## **DEI in STEM & Physics**





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## Near and dear to my heart

**REYES** (REMOTE EXPERIENCE FOR YOUNG ENGINEERS AND SCIENTISTS) **PYTHON 4 PHYSICS** HALES (HIGH ACHIEVING LATINX IN ENGINEERING AND SCIENCES) **ODU/JLAB REU JLAB & LBNL SULI** 



### **ENDLESS DEI COMMITTEES ASYNCHRONOUS QFT MFURA PARTNERSHIPS WITH HS** NUCLEAR MENTORING PROGRAM **MEXICAN SUMMER INTERNSHIPS LATINAMERICAN MENTORING**



## disclaimer



- **D** problems in DEI
- □ why should we care?
- Causes of the problems?
- □ solutions to the problems?

### **□** problems in DEI

### Pro tip: 🔲 Please, don't get depressed! 😁 📦 Think like a scientists 👳

(things rarely are as simple as they seem, and this is a highly complicated multivariate problem)

Think about a group other than your own (activate the sympathetic response for others)



- ----All Bachelor's
- Biology
- Chemistry
- Math & Stats
- Earth Sciences
- Engineering
- Physics
- Computer Science





Source: IPEDS and APS











Source: IPEDS, US Census, and APS





he individuals marginalized by race/ethnicity include Black and African Americans, Hispanic and Latino Americans, American Indians, Alaska Natives, Native Hawaiians, and other Pacific Islanders

Source: IPEDS and APS



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![](_page_13_Figure_0.jpeg)

### Bachelor's Degrees (5-year average 2017-2021)

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### problems in DEI

- □ why should we care? **I** some might point to something negative about academia, **\[** we are missing out on talent, □...
- Causes of the problems?
- solutions to the problems?

### **o**problems in DEI

Why should we care?

causes of the problems?
Socio-economic reasons,
Gender-equality paradox
Work place climate,
Biases [CV Study],
Lack of representation,
Self-perception,...?

□ solutions to the problems?

### problems in DEI

Why should we care?

Causes of the problems?

**□** solutions to the problems? **C** create an inclusive / welcoming environment, 🗖 outreach, D avoid arguments [create bridges, don't burn them!], **□** get educated, **□** get involved helping others,

### "Be the best, so you can help others"

my grandma

![](_page_16_Picture_8.jpeg)

![](_page_17_Figure_1.jpeg)

Causes of the problems?

**□** solutions to the problems? **C** create an inclusive / welcoming environment, **D**outreach, avoid arguments [create bridges, don't burn them!], **□** get educated, **□** get involved helping others,

"Be the best, so you can help others" "smile like a goof, and you will get whatever you want." *i.e. a little bit of sweetness & kindness goes a long way.* 

my grandma

![](_page_17_Picture_6.jpeg)

![](_page_17_Picture_7.jpeg)

## What to do **ASSESS HOW MUCH POWER YOU ACTUALLY HAVE. REALIZE EVERYONE WANTS THE BEST FOR OUR FIELD SUPPORT OTHERS THAT ARE LEADING! LESS TALKING/PREACHING. MORE DOING GET INVOLVED** MENTOR THINK LIKE AN OPTIMIST REALIST

![](_page_18_Picture_1.jpeg)

("WE MIGHT BE SCREWED, BUT IF WE DON'T TRY TO DO **SOMETHING, WE WILL DEFINITELY BE SCREWED!"**)

![](_page_18_Picture_3.jpeg)

# Venn diagram of action

### what brings you joy?

(what gets you up in the morning? Neglecting your joy will lead to burnout.) do you like tweeting nerdy science? blogging? making music? making spreadsheets? writing code?

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going to HS is great, but we might not all be good at talking to HS'ers. What are you actually good at?

### What are you good at?

(what are you special skills? Networking, magic, running...?) do you like tweeting nerdy science? blogging? making music? making spreadsheets? writing code?

# Venn diagram of action

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### What are you good at?

(what are you special skills? Networking, magic, running...?)

do you like tweeting nerdy science? blogging? making music? making spreadsheets? writing code?

### What you "should" do

### What needs to get done?

(educate the next generation of scientists, while creating equitable environment for all)

create an attractive environment for talent to be drawn! Make science widely accessible.

![](_page_21_Picture_12.jpeg)

## My Venn diagram

### what brings you joy? Physics, musics, talking to people, education

**Outreach &** advocacy

### What are you good at?

**Dancing**, getting people together, teaching, solving some equations

What needs to get done? educate the next generation of scientists, while creating equitable environment for all

## Break out session

☐ Is our field welcoming enough?

Remember, we might disagree on this...and that's ok! We all have very different backgrounds and experiences.

What could be done to make our field more welcoming? You could say nothing...that's fine too.

What could YOU do to make our field more welcoming? Again, nothing is an acceptable answer.

☐ What does your Venn diagram of action look like? It could be the empty set ☺

We will break out for 15min, and the come back here to share your answers to this question, and show some Venn diagrams.

## Outreach

There are forces "pulling out" and "pushing out" people, these may be worst for some demographics, which results in lack of diversity, but they affect everyone,

Outreach aims to counteract ALL of these 🥰

![](_page_24_Picture_3.jpeg)

outreach

![](_page_24_Picture_5.jpeg)

socioeconomic issues, perceptions that physics isn't a realistic path, lack of representation, not feeling good enough, lack of preparation, hostile environment? you don't see physics until 10th-11th grade

![](_page_24_Picture_7.jpeg)

![](_page_24_Picture_8.jpeg)

## **Python4Physics**

whole life", "student don't like Physics" - HS Teachers

numerical problem solving.

All ages and backgrounds [lower barriers of entry].

in collaboration with Ted Rogers

![](_page_25_Picture_5.jpeg)

- "Students don't typically take Physics until 11th grade, and by then they have already planned out their
  - **Free** class aimed at making programming fun and teach some basics of data analysis and

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## **Python4Physics**

Talk to me if you want to host a chapter of P4P

in collaboration with Ted Rogers

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## Mentoring

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JLab's mentoring (paid/unpaid) programs, □ JLab's SULI and ODU/JLab's REU programs, **Science** Graduate Student Research (<u>SCGSR</u>) Program, **HUGS** (?), **□** Summer internship program for Mexican, students [Arkaitz Rodas, Carlos Hernandez], **REYES** Mentoring program.

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### REYES

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https://physics.berkeley.edu/reyes

![](_page_28_Picture_3.jpeg)

STEM-H virtual sessions and classes; supported by UC Berkeley and Old Dominion U.

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Free and open to the public, accessible via YouTube

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Mentoring from world experts

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## Some stats from 2023

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- over 1,200 registrants
- The second se
- 75% are 18yrs or older, 25% minors
- To 75% outside of the USA
- 41% female // 56% male // 1.5% nonbinary
- 48% College // 21% HS // 17% Grad.

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![](_page_30_Picture_0.jpeg)

![](_page_30_Picture_1.jpeg)

### EXPERTS

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## WHAT THEY ARE SAYING

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https://physics.berkeley.edu/reyes

### **STEM Inspiration**

Thanks to REYES, **70%+** felt more confident and enthusiastic in pursuing a career in STEM and conducting research.

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## Homework for you!

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### "Be the best, so you can help others" "smile like a goof, and you will get whatever you want."

![](_page_32_Picture_3.jpeg)

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## Ideas/recommendations [these are meant to be conversation starters]

1. Awards & recognitions for outreach efforts. Financial support 2. Fellowships/internships for students abroad to come to DOE facilities. On going Mexico with JLab and now Berkeley internships, using individuals funds. 3. Prestigious fellowships/postdocs and/or bridges not tied to any specific effort. Folks from diverse background respond more to broad advertisements. Narrow searches can have unintended exclusionary effects. "Diversifying the workforce in nuclear science requires that the entry pathways be broadened." - LRP (2015) Possible model is the <u>NASA Hubble Fellows</u>.

Perhaps existing fellowships could be modified to improve outreach efforts.

### 4. Travel fund award for grad students and scientists to go abroad or rural places. "Engineers without borders" but for Nuclear Physicists.

See Sherwood Richers <u>slide</u> on efforts in el Salvador.

5. Nuclear physics summer schools abroad (Mexico, ..., Africa...) and/or Puerto Rico

- 6. Teaching relief funds for faculty hosting summer schools.
- 7. Flexible pools of money for miscellaneous outreach efforts.
- 8. Remote mentoring funds.

<u>REYES</u>. Salary for admin, grad students, postdocs, and students. Funding international students and / or mentors?

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## Ideas/recommendations [cont.]

### 9. Open up REU, SULI and SCGSR for non-Americans

Visas may place restrictions on whether some students may or not be paid. One should be mindful to not hurt Americans coming from disadvantaged backgrounds.

### **10. REU & SULI partnerships with community colleges and minority serving institutions 11. More needs for asynchronous teaching of advanced courses. 12. NSF vs. DOE grants:**

[e.g. do NSF PIs have more diverse groups?]. If so, should this be incorporated into the DOE? If not, should this requirement be replaced or changed? Should it be required that DOE PIs get involved in existing outreach efforts?

### 13. Should lab bridges continue to require faculty to spend time at lab?

If so, does this hurt individuals with family?

### 14. Should lab offer or help with child care?

In particular junior / temporary staff that are new to the area? **15. Financial support from funding agencies for parental leave.** In particular for grad students and postdocs.

- It might still be valuable to allow them to participate and have their housing and possibly meals paid.
- Do the NSF Broader Impacts requirement have a measurable impact in the actions of the PI/groups?

### **Backup slides**

- Workforce development is critical.
- It should include broadly accessible training sites that take advantage of distributed expertise with strong emphasis on project based learning.
- Graduate course on reaction theory (2015,2017)
- Seminar on Scattering Theory and Applications (2019-present)
- National Nuclear Physics Summer School (only second time outside the US UNAM, 2021)
- Outreach

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**GLOBAL CLASSROOM** SCATTERING THEORY

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![](_page_42_Picture_13.jpeg)

June 21 - 25, 2021. Virtual, UNAM (Mexico) and IU (USA)

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### Adam Szczepaniak

## **Optimizing local DEI efforts**

NSF Broader Impacts leads to a wealth DEI efforts at various institutions

Because these are developed at the individual PI level, there may be repeated efforts, programs that are dissolved because funding falls through/PI leaves etc

Also, PIs are not trained on DEI efforts

What can be done?

- Crowdsourcing efforts with other faculty
- Bring in physics education researchers
   EX: Geraldine Cochran (PER) running INSIGHT
- Document efforts across a department, coordinate efforts
- Track statistics on your programs

Example: University of Illinois Urbana-Champain's Nuclear experimental group started the Young Scholars program (initially through NSF grant): <u>https://</u> <u>physics.illinois.edu/outreach/young-scholars</u>

- Crowdsourced by various PIs, different fields
- Eventually moved to university level
- Brings in local, high school students, pays for lab work; provides college prep/application help
- Now there is a university level buy in. Administrators, outreach, advertisement, extended across multiple departments

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![](_page_43_Picture_16.jpeg)

## **Mentoring for Careers in Physics**

One-on-one professional mentoring for female students in the Department of Physics at William & Mary

Goals: build STEM identity and sense of physics belonging; develop professional skills; and provide networking, internship and employment opportunities

One year pilot program launched in Dec 2021 24 female undergraduate student mentees 24 female mentors in STEM fields, with physics or engineering-physics training or in physics-related positions, drawn from organisations as diverse as NASA, leading semiconductor manufacturers, and TikTok

Mentee-mentor pairs meet (at least) monthly, with structured mentoring and social activities

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WILLIAM & MARY Chris Monahan CHARTERED 1693

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- On-going qualitative and quantitative program evaluation carried out in collaboration with the School of Education
- Administrative assistance provided through an undergraduate Program Assistant Website and social media presence under construction, built by undergraduate web developer
- Recruitment for both mentees and mentors for the 2022-2023 cohort starting now!

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### **Quantum Computing Internship For Undergrads**

3-week Summer school for 15-20 Students + year-long internship for 4-5 Students Goal to develop diverse workforce with skills needed to succeed in academia and industry

### Young field provides opportunity to build inclusive community Students paid competitive hourly wage

**Essential** to enable participation by students from all socioeconomic backgrounds.

 Topical lectures by experts in the field Quantum physics & mathematics, quantum algorithms, error mitigation & correction,

quantum hardware. Self-contained and accessible to all preparation levels.

- Pair programming on quantum simulators & real devices Computational exercises in Python + Qiskit (IBM's SDK) on classical and quantum algorithms. Final project simulating 1+1d gauge theory on real devices.
- Panels and informal discussions on career opportunities Panelists from **both academia and industry**. Information about applying to and paying for graduate school especially important for first-generation college students.

• Year-long interns perform publishable research Primitive Quantum Gates for an SU(2) Discrete Subgroup: BT [2208.12309] Lattice Simulation of Z2 gauge theory on a quantum computer (in prep)

Henry Lamm **Fermilab** Michael Wagman Ruth Van De Water 50 DOE Quantum Information Science Enabled Discovery (QuantISED)

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## Improving undergrad's scientific methodology

- •Motivation: Development of a massive online scientific prediction engine (MOSPE)
- •A database of predictions to assess scientific progress
- •Current project: Simulate the effect of different reward algorithms

T.C. Rogers, A self-governing, self-regulating system for assessing scientific predictive power, https://arxiv.org/abs/2205.04503

•We need more support for this and similar projects that simultaneously aid the nuclear science program while training new generations in good scientific practice

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## **NSF Al Institute** for

### **Artificial Intelligence & Fundamental Interactions (IAIFI)**

### **IAIFI Fellowship Program**

- 3 postdoocs / yr
- Currently, 7 postdocs ranging from astrophysics to neutrinos

### Interdisciplinary PhD in Physics, Statistics, and Data Science

- Launched Fall 2020; 5 students enrolled, +4 graduated
- Particularly beneficial to international students
- Utilizes existing structure of MIT's Interdisciplinary Doctoral Program in Statistics

### **MITx Course in Physics & AI**

- Based on Computational Data Science in Physics course,
- will launch on **MIT's digital learning platform**,
- Applies statistical/AI methods to real-world experimental data sets from LHC, LIGO, and astrophysics
- Modular, open access resource for physicists interested in computational data science

### **IAIFI Summer School & Workshop**

- Held first in August 2022: ~80 Summer School and >100 workshop attendees
- Covered topics at the intersection of physics and AI, attendees from both fields
- About 200 applications for the Summer School, included virtual option

Phiala Shanahan

![](_page_47_Picture_24.jpeg)

## **Everyone Should Learn QCD!**

### Free app designed to teach kids the quark content of hadrons.

![](_page_48_Picture_2.jpeg)

### Available at: Google Play and Apple Store

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![](_page_48_Picture_5.jpeg)

The app has also been used in the intro to physics and nuclear physics undergraduate class <u>Link</u> to story about app

![](_page_48_Picture_7.jpeg)

Replying to @NSF\_MPS and @michiganstateu

![](_page_48_Picture_9.jpeg)

![](_page_48_Picture_11.jpeg)

## **Podcast for Students**

- Podcast aiming to humanize physicists,
- On each episode, a different physicist discusses:
  - their research,
  - what got them interested in physics,
  - Obstacles they overcame,
  - what their typical day looks like,
  - tips and suggestions for students.

Physicists are people with lives outside of the lab. Guests share about their interests and hobbies outside of research. Be sure to listen if you are interested in becoming a physicist too!

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![](_page_49_Picture_12.jpeg)

## Lattice QCD Summer School

- Flipped classroom model
- Students learn in advance with pre-recorded lectures
- Pre-class questions to test their understanding
- During the class
- $\bullet Q\&A$
- Test students' understanding with in-class activities & problem solving
- Peer learning among small groups
- More chance to interact with lecturers and TAs
- Slack channel for post-class discussions

![](_page_50_Picture_15.jpeg)

![](_page_50_Picture_16.jpeg)

## Astronomy in El Salvador

- Sherwood Richers travels to El Salvador annually to forge connections with Salvadoran universities.
- Public and research talks
- Portable solar observing
- University workshops
- Teacher education
- Remote research advising
- Communication requires in-person presence.
- University students are very eager to do research but have poor understanding of the system and little access to opportunities.
- School teachers are as thrilled as school students to look through a telescope and learn about astronomy.
- Physics / astronomy are not generally viewed as useful degrees.

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### Sherwood Richers

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## **N3AS-PFC Program in Support of Transferring Undergraduates**

### Motivation:

- economic mobility
- off access\*
- university curricula, so that the most talented CC students could successfully transfer
- about 1/3rd of Berkeley physics juniors now enter through this portal
- experience, economic independence
- STEM disciplines the most popular, but the transition has proven very difficult for many students: course articulation difficulties, social isolation on joining a new group. Many students give up, leave Physics for less challenging areas

**<u>N3AS program</u>**: Two years of postdoc- and faculty-led individual mentorship, paid introduction-to-research appointments, to support, encourage, and motivate the students. Peer interactions provide a sense of identity, belonging. Designed by and led by N3AS postdocs. 16 students in 2022.

**Now:** Seeking private support to extend this program

• Public research universities have traditionally been at the forefront in keeping university education asccessible and enabling

• 2009 recession led to widespread cuts in state support that have proven permanent, causing large tuition increases, cutting

• UC system in 2016 created UC Transfer Pathways to address this issue, coordinating community college programs with

• this student group is significantly more diverse than their four-year cohort: race, ethnicity, immigration status, age, work

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Wick Haxton

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## More demographics

![](_page_53_Figure_1.jpeg)

Source: IPEDS, US Census, and APS

Source: US Census, IPEDS, AIP, and APS

## **More demographics**

![](_page_54_Figure_1.jpeg)

Source: IPEDS and APS