



Welcome to USCMS PURSUE! (5 June - 11 August 2023)

Fermilab
June 5, 2023



Code of Conduct

CMS Code of Conduct

Approved by the CMS Collaboration Board 12-April 2019

The CMS collaboration consists of members with varied national origin, ethnic background, race, gender identity, sexual orientation, gender, age, physical ability, and religion. As a community, we are committed to being positive and inclusive in all regards.

We follow the [CERN Code of Conduct](#). Members of CMS must maintain a professional environment in an atmosphere of tolerance and mutual respect and abstain from all forms of harassment, abuse, intimidation, bullying, and mistreatment of any kind. This includes, but is not limited to, intimidation, sexual or crude jokes or comments, offensive images, and unwelcome physical conduct. Members must keep in mind that behavior and language deemed acceptable to one person may not be to another.

We commit to helping our community adhere to this code of conduct and speak up when we see possible violations of it. We strive to treat those outside of CMS as we would members of our own community. In the event that the letter or the spirit of this code has been violated, appropriate action will be taken, up to and including procedures specified in Annex A3.2 of the CMS Constitution.



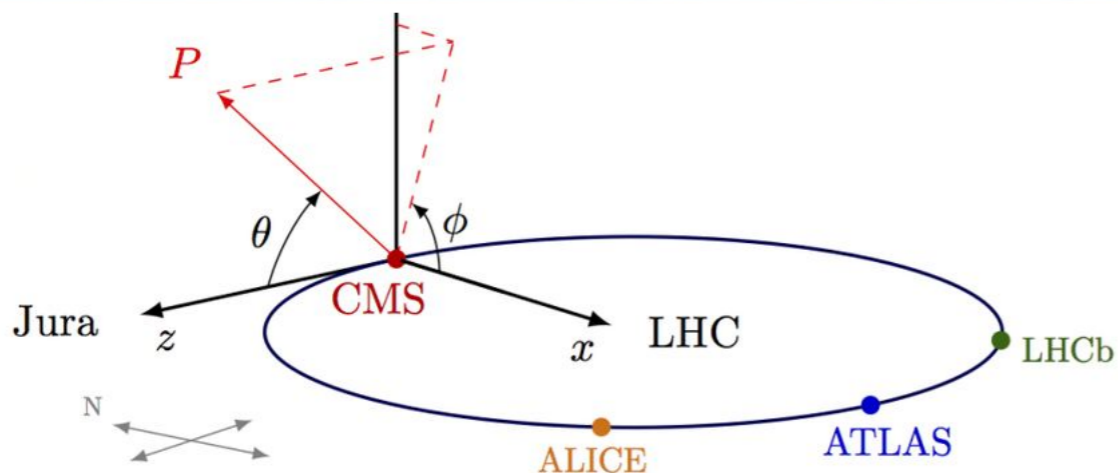
CMS Experiment and PURSUE

PURSUE:
Program for Undergraduate Research Summer Experience)

Large Hadron Collider



- Immersive research program with the CMS experiment at the Large Hadron Collider (LHC) located at CERN, Switzerland
- Use computational tools, data-science methods, learn about fundamental particles and their interactions, analyze data/simulation...
- Mentors are physicists from US institutes affiliated with the CMS experiment at the LHC - university faculty, scientists from national labs, postdoctoral fellows, and advanced graduate students
- Funded by U.S. Department of Energy RENEW-HEP Grant, U.S. CMS Operations program

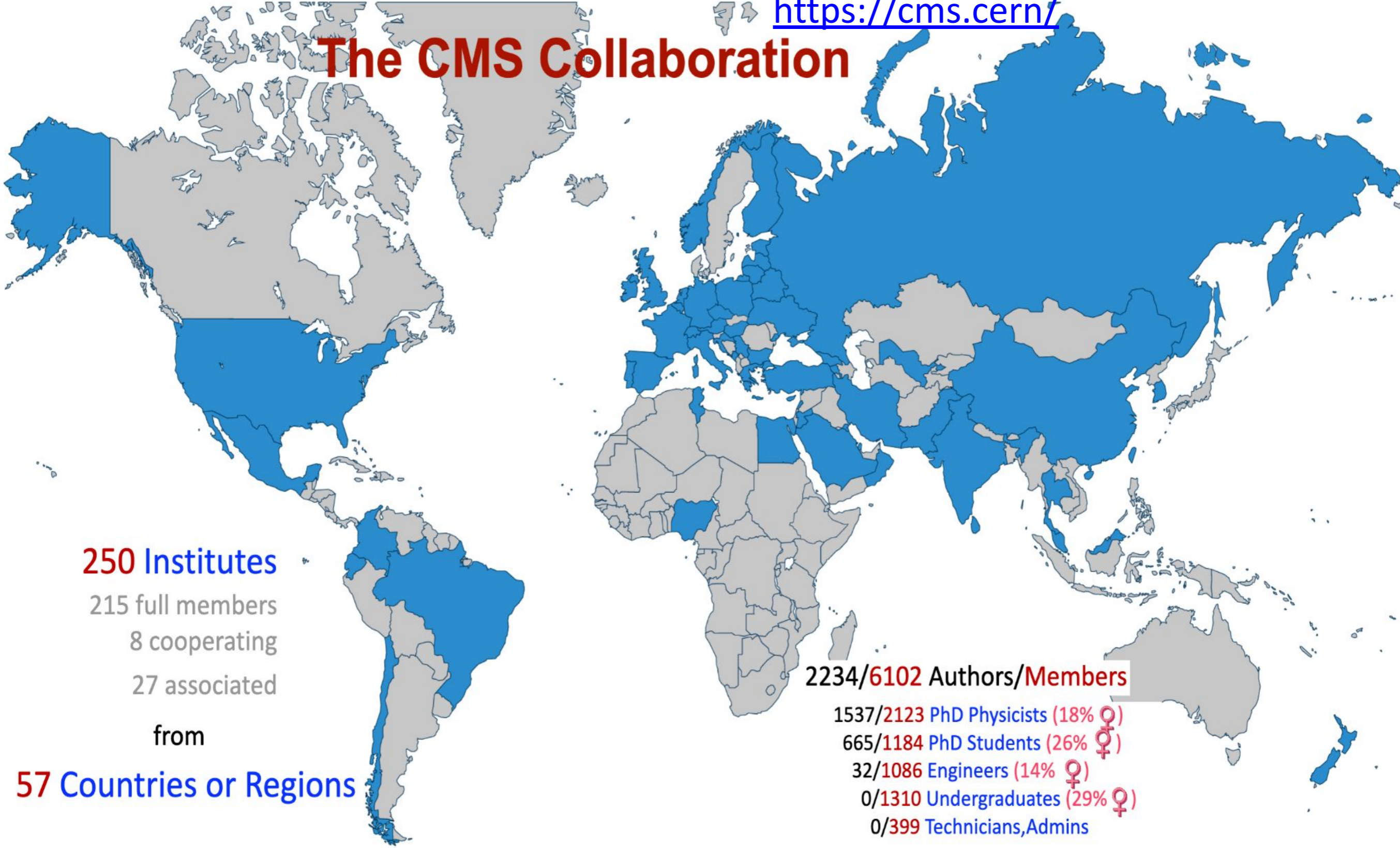




CMS Worldwide

<https://cms.cern/>

The CMS Collaboration



250 Institutes

- 215 full members
- 8 cooperating
- 27 associated

from

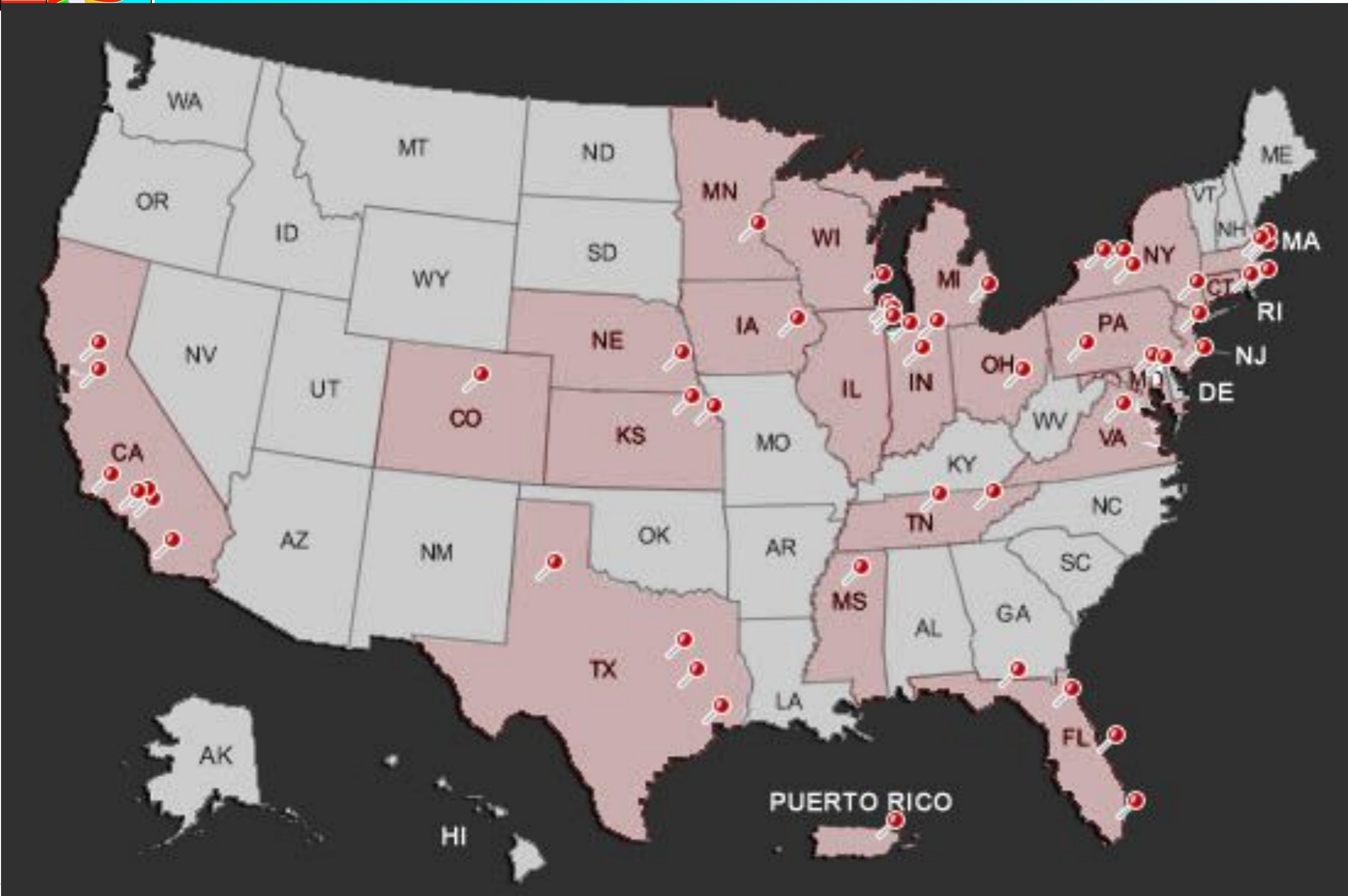
57 Countries or Regions

2234/6102 Authors/Members

- 1537/2123 PhD Physicists (18% ♀)
- 665/1184 PhD Students (26% ♀)
- 32/1086 Engineers (14% ♀)
- 0/1310 Undergraduates (29% ♀)
- 0/399 Technicians,Admins



U.S. CMS Collaboration Map





U.S. CMS Collaboration

- [U.S. CMS](#) is a collaboration of about ~1200 members from [54 Universities](#) institutes including Fermilab.
- It is one of the largest collaborations in the US particle physics community.
 - trains ~200 students/yr, ~100 postdocs/yr,
 - produces ~45 Ph.Ds/yr,
 - published ~1000 scientific papers; and
 - provides significant leadership of the Large Hadron Collider (LHC)
- U.S.CMS is strongly committed to Diversity, Equity and Inclusion (DEI) with specific action plan and goals
 - provide research opportunities to students from non-LHC institutions and those who are traditionally underrepresented in Physics

**The PURSUE program maps to the USCMS DEI Action Plan
“*Identity formation and community engagement*”.**



History of PURSUE

- First developed in 2022 and spearheaded by Prof. Meenakshi Narain
 - Prof. Narain was a physicist par excellence, an inspirational leader and a champion of diversity
 - she unexpectedly passed away on Jan 1, 2023
- [Memorial Symposium](#) at FNAL
- Her impact on our field is huge
 - [FNAL/CERN](#),
 - [Brown University](#)
 - [APS](#)

The American Physical Society (APS) recently renamed the mentoring award for its Division of Particles & Fields (DPF) in her honor



(1964 – 2023)

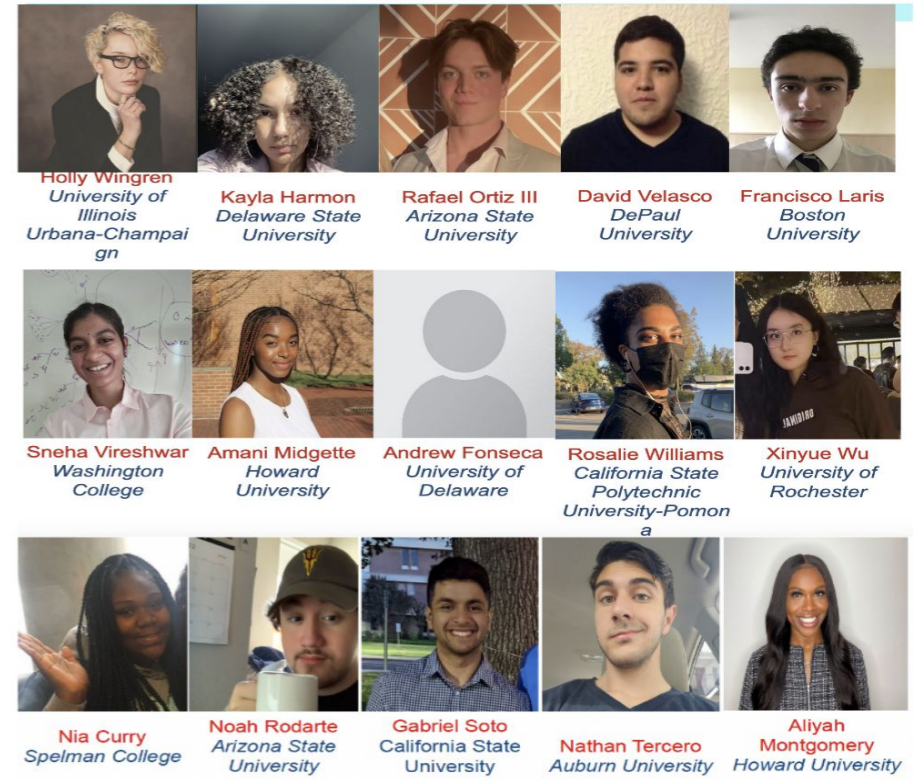


PURSUE

- Organized for the first time in Summer 2022
 - Paid internship for 10-week period
 - Supported 16 interns
 - Fully virtual programming
 - Funds provided by the U.S. CMS Operations Program
- This is the second year of the program, *first time*

in-person

- 20 interns from non-LHC institutions
- internship includes two weeks of training at Fermilab
- 8 weeks of R&D projects with mentors at Fermilab/USCMS universities
- Funds provided by:
 - ★ “RENEW-HEP: U.S. CMS SPRINT - A **S**cholar **P**rogram for **R**esearch **I**NTernship”
 - Tougaloo College, Brown University, University of Puerto-Rico (Mayaguez), University of Wisconsin-Madison, DOE RENEW HEP
 - ★ U.S. CMS Operations Program
 - Tougaloo College NSF subaward from University of Nebraska, Lincoln, USCMS PURSUE
- Invaluable support of:
 - ★ LHC Physics Center at Fermilab (LPC)
 - ★ Brown Tougaloo Partnership





Goals of PURSUE

- This internship offers undergraduate students an opportunity to perform a project under the mentorship of scientists working at the frontier of Physics.
- Students will learn about fundamental particles and their interactions. They will learn how to use computational tools and data-science methods. Students will work with members of the CMS collaboration on projects that will help develop skills related to data analysis, hardware/software, computing, and machine learning
- Our aim is to strengthen our research by building an inclusive and diverse community with a wide range of perspectives.
- In addition, we hope that the research internships will possibly help and encourage the students to persist in a STEM major through college and train them in skills needed for a future career in the STEM workforce.



Incredible learning experience

- 20 interns from several universities across the US selected, ~30 mentors in different roles including physics projects and several speakers from USCMS on different topics
- First 2 weeks all 20 interns at LPC, Fermilab
 - Software Training + Mentoring + cohort building + Professional Development + USCMS Talk sessions
- Remaining 8 weeks - Physics projects with mentors from different USCMS institutions + USCMS Talks
 - 12 interns travel to various USCMS institutions to be with their mentors
 - 8 interns remain at Fermilab as mentors are FNAL based

- Quality assurance of Macro-Pixel Sub-Assemblies before installation in CMS
- Profiling CMSSW for High Luminosity LHC
- Reconstruction of di-tau resonance mass using the SVFit algorithm Search for a right-hand W boson and heavy neutrino in Run3 data
- Tagging strange jets in Run-3
- Enabling GPU-based simulation of optical photons in Geant4
- Open physics analysis with 2015 NanoAOD
- ML-LLP tagger@L1
- Feature extraction and dimensionality reduction with high-energy physics data using machine learning
- Machine-Learning for the Muon Trigger
- Cosmic Muon Station for Outer Tracker Module Testing – Analysis Software
- Cosmic Muon Station for Outer Tracker Module Testing – Hardware setup
- Integration and Testing of GEM detectors and electronics
- VHH Search in Run 3
- Search for heavy resonance decaying to a pair of boosted Higgs where each decays to a pair of tau lepton
- Optimizing the signal over background ratio in the search for Vector-Like Leptons
- Search for elusive quantum mechanical properties of the top quark.
- Heterogeneous computing as-a-service for CMS
- Develop a leading-edge material for high energy physics experiments
- Analysis Grand Challenge with CMS Run2 data

USCMS Institutions hosting interns for 8 weeks

Inst. (no. of interns)

Fermilab (5)
Florida State (1)
Univ of Minnesota (1)
UC San Diego (1)
Alabama (1)
Rice University (1)
Princeton University (2) Florida Tech (1)
Maryland (1)
UW-Madison (2)
Purdue University (3)
Nebraska (1)



Organizing Team



Prof. Santanu Banerjee
PI, DOE RENEW HEP, USCMS PURSUE
(Tougaloo College) Funding/Logistics



Prof. Sudhir Malik
Co I, DOE RENEW HEP
(UPRM) Training Program



Prof. Tulika Bose
Co I, DOE RENEW HEP
(UW-Madison) Projects/Research Experience

Contact all four via email using
USCMS-PURSUE-COMMITTEE@fnal.gov



Prof. Ulrich Heintz
Co I, DOE RENEW HEP
(Brown University)



U.S. CMS Operations Program



Dr. Lothar Bauerdick
(Fermilab)
U.S. CMS Operations Program Manager



Prof. Ken Bloom
(University of Nebraska)
Deputy U.S. CMS Operations Program
Manager



Mentors for tutorials



Dr. Marco Mambelli (Fermilab)



Bruno Coimbra (Fermilab)



Shivani Lomte
(University of Wisconsin Madison)



Guillermo Fidalgo
(University of Puerto Rico Mayaguez)



Nikolas Pervan
(Brown University)



Cohort, Mentoring, Professional Development



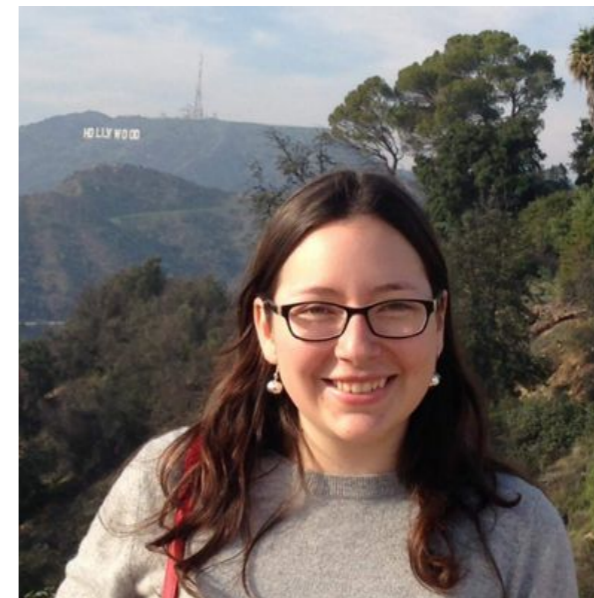
Prof. Julie Hogan (Bethel University)



Prof. Matthew Bellis (Siena College)



Prof. Chris Palmer
(University of Maryland)



Dr. Cristina Suarez
(Fermilab)

LPC: LHC Physics Center

- An established center of excellence in CMS founded in 2004
 - Serves as an intellectual hub and resource for physics at CMS
 - Over 500 LPC users including from over 90% of USCMS institutions
- Unique resource for CMS physicists
 - Physically located on the 10th and 11th floors of Wilson Hall
 - Proximity to broad range of resources and expertise
 - ★ Computing resources, software support, engineering staff, Fermilab theory division
- LPC focus is on three primary thrusts
 - Community support and engagement
 - Training and education
 - Computing





LPC

Coordinators:



Kevin Black (UW-Madison)



Bo Jayatilaka (FNAL)

Support scientists:



Gabriele Benelli (Brown)
Physics support lead



Marguerite Tonjes (UIC)
Computing support lead



David Yu (Nebraska)
Operations support lead

Regular LPC events: discussions

- **LPC Journal Club**
 - No-reading required journal club for LPC community
 - Participants vote on which papers to discuss
- **LPC Coffee Hour**
 - Informal discussion on interesting topic
 - Food/coffee/tea provided
- **DR Office Hours**
 - Weekly informal gathering encourages networking
 - Junior members of community have chance to ask questions
- **LPC Physics Analysis Discussions**
 - Weekly roundtable from physics tools experts
 - Initially started to help jumpstart Run 2 analyses. Now Run 3
- **LPC Computing Discussions**
 - Forum to discuss/ask questions about computing issues





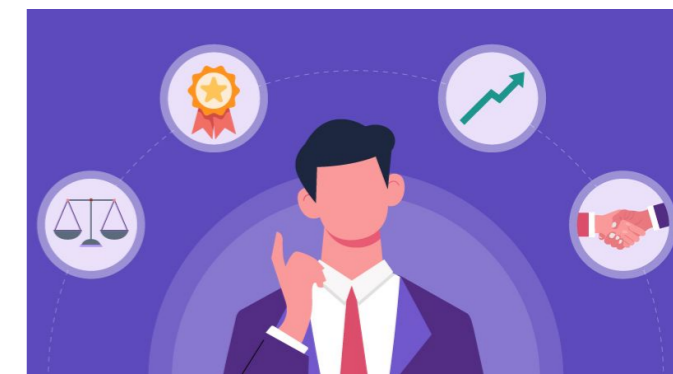
Schedule at a glance

- You must watch slack channel as a prime method of communication
- The agenda page is here
 - <https://indico.cern.ch/event/1269936/timetable/>
 - There could be updates, do check daily and refresh the page
 - Your physical room is called Pileup (WH11NW)
 - *WH11NW - Wilson Hall 11th Floor North West*
- Talks are listed in agenda
 - Fermilab wide talks are listed **EXTERNAL Talk** and are in Ramsey Auditorium (access from Wilson Hall is near the back of the cafeteria)
 - PURSUE talk are listed as **USCMS Talk**
 - Look for paper/articles related to **USCMS Talks** [here](#)
- Lunches times are 12-1 PM except today (5 June and it is 1-2 PM)
 - Lunch pre-order link
<https://www.clover.com/online-ordering/fermilab-caf---taher-batavia>
- There will be GROUP PHOTO, watch for an announcement in slack and agenda



Expectations

- Report for work for the hours agreed upon with your supervisor; interns work 40 hours a week
- Report to your mentor in case you get sick
- Inform your supervisor promptly if an absence from work is unavoidable; maintain consistent communication regarding your status and expected return
- Contact your mentor to report any situation that prevents you from completing your work
- Perform duties as assigned by your mentor
- Conduct yourself in a responsible and professional manner
- Respond promptly when contacted by your mentor, program organizers
- Attend the all Lectures that are part of the program and in addition any lecture as part Fermilab summer lecture series (when possible and indicated in the agenda)
- Attend laboratory tours organized for interns
- Complete written and oral program deliverables





Deliverables

- 5 minute 5 slides at the end of Week-3 into the internship
 - Reflecting your preliminary understanding, goals and methods of your project
- A poster ready at by end of Week-9
 - Poster should of high quality
 - Able to be shown at a conference
 - Instructions for style, format will be provided;
 - For content ask your mentor
 - Acknowledgments
 - DOE RENEW-HEP grant
 - USCMS Operations
- Final week is busy
 - ~2 days of presentations - schedule will be announced
 - Presentations in the form of slides that can fit 15 min of time (~12 - 15 slides)
- Surveys requested must be filled and submitted
 - During or after the internship
 - Your feedback is critical to the success of the program





Logistics

- Airfare is included, laptop provided during training and research, group shuttles/rideshare arranged from Airport and individual rideshare provided if necessary, one standard luggage fee will be reimbursed with receipt.
- During training period, breakfast is included. Lunch and Dinner on their own.
- Stipends distributed in four installments June 5, June 30, July 31 and Aug 18 with satisfactory progress and once necessary documentation is provided. Checks provided unless direct deposit can be arranged.
- Support (over 45 personnel are wholeheartedly assisting this project to ensure success and provide a truly enriching experience to this first cohort of in person PURSUE scholars - Please let us make a mark!)



Logistics



Ms. Maggie Slusarczyk
(Tougaloo College)
Project Assistant, USCMS PURSUE
Person to reach out for any logistical
assistance or needs



Plan for the day

- 09:00** **Welcome by USCMS** 🕒 1h ✎
- 10:00** **FNAL ID and Badging Time** 🕒 1h ✎
- 11:00** **Cohort building and Introductions (Interns and Mentors)** 🕒 2h ✎
Speakers: Julie Hogan (Brown University, Bethel University (US)), Matthew Bellis (Cornell University/Siena College (US))
[🔗 Slide Deck Into](#)

13:00 → 14:00 **Lunch** 🕒 1h 📍 Fermilab Cafeteria

- 14:00** → 18:10 **Afternoon Session: Overview of CMS and meet with Mentors** 📍 WH11NW (Pileup Room) ✎
- 14:10** **Physics Overview** 🕒 1h ✎
Speaker: Tulika Bose (University of Wisconsin Madison (US))
- 15:10** **CMS Detector - a discovery tool** 🕒 1h ✎
Speaker: Steve Nahn (Fermilab)
- 16:10** **Computing and Software for Physics** 🕒 1h ✎
Speaker: Andrew Malone Melo (Vanderbilt University (US))