EDUCATIONAL PROPOSAL

STATEMENT OF THE PROBLEM, SIGNIFICANCE OF THE PROBLEM, AND YOUR PLAN OF PROCEDURE*. Describe identified educational priorities in your department and explicitly detail how your plan fits. State clearly the problems or issues you wish to address and how they relate to any ongoing work. Cite precedent. Carefully outline the importance of your plan and the impact it may have on your undergraduate and/or graduate students. A viable approach should be given, including examples from your own prior experience and/or from the literature. Indicate ways in which the completion of this work has a broader impact. Use Arial 11point font. Limit to three pages.*

The Problem:

The number of Physics PhDs earned by underrepresented minority (URM) students in the United States falls persistently short of the general demographics of our country. In fact fewer than 7% of PhDs in Physics (and 5.5% in Astronomy) were awarded to URM students between 2013-2017 (IPEDS and APS), lower than any of the other major academic disciplines (URM students earn 7.5% of Math/Statistics PhDs, 10.2% of Engineering PhDs, 10.7% of Chemistry PhDs, and 12.2% of Biology PhDs). This is a complex problem that reflects a history of structural racism in our country and a failure to create a truly equitable academic environment at every stage from recruiting to mentoring and training to graduation. For every student the path to a PhD is a narrow and difficult one; for students from minoritized backgrounds the barriers are even more plentiful (e.g., Rosa & Mensah 2016; Hyater-Adams et al. 2019; Barthelemy et al., 2020). The situation is especially stark at the University of Pittsburgh, where of graduate students enrolled in our Physics PhD program between 2007 and 2017, only 22% identified as women and just 3% came from underrepresented minority groups.

The Significance:

Universities and institutions strive to provide equitable and inclusive environments that support students and faculty from all backgrounds. Promoting diversity and inclusion is one of 6 primary goals in the 2016-2020 “Plan for Pitt” Strategic document. This is a lofty and worthy objective; one that we as physicists are failing to achieve. Our failure manifests at many levels - even amongst undergraduates the fraction of female (20%/34%) and URM (<12%) students earning bachelor's degrees in Physics and/or Astronomy is woefully behind that of other natural sciences, let alone at the faculty level (APS). If we continue to disproportionately fail to attract and train graduate students from minoritized groups, we will never remediate our lack of diversity. In no group is this more striking than for African American students, who earn a mere 1.9% of Physics PhDs in the United States (~20 per year), but account for at least 13% of the population (U.S. Census). Statistics for intersectional groups are even more dramatic; for example, only ~100 African American women have *ever* earned PhDs in Physics.

The Solution: bolstering equity in the Physics PhD pipeline via the APS bridge program

The number of PhDs granted in physics in any given year is small, therefore recruiting and training *even one student per year* at the University of Pittsburgh (Pitt) would make a significant difference. According to APS statistics, an average of 74 URM students earn U.S. Physics PhDs every year (out of a total of 1075.6 domestic PhDs); if a school increases its graduate cohort by 2 URM students that would correspond to a 0.3% change overall. Small shifts in the priorities at many institutions could make profound changes in a short period of time. This is the goal of the APS bridge program, a consortium of 39 APS Bridge Partnership Sites rallied around the common purpose of “eliminating the achievement gap between undergraduate and graduate participation” of URM students. Each partnership institution applies to join the consortium and designs an implementation that reflects their resources, existing programs, and institutional strengths. As an active member of the department equity and inclusion (E&I) committee, I helped lead the APS Bridge partnership application and the design and implementation of the bridge program in our Physics and Astronomy Department, which enrolled its first student in 2019. Although we have made dramatic changes to our recruiting, (11/20 incoming PhD students in 2020 are women and 4 come from URM groups), we must ensure that all of our students succeed academically, launching a more diverse group of Physics PhDs into the academic field or industry positions.

As chair of the mentoring committee and leader within the APS bridge program, I am uniquely positioned to build a strong, sustainable mentoring program to provide the support and tools to thrive at Pitt. These resources are designed with the needs of Bridge students in mind, but to foster community (Sabella et al., 2017) and minimize feelings of isolation or stereotype threat (e.g., Steele 1997) will include all Physics PhD students.

The APS bridge program and my role as chair of the mentoring committee

Although many APS bridge partners provide 1-2-year short term programs, at Pitt we admit bridge students directly into our PhD program with the same guarantees of funding as any other graduate student and more flexibility in the timeline to degree and enhanced mentoring. As with any of our PhD students, we only admit students that we expect to be prepared to earn a PhD in ~6 years. Bridge students are provided with funding via University recruiting

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Fellowships during their first year in addition to small research grants, which could be used to subsidize the purchase of a laptop or conference attendance during their time as a student, and a $2,500 relocation subsidy. Beyond this, bridge students are integrated in the PhD program, which is designed to train students from a diverse range of backgrounds: including those from liberal arts schools that lack extensive upper division physics courses, European students with master's degrees, and students with engineering backgrounds.

Paving the way to a strong and sustainable APS bridge program at Pitt
The long-term goal of this proposal is to continuously increase the number of PhDs earned by URM students at the University of Pittsburgh. The basic framework and funding for the APS bridge program at the University of Pittsburgh is in place and our first two cohorts have been admitted, but this is only the first step. During graduate school students will face a series of external (e.g. academic coursework and exams, research hurdles) and internal (e.g. grappling with mental or physical health issues, countering self-doubt or imposter syndrome, feelings of isolation or stereotype threat) barriers that will stand between them and defending their dissertations. As a Cottrell scholar I will build a stronger mentoring and support network to help students identify, anticipate, and navigate those challenges by connecting them to departmental and University resources. By documenting and iterating on the APS bridge program, mentoring program, and first year curriculum over the three-year period, I will create a lasting initiative to lead our more diverse admitted cohorts from convocation to PhD.

Formalizing the admission process to the APS bridge program at Pitt
The critical component provided by the APS to the bridge program is the centralized clearinghouse that collects applications from students from URM groups who have somehow fallen through the ever-widening cracks of graduate school admissions. This can happen for any number of reasons, such as lacking research opportunities, limited coursework, expectations of the fixed abilities of applicants (Canning et al., 2019), overreliance on biased standardized tests (e.g., Miller and Stassun 2014), and limited or poor advising about application strategies. The online portal to these applications opens on April 15 and schools are expected to quickly evaluate applications, invite, organize, and conduct interviews, and make final offers to the first round of applicants in ~3 weeks. I have been extremely active in this process over the last 2 years and as a Cottrell scholar I will collaborate with E&I committee chair Jeffrey Newman to hone and document our admissions strategies to identify the most promising candidates from the pool of more than 100 students.

Formal and informal mentoring of graduate students at the University of Pittsburgh
Prior to last year, students were assigned peer mentors (senior graduate students) and academic advisors, whose primary responsibility is to help students select and succeed in their courses. Although peer mentors have the invaluable perspective of recent experience, faculty have a different set of experiences that is generally informed by longer careers, more institutional knowledge, and greater seniority, power, and resources with which to problem-solve. Starting in the Fall 2019, I was the founding co-chair of the department graduate student mentoring committee. In this role I identified interested/capable colleagues and matched each pre-comprehensive exam student with a faculty mentor, who was asked to check in on a ~monthly basis with their mentee. Although some of the students made use of this additional resource, this program needs more structure. Specifically, students felt like their meetings with faculty mentors were too infrequent and the relationships were too cursory to actually discuss difficult or personal problems with their mentors; if students came to their faculty mentors with problems it was only after those issues had snowballed and were harder to solve. As a Cottrell Scholar I will help both students and faculty mentors form a complementary support network to help solve problems before they get in the way of succeeding in coursework or research. Starting this year, I will (1) organize a social event aimed at forming a more social bond between mentors and mentees with refreshments and games and (2) shorter monthly meetings to ensure issues are addressed before they grow (e.g. finding doctors or therapists, identifying research opportunities). (3) I will send regular reminders encouraging mentors to check in on their mentees. Finally, (4) I will collect resources to help faculty build mentor-mentee connections and understand the University resources that are available to all graduate students, including non-academic career paths. These initiatives will focus on pre-comprehensive exam students (years 1-2), after which research supervisors are confirmed. Informal mentorship will hopefully continue throughout a student's career.

Creating a culture of open and formalized discussions of systemic barriers for all first-year students
Although the challenges that any individual student faces in graduate school, there are a number of demonstrated sociological phenomena and nearly universal problems that are rarely discussed in formal

classroom settings, but that can systematically and preferentially impact the resolve and sense of belonging for students from minoritized groups. Since I arrived at Pitt, I have organized an "unprofessional seminar" called the "T" (read: the truth) focused on honest discussions about the cultural aspects of being a physicist. No topic is off-limits, and the only rule is that participants must listen and speak to each other respectfully. The topics of these meetings have ranged from applying to postdoc positions or non-academic jobs, imposter syndrome (e.g., Clance & Imes 1978), protecting or seeking treatment for mental health issues, and navigating an academic career with a partner or maintaining a family. I often enlist visiting speakers, especially junior visitors. Often these conversations center on the visitor's professional trajectory, but sometimes visitors suggest specific topics. For example, one speaker told us about her personal experiences with professional bullying and sexual harassment and the network she built to fight the prevalent issue (http://www.astronomyallies.com/). These meetings are voluntary, and participation is usually skewed towards more senior students.

I will integrate some of these conversations (monthly) into the "teaching of physics" (PHYS 2997) required first year seminar to raise broader awareness of and improve community language to address these issues amongst *all students*. I will engage senior students, particularly those currently serving as peer mentors, to help lead the discussions. Initially this curriculum will focus on the following 4 themes: (1) Imposter syndrome, (2) unconscious bias and stereotype threat, (3) mental health and finding support outside of the department, and (4) research ethics and being a good academic citizen but the curriculum will evolve with time.

Building physics identity and supporting a top-down mentoring program for undergraduate students
Although the primary focus of this educational proposal is in supporting graduate students from minoritized groups, currently *no formal mentoring program exists* for the ~105 undergraduate majors in the Pitt Physics and Astronomy Department. These students (~80 men, 25 woman, and 5 who identified with URM groups) face similar internal and external challenges as graduate students at Pitt and are currently without personalized and systematic guidance beyond designing their course schedules. I will leverage the successful mentoring model to spearhead a peer mentoring program for undergraduate students led by graduate students. I will work with the Director of Undergraduate Studies Michael Wood-Vasey and Undergraduate Advisor Dr. Russell Clark to integrate a similar curriculum into our undergraduate First Year Seminar. These conversations will be led by the graduate students to build their confidence as experts (Aschbacher, Li, & Roth 2010) and provide a network of graduate-undergraduate mentoring. Additionally, the graduate students will provide an immediate network of role models that span the racial backgrounds and gender identities of the undergraduate population, in contrast with the physics faculty.

Building a larger network of community across the University
Although students from minoritized groups may never find significant cohorts with shared backgrounds and experiences within the department, the university provides a much larger community and portfolio of resources. In my mentoring role, I will act as concierge to help direct bridge students (and mentors) towards cross-disciplinary opportunities. For example, the Director of Diversity Initiatives and Academic Affairs Philippa Carter organizes monthly dinners for underrepresented minority graduate students and has access to additional lines of funding and support. The University of Pittsburgh offers a cross-disciplinary "Hot Metal Bridge" program - we have already begun to make connections with Psychology and Biology bridge programs; I will organize interdisciplinary social events, including Physics Bridge students and their peer mentors, to facilitate friendships and support outside of the department. Such "counterspaces" often provide crucial sources of support from other members of the same gender identities, sexual orientation and/or ethnicity (Ong, Smith, and Ko 2018).

Creating a department presence for recruiting and community at NSBP and SACNAS
Expanding to national counterspaces, I will provide ~$2500 annual funds for bridge or URM graduate or undergraduate students to attend National Society of Black Physicists (NSBP) and/or Society for Advancement of Chicanos/Hispanics and Native Americans in Science (SACNAS) meetings and commit to insuring faculty attendance (committing myself and/or another colleagues) along with any interested students.

Designing a robust and sustainable APS Bridge program and pipeline of URM Physics PhDs at Pitt
Finally, I will document the mentoring guidelines and first year seminar curriculum in addition to maintaining regular communication with peer and faculty mentors. I will synthesize existing mentoring resources including qualitative advice (e.g., Lee et al. 2007) in addition to specific rubrics from the extremely successful Fisk-Vanderbilt Bridge Program (Stassun et al. 2011). These resources and my personal interactions with graduate students and faculty I will generate a lasting and transferable mentoring guidebook.

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ASSESSMENT PLAN. *Define expected outcomes of your educational plan. How will your evaluation design provide information to improve your project as it develops and progresses? How will you determine whether your stated project objectives are being met according to the proposed timeline?*

The minimum outcomes that I expect from my educational plans include the following seven components. (1) Increase the number of URM graduate students in the University of Pittsburgh PhD program, enrolling at least 2 students per year via the APS Bridge. (2) Although the three-year duration of the Cottrell fellowship is insufficient to see bridge students from admission to PhD, I make a long-term commitment to the continued mentoring and tracking of Bridge students throughout their graduate careers. (3) All APS bridge students pass comprehensive exams (>60% on final examinations in each of four core graduate physics courses) within the first two years of study, with the possibility to extend into a third year in extenuating circumstances. APS bridge students should be integrated into a research group by the end of their second year, but ideally in their first summer. (4) Written and evolving "Guide to mentoring" posted on Pitt Physics and Astronomy Department Website (posted by the end of first year) including: Mentoring guidelines including checklists and rubrics and Department and University Resource Guide (including Counter Spaces). This guide will inform faculty mentoring of graduate students and graduate student mentoring of undergraduate students. (5) All students will be paired with mentors (graduate students with faculty mentors, undergraduates with graduate student mentors), with flexibility to request or change mentors at any time. (6) Compilation of University of Pittsburgh APS Bridge program Admissions Documents, to be posted on the department website, including Admissions Rubric (to evolve over time) and Interview Questions. And finally, (7) annual faculty and student attendance at both the NSBP and SACNAS conferences.

Although I will informally assess the success of my contributions to the Bridge program along with other faculty and peer mentors it is also important to conduct formal assessment of the program's efficacy. As the program is extremely new, the longer-term success is unknown.

I will conduct annual attitudinal surveys (google form, interviews of APS bridge students) regarding the efficacy of the APS Bridge and Mentoring Programs at the University of Pittsburgh. These studies will address the sense of belonging and physics identity of all students in the PhD program and in collaboration with the discipline-based science research center and Pitt Professor Chandralekha Singh we will evaluate the relative success of the mentoring program on the attitudes of URM and female graduate students. Annual interviews will ask students to evaluate their knowledge and use of Department and University resources, especially regarding counterspace options and funding support.

Identify departmental or institutional colleagues who might play a role in this educational endeavor (as mentors, collaborators, etc.) as appropriate and describe the role they will play.

Professor Jeffrey Newman - Chair of the Equity and Inclusion Committee

- Dr. Newman has been the strongest proponent for the application and founding of the APS bridge program at Pitt. He and I will continue to collaboratively ensure that existing bridge students are supported within our program and recruit future cohorts of bridge students.

Research Assistant Professor Brett Andrews

- In addition to our scientific collaboration, Dr. Andrews is an active participant in the "T" conversations and has spearheaded a NSF-funded AstroPGH summer bootcamp and seminar series (https://astropgh.github.io/astropgh-boot-camp-2020/) designed to get junior researchers, including undergraduate and graduate students, up to speed with programming and basic statistical analysis skills. This technical resource will contribute to the portfolio of departmental resources that will support APS bridge students navigate the path to PhD.

Professor Chandralekha Singh – AAPT president, founding director of dB-SERC (data-based Science Education Research Center) at the University of Pittsburgh, and member of the equity and inclusion committee

- Dr. Singh will help design and analyze the attitudinal surveys and interviews to help assess the success of the mentoring and APS bridge programs at Pitt.

Professor Michael Wood-Vasey - Director of Undergraduate Studies

- Dr. Wood-Vasey currently teaches the undergraduate first-year seminar, into which we will incorporate graduate student-led conversations. Dr. Wood-Vasey will also help facilitate pairing of graduate student-undergraduate mentors and mentees.