet
 - Run additional summer coding camps for K-12 teachers in US
 - Software training outreach in Puerto Rico
 - Social media (Facebook groups)
 - Society of Physics teachers
- Serves as an opportunity for the to perform public engagement and impact the nation's STEM education

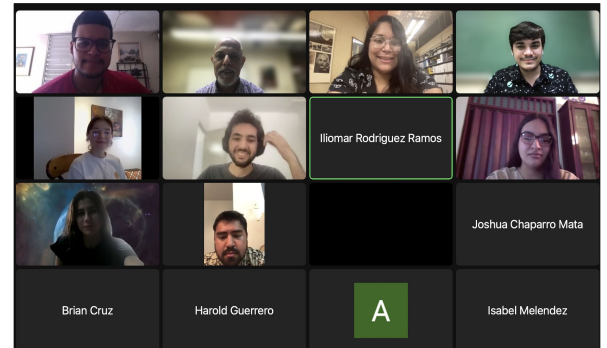
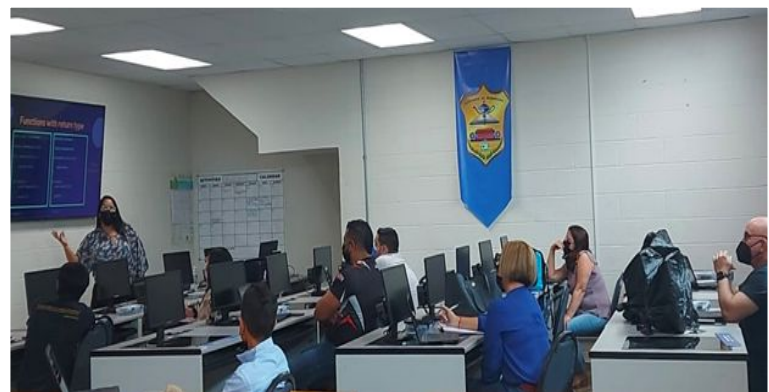


That kind of feedback is music to the ears of Sudhir Malik, associate professor of physics at the University of Puerto Rico, Mayaguez Campus. Malik is part of IRIS-HEP and collaborating principal investigator (with Elmer) on a related NSF-funded project called "Framework for Integrated Software Training for High Energy Physics," or FIRST-HEP. Malik and his colleagues are responsible for prototyping various outreach and training ideas such as hackathons and programming workshops for STEM teachers.

Said Malik: "While our core software training model is built around high energy physics institutes, universities and national labs worldwide, it is also well positioned to engage corresponding local communities of K-12 teachers and students in STEM disciplines in cybertraining and software skills. We recently launched several activities, including software workshops, machine learning hackathons and Python programming for STEM teachers, which are all steps in this direction."

Outreach events

Year	Month	Name	Participants/ Tutors
2022	July	Coding Camp at Fermilab (1 week) with QuarkNet	21/5
2022	Mar	<u>Data Analysis for Lab Research (Virtual)</u> (1 day)	20/3
2021	Aug	<u>Arduino Micro Controller and C++ programming (STEM Teachers)</u> (In person) (2 days)	9/3
	Feb	<u>Machine Learning Basics for STEM teachers (Virtual)</u> (2 days)	8/3
2020	July	<u>Data Analysis for STEM teachers (Virtual)</u> (2 days)	16/3
	June	<u>Data Camp for STEM teachers (Virtual)</u> (1 day)	11/3
2019	June	<u>An introduction to programming for STEM teachers (2 days)</u>	16/1
	April	<u>Machine Learning Workshop/Hackathon</u> (3 days)	25/1





- Introduction to Programming
- Python, Jupyter notebooks, Colab
- hands-on Data analysis
- HEP data preview with CMS Open Data Examples

To implement a strategic plan for training high school teachers, IRISHEP and QuarkNet have developed a program to provide software training paths from science teachers

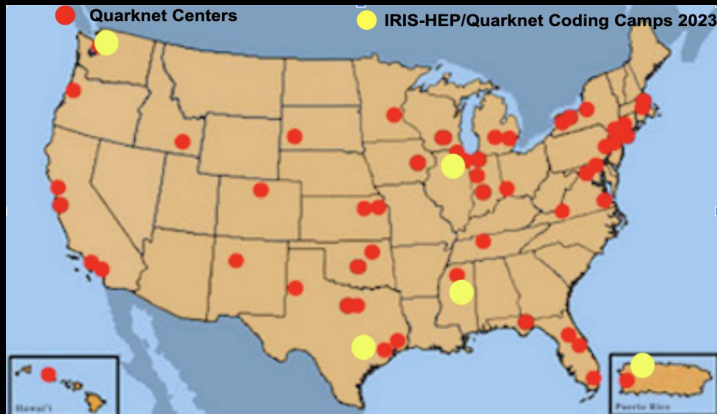


Danelix Cordero - Rosario - CHEAP 2023, Virginia, USA



QuarkNet

- Brings real research experience to high school Science teachers, students, and classrooms.
- QuarkNet has ~50 centers in universities and laboratories participating in high energy physics experiments

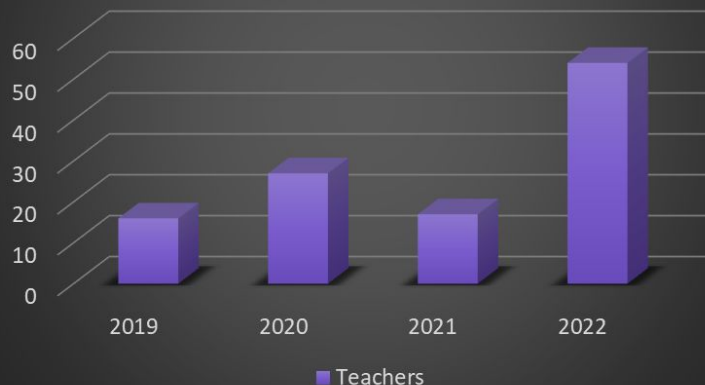


IRIS-HEP

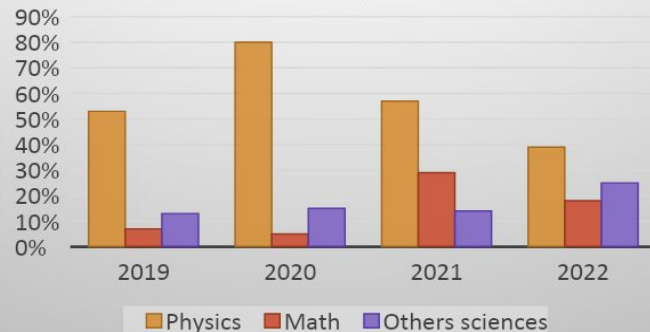
- Growing partnership with QuarkNet to run additional summer coding camps for K-12 teachers
- Serves as an opportunity for public engagement and impact the nation's STEM education.



Summary of teacher's participation in coding activities held in the last years



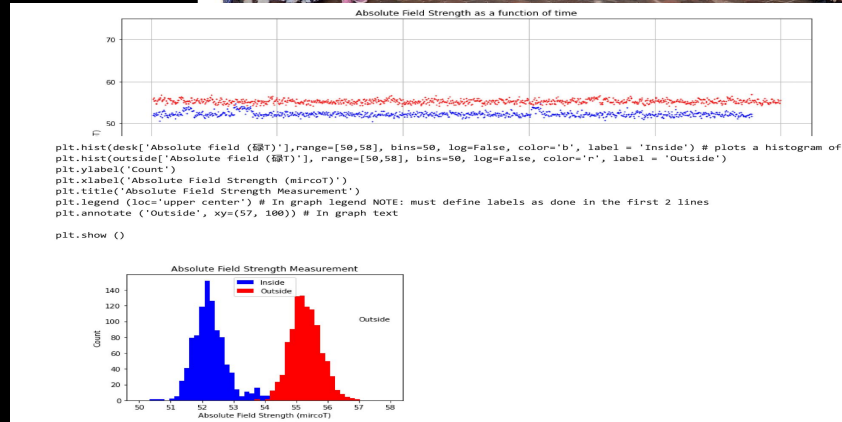
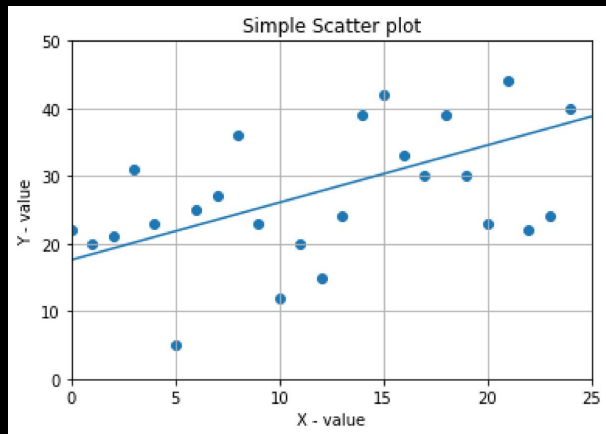
Teachers – Participation and Specialty



- Teacher participation has increased over the years
- Teachers develop educational material at the end of the workshop e.g. python notebooks on physics topics for students
- Inclusive – more teachers of different specialties
- Increase the cross-cultural and diversity in the teacher's participation

Coding Camp content

- Coding Camp (google colab, Jupyter notebooks)
- Data Visualization: Plot a function with lines, pace and customize plots with pyplot, define a function.
- B-field Variation: Analyze data from mobile app
- Muon Tracks: Analyze tracker data from muons in CMS
- Muon Tracks with Machine Learning: Repeat the muon tracks analysis with several machine learning



Objectives



1. Review and reteach core concepts of particle physics, such as the framework of the Standard Model, the anatomy of a particle accelerator and detector, and the methods for calculating invariant mass from 4-vector data.



2. Review and apply basic aspects of computer programming in Python, such as conditional, math functions and plotting, and file manipulation.



3. Use simple programming tools to analyze large datasets generated from the CMS experiment in the 2010 and 2011 runs; and, run analyses of these data. Generate conclusions about these analyses that include both calculations and plots (e.g., of invariant or transverse mass).



4. Search for new scientific datasets available online and write code to perform analyses of these new data.



5. Design a series of code-centered activities that either add onto existing units in a high school physics course or replace an already existing activity; create a plan from implementation of these activities.

Implementation Plan

Modules

The curriculum is comprised of a set of standardized modules, so that students can focus on what is most relevant to them.

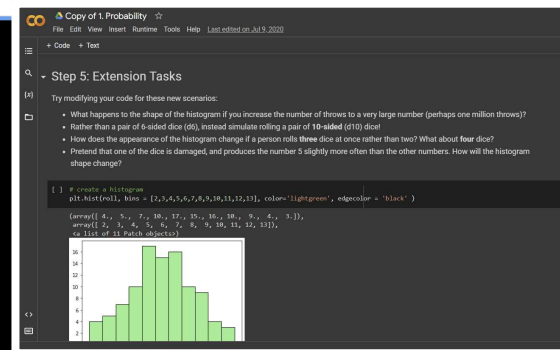
The modules

Basics

The UNIX Shell A guide through the basics of the file systems and the shell. Start learning now! Contribute!	Version controlling with git Track code changes, undo mistakes, collaborate. This module is a must. Start learning now! Contribute!	Programming with python Get started with an incredibly popular programming language. Start learning now! Contribute!
SSH Introduction to the Secure Shell (SSH) Status: Early development Start learning now! Contribute!	Machine learning Get behind the buzzword and teach machines to work for you intelligently! Start learning now! Watch the videos! Contribute!	Matplotlib for HEP Make science prettier with beautiful plots! Status: Beta testing Start learning now! Contribute!
ROOT The most famous data analysis framework used in HEP. Start learning now! Contribute!		

Software Development and Deployment

Microsoft Windows Workflow Suite



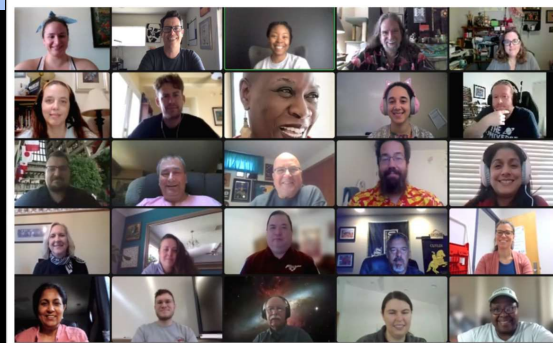
“student hat” Engage, Explore, Explain

- Teachers work in groups
- Running Python code
- Using pre-Jupyter notebook
- Review basic coding
- Use CMS data



“teacher hat” Elaborate and Evaluate

- Teachers develop implementation plans for their own classroom
- Writing Jupyter notebook
- Adapt and apply appropriately to their classroom





More Workshops across the nation

More virtual Workshops - Spanish and English language

More HEP data relevant to HS Physics content

Coding Camps

- Engage in Coding Techniques
- 2 or 3 days in basic programming
- More model-fitting and ML

Thanks for your attention!

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