APS physics

CSWP & COM Gazette

Vol. 40, No. 2

Fall 2021

Newsletter of the Committee on the Status of Women in Physics & the Committee on Minorities of the American Physical Society

INSIDE

True Diversity, Inclusion & Equity in STEM Requires Minority Professional Organizations

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Anyone working in a Science Technology Engineering or Mathematics (STEM) field has heard about the lack of participation by ethnic minorities, women and members of the LGBTQ+ communities. One statistic from the American Physical Society (APS) shows that while African Americans make up roughly 16% of the college aged population, they receive only 3% of bachelor degrees in Physics. In Mathematics, that number goes up slightly to 4.5%, while in Computer Science African Americans receive 9% of the degrees. STEM is essential to American prosperity and security. According to 2019 Pew Research, a non-partisan fact tank, 8 out of 10 Americans believe it is important to have a diversified workforce. So how do we get there?

For years we have all been inundated with proposals that kick the can down the road, claiming that diversity goals are hampered by under-preparedness at the elementary, middle or even high school levels. Solutions do not have to focus on the environments students find themselves living, studying and working in, because the issues are always said to be far removed. However, the development and continued relevance of organizations such as the National Society of Black Physicists (NSBP), the National Society of Hispanic Physicists (NSHP), Women in Physics (WiP) groups, and the National Society of Black Engineers (NSBE) among others, bear witness to many causes of the "leaky pipeline" impeding attempts to achieve true Diversity, Inclusion and Equity.

While STEM professionals, academics and institutions have sought to create in-house Diversity & Inclusion staff, the process of building the structures needed to welcome people from communities of color into an organization and maintain a healthy working environment requires collaboration with minority leaders in these professions. Leaders who have navigated the same career paths. Working with professional organizational leadership can identify potential pitfalls to recruiting and address environmental factors diminishing retention. A new generation of minority leaders, such as NSBP's President Dr. Stephon Alexander, have proven effective at dismantling barriers for African Americans.

Carol Scarlett

One of several professional organizations aiming to move the needle on Diversity & Inclusion in the US, the National Society of Black Physicists (NSBP) was founded to create a sense of community and fellowship for black physicists. Since its inception, it has offered opportunities for the works of African American students, post doctorial researchers and academics to take center stage. But like most organizations founded to support minority professionals, NSBP has traditionally operated on a year-to-year plan. In a new era where "Diversity & Inclusion" has become central to reconciling with long overdue social justice, leadership at the organization has shifted to long range planning as well as analysis of how best to serve its community. As membership swells, the ability of leaders like Dr. Alexander to develop strategies for increasing NSBP's relevance to the careers of African American Physicists stands as an example of what can be achieved. This includes attracting board members and volunteers who develop and implement programs that: 1. Inspire African American students early on to pursue advanced degrees, through providing internship and mentoring opportunities as well as highlighting their success, 2. Recognizing early career productivity, awards for the up-and-coming, 3. Promoting mid-career professionals and 4. Recognizing support staff who enable students and faculty success.

Of course, NSBP is not the only organization dedicated to achieving Diversity, Inclusion and Equity for under-represented Americans. Just take a look at some of the other minority leaders of professional organizations: Dr. Ramon Lopez of the National Society of

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Publication Information
The COM/CSWP GAZETTE, a newsletter of the American Physical Society Committee on Minorities (COM) and Committee on the Status of Women in Physics (CSWP), is mailed free of charge to all those listed on the Roster of Women and Minorities in Physics, all U.S. physics department chairs, and others upon request. Please address all correspondence to: COM/CSWP Gazette, American Physical Society, One Physics Ellipse, College Park, MD 20740-3844, or email to: gazette@aps.org. Opinions expressed are those of the authors and do not necessarily reflect the views of the APS or of the COM and CSWP.

Re-Establishing Physics & Astronomy as a Native Identity

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When discussing inclusivity and equity in physics, we also must acknowledge the low representation of women and minoritized persons across the community, at nearly every education and career level. The unfortunate result of such a mono-gendered and mono-ethnic structure is that it fosters a false equivalence between the lack of representation with the identity of physics itself. In other words, we assume that the identity established by this demographic is all encompassing of the entire field, which makes the problem of increasing participation more nuanced. Persons who may not want to assimilate to such an identity may not want to participate at all. In the most egregious case, we may falsely equate a student not wanting to participate with a deficit model, confusing not wanting to participate with not being qualified.

I find myself in similar conversations throughout academe, and it often arises in discussions surrounding Native Americans in Physics & Astronomy. As a member of the Dry Creek Band of Pomo Indians who now is a faculty member at the University of California, I advocate strongly for effective and meaningful support and outreach regarding indigenous persons in the education system. These conversations are made difficult by the low awareness of indigenous identities and culture that currently exists. Indigenous identity is extremely diverse and rich, and unfortunately many of the identifiers used to hide this fact. A great article to survey the broad spectrum of identities which exist can be found in a previous APS Gazette article, "Indigenous Peoples Exist Within Physics" [1]. My perspective and focus in this article will be on the indigenous communities which I have interacted with the most, tribes located in the contiguous United States.

Franklin Dollar

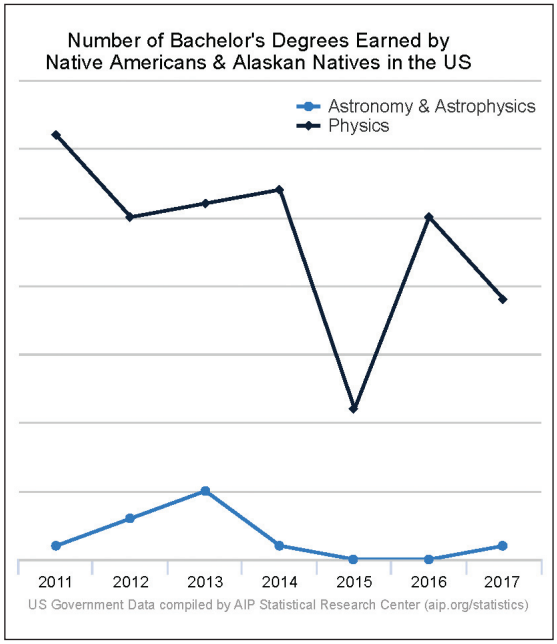

Figure 1: Total number of Bachelor's degrees award to Native Americans and Alaskan Natives in Physics (black) and Astronomy or Astrophysics (blue) majors in the united States from 2011 to 2017. Courtesy of AIP Statistical Research Center.

Native American representation in Physics & Astronomy is far below that of the US population; in 2017, out of the 8,523 physics and astronomy bachelor's degrees awarded, only 20 were awarded to Native Americans or Alaskan Natives (Figure 1). Despite a 37% increase in the number of overall degrees awarded compared to 6 years prior, there were 11 fewer degree recipients in Native Americans and Alaskan Natives than in 2011. Discussing metrics in terms of percentages can hide the fact that there is an extremely low overall number of students involved. However, whether looking over the past decade or longer, an overall decrease of Native Americans in Physics can be observed, despite the growth of both that population and the number of degrees awarded [2].

I find that much of the conversation that takes place is centered on the perceived lack of preparedness or lack of interest in the participant. Underneath this line of thinking is the perception that there are not, nor have there been, Native Americans in physics & astronomy. It also reinforces the notion that since there has not been a core identity component of indigeneity in physics and astronomy, that it does not have a purpose for indigenous communities. I will attempt to dissuade such an argument, by discussing the concept of colonization in physics and how it can be destructive for inclusivity. I will discuss how Native American students successfully participate in such a structure currently, and what we can learn from it. Finally, I will show how initial efforts can make a substantial impact, and how the field is better for them.

Physics and astronomy are often described as the study of the universe and natural world, something that obeys the scientific method and can provide predictions about what can occur in the future. To that end, physics and astronomy can be historically described as one of the most fundamental aspects of

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Creating a more diverse workforce for Nuclear Physics

Rene Bellwied, M.D. Anderson Chair and Professor of Physics, University of Houston
Claudia Ratti, Associate Professor of Physics, University of Houston

The NuSTEAM (Nuclear Science in Texas to Enhance and Advance Minorities) project is a new collaborative effort by four Texas-based minority-serving universities to host an annual undergraduate traineeship program under the guidelines of the Department of Energy TBD-NP (Research Traineeships to Broaden and Diversify the Nuclear Physics community) initiative. This DOE pilot program, funded jointly by Nuclear and High Energy Physics Divisions, presently supports eight projects nationwide for the next two years at a level of roughly $3 Million. The NuSTEAM collaboration is the biggest supported group and presently consists of the University of Houston (UH), University of Texas - Rio Grande Valley (UTRGV), University of Texas – El Paso (UTEP) and Prairie View A&M University (PVAMU). UH, UTRGV and UTEP are among the largest certified Hispanic-serving institutions (HIS) in the country and PVAMU is the largest historically black college (HBCU) in Texas. The program is led by Dr. Claudia Ratti at the University of Houston, together with nine co-PIs from all participating universities. Four of the co-PI faculties are minorities, so is the program's UH coordinator, Dr. Israel Portillo-Vazquez.

UH has an extensive Experimental and Theoretical Nuclear and High Energy Physics Research Program for graduate and undergraduate students and will serve as a host for the summer program of the year-long traineeship (https://uh.edu/nsm/physics/nusteam/). All four institutions provide minority undergraduate students based on their GPAs and their interest in becoming part of the nuclear workforce. The curriculum of the summer course focuses on developing a Nuclear/High Energy Physics based skill set, which will be applicable to future professions in academia and industry within these fields. Areas that will be covered in the course are low- and high-energy Physics research, neutrino and dark matter physics, radiation applications in Space Science and Medical Physics, Instrumentation and Detectors, Electronics, Software Development, Analysis tools, Machine Learning, and finally Networking, Presentation Skills and Career Planning. Jemal Wote, one of the undergraduate students from Prairie View A&M is very excited to be in the program: 'This is an amazing opportunity and it is very timely at, hopefully, the tail end of the pandemic. I was not sure what to do next with my Physics Bachelor degree, but this program allows me to gauge a variety of options in Nuclear Physics and neighboring fields.' After completing the six-week course at UH, Brookhaven National Laboratory (BNL) has agreed to host the students for a two-week hands-on experience in the laboratory environment. 'The possibility to experience the laboratory environment first hand already as an undergraduate student is what really excited me to this program', says Ammber Valverde from UT El Paso. Upon returning to their home institutions, the students will continue to be supported for the Fall and Spring semesters, while working on selected research topics supervised jointly by the local mentor and the UH coordinators. Possible topics will include nuclear and high energy data analysis, neutrino and dark matter data analysis, phenomenological modeling of data from the Relativistic Heavy Ion Collider (RHIC) at BNL and the Large Hadron Collider (LHC) at CERN in Geneva, Switzerland, radiation physics studies, machine learning applications in nuclear physics, detector calibration and electronics testing for new instruments.

The first cohort of 2021 consists of eight students, three female and five male, seven Hispanic and one African-American student. Prof. Efrain Ferrer, one of the Co-PIs from UT Rio Grande Valley, whose two Hispanic female undergraduate students contribute significantly to the diversity of the group, thinks that these programs are long overdue, 'We have hoped for federal support for these types of programs for many years. The students are here, they are talented, well educated, and eager to contribute. Now we have the projects to raise them to the next level in their career.' The program balances fair wages for the students, the experience of working at a laboratory and being embedded in programs with strong minority support. More than 80% of the allocated funds are used for student

Prof. Ratti, the principal investigator (middle) and Dr. Portillo, the program coordinator (right) together with students from the first NuSTEAM training program.

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Rene Bellwied

Claudia Ratti

Is Physics Color Blind? Opposing Racism and Promoting Racial Equity in Physics

Mario F. Borunda, Associate Professor of Physics, Oklahoma State University, APS COM Chair, Technical Officer of the National Society of Hispanic Physicists

Roseanne Cheng, Staff Scientist, Theoretical Division, Los Alamos National Laboratory and APS COM member

Mario F. Borunda

Roseanne Cheng

"Physics is 100% meritocratic. [Physics] is blind to sex, race, sexual preference, religion, and disability. Stop obsessing over these things and instead focus on science. My former classrooms were diverse BECAUSE science is inclusive."

"This is disgusting! Injecting this identity politics is what WILL ruin the field and set humanity back as the hard sciences abandon the scientific method for antiracism or decolonialized [sic] science."

As members of the Committee on Minorities (COM) of the American Physical Society (APS), we get to work on numerous initiatives and take action in programs that impact increasing diversity in the physics community. As such, we have a different perspective from the majority of physicists working in the United States. These quotes are a small part of the feedback received during physics conferences or when hosting diversity events. The assumption made by these quotes is that because the field of science is objective, then the people that practice it must also be objective. Bias in the field of physics, therefore, does not exist. As members of COM, we accept that bias exists in physics. In our research we actively work to eliminate bias to obtain the "true" result, as free of errors as possible, by controlling for different variables, experimental designs, or modifying hypotheses. These quotes are akin to saying that proximity to objectiveness makes us objective, or in other words, "I have a Black friend, so I cannot be racist."

The foundations of these statements are questionable. The second quote suggests that being anti-racist is a bad thing. To address this, we reflect on the extent to which physics is infected with racism and how far we are from inclusivity. As physicists with open minds, we constantly spend time thinking about what external forces affect our systems. We look for "systemic" problems that could interfere with how we get the facts we want to obtain and root them out. A systemic problem that affects our broader society is racism. Given that Physics is practiced at institutions within our society, with open minds, we must acknowledge that this is also a problem for Physics. Rooting systemic racism out is how we are anti-racist. That is, we adopt practices that oppose racism and act towards racial equity.

In this way, we reflect on how we do science and work towards eliminating bias and marginalization. Being an anti-racist is to look at our Institutions (how we hire, who we hire, who we promote/award degrees, how we teach, how we value those who support diversity), Cultural Values (who we elevate, how we define scientific success, how we support colleagues, how we define best), Peer Review (how we fund, how we review proposals/papers), and Communication (how we showcase work at conferences/news articles, how we give credit).

Merit-based?

As in most of academia, in Physics, it is a cultural belief that our success is merit-based. It is determined by ability, talent, hard work, and career advancement established by a fair comparison of one's accomplishments to others, similar to how scientific ideas are accepted after systematic reasoning based on all of the available facts. For example, one could assume that a professor at a university is hired because they worked hard for a scientific discovery recognized by the community. Indeed, it is the case that the competition for the position would initiate concerted efforts on many to get the job. What is not clear is who has had more opportunities than others to receive the recognition? Are there factors other than the merit-based selection that elevate some more than others? If we assume that we have all of the available facts, that we promote people solely based on the recognition of their scientific accomplishments, then we are perpetuating the myth of meritocracy. In doing so, we are close-minded to many factors that affect the broader society as well as the Physics community.

According to the American Institute of Physics, starting in 2008, women represented about 19% of the physics PhDs awarded in the United States. Contrast that number with 50.8%, the percentage of people that identify as females. During 2018-19, the breakdown of race or ethnicity of PhDs obtained by US nationals was 89% White, 9% Asian-American, 4% Hispanic, and 1% Black. The AIP lists 2% of physics PhDs as Other US Citizens, possibly being people that declined to identify or Indigenous Peoples. In 2010, the breakdown by race of the US population ages 25- to 34-year-olds (the median age of Physics PhDs was 29.5) was 68.7% White, 6% Asian-American, and 13.2% Black. In 2019, the census estimated that 20.6% of the population in that age range identified as Hispanic. Thus, certain races/ethnicities/genders are severely underrepresented, and it is hard to argue that Physics is not plagued by structural racism. We should strive for Physics to reflect the country in which we live. To accomplish that, we need to be open-minded and take action to include more people. As cultural beliefs are learned and shared through our interactions, we make changes for the better in our society by being mindful of what we do. Inclusion in Physics is a practice where we acknowledge the diverse identities

of our colleagues and act to ensure voices are heard while centering marginalized identities.

Being Anti-racist

As Physicists, we can take anti-racist actions. In our roles as instructors or educators, we can examine the expectations and assumptions we have of our students. As outlined in the TEAM-UP report[1], a common myth is that students from marginalized groups have learning challenges. The research literature shows that instructors should recognize student abilities and build on their strengths while providing them with additional academic resources rather than focusing on their weaknesses. One aspect to be aware of is that deficit thinking, and the notion of meritocracy can lead faculty to judge the student and their potential erroneously. Peer interactions are essential for the sense of belonging and engagement of all students. Faculty can foster positive peer interactions by educating their students about diversity, equity, and inclusion. Instructors can also prepare and be ready for challenging discussions related to racism and inequality in physics.

As mentors, we can help our students from underrepresented groups by being aware of the barriers they face. Most students have to go into debt to attend college. According to 2019 estimates from the Federal Reserve, Black and Hispanic families' median wealth is 13% ($24,000) and 19% ($36,000) that of the median wealth of White families ($188,000). These wealth disparities in the US show that specific demographic groups are impacted harder by financial stress. Mentors can point their students to resources such as the APS National Mentoring Community (NMC) Bringing Emergency Aid to Mentees (BEAM) fund[2] and other funding mechanisms in their institutions to relieve financial pressures. Given that mental health issues can be due to the responsibilities some of our students face, such as supporting their family, or due to experiencing racial bias and microaggressions, it is vital for mentors to discuss stress and self-care with their mentees so that they can normalize seeking help. Further, mentors should listen to their mentees to better support them.

As researchers, we have several opportunities to be anti-racist. For instance, when peer-reviewing proposals or manuscripts, are we as unbiased as we should be, or do we elevate institutions or countries? It is astonishing to see proposals severely criticized solely based on the nation of origin of the proposer. When presenting our research and writing our manuscripts, do we give credit to the originators of the ideas being cited or to the most famous groups working in that subfield?

In our institutions, we have the pressure of living up to the meritocratic ideal. This is reflected in hiring and retention practices. Candidates for positions are usually screened based on a statement of research interest and future research plans, their CV, which consists of evaluating the rank of their academic institutions and counting their number of publications, and their reference letters. At first glance, the criteria are fair. However, letter writers may unintentionally write weaker letters for students and colleagues belonging to marginalized groups.[3] The number of publications does not reflect quality of scientific ideas. The quantity might be due to being at the right time with the right research group. Some people might benefit from a head start created in their research group by the work of previous members. People who did not obtain their PhD from a top institution will find that elitism is the most significant hurdle in obtaining a position in academia. A study of the hiring practices in Computer Science, Business, and History disciplines, found a perfect hierarchy in going from doctorate to a faculty position. On average, faculty members are hired at departments that rank 30 to 50 spots below their PhD institution. The statement of research is usually just read if the candidate was able to pass other criteria. However, it holds the essential information available to the committee when assessing if the candidate has innovative and diverse ideas. Several institutions are now requiring a statement on diversity/equity which is a change in the right direction. We think that such statements should be an essential aspect of evaluation when hiring committees assess (and possibly credit) candidates' commitment to diversity and equity. One of the values of having a diverse scientific discipline is that it is the best way to fight the homogeneity of viewpoints and experiences that stagnate the discipline.

We urge colleagues to work towards better hiring and retention practices which value diversity. During site visits to evaluate institutions, we will routinely ask about the diversity of the faculty (or lack of diversity), and we are told that the faculty pool is not diverse or that their institution is at a geographic disadvantage. Recruiting minorities involves seeking out diverse candidates instead of relying on a small, personal network of colleagues, building connections with minority organizations both at individual and organization-level, educating the hiring committee on their implicit (and in some cases explicit) biases, not being ultra-specific on the research field, and having a department that makes efforts to address racial and gender barriers at both the undergraduate and graduate levels. It is important to note that most efforts as an individual end up being individual/volunteer efforts with limited impact if not backed by administrators. As such, to our colleagues in leadership roles: use your positions to elevate diversity, inclusion, and equity in your institutions, teams, and groups. Leaders can prioritize and show commitment that will then set the expectations for the organization. ■

Acknowledgements

We thank Geraldine Cochran for motivating our initial discussions on this topic. We are also grateful to Sowjanya Gollapinni and Yolanda Vasquez for feedback and comments on the manuscript.

1 *www.aip.org/sites/default/files/aipcorp/files/teamup-full-report.pdf*

2 *www.aps.org/programs/minorities/nmc/nmcbeam.cfm*

3 *www.aps.org/publications/apsnews/202101/backpage.cfm*

a society. Unfortunately, in many of our textbooks we see that the history of the field begins with names such as Newton, Kepler, or perhaps Aristotle. Rarely will we see a discussion of magnetism involving Chinese history, for instance, or Polynesians being mentioned in astronomy [3, 4]. Unfortunately, much of this can be attributed to much stronger historical prejudices. For instance, only 4 Mayan historical documents remain due to the systemic Spanish burning of sacred texts as part of an assimilation and conquest campaign [5]. Despite this, the Mayan people survive to this day and continue to carry on their traditions [6].

The act of suppressing and removing an indigenous culture and history to be displaced with one's own is known as colonization. Higher education has facilitated colonization since its inception in America. For instance, The Morrill Act not only provided universities with land to build on, but sold 11 million acres of expropriated tribal land to endow them [7]. Tribes in Washington and New Mexico were again displaced for the Manhattan Project [8]. Many are simply unaware that current university land exists on top of sites ranging from small villages to complex cities with carefully constructed buildings and mounds. Similar colonization acts continue today, as echoed by the protests of Native Hawaiians in response to the proposed construction of the Thirty Meter Telescope.

The lack of such discourse in physics and astronomy makes the field less attractive for Native Americans, which in turn perpetuates extremely low levels of representation. Many Land Grant institutions and national laboratories do not formally recognize the land that they inhabit with a land acknowledgment [9]. With too few numbers, assessments used in Physics Education Research can come to conclusions that are not necessarily generalizable to indigenous students [10]. For those Native Americans who are in this higher education system, it often feels like they are "walking in two worlds" having to exist in both [11].

Their success provides a path for how physics and astronomy can move forward. Research interviewing numerous indigenous STEM professionals shows several general aspects, including a strong desire to give back to their community and the importance of culture and identity in being a scientist [12]. These are components which would benefit the field, but are not commonly defined as core requirements of being a scientist. Likewise, there exists anxiety in the perception that indigenous people need to leave their culture behind in order to become a successful scientist. Promoting cultural identity and ownership over physics and astronomy can then be a means of reconciling these identities.

There is a trend of new programs which actively seek to engage indigenous communities as stakeholders, rather than subjects, leading to innovative new curriculum. A project at Concordia University is collaborating with local First Nation tribes to develop a new physics curriculum, tellingly the majority of the funds are for engaging tribal leaders and elders [13]. Dr. Corey Gray helps translate LIGO press releases into the Blackfoot language as a means of language revitalization and dissemination [14]. An NSF funded summer undergraduate research program I host explores how laser driven particle accelerators can be used for nuclear waste cleanup. These efforts seek to establish Native identities in Physics and Astronomy from within the community, as opposed to being dictated by the current majority structure. Rather than being told what the field can do for indigenous communities, we provide the opportunity for the indigenous perspective to be shared broadly. It enables problems to be examined from a different perspective, and the terms on how to proceed with them are owned by the respective communities.

Fostering efforts such as these is the next step in the wayfinding occurring in the field today; though ideally the field would adapt such that these trailblazed paths were part of the identity of physics and astronomy. These small scale efforts are beginning to show impact. In the past five years I have had the great fortune to be able to support three Native American women to participate in my research group, one of whom is currently pursuing their doctoral degree. Considering that between 1977 and 2006 there were only 4 doctoral degrees in physics awarded to that same demographic [2], there is reason to be optimistic about the future.

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True Diversity, Inclusion & Equity in STEM Requires Minority Professional Organizations

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Hispanic Physicists (NSHP), Dr. Mary Owens of the Association of American Indian Physicians (AAIP), Dr. Lyons-Jones of the Association of Black Women Physicians (ABWP), just to name a few. The lessons learned, over several generations of these organizations, about the root causes for lack of recruitment and retention are the reasons professional organizations and institutions looking to hire minorities must work with minority leadership to develop truly impactful diversity programs.

NSBP is not atypical of a professional organization serving a distinct demographic within a larger profession. Other such organizations have grown out of the same need to create space for minorities to thrive and, as such, have accumulated a wealth of responses and tactics for achieving true diversity. There has never been a time like the present, where minority leadership has a particularly valuable role to play. More than ever, institutions committed to Diversity, Inclusion & Equity in STEM must engage minority leadership in professional organizations such as the ones discussed above. ■

Creating a more diverse workforce for Nuclear Physics

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support. 'I believe it is important to show our students that there are professional opportunities in Nuclear and High Energy Physics, and that there are role models that have already succeeded in establishing themselves in these highly sophisticated areas. This program is also meant as a confidence building exercise in fields where minorities are traditionally underrepresented' says Prof. Jorge Munoz from UT El Paso. Students completing the program will be well prepared for future employment in a nuclear physics based profession at laboratories, universities or industrial research facilities. 'We are very excited about hosting and coordinating this program. Over the past decade we have seen a steadily rising number of highly skilled minority and first generation immigrant students in our Physics program. Giving these young researchers the opportunity to develop the necessary skills for their future, not only through our training program, but also through active mentorship by our diverse group of investigators, will hopefully lead to a whole new and diverse generation of nuclear physicists' says Dr. Ratti, the program's PI and UH Physics Associate Chair. ■

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