

# Successfully Engaging Minority-Serving Institutions in Nuclear Physics

Topic: what works and what does not work to engage Minority-Serving Institutions (MSIs) in the U.S.

Paul Guèye, Michigan State University, USA

Rolf Ent, Jefferson Lab, USA

Cynthia Keppel, Jefferson Lab, USA

# Outline

- Minority Serving Institutions in the U.S. & Physics Programs
- Highlights of Nuclear Physics Partnerships
  - National Labs: JLab & FRIB
  - The Nuclear Physics program at Hampton University: A Success Story
- Some criteria for Success
  - Critical Time: the Right People at the Right Time
  - PING: Expanding the Pipeline to Pre-College
  - The MoNA Collaboration: Impactful Model for Collaborative Research
  - Connections to EIC: MSI involvement, Professional Societies & Beyond
- Lessons Learned & Final Remarks

## Some Definitions

- U.S. Department of Labor

<https://www.doi.gov/pmb/eo/doi-minority-serving-institutions-program>

- Minority Serving Institutions

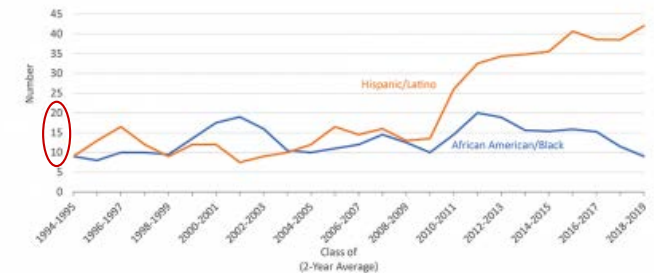
*“MSIs are institutions of higher education that **serve minority populations** ... Some are only **a few decades old**, whereas others, have been **striving for more than a century** to give their constituents the **social and educational skills needed to overcome racial discrimination and limited economic opportunities.**”*

	Focus	Total
Historically Black Colleges and Universities (HBCUs)	African-Americans	108
Hispanic Serving Institutions (HSIs)	Hispanics	274
Tribal Colleges and Universities (TCUs)	Native Americans	35

**Need a critical mass = pipeline from Pre-College to Professionals!**

American Institute of Physics, February 2021

Number of African American and Hispanic People Earning a Physics Doctorate, Classes of 1994 through 2019

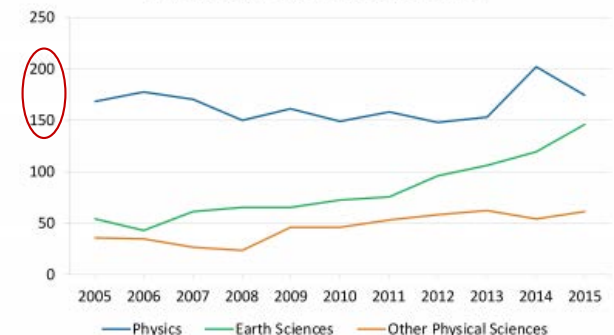


AIP Statistics

aip.org/statistics

American Institute of Physics, August 2019

Trends in African-Americans Earning Bachelors in Physics, Earth Sciences, and Physical Sciences, 2005 to 2015

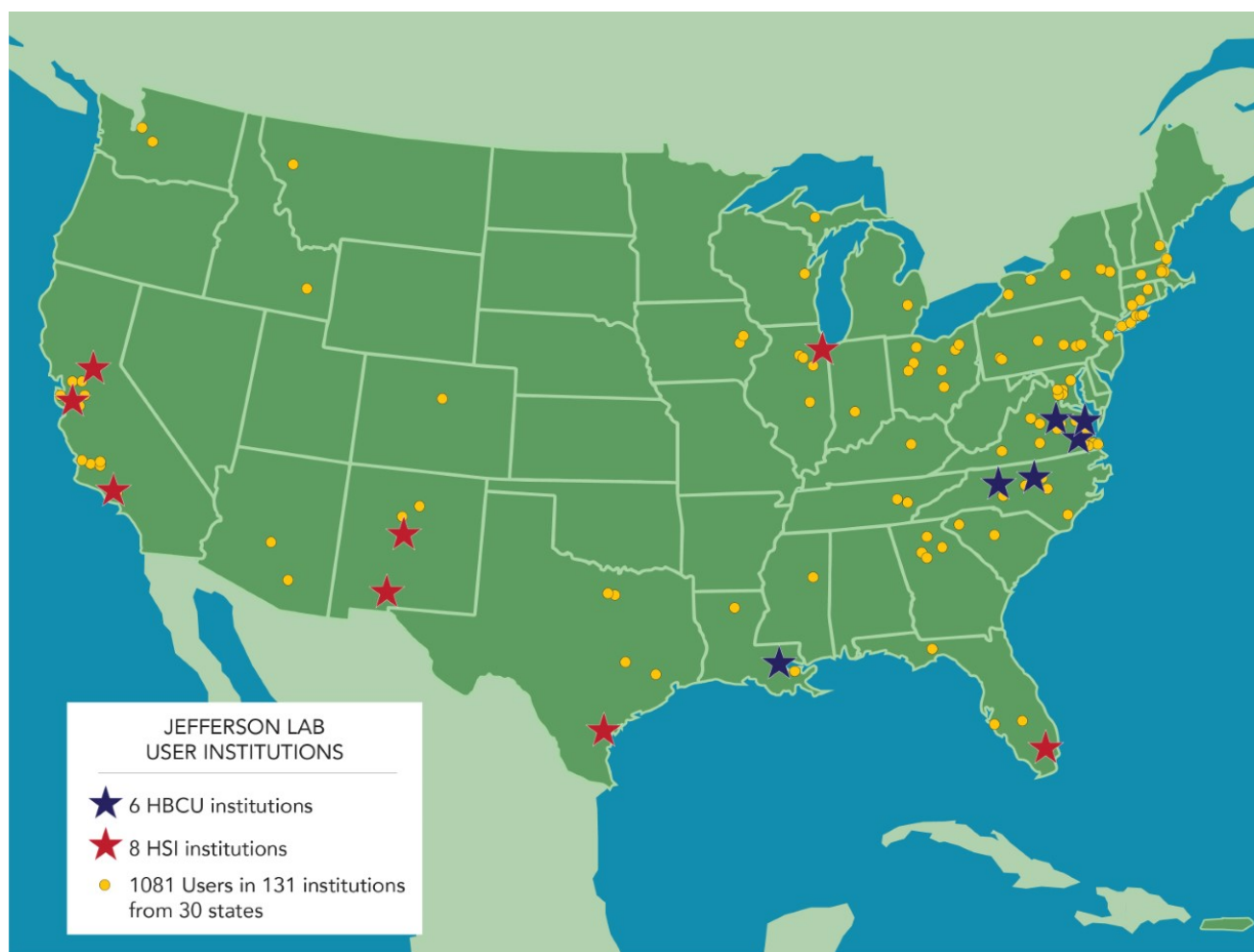


Beginning in 2010, the NCES's Integrated Postsecondary Education Data System (IPEDS) survey began implementing a new methodology to collect race data. Prior to 2011, the NCES data on the number of physics bachelor's degrees awarded to underrepresented minorities each year tracked very closely with the data collected by AIP's Statistical Research Center. The differences in data collection may result in differences in recent data trends.

AIP Statistics

aip.org/statistics

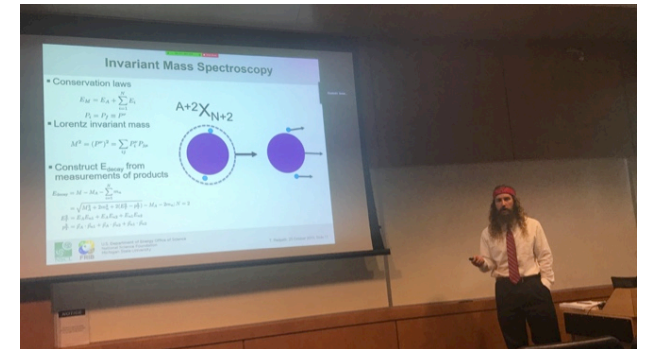
# Jefferson Lab Has Strong Ties to Minority-Serving Institutions



- Jefferson Lab has ~1700 users of which 2/3 are domestic and 1/3 international.
- Users from Historically Black Colleges and Universities (**HBCUs**) and from Hispanic-Serving Institutions (**HSIs**) comprise **near-10% of the 1000+ domestic users**.
- **This was rooted by a strong joined and bridged faculty program**, with some further institutions joining once young scientists became faculty elsewhere.

# NSCL/FRIB Minority Fellowship Program

- **Facilitate transition to faculty position at MSI**
  - One-year research position at FRIB
  - Bridged position at a Minority Serving Institution
    - Research fraction funded by bridge
    - Teaching fraction at university
- **(pilot) MSI Program [MSU/FRIB funded]**
  - 2020-2021: Virginia State University (VA)
    - Thomas Redpath (PhD, MSU, 2019)
    - Fall 2020: toward a Nuclear Chemistry track
    - Undergrads: 2020-2, 2021-4 (+2)
    - Proposals: NSF & DoE – FRIB research (analysis, detectors R&D)
  - 2021-2022: Morgan State University (MD)
    - Clémentine Santamaria (LBNL postdoc, 2021)
    - Fall 2021: Basic and Applied Accelerator/Nuclear Physics track
    - Grad student: fall-2 expected



*Note: our EICUGM host  
Narbe Kalantarians @ VUU  
came in through JLab!*

**Another approach to make ties with MSIs**

## Hampton's Nuclear and High-Energy Physics (NuHEP) Center

- Funding
  - NSF Human Resources Division, 1991-1996 & 1996-2002.
  - Amount: \$1M/year.
- Taking full advantage of proximity of Jefferson Lab.
- Crucial Outreach Program
- Some highlights (~2000):
  - Experimental Group meetings of 3.5 faculty, ~3 postdocs, ~8 students, ~10 undergrads, in a corridor (ex-laundry building!) with portable screen and projector. ~2/3 of the group was Afro-American, ~10% was African.
  - 15 years after establishment, the **HU program graduated over half of the doctoral degrees awarded to African-Americans annually.**
  - At one time, **the group led two experiments simultaneous in Halls A and C.** Still, the Hampton group covered 1/4 and 1/3 of all shifts, respectively!

**Highly successful! – Critical Mass established!**

# Outreach at NuHEP

- SPS and Sigma Pi Sigma Chapters (won APS Outstanding Chapter Award)
- Student-led Traveling Physics Demonstration Show (featured at APS Centennial)
- Local Scholarship Contest (on-campus competitive test with scholarship prize, tours, demo show)
- Faculty talks at other HBCU/MSIs
- Graduate (**HUGS, since 1986**) and Undergraduate (UnIPhy) Summer Schools



Publications Meetings & Events Programs Membership Policy & Advocacy C

## APS NEWS

March 1999 (Volume 8, Number 3)

Guide to Special Centennial Events



Gala at the Fernbank Museum of Natural History on Sunday. (Courtesy of the Atlanta Convention and Visitors Bureau)

### Physics Demonstration: Adventures in Physics

GWCC Lawn

12:30 PM and 1:30 PM

Cynthia Keppel of Hampton University and several students present dynamic, interactive physics demonstrations illuminating physics principles, including a vacuum cannon, liquid nitrogen bath, bed of nails and exploding powder.

### Public Lecture: "Fractals and Chaos: Bridging Science and Culture."

Atlanta College of Art, Woodruff Arts Center, Rich Auditorium (Midtown)

3:00 - 4:15 PM

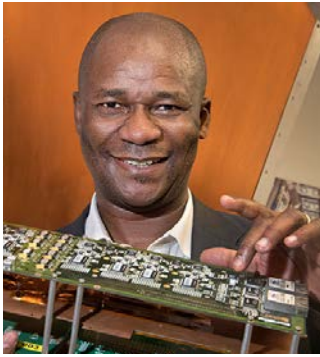
Richard Voss reprises his discussion of fractal geometry and chaos theory for a general audience, focusing on how these new fields provide tools and unifying concepts that bridge the traditional boundaries between science, art and finance.



**Start early and give young students a motivational boost to create a pipeline.**



## What it takes – a critical mass





# Hampton's Nuclear and High-Energy Physics (NuHEP) Center

**It definitely worked!**

From a 1997 program advisory committee review (with prestigious members such as Jerry Friedman and Jim Gates):

- “clear evidence that, despite its relative youth, the Hampton University program has already achieved at least one of its goals, namely a **scientific position among the leading institutions at the forefront of nuclear physics research.**”
- “At Jefferson Lab, NuHEP scientists are the spokespersons for **10 major experiments, 8 approved and 2 conditionally approved.**”
- “The committee believes that the faculty and staff of the NuHEP Center, together with students, have developed a **forefront program that compares favorably with programs at the major research universities in the country (world).** They are to be commended for their achievement.”, but also
- “The future, however, will present a new set of challenges. Among these are the obvious funding issues” and
- “While funding is, and will continue to be, a major issue, the primary consideration should be the scientific objectives and goals of the scientists and the NuHEP center.”

**... but ...**



## Hampton's Nuclear and High-Energy Physics (NuHEP) Center

- What happened in ~2000?
  - Meeting of Hampton group with **NSF Human Resources Division and Physics Division** to expedite **transition**.
  - The Hampton group proposal to NSF got **excellent/very good reviews** but was told to **separate in experiment and theory** and submit again.
  - The Hampton experiment group proposal was resubmitted a year later and was grouped for review together with the Caltech and UIUC groups, got excellent reviews, and ...
  - ... NSF politics took over, driven by HEP. The group was offered **annual funding for ATLAS/TRT construction**, was asked “if you get this, will you stay together?”. We replied “no, thank you” and the **Nuclear Physics group split**.

**It is real easy to lose all momentum ...**

# Physicists Inspiring the Next Generation (PING)

- **Goals**

- Two-week summer program for undergraduate and high school students
- Eight-month research with the MoNA Collaboration
- Exposure to research, increase mentoring (UG students) and increase college exposure (HS students)

- **Background**

- Launched (radioastro): Summer'14 with NRAO @ GBT, West Virginia, USA
- Piloted at MSU (nuclear): Fall'19 and Spring'20, 2 UG and 4 HS
- NSF funded (2020): 4 [6] UG and 8 [10] HS

- **Past successes (nuclear/astro-physics)**

- PING'14: Jordan G. Owens-Fryar, high school student, PhD/MSU (2018)  
Phuonghan Pham, middle school student, BS/MSU (2020)
- PING'16: Ameer Blake, MS, Hampton University (left, high school teacher)
- PING'19: Tracy Edwards, BS, Hampton University, PhD/MSU (2020)\*  
Angelina Gallego, BS, Hampton University, PhD/Minnesota (2020)
- PING'20: Yannick Guèye, MSU physics/art, Maya Wallach, MSU physics

**Start early and give young students a motivational boost to create a pipeline. At later stages one will already have lost them. *PING* idea came from listening to a young student.**



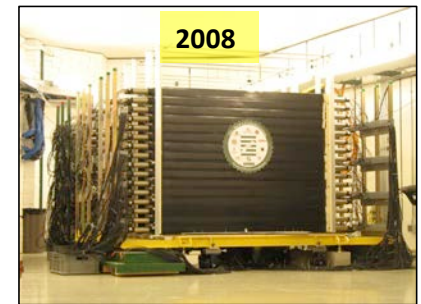
# The MoNA Collaboration



- 11 undergraduate physics departments + 1 HBCU (HU) + MSU
- 2001: NSF Proposal for the Modular Neutron Array (MoNA)
- 2002: Construction of MoNA Detector
- 2004: First physics experiment
- 2011: Expanded to Large multi-Institutional Scintillator Array detector (LISA) → MoNA-LISA detector: large angles, fast neutrons
- 2015: First experiment in N2
- 2017: Last experiment in N2
- 2019: First experiment in S2 (FRIB era)



2007



2008



2019



2016

**Example to engage multiple undergrad-serving institutions in meaningful research with a clear role – the same can apply to MSIs!**

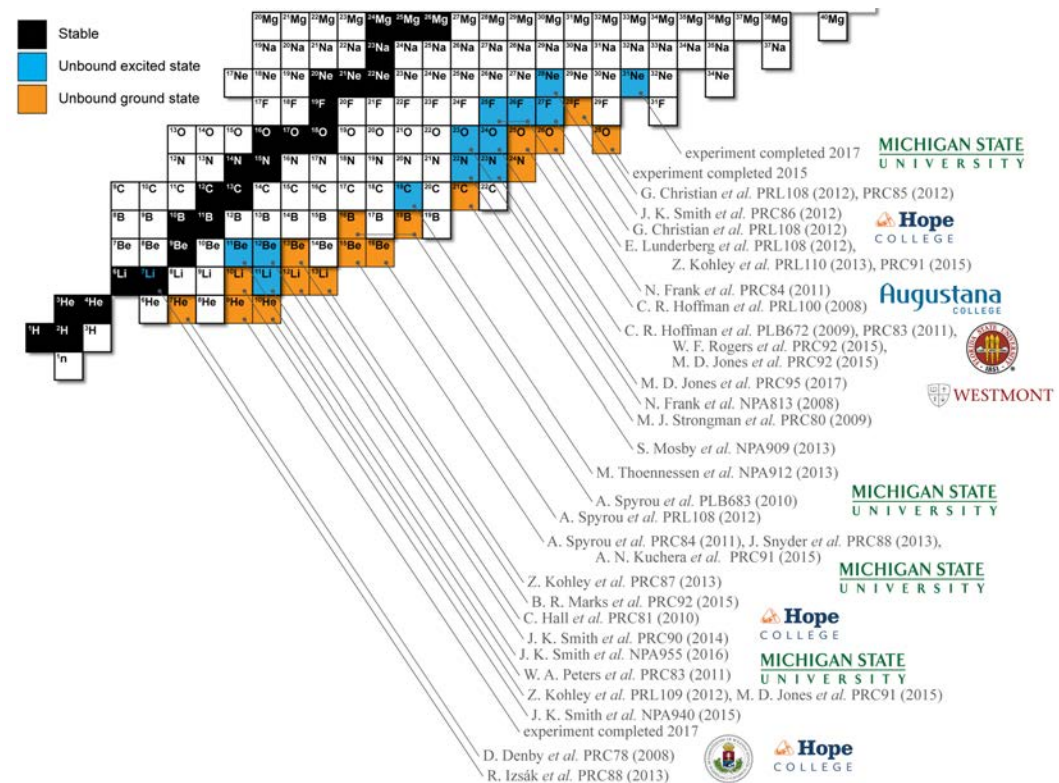


# Can it be successful? Yes!

## 2021 fact sheet

- 215 undergraduate students
- 102 graduate students
- 25 institutions
- 34 experiments completed
- 75 publications
- Meaningful research!

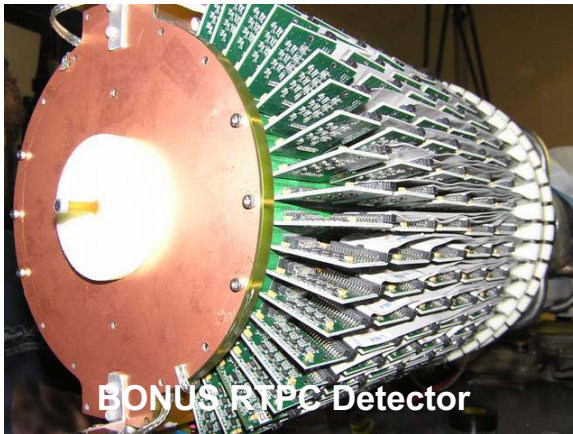
Example to engage multiple undergrad-serving institutions in meaningful research with a clear role – the same can apply to MSIs!





# Enable Chances for EIC Engagement

## A few Jefferson Lab examples where MSIs played large roles



BONUS RTPC Detector

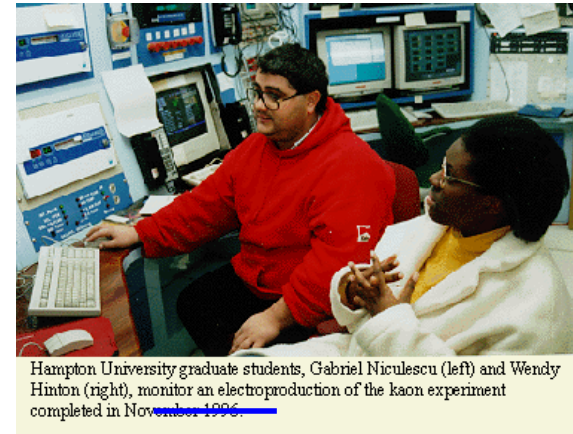
First use of GEM foils in curved geometry worldwide!



ENGE/HKS Setup

Large-installation experiment:

- Hampton responsible for ENGE
- Japan was responsible for HKS
- FIU for some of HKS detectors



Hampton University graduate students, Gabriel Niculescu (left) and Wendy Hinton (right), monitor an electroproduction of the kaon experiment completed in November 1996.

The first major experiments, of at least four by HU, to be conducted by faculty from a Historically Black College or University (HBCU) at a national lab concentrating in nuclear physics.



- This underscores that MSIs can play meaningful roles in detector R&D, in (very) large projects, in detector construction, and of course also in controls (first use of PLCs for spectrometer rotation), in simulations (first implementation of Jefferson Lab spectrometer in GEANT), in software development, in data analysis, etc.
- It often requires **champions and allies**!

### 1st Annual Hampton/MIT Summer Program

for Undergraduate Research with an Electron Ion Collider

Application deadline: **March 15, 2007**

*Inside protons and neutrons, or nucleons, quarks and gluons move around at nearly light-speed, and extra gluons and quark-antiquark pairs pop into existence only to disappear the next instant. It is this activity that generates nearly all the mass of hadrons and ultimately of all visible matter. Deep inside the nucleon with a microscopic resolution microscope one can witness a few even-variant quarks and a sea of activity. How are the quarks, anti-quarks and gluons spatially distributed in nucleons, how do they move, and how do they contribute to the nucleon spin? How do parton densities in these quarks from years of deep-inelastic scattering with high energy probes, yet their precise roles remain to be determined and mapped out. Improving the resolution even further reveals a flood of quarks that overwhelm the quarks, with gluons paid to deny that they start annihilating each other. Are these gluons affected by nuclear properties, and can one directly study the properties of these gluons in bulk?*

A novel Electron Ion Collider has been proposed that will allow us to look in detail into the sea of quarks and gluons, to create and study quarks, and to discover how energy transforms into matter. It will also involve compelling key physics questions essential for our understanding of the fundamental structure of matter.

- Predict imaging of the sea quarks and gluons to determine the spin, flavor and spatial structure of the nucleon.
- Define study of the universal nature of strong gluon fields manifest in nuclei.

The Massachusetts Institute of Technology (MIT) and Hampton University (HU) Physics groups are key players in the development of this Electron Ion Collider, and in particular co-lead the physics simulation and the detector research and design efforts. We offer a summer research opportunity to undergraduate students to participate in these studies from June 2nd to August 1st. Accepted students will work with HU faculty, with a visit to MIT in the last week. Students of last year's program will work with MIT faculty and previously reside at MIT. For the nine weeks of participation, students will receive a stipend of \$4,000, housing on HU or MIT campus and support for meals. Students will be reimbursed for the cost of travel to HU for up to \$300. Travel to MIT is also paid for. First-year participants will be encouraged to continue this program for a second summer period at MIT in 2010.

To be considered for this program:

- Complete and submit the application ([www.jlab.org/~mit/HU-EIC-SummProg.doc](http://www.jlab.org/~mit/HU-EIC-SummProg.doc)) and send to the address below.
- Have two faculty members or research mentors send letters of recommendation.
- Send a transcript of all college courses (it can be unofficial).
- Write a succinct paragraph stating your interest and academic background.

**For information and applications contact:**

Dr. Claudia Rantala, Dean  
School of Science  
Hampton University  
Hampton, VA 23668  
(757) 722-5295 or (757) 722-5279  
claudia.rantala@hamptonu.edu

### 2nd Annual Hampton/MIT Summer Program

for Undergraduate Research with an Electron Ion Collider

Application deadline: **March 17, 2008**

*An Electron Ion Collider with polarized beams has been embraced by the U.S. nuclear science community as embodying the vision for reaching the next frontier in understanding the fundamental quark-gluon structure of matter. It will allow us to look in detail into the sea of quarks and gluons deep inside atomic nuclei, to create and study dense systems of quarks, creating fields whose intensity may be the strongest allowed in nature, and to discover how energy transforms into matter.*

The Massachusetts Institute of Technology (MIT) and Hampton University (HU) Physics groups are key players in the development of this Electron Ion Collider and, in particular, co-lead the physics simulation and the detector research and design efforts. We offer a summer research opportunity to undergraduate students to participate in these studies from June 2nd to August 1st. Accepted students will work with HU faculty, with a visit to MIT in the last week. Students of last year's program will work with MIT faculty and previously reside at MIT. For the nine weeks of participation, students will receive a stipend of \$4,000, housing on HU or MIT campus and support for meals. Students will be reimbursed for the cost of travel to HU for up to \$300. Travel to MIT is also paid for. First-year participants will be encouraged to continue this program for a second summer period at MIT in 2010.

To be considered for this program:

- Complete the application ([www.jlab.org/~mit/HU-EIC-SummProg.doc](http://www.jlab.org/~mit/HU-EIC-SummProg.doc)) and send to the address below.
- Have two faculty members or research mentors send letters of recommendation.
- Send a transcript of all college courses (it can be unofficial).
- Write a succinct paragraph stating your interest and academic background.

**For information and applications contact:**

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School of Science  
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claudia.rantala@hamptonu.edu

### 3rd Annual Hampton/MIT Summer Program

for Undergraduate Research with an ELECTRON ION COLLIDER

Application deadline: **March 16, 2009**

*An Electron Ion Collider with polarized beams has been embraced by the U.S. nuclear science community as embodying the vision for reaching the next frontier in understanding the fundamental quark-gluon structure of matter. It will allow us to look in detail into the sea of quarks and gluons deep inside atomic nuclei, to create and study dense systems of quarks, creating fields whose intensity may be the strongest allowed in nature, and to discover how energy transforms into matter.*

The Massachusetts Institute of Technology (MIT) and Hampton University (HU) Physics groups are key players in the development of this Electron Ion Collider, and in particular co-lead the physics simulation and the detector research and design efforts. We offer a summer research opportunity to undergraduate students to participate in these studies from June 1st to July 31st. Accepted students will work with HU faculty, with a visit to MIT in the last week. Students of last year's program will work with MIT faculty, and permanently reside at MIT. For the nine weeks of participation, students will receive a stipend of \$4,000, housing on HU or MIT campus, and support for meals. Students will be reimbursed for the cost of travel to HU for up to \$300. Travel to MIT is also paid for. First-year participants will be encouraged to continue this program for a second summer period at MIT in 2010.

To be considered for this program:

- Complete the application ([www.jlab.org/~mit/HU-EIC-SummProg.doc](http://www.jlab.org/~mit/HU-EIC-SummProg.doc)) and send to the address below.
- Have two faculty members or research mentors send letters of recommendation.
- Send a transcript of all college courses (it can be unofficial).
- Write a succinct paragraph stating your interest and academic background.

**For information and applications contact:**

Dr. Donald Whitney  
School of Science  
Hampton University  
Hampton, VA 23668  
(757) 722-5820  
Donald.Whitney@hamptonu.edu

### 4th Annual Hampton/MIT Summer Program

for Undergraduate Research with an ELECTRON ION COLLIDER

APPLICATION DEADLINE: **MARCH 15, 2010**

APPLICATION URL: [www.uniphyre.org](http://www.uniphyre.org)

*An Electron Ion Collider with polarized beams has been embraced by the U.S. nuclear science community as embodying the vision for reaching the next frontier in understanding the fundamental quark-gluon structure of matter. It will allow us to look in detail into the sea of quarks and gluons deep inside atomic nuclei, to create and study dense systems of quarks, creating fields whose intensity may be the strongest allowed in nature, and to discover how energy transforms into matter.*

The Massachusetts Institute of Technology (MIT) and Hampton University (HU) Physics groups are key players in the development of this Electron Ion Collider, and in particular co-lead the physics simulation and the detector research and design efforts. We offer a summer research opportunity to undergraduate students to participate in these studies from May 31st to August 31st. Accepted students will work with HU faculty, with a visit to MIT in the last week. Selected students will work with MIT faculty, and permanently reside at MIT. For the nine weeks of participation, students will receive a stipend of \$4,000, housing on HU or MIT campus, and support for meals. Students will be reimbursed for the cost of travel to HU for up to \$300. Travel to MIT is also paid for. First-year participants at HU will be encouraged to continue the program for a second summer period at MIT in 2011.

To be considered for this program, applicants must:

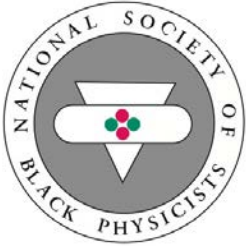
- Have completed their freshman, sophomore, or junior years with a physics major.
- Complete and submit an application package to [uniphyre@mit.edu](mailto:uniphyre@mit.edu).
- Provide two letters of recommendation.
- Provide a transcript of all college courses.

Questions? Email [uniphyre@mit.edu](mailto:uniphyre@mit.edu) or contact  
Dr. Jon M. Hanning, Associate Director for Education  
Department of Physics  
Hampton University  
Hampton, VA 23668  
(757) 722-4948 or (757) 722-5277

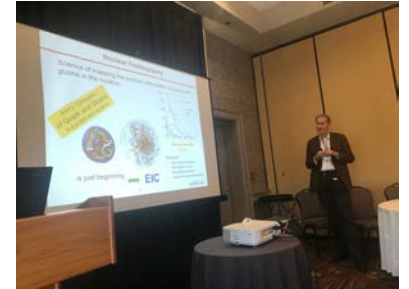
- Program ran from 2007 to 2011, funded as NSF-REU with help from JLab and MIT.
- Structure was students could opt as one or two years: one at Hampton/JLab for early training and one at MIT.
- **Being at Jefferson Lab and at MIT opened their eyes to what was possible.**
- Several went on to PhD (Columbia, Hampton, UC Berkeley, ...).



# National Society of Black Physicists (NSBP) Engagement



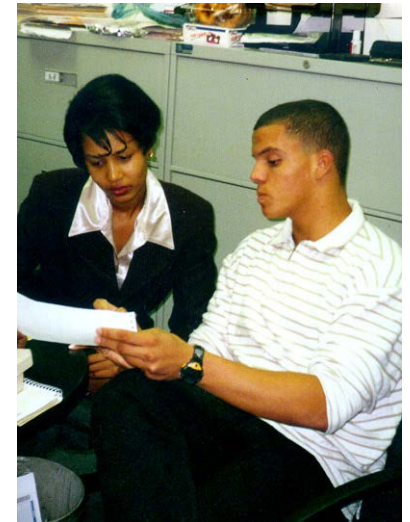
- Site: [www.nsbp.org](http://www.nsbp.org)
- Largest gathering of AA physics students
- 16 Physics sections:
  - Nuclear & Particle Physics
- “Sisters organizations”
  - National Society of Hispanic Physicists (<https://hispanicphysicists.org>)
  - Society of Indigenous Physicists (<https://indigenousphysicists.com>)
  - One success story
    - Tracy Edwards
    - High school (Missouri) → BS (Hampton) → PhD (Michigan State)
    - NSBP Student Council



**Reaching out to the Community is paramount for success.  
One cannot be idle and wait!**

## STEP-UP and Importance of People Facilitating

		2018-2019	2019-2020	Cummulative
<b>Total</b>		<b>161</b>	<b>205</b>	<b>366</b>
<b>Students in contact</b>		<b>147</b>	<b>120</b>	<b>267</b>
Middle school			83	83
Highschool		20	9	29
Undergraduate (HBCUs + NSBP)		87	23	110
Graduate (HBCUs + NSBP)		40	5	45
<b>MSU Application</b>		<b>7</b>	<b>2</b>	<b>9</b>
Graduate school (from HBCUs)		2	0	2
Undergrad school (from high school)		4	2	6
Undergrad from PING		1		1
<b>MSU programs</b>		<b>7</b>	<b>83</b>	<b>90</b>
PING (high school + undergraduate)		6	17	23
PEGASUS (undergraduate)		1		1
Extended Collaboration			29	29
JINA Lecture series			37	37



**Need dedicated team that can immersed itself within the targeted group**

- **Student Training and Engagement for Undergraduates in Physics (STEP-UP) Program [FRIB/JLab]**
- **The HU “behind the door” team: Carlane, Vevelyn ... then ... Monique, Edna ...**

## Lessons learned

- **HBCU/MSI partner must have substantive, meaningful role and responsibility in research partnership** – not just contribute students
- **Can be hampered by lack of understanding of research environment on HBCU/MSI campus** (need accessible accounts for supplies, efficient travel processing, contract streamlining,...)
- **Need to develop and nurture pipelines and partnerships** (faculty lectures/visits to other schools, reach out to local high schools, work directly person-to-person) – will take dedicated effort
- **Engage students in recruiting activities** (but don't overwhelm them)
- **Take advantage of existing public outreach opportunities** (live demo shows, radio opportunities, even a State Fair or beauty contest... be creative in getting the word out) - identify engaging speakers





## What works to get successful program with MSIs

- **A critical mass!** – Role models and examples do wonders.
- **A seat at the table** – One needs to give opportunity. Take advantage of bridged faculty and bridged postdoc positions to build bridges and make them part of a team. Enable some remote access infrastructure.
- **A meaningful contribution** – Multi-institutions working on a meaningful project on the MSI campus can have large impact.
- **A small dedicated common fund** – Bypass administration nightmares common at many small (and not so small) colleges and universities. It frustrates young scientists if they are enthusiastic but can not contribute waiting for say aluminized mylar to wrap their detector.
- **Long-range goals and scientific direction** – keep these in mind as opposed to political-driven goals, these are a short-term solution that fizzles out.

**Take advantage of modern times for engagement and form a team!**

# For questions: EICUG DEI committee

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Taya Chetry  
Paul Guèye  
Narbe Kalantarian  
Astrid Morreale  
Sanghwa Park

U. Manitoba, Canada, Chair  
Mississippi State University, USA  
Michigan State University, USA  
Virginia Union University, USA  
Los Alamos National Lab, USA  
Stony Brook University, USA

