

NuSTEAM

Nuclear Science in Texas
to Enhance and Advance Minorities



Daniel Cherdack
University of Houston



Snowmass Summer Workshop

University of Washington
Seattle Washington

July 24th, 2022

Outline

- Program goals
- Program overview
- Participating institutions
- Program at UH
- Program at BNL
- Home institution research projects
- The students
- Looking forward

Program Goals

- Removing barriers for URM student participation in STEM
 - Competing priorities (e.g. the need to be paid)
 - Lack of mentorship
 - Lack of opportunities to “stand out”
- Provide training to students
 - Academic program on variety of NP/HEP topics
 - Technical skill useful for NP/HEP and industry
 - Hands-on experience with hardware and software
 - Presentation generation and delivery
- Networking and professional development
 - Opportunities to meet with and talk to URM students at multiple career levels
 - Travel to national laboratory to work with “physicists in the field”
 - A week of career development training
- Resume building
 - Program participation
 - Year-long paid research project
 - Opportunities to find letter writers
 - Talks and/or poster presentations
 - Potential for publications

Program Overview

- The students
 - Rising seniors majoring in physics
 - From Minority Serving Institutions (MSIs)
 - Departments without graduate programs or standard NP/HEP portfolios
- The program
 - Six-week paid trainee program at UH
 - Two-week paid laboratory experience at BNL
 - Two-semester paid research experience at home institution
- The “Faculty”
 - A postdoc-level administrator
 - Academic faculty from UH delivering content in the mornings
 - Faculty and postdocs running afternoon activities that build on the morning lessons
 - External faculty teaching about career development and networking



Claudia Ratti
Lead-PI



Israel Portillo
Coordinator



Lecturers



Claudia Ratti (PI)

Quantum Chromodynamics

Lattice QCD

Effective field theories

Theoretical heavy-ion physics



**Israel Portillo
(Coordinator)**

Theoretical nuclear physics

Computational techniques

Hands-on exercise sessions



Rene Bellwied

Experimental heavy-ion physics

Detectors

Computational techniques

Professional opportunities in Nuclear Physics



Daniel Cherdack

Experimental neutrino physics

Neutrino fluxes and connections to nuclear physics

Applied math and statistics for neutrino physics

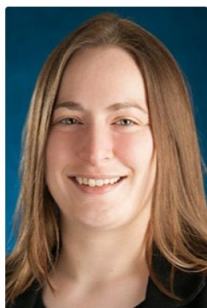


**Jamie Karthein
(guest lecturer - MIT)**

Leadership

Self-awareness

Role of personality and personal history



Lisa Koerner

Experimental neutrino physics

Neutrino detectors

Neutrino experiments



Lawrence Pinsky

Low energy nuclear physics

Space science

Medical physics



Anthony Timmins

Experimental heavy-ion physics

Detectors

Computational techniques



**Angeliki Diane Rigos
(guest lecturer - MIT)**

Leadership

Self-awareness

Role of personality and personal history



Aymen Shamooun

Aymen is a theoretical condensed matter graduate student. He will facilitate the summer program and help to make connections between different fields.



Micheal Kahangirwe

Micheal is a theoretical heavy-ion graduate student. He will facilitate the summer program and advise on academic career paths.

Student Support

Participating Institutions



- Hispanic Serving Institutions (HSIs)
 - UH
 - 50,000 students, 34% Hispanic
 - Top 5 US University for Hispanic Students
 - 2nd most diverse campus in the US
 - UTRGV
 - 25,000 students, 91% Hispanic
 - Largest in HSI TX, top 10 US
 - UTEP
 - 22,000 students, 84% Hispanic
 - 2nd largest HSI in TX, top 10 US
- Historically Black Colleges and Universities (HSBC)
 - PVAMU
 - Largest in TX with 10,000 students

Program at UH

- Week 1: Theoretical Modeling and tools in relativistic heavy ion physics
 - Monday: Introduction to Mathematica
 - Tuesday: Introduction to Quantum Chromodynamics
 - Wednesday: Lattice QCD – solving QCD on your computer
 - Thursday: Statistical and phenomenological models
 - Friday: Results
- Week 2: Nuclear high energy physics at RHIC and the LHC
 - Monday: Big Bang Theory and forces in the universe
 - Tuesday: Phase transitions and the QGP
 - Wednesday: RHIC and LHC – accelerator and detector technology
 - Thursday: Results from RHIC
 - Friday: Results from LHC

Program at UH

- Week 3: Experimental and Computational Techniques in relativistic heavy ion physics
 - Monday: Introduction to C/C++
 - Tuesday: Introduction to C/C++
 - Wednesday: ROOT: an analysis platform for heavy ions
 - Thursday: PYTHON and modern tools in nuclear and particle physics
 - Friday: the GRID: running TB of data around the world
- Week 4: Low energy nuclear physics, space science & medical physics
 - Monday: Technologies applied at lower energies in fund. nuclear research
 - Tuesday: The intersection between nuclear, space and medical science
 - Wednesday: Using nuclear state of the art detectors in space science
 - Thursday: Using nuclear state of the art detectors in medical applications
 - Friday: The future of high precision, robust detector development

Program at UH

- **Week 5: Neutrino detection - Hardware and software techniques**
 - **Monday: The Physics of neutrinos**
 - **Tuesday: Neutrino Fluxes, Cross Sections, and Connections with Nuclear Physics**
 - **Wednesday: Neutrino detectors**
 - **Thursday: Neutrino experiments**
 - **Friday: Applied Math, Statistics, and Computing in Neutrino Physics**
- **Week 6: Prof. opportunities in Nuclear Physics, networking, presentation skills**
 - Monday: Leadership, self-awareness and the role of personality and personal history
 - Tuesday: Opportunities at universities, federal laboratories and at companies related to Nuclear/High Energy Physics
 - Wednesday: How to prepare professionally for a talk and a job interview
 - Thursday: Opportunities in seemingly unrelated fields
 - Friday: Student Presentations

Program at BNL

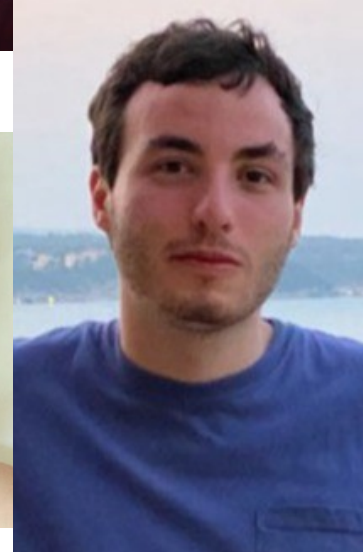
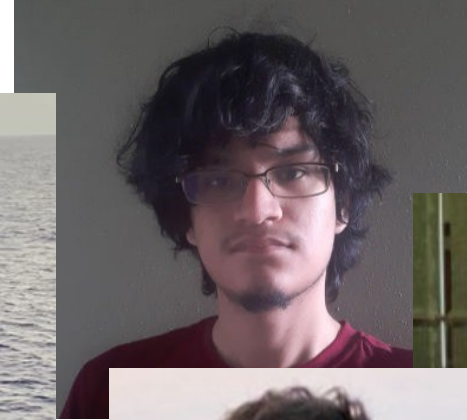
- Week 7: The STAR experiment at BNL
 - Monday: National holiday
 - Tuesday: Introduction of STAR detector and STAR Live Tour
 - Wednesday: STAR data acquisition system
 - Thursday: Forward tracking software
 - Friday: STAR forward upgrades -- forward silicon tracker and small-Strip Thin Gap Chamber
- Week 8: 7/11-7/15 – STAR and neutrino physics at BNL
 - Monday: STAR Muon Telescope Detector
 - Tuesday: STAR High-Level Trigger, hypertriton reconstruction
 - **Wednesday: Introduction to BNL neutrino program**
 - **Thursday: Introduction and tour of BNL liquid scintillator lab**
 - **Friday: Student presentations and discussions**

Research Projects

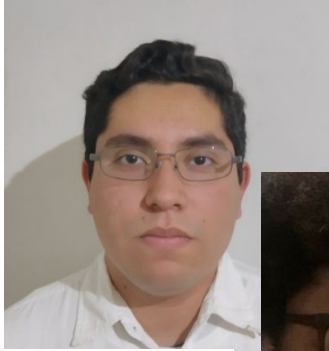
- Unique, year-long research topics at home institutions
- Projects chosen by and supervised by the local co-PIs
- Coordinate with UH faculty partners
- Regular Zoom meetings with
 - Participating students and PIs
 - Progress reports from all projects will be discussed
 - Optimize the student's presentation skills
 - Enhance their professional development
- Possible research topics are:
 - Mapping the phase diagram of matter in strong fields
 - Fluid dynamics in strongly interacting systems
 - Neutrino data analysis
 - Machine learning for particle analysis
 - Radiation measurements in space and atmosphere
 - Resting and operating a TPC
 - Phenomenological modeling of heavy-ion data

S U M M E R	UH Summer Training		
	<ul style="list-style-type: none"> • Physics of RHIC & LHC • Experimental Techniques • Theoretical modeling • Low-energy applications • Hands-on computing • Professional skill training 		
	BNL Traineeship		
F A L L + S P R I N G	Research projects at home institutions		
	UH Mentors	Matter in strong fields (1) Phenomenological modeling of heavy-ion data (1+1)	UTRGV
		Machine learning (1) Detector testing and operation (1)	UTEP
		Radiation Measurements (2)	PVAMU
		Fluid Dynamics (1) Neutrino Physics (1)	UH

Participating Students - 2021



Participating Students - 2022



Lessons Learned and Looking Forward

- Lessons learned

- Meet the students at their level
 - Need to be realistic about “pre-reqs”
 - Each student has different skills/knowledge
- Activities will take longer than you think (less is more)
- Take time to listen to the students and be flexible
- Long days = fatigued students
- Travel can be daunting for undergraduate students

- Looking forward

- First two years have been highly successful
- Renew NuSTEAM through RENEW-NP following success (8 students)
- Apply for increased HEP student participation through RENEW-HEP (4 students)
 - Partner with the TPC
 - Extend lab experience to SURF
 - More integration of HEP program at UH