

You are qualified to be teachers!

Join IRIS-HEP/HSF Training!

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(Princeton University)





Institute for Research and for High Energy Physics

- [Analysis Systems](#)
- [Blueprints](#)
- [Data Organization, Management and Access \(DOMA\)](#)
- [Innovative Algorithms](#)
- [OSG-LHC](#)
- [Scalable Systems Laboratory](#)
- [Training, Education and Outreach](#)
- [Grand Challenges](#)
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- [Education and Outreach](#)
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Computational and data science research to enable discovery in fundamental physics

IRIS-HEP is a software institute funded by the National Science Foundation. It provides state-of-the-art software cyberinfrastructure required for the challenges of data science research at the High Luminosity Large Hadron Collider (HL-LHC) at CERN, and other experiments of the 2020's. These facilities are discovery machines which aim to uncover fundamental building blocks of nature and their interactions. [Full Overview](#)

News and Featured Stories:



- [Fermilab](#)
- [Cornell University](#)
- [International and Energy](#)
- [Munich, Germany](#)
- [Python 2024 - Python in HEP" Developer's Workshop](#)
- [Sep 4-6, 2024 University of Washington IRIS-HEP Institute Retreat](#)
- [Sep 23-25, 2024 Valencia \(Spain\) Fourth MODE Workshop on Differentiable Programming for Experiment Design](#)

[View all past events](#)

Training, Education and Outreach

Quick links

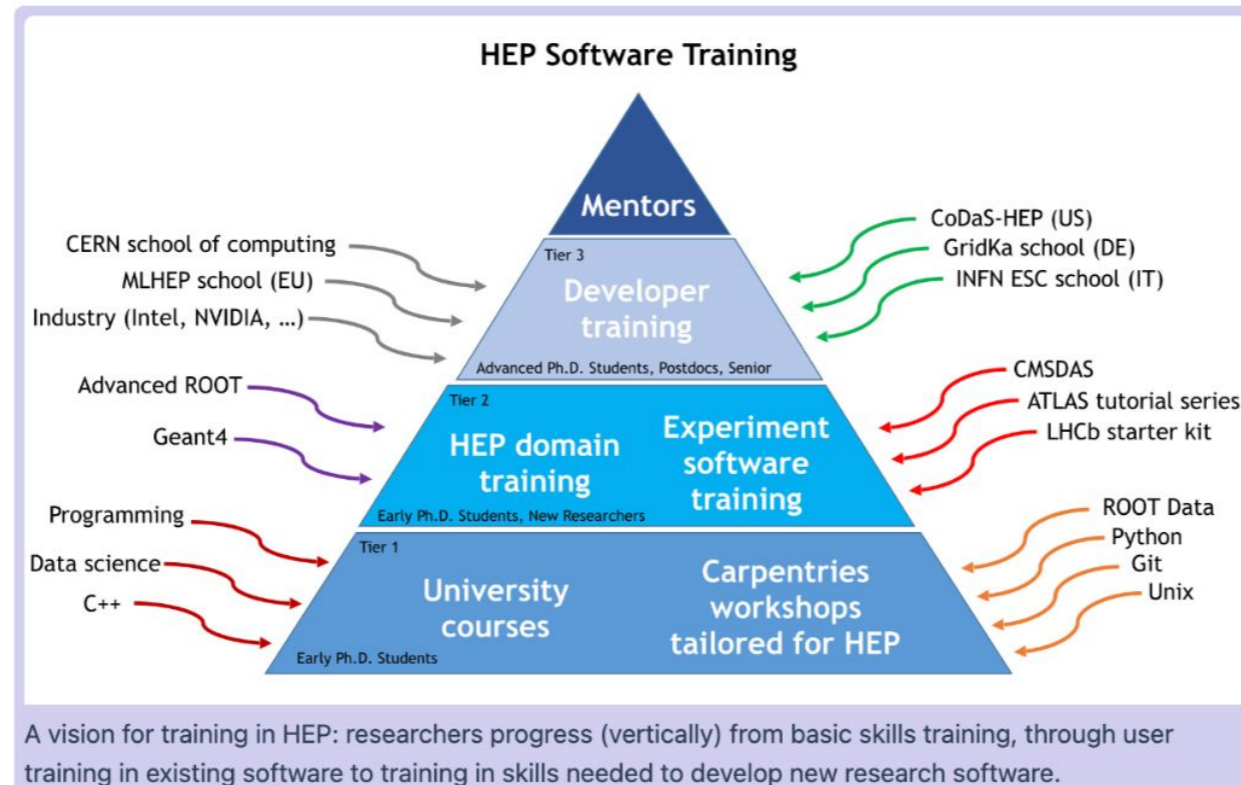
- [Upcoming and recent events](#)
- [Training Modules and videos](#)
- [HSF Training Events](#)
- [Education and Outreach](#)

Introduction

The long-term sustainability of the research software ecosystem is particularly important for HEP, given that the HL-LHC and other facilities will be relevant through at least the 2030s. The IRIS-HEP Software Sustainability Core (SSC) focuses on activities which promote the sustainability of the software. The SSC has primarily focused on **Training, Education and Outreach**.

To implement this vision, IRIS-HEP has developed a program to provide software training paths from a researcher's first steps through active contribution along with its partners: [HSF](#), [FIRST-HEP](#) and the [Carpentries](#). In particular, it has developed an [introductory HEP software](#) and several software modules on techniques and methods for computing and data science. The training program has enabled HEP users to contribute to their research and contribution to the field. The common efforts on training across HEP has helped build a strong sense of community.

Our efforts have established a platform from where we can scale and sustain our training efforts. Our training vision is reflected in the



Best Practices

IRIS-HEP continues to document, disseminate, and work towards community adoption of the best practices (from HEP and beyond) in the areas of software sustainability, including topics in software engineering, data/software preservation, and reproducibility. Of particular importance are best practices for the software development process for scientists.

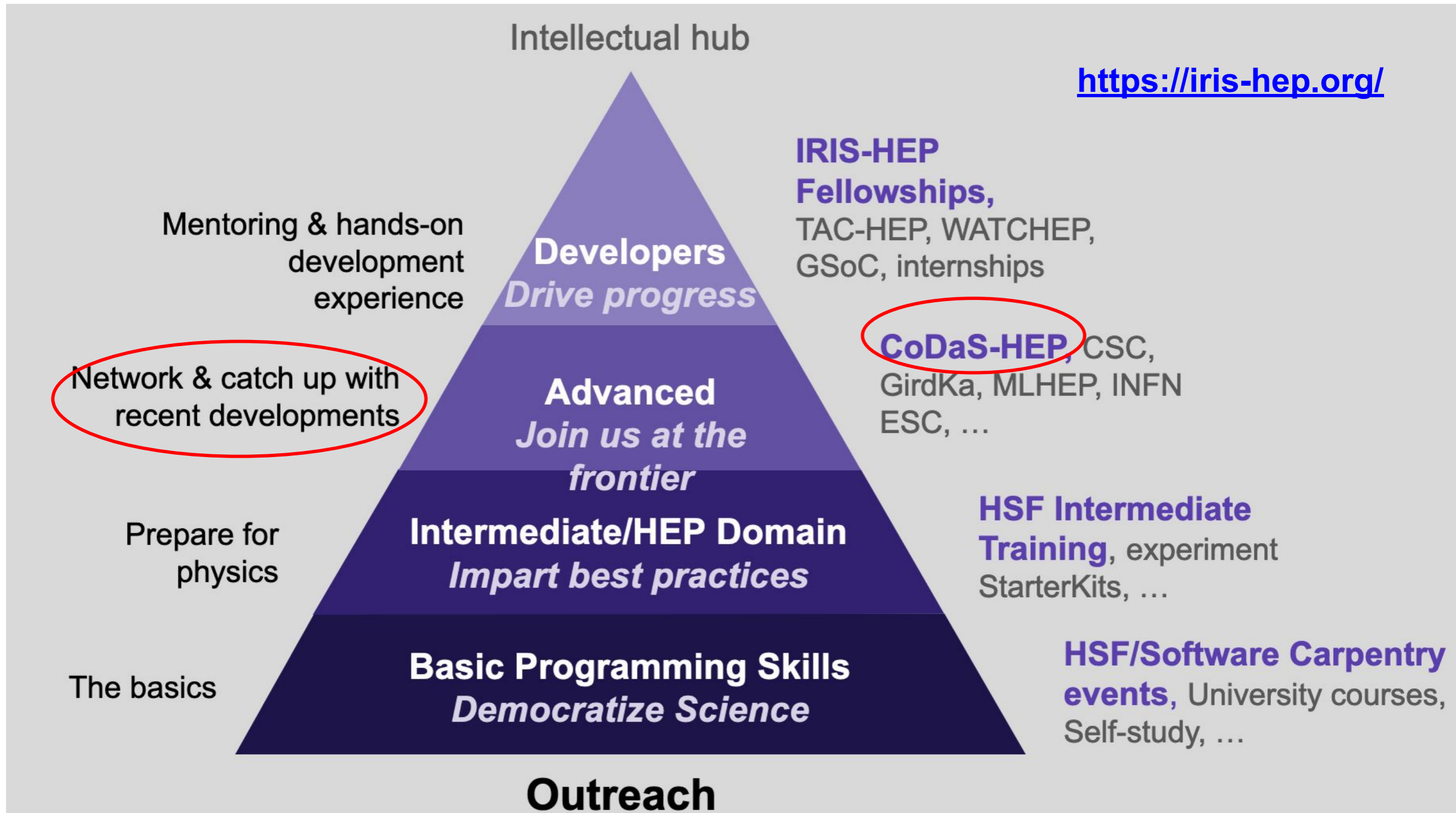
Upcoming and Recent Training and Outreach Events


- 2 Jul - 26 Jul, 2024 - [CoDaS-HEP 2024 - Computational and Data Science Training](#)
- 21 Jul - 26 Jul, 2024 - [Coding Camp - Fermilab \(Fermilab\)](#)
- 18 Jul - 19 Jul, 2024 - [USATLAS/IRIS-HEP Software Training \(University of Washington\)](#)
- 25 Jun - 27 Jun, 2024 - [Coding Camp - Nebraska \(University of Nebraska Lincoln\)](#)
- 20 Jun - 21 Jun, 2024 - [USCMS/IRIS-HEP Software Training \(Princeton University\)](#)
- 10 Jun - 12 Jun, 2024 - [Coding Camp - Oklahoma \(Oklahoma State University\)](#)
- 10 Jun - 13 Jun, 2024 - [Coding Camp - Puerto Rico \(University of Puerto Rico\)](#)
- 5 Jun - 5 Jun, 2024 - [HSF/IRIS-HEP Python for Analysis Training \(Virtual\) \(Virtual\)](#)
- 20 May - 21 May, 2024 - [HSF/IRIS-HEP Software Basics Training \(Virtual\) \(Virtual\)](#)
- 24 Apr - 26 Apr, 2024 - [Joint ATLAS / IRIS-HEP Kubernetes Hackathon \(University of Washington\)](#)
- 26 Feb - 1 Mar, 2024 - [Training on Analysis Pipelines \(Virtual\) \(Virtual\)](#)
- 22 Nov - 22 Nov, 2023 - [HSF/IRIS-HEP Python for Analysis Training \(Virtual\) \(Virtual\)](#)
- 13 Nov - 14 Nov, 2023 - [HSF/IRIS-HEP Software Basics Training \(Virtual\) \(Virtual\)](#)
- 23 Jul - 28 Jul, 2023 - [Coding Camp 2 \(Fermilab\) \(Fermilab\)](#)
- 17 Jul - 21 Jul, 2023 - [CoDaS-HEP 2023 - Computational and Data Science Training](#)
- 13 Jul - 14 Jul, 2023 - [HSF/IRIS-HEP Software Basics Training \(Virtual\) \(Virtual\)](#)
- 12 Jul - 12 Jul, 2023 - [HSF/IRIS-HEP Python for Analysis Training \(Virtual\) \(Virtual\)](#)
- 10 Jul - 12 Jul, 2023 - [Coding Camp \(Virtual\)](#)
- 10 Jul - 12 Jul, 2023 - [Coding Camp - Univ of Washington, Seattle \(Washington, State\)](#)

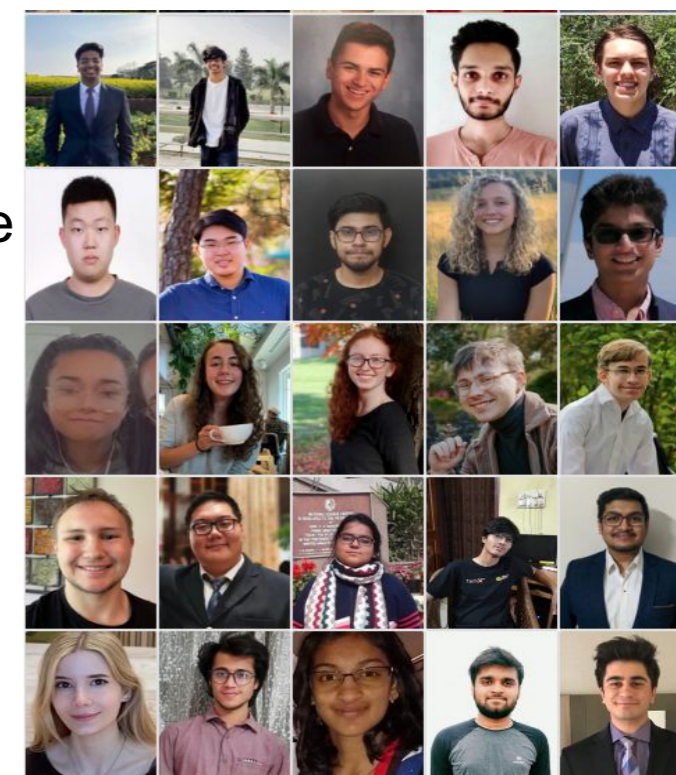
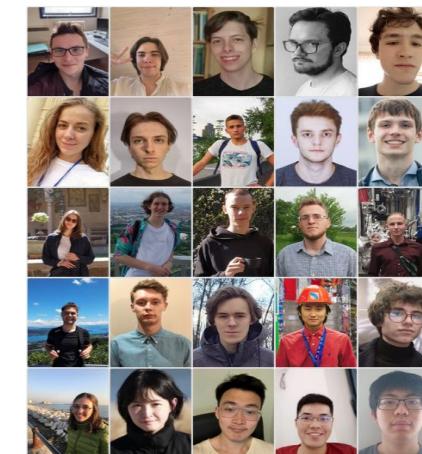
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Training - an Intellectual Hub

Brings expertise from LHC Experiments, Neutrino and Nuclear Physics community



- Software Training Curriculum provided by HSF/IRIS-HEP
 - [IRIS-HEP](#) (Institute for Research and Innovation in Software for HEP)
 - [HSF](#) (HEP Software Foundation) 
- HSF/IRIS-HEP provides software training hub for new researchers in
 - High Energy Physics (LHC)
 - Related communities - Nuclear, Neutrino, Astro, Theory
- Software Skills are essential
 - To produce high-quality and sustainable software needed to do the research, solve future challenges
- Thousands of users in the community
 - Sustainability is the centerpiece of its approach
- The training modules are
 - [Open source](#) - [GitHub](#), [Slack](#), [Websites](#), [Indico](#), [youtube videos](#)
 - Enable technical continuity, collaboration and nurture the sense to develop software that is reproducible and reusable
- Pivotal Role in making training integral of HEP future
- Made huge input impact to Snowmass 2021 process on [Community Engagement Efforts](#)
- Training Scientists, Postdocs, Graduate Students, Undergrads
- Broader Impacts - Training High School Teachers, diversity



HSF Training Center
Training and educational material for the High Energy Physics community.

Curriculum All Tutorials

Basic
Basic skills for HEP software development.

- The UNIX Shell** - A guide through the basics of the file systems and the shell. [GitHub](#)
- Version controlling with git** - Track code changes, undo mistakes, collaborate. This module is a must. [GitHub](#)
- Programming with python** - Get started with an incredibly popular programming language. [GitHub](#)
- SSH** - Introduction to the Secure Shell (SSH), your number one tool for remote computing. [GitHub](#) Early development
- Machine learning** - Get behind the buzzword and teach machines to work for you intelligently! [GitHub](#) [Videos](#)
- Matplotlib for HEP** - Make science prettier with beautiful plots! [GitHub](#) Beta testing
- ROOT** - The most famous data analysis framework used in HEP. [GitHub](#)

- Machine learning** - Get behind the buzzword and teach machines to work for you intelligently! [GitHub](#) [Videos](#)
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- ROOT** - The most famous data analysis framework used in HEP. [GitHub](#)

Software Development and Deployment
Ensure that your code is easy to use and maintain.

- Version controlling with git** - Track code changes, undo mistakes, collaborate. This module is a must. [GitHub](#)
- Advanced git** - Learn to work with branches and more with this interactive webpage. [GitHub](#)
- CI/CD (gitlab)** - Continuous integration and deployment with gitlab: automatically run unit tests and more for every commit that you push on gitlab. [GitHub](#) [Videos](#)

- Docker** - Introduction to the docker container image system. Docker allows to consistently run your code in any environment or on any machine, making it an important ingredient to analysis preservation. [GitHub](#) [Videos](#)
- Singularity** - Introduction to containerization with Singularity/Apptainer. Singularity is a containerization tool (similar to Docker) that is particularly useful for HPC environments. [GitHub](#) [Videos](#)
- Reproducible analyses with REANA** - Run containerised data analysis pipelines on remote compute clouds. [GitHub](#)
- Unit testing** - Unit testing in python. [GitHub](#) Beta testing

- CI/CD (github)** - Continuous integration and deployment with github actions: automatically run unit tests and more for every commit that you push on github. [GitHub](#) [Videos](#)
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- Unit testing** - Unit testing in python. [GitHub](#) Beta testing
- Level up your python** - Advanced bits of python (testing, debugging, logging, and more). [GitHub](#)
- Software Engineering for Scientific Computing** - This course covers various best practices like testing, object oriented programming, packing, CI, and more. [GitHub](#)
- C++ corner** - Learn C++ for blazing fast code! [GitHub](#)
- HEP C++ Course** - A full introduction to C++ based on a series of slides and exercises. [GitHub](#) [Videos](#)
- Build systems: cmake** - Building code is hard. CMake makes it easier. [GitHub](#)

Complete courses
These modules cover a variety of topics

- Software Engineering for Scientific Computing** - This course covers various best practices like testing, pytest, object oriented programming, packing, CI, and more. [GitHub](#)
- Level up your python** - Advanced bits of python (testing, debugging, logging, and more). [GitHub](#) Beta testing
- Particle physics methods** - Learn about ROOT, RooFit, machine learning with TMVA, and physics simulations. [GitHub](#) Beta testing
- LHCb Analysis Essentials** - From python, shell, and git to reproducible analyses with Snakemake. Written for LHCb, but applicable to everyone. [GitHub](#)
- Julia corner** - Learn Julia for fast and easy code! [GitHub](#)
- Julia** - An introduction to Julia for HEP, especially for those familiar with Python (or C++). [GitHub](#)
- UnROOT** - Open ROOT files in Julia! [GitHub](#) Beta testing

HEP specific tools
Workflows and reproducibility

- Scikit-HEP** - A collection of packages for particle physics analysis in Python. [GitHub](#)
- ROOT** - The most famous data analysis framework used in HEP. [GitHub](#)
- UnROOT** - Open ROOT files in Julia! [GitHub](#) Beta testing
- Reproducible analyses with REANA** - Run containerised data analysis pipelines on remote compute clouds. [GitHub](#)
- Particle physics methods** - Learn about ROOT, RooFit, machine learning with TMVA, and physics simulations. [GitHub](#) Beta testing

Data Analysis
Machine Learning and other analysis tools

- Machine Learning** - Get behind the buzzword and teach machines to work for you intelligently! [GitHub](#) [Videos](#)
- Machine Learning on GPU** - Speed up your machine learning using massive parallelization! [GitHub](#) [Videos](#)

HSF iris hep

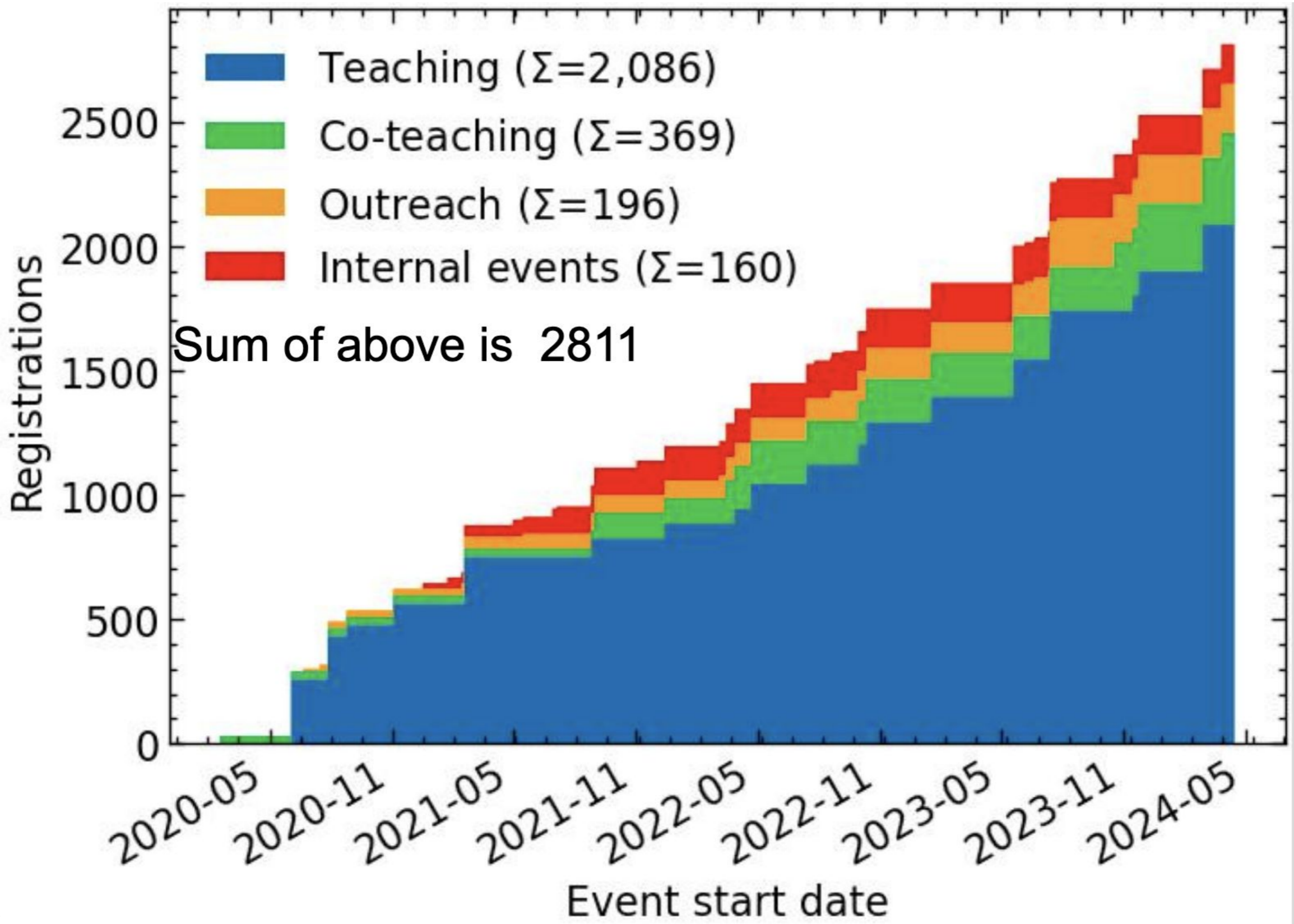
HSF Training Center
Training and educational material for the High Energy Physics community.

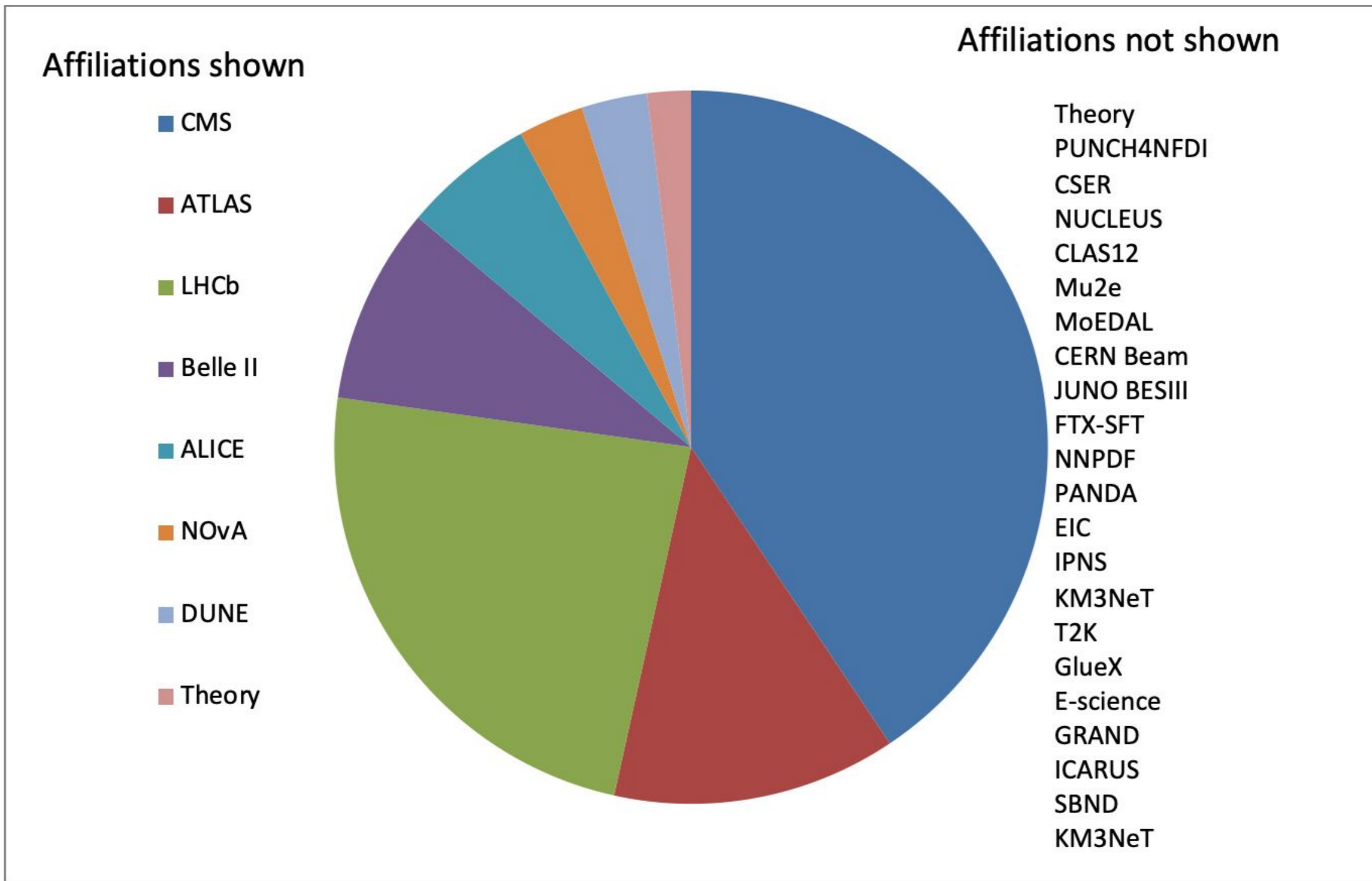
Curriculum All Tutorials

Home Contribute About

- Analysis preservation** - Learn how to ensure that your analysis survives the test of time. [GitHub](#)
- Version controlling with git** - Track code changes, undo mistakes, collaborate. This module is a must. [GitHub](#)
- CI/CD (gitlab)** - Continuous integration and deployment with gitlab: automatically run unit tests and more for every commit that you push on gitlab. [GitHub](#) [Videos](#)
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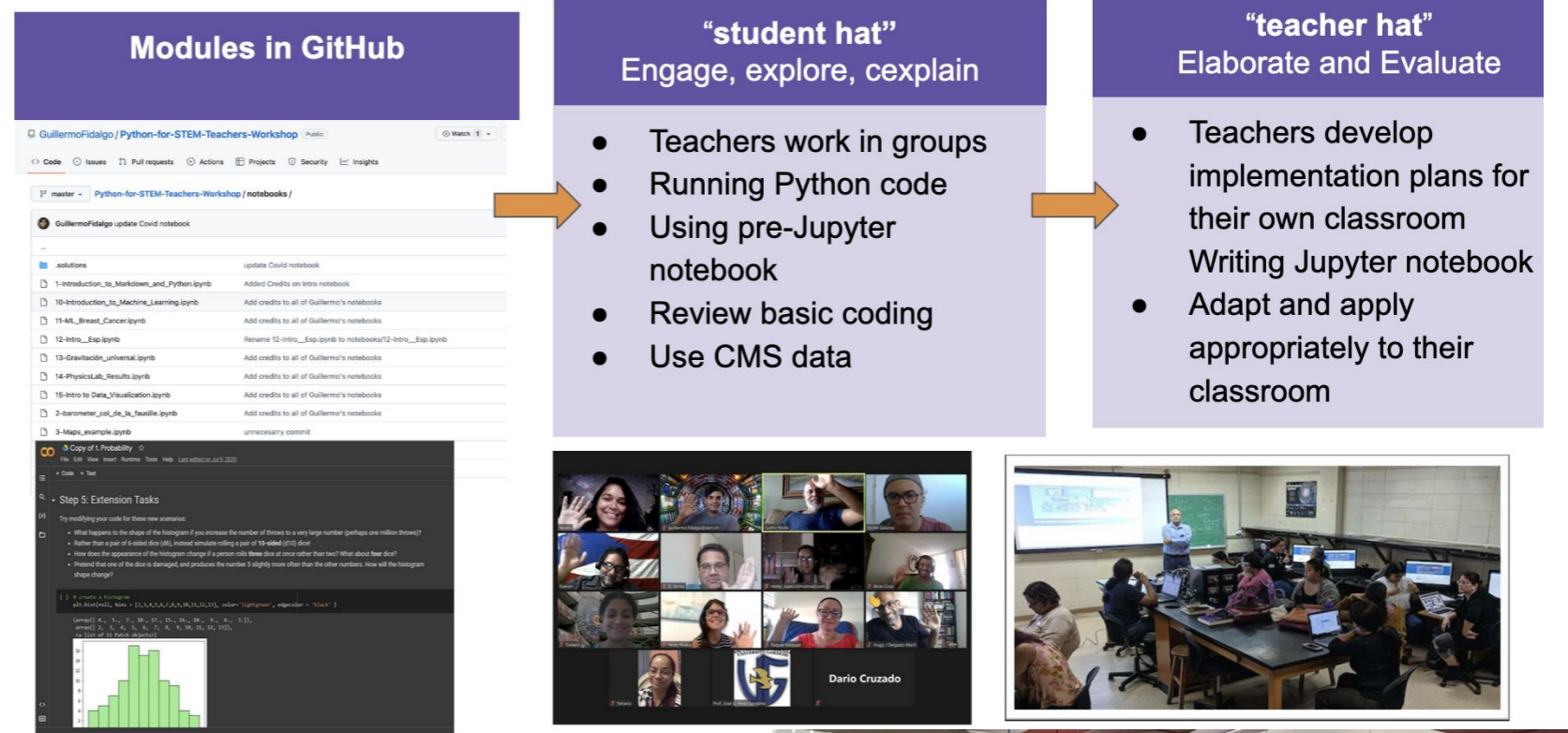
Participants





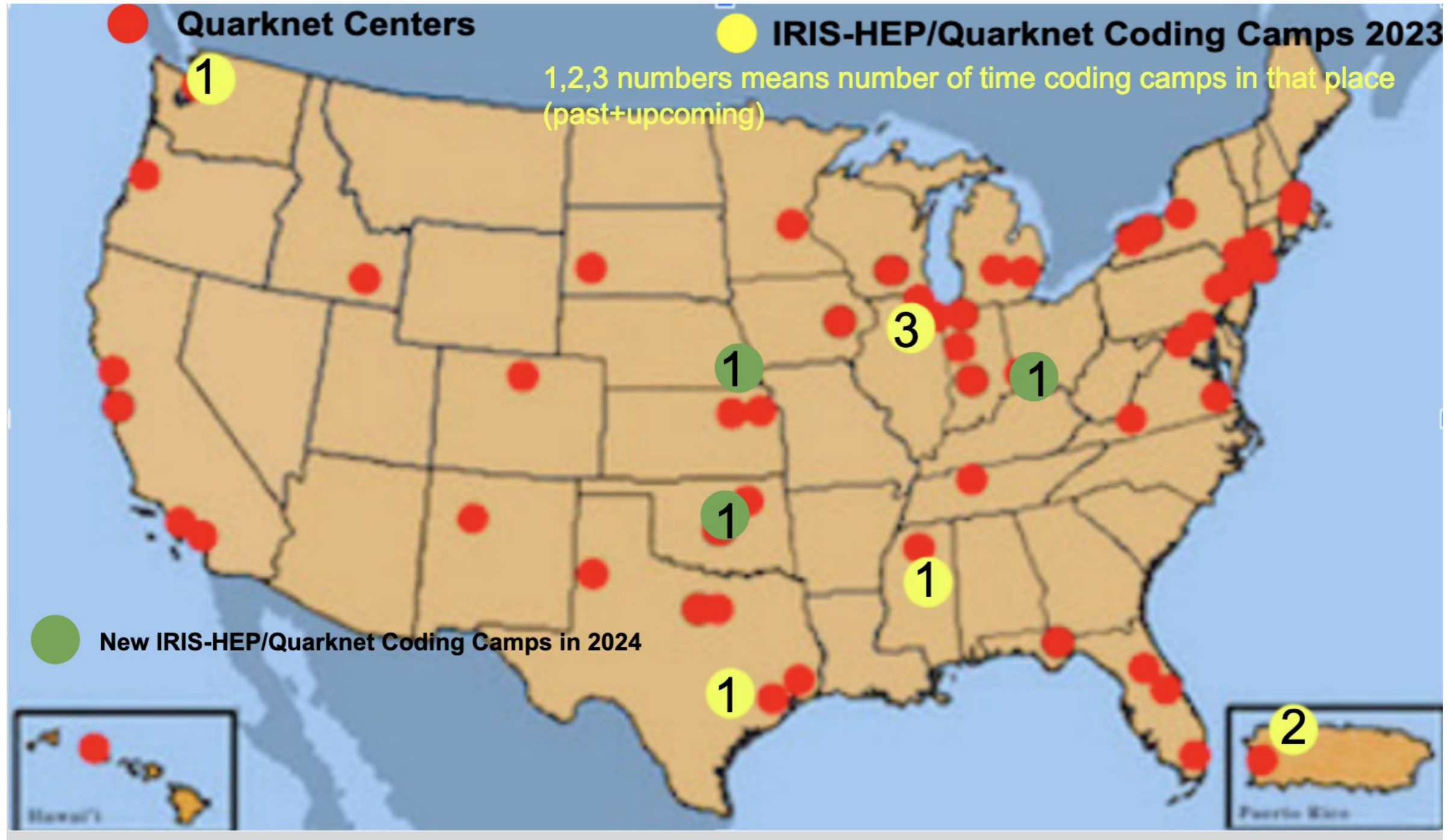
Coding Camp for K-12 Teachers

- Software awareness and skill development among high school students via teachers
- Developed Software module
- Coding Camps
- Relation with community of teachers to expand and sustain our efforts
- Access to wider community of teachers to get software training
- Notebooks in Spanish
- Breaks barriers and enables diversity



Coding Camps

For High School Teachers - Year 2023 and 2024 (synergy with Quarknet)



USCMS Internship Program

Software Training Curriculum provided by HSF/IRIS-HEP

Gives minoritized, MSI and HBU students opportunity for HEP tools

Internship programs

High School	>
Undergraduate	>
<p>Accelerator Engineering Fellowships for Underrepresented Minorities (ASPIRE)</p> <p>Business Intern Program (BIP)</p> <p>*Community College Internships (CCI)</p> <p>Cooperative Education Program</p> <p>Fermilab and Brookhaven Summer School Exchange Program</p> <p>Fermilab Environmental Management Internship (FEMI)</p> <p>Helen Edwards Summer Internship</p> <p>LBNF/DUNE in South Dakota FSCF Internship</p> <p>Lee Teng Undergraduate Internship</p> <p>Quantum Computing Internship for Physics Undergraduates Program (QCIPU)</p> <p>SQMS Quantum Undergraduate Internship</p> <p>*Summer Internships in Science and Technology (SIST)</p> <p>*Science Undergraduate Laboratory Internship (SULI)</p> <p>URA-Fermilab: Undergraduate Women in STEM</p> <p>US CMS Undergraduate Internship</p> <p>VetTech</p>	
Graduate	>
International Student Program	
Professional	>
Contact us	
FAQs	

US CMS Undergraduate Internship

Program Description

The US CMS Summer Undergraduate Research Internship Program seeks to address the under-representation of women and minoritized students in STEM fields, in particular Physics. It is a 10-week paid internship program, which offers female and minority undergraduate students an opportunity to perform a project under the mentorship of scientists working at the frontier of Physics at one of the **50+ institutions in the US**.

The internship program is open to students pursuing physics, engineering, computer science, math, chemistry, or related majors. We aim to strengthen our research by increasing diversity.

The research internships will be structured to encourage students to persist in a STEM major through college and to train them in skills needed for a future career in the STEM workforce, in order to sustain a diverse and inclusive talent pool in research and innovation.

This immersive research internship opportunity will cover areas in instrumentation, technology, and computing projects. Students will use computational tools and data-science methods to learn about fundamental particles and their interactions, by analyzing data obtained from the **CMS experiment** at the **Large Hadron Collider (LHC)** located at **CERN**, Switzerland. The pool of mentors are physicists from US institutes affiliated with the CMS experiment at the LHC and at the rank of university faculty, **Tougaloo College**, scientists from national labs, postdoctoral fellows, and advanced graduate students.

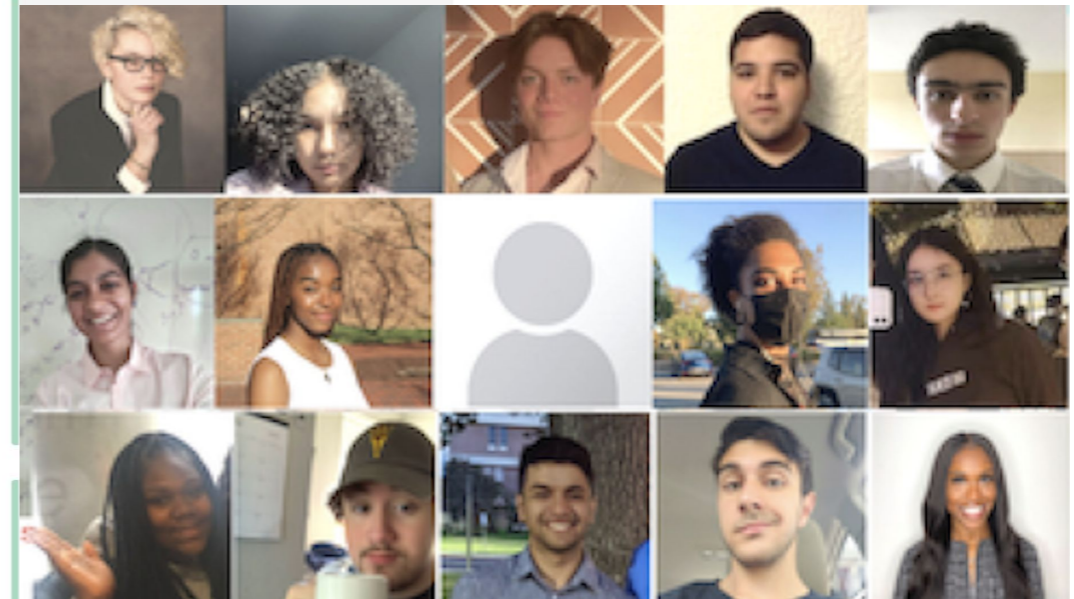
The program is funded by U.S. Department of Energy RENEW-HEP: U.S. CMS SPRINT award at Tougaloo College, Brown University, University of Puerto Rico (Mayaguez), and University of Wisconsin; and the U.S. CMS Operations program at Fermilab and the University of Nebraska-Lincoln.

Questions about the US CMS internship program can be directed to USCMS-PURSUE-COMMITTEE@fnal.gov.

Eligibility

- Be full-time undergraduate students enrolled at an accredited U.S. institution and have completed at least one year as a matriculating student
- Be at least 18 years of age
- Be able to work at one of the U.S. CMS institution sites, including Fermilab. In special circumstances remote participation maybe considered.

Application Procedure



- **Post CoDaS-HEP**
 - You are ready to teach !
 - And there are opportunity to teach software modules
- **Learn more by teaching**
- **Build Networking**
- **Make difference to your HEP community**
 - creating inclusive training environment

Become part of our training community

The HSF Training Community

To fulfill our mission, we rely on active community members to support us in various ways. We would like to thank everyone for their time, energy and dedication!

Community by year
See who contributed when.

Add/update my profile!
If you made contributions, don't hesitate to add yourself!

Our community



Participate & Contribute! <https://hepsoftwarefoundation.org/workinggroups/training.html>

The easiest way to get in touch are our weekly meetings, usually held at 16h00 CERN time on Mondays. Everyone is welcomed to discuss! Check **Indico** for details. The live notes and the zoom connection is linked in the right sidebar in the category view.

Everybody is welcome to join the **forum** dedicated to HSF training activities. This is the place where ideas and proposals are discussed and actions decided!

Talk to us!

We meet weekly, usually on Monday at 16h00 CERN time.

Chat with us on Slack!

Brainstorm your ideas with us.

Join the community!

Join more than 70 people working on our mission.

Browse our GitHub Organization!

Browse all of our training material. Issues & pull requests are always welcome!

Write us!

Use our public mailing list and reach a wide range of training enthusiasts.

- **IRIS-HEP Training website** : <https://iris-hep.org/ssc.html>
- **Training events**: <https://indico.cern.ch/category/11386/>
- **Weekly Training Meetings**: <https://indico.cern.ch/category/10294/>
- **IRIS-HEP Outreach events**: <https://indico.cern.ch/category/17100/>
- **Material (open access)**: All the training modules developed so far resides: <https://hsf-training.org/training-center/>
- **Training Community**: Our training community is listed here: <https://hepsoftwarefoundation.org/training/community.html>

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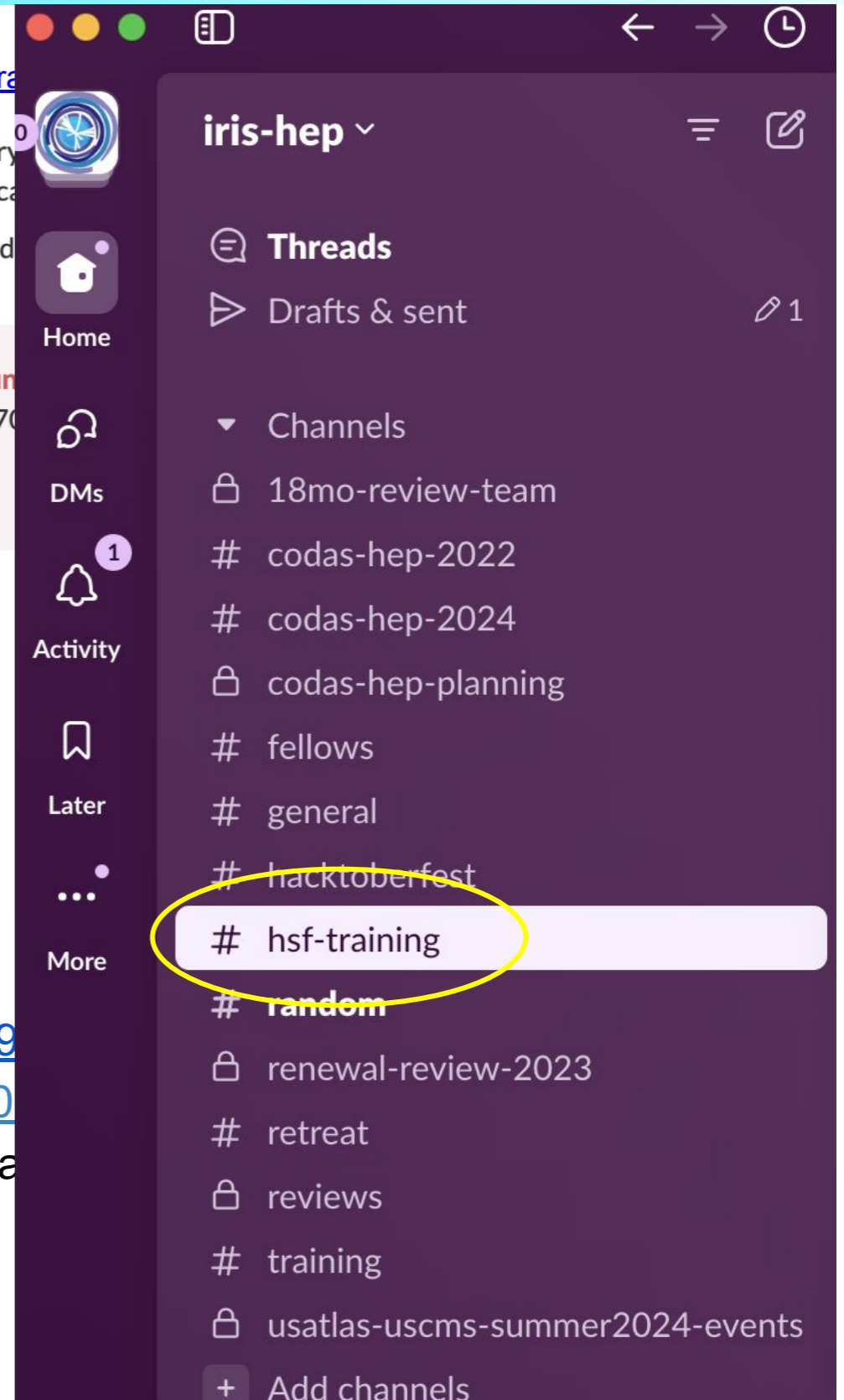
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Training based Publications and References

- A novel internship program in HEP <https://arxiv.org/abs/2401.16217> (2024)
- U.S. CMS - PURSUE (Program for Undergraduate Research SUMmer Experience) [arXiv:2209.10109](https://arxiv.org/abs/2209.10109) (2022)
- Software Training in High Energy Physics [J. Phys.: Conf. Ser. 2438 012063](https://arxiv.org/abs/2203.01206) (2022)
- Broadening the scope of Education, Career and Open Science in HEP [arXiv:2203.08809](https://arxiv.org/abs/2203.08809) (2022)
- Enhancing HEP research in predominantly undergraduate institutions and community colleges [arXiv:2203.11662](https://arxiv.org/abs/2203.11662) (2022)
- Facilitating Non-HEP Career Transition [arXiv:2203.11665](https://arxiv.org/abs/2203.11665) (2022)
- Particle Physics Outreach to K-12 Schools and Opportunities in Undergraduate Education [arXiv:2203.10953](https://arxiv.org/abs/2203.10953) (2022)
- Software Training in HEP [Comput. Softw. Big Sci. 5 22](https://arxiv.org/abs/2105.02200) (2021)
- Software Sustainability & High Energy Physics [arXiv:2010.05102](https://arxiv.org/abs/2010.05102) (2020)
- “HSF Community White Paper Working Group - Training, Staffing and Careers [arXiv:1807.02875](https://arxiv.org/abs/1807.02875) (2018)

Snowmass summary reports on Community Engagement Frontier and its Topical groups can be accessed from

- <https://www.slac.stanford.edu/econf/C210711/Engagement.html>

P5 recommendations

- <https://www.usparticlephysics.org/2023-p5-report/a-technologically-advanced-workforce-for-particle-physics-and-the-nation.html>

Thank you

