

SPECTRUM



A report on underrepresented minorities in astronomy

INSIDE THIS ISSUE

Letter from the New CSMA Chair

by Adam Burgasser, UC San Diego

In June 2013, Professor Adam Burgasser became the new chair of the AAS CSMA. In this article, we asked Prof. Burgasser to introduce himself and to articulate his vision of how the CSMA can best serve the astronomy community.



Happy 2014, everyone! I am pleased to introduce myself as the new CSMA chair, stepping into the rather large shoes of Lou Strolger (size 11!) who has served this committee for 6 years. I am very honored to have the opportunity to serve my community alongside truly creative, compassionate and dedicated astronomers (meet them on p. 8), as we work to increase the successes and opportunities for all involved in the astronomy endeavor, particularly those from underrepresented groups.

I believe in inclusion. As such, I have long been troubled by minority participation in physics and astronomy, what Keivan Stassun has called “the real order of magnitude problem in astrophysics”. For me, breaking down barriers to participation is not just a matter of increasing the workforce¹ or even diversifying per-

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!Imposter: Understanding, Discussing, and Overcoming Imposter Syndrome

by Kathy Cooksey, University of Hawaii at Hilo

Imposter syndrome is the feeling that a woman or man does not deserve the success s/he has achieved, that s/he has so far been lucky, and that s/he will be uncovered as someone who does not rightfully belong. This feeling is common among people in all stages of life: high school, undergraduate, and graduate students; postdocs, researchers, and faculty; and professionals. Women more often experience imposter syndrome; the original term “imposter phenomenon” was used in an article about chronic self-doubt in high-achieving women [1]. Institutions focusing on increasing participation in STEM by underrepresented minorities have identified imposter syndrome as a relevant issue [2, 3].

Symptoms of imposter syndrome include stress, low self-esteem, and underperformance. The latter manifests itself as sufferers not applying for scholarships or jobs because they do not think they could possibly get them. Sufferers may also “self-sabotage” by not asking for help or speaking poorly about themselves, which leads to problems that “prove” they are imposters.

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spectives in science; it is a moral issue. I believe we have a fundamental human right to explore our Universe, because we all have senses, brains, and imagination. We all look up to the sky and ask questions; we should all have equitable opportunities to seek answers.

When I was approached about taking up the chairship, I sat down to think about the CSMA, its successes, strengths and weaknesses, and the parallel efforts of our colleagues in the CSWA and the APS Bridge Program. We all clearly share a personal passion in this endeavor, reflected in the substantial and ongoing efforts to support, prepare and transition students for graduate and post-graduate work, and the social science research that astronomers are undertaking to identify barriers and develop effective solutions. These efforts must be encouraged and shared. Through *Spectrum*, AAS special sessions, and social events, the CSMA will aim to highlight opportunities, activities and successful outcomes, and to encourage collaborative steps forward. I'm personally looking forward to Keivan Stassun's session on the proper use of the Physics GRE in graduate admissions at this month's AAS meeting.

Awareness and recognition of diversity work is also important for those actively seeking solutions, and this is also an area where the CSMA can certainly serve our community. Underrepresentation in the sciences is a triple-hooked anchor: the scope of the problem seems daunting, the number of colleagues active in solution-finding feels small, and efforts often go unrecognized by our colleagues, advisors, or supervisors, who are simply unaware of the problem. A lot falls on a few shoulders. So I ask all of you to take a moment to acknowledge those who are devoting their time, however limited, to helping minority students and colleagues succeed. Send them an email, thank them for their service, nominate them for a AAS or departmental award. A little recognition can be a real boost to continuing one's work. Then, get involved. Anyone can contribute to increasing minority participation in astronomy, not just those from underrepresented groups!

While we're acknowledging our colleagues, let's also highlight the research and successes of minority astronomers. Too often when discussing

diversity issues we focus on the negative statistics—low degree rates, high attrition rates, biases in standardized tests, lack of faculty of color—which can feed stereotype threat. Self-affirmation is a research-validated solution to stereotype threat², and what is more self-affirming than having your research highlighted in *Spectrum*? Send us research highlights from your own work or that of your students', advisors or colleagues, and we'll include them in future issues of *Spectrum*, highlight them on our soon-to-be-released CSMA blog, and tweet them into cyberspace! We are also looking at reinstating the visiting minority speaker program with travel grant support to allow minority astronomers the opportunity to speak on their research around the country.

Finally, we need to be advocates, as both astronomers and citizens, and encourage our governmental representatives to take strong and unambiguous stances on issues that improve the success of students and researchers of color in all STEM fields. This includes opposing cuts to NSF and NASA graduate training and E/PO funding, and encouraging lawmakers to adopt recommendations made by the National Academies of Science in their reports, *Rising Above the Gathering Storm* and *Expanding Underrepresented Minority Participation*, that advance the participation of underrepresented groups in STEM fields.

These are just a few of the ideas we have tossed around—there is no shortage of ideas!—but we are more interested to hear what you have to say. What issues are you facing as a minority astronomer? What resources are you lacking? How can the CSMA help? To help us plan our efforts, we encourage everyone to take our community survey at:

<http://bit.ly/1fNWI9J>

The survey will be open through the month of January, and we will report the results of the survey on our website.

Thank you, and have a great 2014!

¹ This is one of the primary motivators for increasing minority success in STEM education laid out in the National Science Board's 2003 report *The Science and Engineering Workforce: Realizing America's Potential*.

² See Cohen et al. 2006, *Science*, 313, 5791, for an example of a simple writing assignment to reduce stereotype threat in the classroom.

Understanding Imposter Syndrome... (cont'd)

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Talking About Imposter Syndrome

The MIT Department of Physics holds a monthly Diversity & Inclusion Luncheon. At a luncheon recently, the topic was imposter syndrome, and we had the following two goals: (1) identify “symptoms” and causes of imposter syndrome for different demographics, and (2) brainstorm practical suggestions for (a) informing people (students and advisors) about imposter syndrome and (b) dealing with and overcoming it. After a brief introduction,

the attendees broke into small groups (eight to ten people each, including the discussion leader) to discuss for 30 minutes.

The small group discussions centered around the following five questions:

1. What are the symptoms/signs of imposter syndrome? Which of these could be assessed/observed by others?
2. What are causes/stressors of imposter syndrome? Which can be eliminated from the sufferer’s life?
3. What are preemptive/preventative measures? What are ways to deal with an imposter syndrome “attack”?
4. For all of these, what are the differences for different demographics (women, men, minorities, students, academics, professionals) suffering from imposter syndrome?
5. What short message could MIT put on a bumper sticker for “Imposter Syndrome Awareness Week”?

Each group had a designated discussion leader, chosen for their deep understanding of the issues of imposter syndrome so that they could be a source of information. More importantly, the discussion leaders were tasked with keeping the discussion flowing and productive, which included making sure everyone shared. Afterwards, there was a ten-minute share-out by the groups and a five-minute synthesis, where the consensus points were summarized and a few final thoughts were made.

The attendees of the Diversity & Inclusion Luncheon represent a range of people in the MIT Physics Department; there are graduate students and postdocs, junior and tenured faculty¹, and administrators. To be inclusive to the range of views, we carefully worded questions and statements. For example, we opted to use “researchers” instead of “scientists” because many administrators had science degrees. We also emphasized the value of the perspectives of the administrators, since their interactions with MIT undergraduates differ from those of academics and their jobs allow for different manifestations of imposter syndrome.

We were able to keep the introduction to imposter syndrome brief (hence leaving more time for the small-group discussions) because the attendees were sent a summary article [4] in advance. We

¹ We made sure to seat graduate students and their advisors at separate tables so that both might freely express their views.

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Submission of articles to SPECTRUM is welcome! To contribute articles and ideas, e-mail the Editor: lopez@space.mit.edu

For more information on subscribing to SPECTRUM or to read back issues, please visit the AAS CSMA website:
<http://csma.aas.org>

News You Can Use

If you would like to contribute stories to 'News You Can Use', send articles and ideas to the Editor: lopez@space.mit.edu

CSMA SPONSORS SPECIAL SESSION ON PROPER USE OF GRE IN ADMISSIONS AT JANUARY 2014 AAS MEETING

There will be two special sessions sponsored by the CSMA at the annual AAS meeting in Washington, DC. The first is entitled "The Proper Use of GRE Scores and Noncognitive Measures for Enhancing Diversity and Excellence in Astronomy Graduate Programs". The session (Session 337) will take place on Wednesday, January 8, at 2:00-3:30pm in Room National Harbor 5.

The session will feature three speakers: Professor Casey Miller (U of South Florida), Professor William Sedlacek (U Maryland College Park), and Professor Keivan Stassun (Vanderbilt). The session will highlight recent research indicating GRE performance disparities depending on test takers' race and gender, and it will present effective admissions strategies which may be implemented instead of score "cutoffs". The ultimate aim of this session will be to produce a follow-up white paper for use by the community summarizing the findings and recommended admissions practices.

CSMA SPONSORS SPECIAL SESSION ON ASTRONOMY IN AFRICA AT JANUARY 2014 AAS MEETING

The second special session sponsored by the CSMA is entitled "Astronomy Across Africa: A New Dawn". This session is on Thursday, January 9 at 10:00am-11:30am in Room Maryland 1.

The session will have seven speakers highlighting the wave of current and upcoming multiwavelength facilities in Africa, like SALT, HESS, MeerKAT, and PAPER. Additionally, opportunities for collaboration and US-Africa exchange programs will be discussed, such as a presentation by Dr. Kartik Sheth (NRAO) on a new partnership between the NRAO and South Africa to exchange students and faculty.

HOW CAN THE CSMA HELP YOU? TELL US IN OUR COMMUNITY SURVEY!

The CSMA would like to find out from the AAS community what issues they are facing, what resources they need, and how the CSMA can help. Toward this end, please take this survey on your experiences and ideas:

<http://bit.ly/1fNWI9J>

Your suggestions will help shape the initiatives of the CSMA, so we appreciate any and all feedback! The survey will be open through the month of January, and we will report the results on our website and in a future issue of *Spectrum*.

REQUEST FOR RESEARCH, TEACHING, OR OUTREACH HIGHLIGHTS TO BE FEATURED IN SPECTRUM

Spectrum would like to feature the outstanding research, teaching, and/or outreach efforts of diverse astronomers. Please send any highlights to Laura Lopez (lopez@space.mit.edu) from your own work or that of your students', advisors, or colleagues, and we will include them in a future issue of *Spectrum*!

Why So Few Native American Astronomers? One Student's Perspective

by Calvin John Ortega, Jr. (Pima Community College)

My name is Calvin Ortega, Jr. I am a member of the Tohono O'odham Nation, a federally recognized Native American tribe from Southern Arizona. I spent a majority of my childhood living on the reservation, which is located 60 miles west of Tucson, Arizona, and just a scant 50 miles away from the US/Mexico border. I received my secondary education primarily from schools located on the reservation, graduating from Baboquivari High School in 2010. The fall after I graduated, I enrolled in classes at Pima Community College, where I am currently pursuing a degree in Physics.

Because of my involvement with NOAO's Research Experiences for Undergraduates (REU) program during the summer of 2012, I was able to attend the American Astronomical Society's 221st meeting in Long Beach, California, in early January 2013. While at the conference, I was able to attend a session that was of paramount interest to me. The session was entitled, "The First Nation Astronomers and Educators." It was a discussion panel to examine why there are so few Native American and indigenous people entering graduate studies in the field of astronomy. Dr. Jarita Holbrook of University of California Los Angeles (UCLA) was the moderator, with panelists Dr. Paul Coleman, a Native Hawaiian, professor at the Institute for Astronomy at the University of Hawai'i; Carmen Martinez-Yaden, a member of the Tohono O'odham Nation and undergraduate director of Project Native of the Tohono O'odham Community College and the University of Arizona; and Charee Peters, a member of the Yankton Sioux tribe, graduate student enrolled in the Fisk-Vanderbilt Master's to PhD Bridge program.



Calvin John Ortega, Jr.

The panel had a large turnout and a very engaged but subdued pace. The mood was refreshing compared to the rest of the sessions, which were all high impact. The panelists shared their experiences, concerns, and recommendations about the plight of indigenous peoples at the student, professional, and administrative level. The audience was keen to hear the panelists' opinions and stories, and had genuine interest in the issue at hand, especially myself. Several of the issues that affect the ability of indigenous peoples to succeed that were brought up included the social, cultural, and academic environments to which indigenous people are exposed. The issues that were brought up in this panel are important to note not only for minorities

in the science, technology, engineering, and mathematics (STEM) fields but for anyone who wants to see diversity in science and math. Recognizing and discussing these issues will set the stage so that changes can be made. Perhaps we can find solutions to these problems and others faced by minorities in general.

One of the issues that I feel should receive a fair amount of focus is preparation among Native Americans. I feel that proper preparation is the key to success, not only in astronomy and science, but in any aspect of life. I also feel that Native Americans have substantially more hindrances in their pursuit of technical and scientific degrees. Academic preparation among Natives who wish to pursue the sciences in college is precarious. Many of the young men and women who are working toward science degrees are the first in their entire family's history to venture into a scientific profession, with some being the first to pursue any college degree. The home front is the first guild of preparation for all students, and not knowing how or what

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Why So Few Native American Astronomers?(cont'd)

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needs to be done to properly prepare their children to venture into a profession they have zero knowledge about is a huge barrier.

I remember vividly during my first year of college, when I was working on homework for a college algebra course late at night, my mother stood in awe at what most likely appeared to her as gibberish. She took particular interest in Pascal's Triangle, which she had never seen in her life, or if she did, it surely did not make much of an impression. My mother has been there to help and advise me at the most critical points in my life, but how exactly could I expect her to help me with my course work? The first math class I took, which was a few semesters behind the typical four-year college's academic track was beyond her experience. If Pascal's Triangle was beyond her, how could I expect to ask her for help with my differential equations homework at three in the morning? In mathematics, I've noticed that this is a common trend among my tribal peers. Many of the students from tribal schools enter with a slight academic deficiency, and this alone could make students shy away from science programs.

Having the lack of guidance from guardians is not the only hindrance for indigenous students; often, education from schools is insufficient as well. I recall the turmoil I experienced during my high school years. My high school went through more principals and administrative staff than the number of math and science courses that were offered. This inconsistency was not limited to the administrative staff, as instructor positions were just as brief. It is very difficult to absorb a new subject when your teachers are changing faster than you are covering the material. Add to this the fact that a lot of the rotating staff was appointed by the State of Arizona, as my high school was one of the lower achieving schools, a trend which seems to be common among reservation schools. This means that many of the staff coming into the school system had no familiarity with Native American culture or with any of the local customs and problems. Qualified as they may be to teach, it does not help if teachers are not able to establish a connection with the students. This leads both students and teachers to become frustrated and can result in students not attaining the background knowledge ex-



Above: Calvin Ortega, an NOAA EPO student worker and former KPNO REU student, presents a hands-on activity about asteroid discovery at the Arizona-Sonora Desert Museum's Family Astronomy Night.

pected of them in higher education. I knew I wanted to venture into a science field since my sophomore year of high school, but still had to take remedial classes the entirety of my first year of college.

Now, this is not to say that the only type of preparation indigenous peoples lack is academic. College students, science majors in particular, have to develop a certain amount of social dexterity in order to navigate their careers successfully. Native Americans have a different set of social and cultural values regarding interaction and communication that might affect how they respond to their surroundings. Many students, myself included, elect to attend school off the reservation to expand the science options that reservation colleges can't provide. However, many who do opt to leave the reservation for metropolitan settings face leaving for an extended period of time for the first time and find that there is a world's difference from life on

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the reservation. The pace and flow of events can be vastly overwhelming, and the culture and social requirements can catch even the most thoroughly prepared student off guard. This culture shock is inhibiting, and not being able to adapt to “city life” can harm a student’s success.

Cultural identity also can lead to issues developing skills expected of scientists. As a scientist, you are apt to run into problems that are outside of your understanding or ability, sometimes multiple times in a single day. If you do not have the skill set to reach out, discuss, or ask for help, you will face problems. For example: you may be stuck for days on something that is easily answered by a peer or advisor; you will not have the mindset to correct your professor when he/she has clearly written something wrong on the board or to stand up for your scientific beliefs; and you will not be able to reach out to your fellow students and learn important teamwork skills. Most young Native Americans are taught that they must honor the word of their elders and not talk back or question what is said. That doesn’t quite translate to the scientific environment, where questioning and debate is (hopefully) encouraged. These social skills are essential to a scientist, even more so than advanced mathematics at times. Having to assimilate into an entirely different culture in order to obtain these skills is yet another hurdle that claims many would-be Native American scientists.

One of the panelists at the AAS session mentioned that her experience in trying to draw more students to the sciences at the graduate level was a labor-intensive process and involved a lot of community and relationship building, which can be very time consuming. To draw someone who comes from an environment where family and culture are primary priorities and expect that person to succeed in a scientific environment is asking a lot. However, a very observant audience member noted that the connectedness and community so readily found in indigenous cultures is something that is desperately needed in the astronomy community, and would be warmly welcomed. It is an advantage for indigenous people and people in the STEM fields, including astronomy, to work together to find solutions to these and other problems that First Nations peoples face.

While I attended the AAS, I met a majority of the Native Americans involved in astronomy, if not the entire community. These fellow Native Americans and the First Nation panel helped me realize that I had many questions and ideas. But only so much conversation could be squeezed out of such a limited time. I am beginning to analyze my home, my state of education, and my background from an outside point of view. The session was a great success and fulfilled its purpose of informing the public of the nature of Native Americans and indigenous peoples in astronomy, and more importantly, it got people discussing and offering solutions that could be implemented. Many more conversations are needed before some sort of a course of action can be developed, but one is sure to benefit from a conversation on a nice April morning, and a nice June morning, and a nice January morning....

Calvin Ortega is currently pursuing a degree in physics at Pima Community College in Tucson, AZ.

Meet the Members of the CSMA

This year, several CSMA members have concluded their longtime service. We thank Lou Strolger, Dara Norman, Andrew Baker, Kartik Sheth, and Hakeem Oluseyi for their tremendous contributions over the years to the initiatives and success of the CSMA. With their departure, many new faces have joined the ranks of the CSMA. Here, we introduce you to the new and upcoming members (as well as some of the less new members), and we asked them to describe their motivations to serve on the CSMA and to enhance diversity in our profession.



Adam Burgasser is an Associate Professor of Physics at UC San Diego, and an observer and spectroscopist who investigates the lowest-mass stars, brown dwarfs and extrasolar planets. He is also interested in multidisciplinary learning, including merging arts and science education. Adam joined the CSMA to increase inclusion in the physical sciences and address overt and unconscious bias in minority student experiences. His appreciation for minority issues in Physics and Astronomy blossomed while attending the 2009 National Society of Black Physicists meeting, and amid racial tensions that emerged the following year at UCSD. Since then, he has worked to raise awareness of bias and increase opportunities for all underrepresented groups. Adam also runs the UCSD-Morehouse UC-HBCU Physics Bridge Program and mentors the UCSD Undergraduate Women in Physics group.



Kim Coble is an associate professor of physics at Chicago State University, a minority-serving institution on Chicago's South Side. Her current research interests include student understanding of cosmology, use of data and telescopes in general education courses, and identifying the strengths of the urban, minority learner. She is using the results from this research to build effective, interactive curricula. She came to this work after many years in CMB observations. Raised in a diverse community, Kim has always been passionate about making science accessible and satisfying for all people. While attending a conference as a postdoc and realizing there were no visible minorities and few women out of over a hundred attendees, she was spurred to action. She has worked with minority communities to educate herself and others about underrepresentation, racial bias, structural inequality, and the strengths a diverse workforce brings to our field. Kim also serves on the AAS Astronomy Education Board and AAPT's Committee on Diversity. She supports and mentors both faculty and students as Chicago State's campus director for the Illinois Space Grant Consortium.



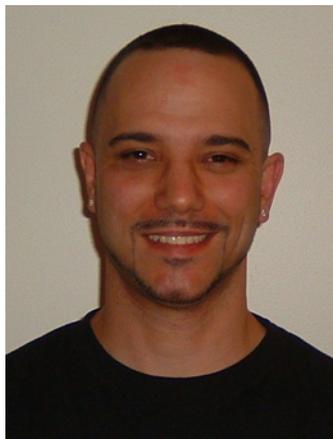
Thompson (Tommy) Le Blanc is a Research and Instrument Analyst at the Space Telescope Science Institute since August 2012, currently assigned to the Near Infrared Spectrograph (NIRSpec) of the James Webb Space Telescope (JWST). He is very interested in contributing to astronomy in a support role, with interests in young stars and the instruments used to study them. Tommy joined the CSMA to increase the participation of minority students in the STEM fields, in particular where astronomy is concerned. As a first generation scientist, he would like share his experiences in an effort to increase awareness of the issues that may make success in the STEM fields difficult.



Jacqueline Faherty received her PhD in Physics from Stony Brook University in 2010. She is currently a Hubble Fellow at the Carnegie Institution of Washington spearheading comparative brown dwarf/exoplanet studies. Prior to graduate school she managed Astrophysics outreach programs at the American Museum of Natural History that targeted poor performing schools in New York City. As an NSF Postdoctoral fellow in Santiago, Chile from 2011-2013, she organized a worldwide viewing of the transit of Venus that targeted youths from underdeveloped parts of the world. She is also co-founder of the 501c non-profit foundation entitled Raising Awareness In Science Education for Women (RAISE-W) that aims to encourage young females to enter STEM fields. As the first PhD from a half Puerto Rican family, she is dedicated to seeing more diversity in Astronomy and excited to make a difference in that respect as a member of the CSMA.



Jedidah C. Isler is currently a Chancellor's Faculty Fellow in Syracuse University's Physics Department. She attended graduate school at Yale University in Astronomy and has recently defended her dissertation entitled, "In Like a Lamb, Out Like a Lion: Probing the Disk-Jet Connection in Fermi Gamma-ray Bright Blazars." She also graduated from Fisk University and Norfolk State University with her Masters and Bachelors degrees, respectively. She is extremely interested in understanding the physical mechanisms responsible for relativistic jet emission in blazars and is equally committed to issues of diversity, access and engagement in Astronomy and in STEM (Science, Technology, Engineering and Mathematics) more broadly. She serves on the CSMA and on the board of trustees for the Museum of Science and Technology in Syracuse, where her goal is to make tangible inroads in both the extension of opportunity to traditionally underserved populations and the sharing of her love of astrophysics. When she isn't working on that, she is logging hours for her pilot's license, hiking, or laying on (or dreaming about) various beaches around the world.



Joseph Barranco earned his B.A in Physics, Astronomy & Astrophysics from Harvard University, and his Ph.D. in Astrophysics from the University of California, Berkeley. Between undergrad and grad studies, Joe worked for two years in the city of Boston as an urban youth worker (assistant director at an after-school tutoring program called Project 21, and a summer day camp called Camp Ozioma; mentor in a gang-intervention program called Gangs Anonymous). While in graduate school, he taught math and science to high school students in the Berkeley Upward Bound program, which works with socioeconomically disadvantaged students to help them get into and succeed at college. He also mentored Oakland youth in the Stiles Hall Black & Latino Violence Prevention Project, and taught math and astronomy to men in San Quentin Prison. His thesis "Theory and Numerical Simulation of Three-Dimensional Vortices in Protoplanetary Disks," was done under the guidance of Professor Philip S. Marcus in the Berkeley Computational Fluid Dynamics Lab, and in 2006, his thesis won the Nicholas Metropolis Prize for Outstanding Doctoral Thesis in Computational Physics from the APS. He was awarded a National Science Foundation Astronomy & Astrophysics Postdoctoral Fellowship, which he split between the Kavli Institute for Theoretical Physics at the University of California, Santa Barbara and the Institute for Theory & Computation at the Harvard-Smithsonian Center for Astrophysics. Joe joined the Department of Physics & Astronomy at San Francisco State University in the summer of 2007, and is now an Associate Professor. In addition to being a member of the CSMA, he also is currently serving on the American Physical Society Committee on Minorities.

Meet the Members of the CSMA... (cont'd)



Andrew West is an Assistant Professor of Astronomy at Boston University (BU) whose research focuses on using large samples of low-mass stars and brown dwarfs to examine the kinematics, structure and evolution of the Milky Way, the generation of stellar magnetic fields, the ages of stars, and the properties of exoplanet hosts. He is also actively involved in the educational mission of BU, including recently creating a non-majors course entitled "Alien Worlds", which explores the detection and characterization of exoplanets and was named one of the "Top Ten Craziest College Courses" by the Huffington Post. Andrew has a strong commitment to being an advocate for policy change and playing a large role in increasing the diversity in Astronomy and the Academy in general. Andrew is a member of the BU Multicultural Advisory Committee, was one of the architects of the University of Washington Pre-MAP program, is the faculty adviser to the BU Graduate Women in Science and Engineering chapter, is the co-chair of the Astronomy/Astrophysics section of the National Society of Black Physicists, and has been a member of the CSMA since 2010. In 2012, he became the founder and director of the BU Pre-Major Program (BU Pre-MaP), which is modeled after the UW Pre-MAP program and introduces first-year, underrepresented undergraduate students to research and provides them with mentoring and cohort building.



Kevin Covey is an Assistant Astronomer at Lowell Observatory in Flagstaff, Arizona, studying the formation and evolution of low-mass stars. Since 2003, Kevin has worked to reduce barriers that discourage students from pursuing careers in science, technology, engineering and mathematics: these barriers negatively affect all students, but disproportionately affect those from underrepresented backgrounds. In addition to his work with the CSMA, Kevin co-founded the University of Washington's Pre-Major in Astronomy Program, co-chairs of the astrophysics section of the National Society of Black Physicists, and regularly mentors undergraduate students through the Northern Arizona University REU & Space Grant programs.



Laura Lopez is a NASA Einstein Postdoctoral Fellow and Pappalardo Fellow in Physics at MIT. Laura earned her PhD in astronomy & astrophysics in 2011 at UC Santa Cruz. Laura's research uses multiwavelength observations to probe the physics of massive stars, supernovae, and the interstellar medium. Laura began pursuing diversity initiatives as an undergraduate after attending the Women in Astronomy II meeting in Pasadena in 2003. To that point, Laura had experienced challenges associated with being a female Mexican-American in physics, but she had not yet appreciated that those experiences were common across the field. WiAII made her realize the scope of the underrepresentation problem as well as the dramatic effect individuals can have to improve the situation. Subsequently, Laura became involved with CSMA initiatives, including serving as Editor of *Spectrum* since 2005. Laura conducted the largest scale faculty demographics survey of PhD-granting astronomy departments in the US (Lopez & Nelson 2004), and Laura has been involved or led university-level mentorship and diversity activities at MIT and UC Santa Cruz. Overall, enhancing participation and representation of minorities in the sciences is one of Laura's primary professional objectives.

Women of Color in Astronomy & Astrophysics

by Dara Norman (NOAO), Jedidah Isler (Yale), Hakeem Oluseyi (Florida Tech), Nancy Morrison (U Toledo), Caroline Simpson (Florida International), Laura Trouille (Northwestern)

Editor's Note: The NRC hosted a conference on Women of Color in STEM Academia in 2012, and the authors wrote this text as a testimonial on behalf of AAS to be added to the conference report.

Women of color (WoC) are at the intersection of race and gender. While they experience issues that arise for both women and minority groups, they are often overlooked in efforts on behalf of either category, to the detriment of their persistence in academia.¹ The next section of this article enumerates barriers that face WoC in astronomy, starting with those that particularly affect career establishment (early graduate student to postdoctoral) and moving to those that impact later career stages. Later sections describe steps toward solutions to these problems, measures taken by the American Astronomical Society (AAS), and lessons learned from academic programs.

Nine Barriers

1. Difficulty Building Networks/Collaborations: In astronomy and astrophysics (hereafter, astronomy), large collaborative projects that employ expensive, cutting-edge instrumentation and are designed to tackle many research questions simultaneously are increasingly important. Career success may require that young researchers join these high-profile collaborations. By doing so, they gain access and visibility, meet future employers and collaborators, establish career-enhancing networks, and are enabled to build skills and confidence. WoC often lack the connections that are required to join these collaborations and be supported in them.

2. Difficulty Achieving Insider Status: In astronomy, some activities in addition to writing research papers identify experts in their field and give younger researchers insider status and the full recognition that comes with it. These by-invitation-only activities include: serving on peer review panels and on telescope time allocation committees; refereeing journal articles; delivering invited talks at conferences, etc. Again, WoC often lack the connections necessary to receive these invitations.

3. Lack of Effective Mentoring: Effective mentoring, especially by thesis advisors, would be a key to overcoming barriers 1 and 2, but it is often lacking, sometimes because suitable role models are unavailable. Effective mentoring is more than giv-

ing academic advice and supervising thesis research; it involves these and other career-building activities.

4. Unfavorable Department Climate and Lack of Support: In the early years of graduate school, it can be crucial to know that at least some people in one's department expect and hope for one's success in astronomy. WoC in astronomy graduate programs encounter not only subtle signs that this is not the case but also even more damaging, overt indications, including: not being taken seriously in complaints of harassment or bias; inability to find department faculty to work with; and exclusion from department activities (e.g., meeting planning, departmental committees, social gatherings at professors' houses). These barriers are especially challenging early in graduate school; WoC who manage to persist to the later stages of their programs develop coping strategies.

5. Cultural Alienation: Cultural alienation often results in WoC never considering astronomy as a career, leaving the field before or after degree completion, and having to manifest one personality while in their department and another outside.

6. Hostility: Unfortunately, racism and sexism are still commonplace in STEM fields, including astronomy. In our experience, most WoC report having been subtly or overtly told that they owe whatever success they may have achieved to being women, minorities, or both, especially when WoC have achieved some milestone, such as landing a job or receiving an award. Such comments are clearly meant to diminish achievements and can be cumulatively devastating over time.

7. Accumulation of Disadvantage and Underestimation of Performance: As WoC in their postdoctoral years seek junior faculty positions, the barriers that they have already faced are often not recognized. Thus, the performance "hit" they may have taken in overcoming these barriers is not taken into account.

(Continued on page 12)

Women of Color in A&A... (cont'd)

(Continued from page 11)

8. Solo Status/Lack of Critical Mass in Job Searches: Since 1985, the percentage of astronomy Ph.D.'s awarded to all underrepresented minorities has been in the range 1% to 5%.³ If the gender balance of the field as a whole holds for WoC, then they receive fewer than 1% of all Ph.D.'s in the field. Research has shown⁴ that a lack of like peers (women or minorities) leads to hiring disadvantages. Because of their small numbers in the field, WoC in Astronomy almost always suffer from solo status. All these barriers conspire to continue this situation.

9. Stereotype Threat: WoC in astronomy are keenly aware that they are often the first, or nearly the first, WoC that colleagues and students have interacted with, sometimes in any STEM field. The pressure that WoC may feel as representatives of their gender and ethnic group, often called stereotype threat, can lead to stresses that manifest in poor self-esteem, underperformance, or ill health.

More generally, WoC face the same barriers as other women in science: insufficient science education, lack of support, and socialized lack of interest in STEM; and, in the professional years, the two-body problem and problems of work-life balance.

Recommendations to External Communities

The above barriers inform our interrelated, but largely independent, recommendations to external communities for action items in support of WoC in academia.

Recommendation #1: Build cohorts of high achieving WoC graduate students at leading institutions to provide supportive, interdisciplinary peer networks for WoC. Organizations like the Posse Foundation, Inc. and the Fisk-Vanderbilt Bridge Program⁵ have valuable experience with this technique and should be seen as resources in establishing strong cohorts of WoC graduate students, in combination with HBCUs (historically black colleges and universities) and MSIs (minority serving institutions). For example, Florida International University (FIU) and Spelman College have successful undergraduate physics programs and can be expected to be able to extend their methods to the graduate level. Larger majority institutions should take the lead in providing the physical resources necessary to host these cohorts, and key participants should cooperate to build a framework for nurturing them.

Key external participants: Posse Foundation, Inc.; Fisk-Vanderbilt Bridge Program; leading STEM HBCUs (FIU, Xavier, Spelman, etc.); leading STEM MSIs; and funding agencies.

Barriers addressed: #1,4,5,9

Recommendation #2: Require diversity and cultural awareness training for people in supervisory roles. Lack of cultural awareness and understanding often leads to over-reliance on stereotypes. Requiring leaders in the academy, such as deans, department chairs, and search committee chairs, to participate in diversity training and awareness programs would force their attention to the issue. Funding agencies could make such training a requirement for federal research funding. In addition, professional societies could provide regular opportunities for such training at their conferences. An important resource is the University of Michigan ADVANCE Faculty Recruitment Guide.⁶

Key external participants: Funding agencies, leaders in the academy, experts in diversity, policy makers, professional societies.

Barriers addressed: #1,2,3,4,5,6,7,8,9

Recommendation #3: Encourage fair hiring practices that minimize implicit bias towards WoC. Studies^{7,8,9} have shown that only after reviewers are given specific metrics with which to assess candidates do they avoid giving unfair advantage to white males. The active dissemination of training materials (such as University of Michigan and University of Wisconsin materials) to departments and at society meetings will promote the adoption of fair hiring practices. Also, encouraging interaction between HBCUs/MSIs and majority institutions may highlight applicants often overlooked in hiring decisions.

Key external participants: Professional societies, majority institutions, HBCUs/MSIs

Barriers addressed: #7,8,6,4

Recommendation #4: Reward departments or individual mentors for support of WoC. Departments, societies, advisors, etc. should be identified and rewarded for their support of WoC. Possible models are the "Woman Physicist of the Month"¹⁰ and the mentoring award of the AAAS.

Key external participants: Funding agencies, policy makers, professional societies, academic departments

Barriers addressed: #1,2,3,4,5,6,7,8,9

Recommendation #5: Maintain better statistics and connections to WoC through graduate school and early career. The small number of WoC pursuing astronomy, together with the lack of information about them, portends a dismal future for recruiting and retaining more. Creating a mechanism to engage and track WoC can provide significant insight into their obstacles and successes, which we can then begin to address. Once identified, these researchers can be invited to serve on review panels and similar bodies.

Key external participants: Funding agencies, professional societies, academic departments

Barriers addressed: #1,2

Recommendation #6: Encourage the development of a network and support group among WoC at the professional level, as a part of, while distinct from, initiatives directed towards women or minorities in the field. This should include special networking opportunities⁵ at major conferences, digital venues for interaction between conferences, and funding to support regular meetings across the country for WoC. Professional societies, partnering with minority-focused, interdisciplinary societies, could lead this effort. Alternating these meetings between majority- and minority-serving institutions will allow communication and networking with all possible participants.

Key external participants: Funding agencies, professional societies (AAS, NSBP, NSHP, SACNAS, etc.), majority institutions and HBCUs/MSIs

Barriers addressed: #1,2,5,6

Recommendation #7: Expand the Faculty and Student Teams (FaST) or Visiting Faculty Programs (VFP). WoC might get turned off by an initial group of people in a specific astronomy subculture, but might consider transitioning to another subculture (as opposed to out of the field completely) if they have the opportunity to engage a leader in another subfield. Funding for a researcher and 1–2 students to spend 2–3 summers with a leading expert can help.

Key external participants: Funding agencies, professional associations, leaders of fields, academic institutions

Barriers addressed: #1,2,3,4,5,7,9

AAS Initiatives Relevant to WoC

We hope that the AAS can be engaged in implementing the above steps. The following already existing initiatives are not specifically designed for WoC but are intended to lower barriers to an astronomy career.

- The AAS vision statement and strategic plan include language supportive of underrepresented minorities.
- The AAS has established committees on the status of women (1979) and of minorities (1997) in astronomy. Both committees have had WoC as active members and have often worked together to benefit underrepresented groups.

-These committees individually and jointly sponsor special sessions and career workshops at AAS bi-annual scientific meetings, such as:

- ♦ “Mentoring a New Generation of Minority Astronomers” (2009)
- ♦ “Mentoring Astronomers: Students to Faculty I & II” (2010)
- ♦ “Addressing Unconscious Bias” (2010)
- ♦ “Mentoring and Networking Groups for Women and Minorities” (2011)
- ♦ “Strategies for Addressing Harassment and Prejudice” (2011)
- ♦ “Increasing Diversity in Your Department” (2012)
- ♦ “Straight Talk About an Astronomical Career: A Professional Development Session” (2012)

-With assistance from the AAS, both committees maintain web sites, discussion boards, and list servers for their constituencies, and both publish bi-annual newsletters.

-Members of these committees collaborated on preparing this testimony.

- The AAS sponsors the Harlow Shapley Visiting Lectureship Program, in which professional astronomers discuss modern astronomy and astrophysics, mainly at colleges that do not offer an astronomy degree. This program is being redesigned with the aim of reaching out to underrepresented minorities.

Lessons learned

Although this testimony emphasizes the needs of WoC at the graduate and professional levels, we are impressed by the achievements of HBCUs and MSIs in improving their undergraduate science programs. For example, by creating inclusive learning communities, FIU grew its physics major from 10 to 150 students over ten years.

Since 1971, Spelman College has increased the percentage of its students earning STEM degrees from 9% to 30%.¹¹ Key factors in its success include: a strong institutional vision combined with cooperation between faculty and administrators; external funding; and strategic partnerships with research institutions, national labs, and private STEM companies. The recommendations in this testimony are consistent with this philosophy.

Understanding Imposter Syndrome... (cont'd)

(Continued from page 3)

also highlighted a few results from an informal survey of primarily Stanford graduate students and postdocs, conducted by Prof. Margot Gerritsen of their Department of Energy Resources Engineering.² First, the female respondents reported more strongly suffering from imposter syndrome. Second, these feelings adversely affected (the perception of) performance for all respondents. Third, when asked about what to do, the responses were approximately as follows: advisors can help (women: 75%, men: 50%); self must handle it (10%, 50%); and “don’t know” (10%, 0%). Our discussion was centered around practical suggestions (for dealing and overcoming) imposter syndrome that can be implemented by sufferers, advisors, and/or institutions, at all stages of career and life.

To keep the conversation going, the discussion leaders also had a list of provocative questions. The following subset demonstrates the breadth of the issues of imposter syndrome:

- Who/what is the primary cause of imposter syndrome? Upbringing? Societal/cultural cues? Internal or external pressure?
- Why do women appear to suffer more from imposter syndrome? Is it caused by stereotype threat, which is when a group performs poorly because they fear confirming a known or perceived stereotype [5]? Made worse by it? Perpetuates the stereotype?³
- How is it similar for underrepresented minorities? Different?
- Is the effect of imposter syndrome and stereotype threat additive? Is this why women and underrepresented minorities leak out of science at higher rates?
- Does affirmative action or diversity-oriented programs adversely affect the recipients/ participants?
- What specific activities or procedures could/should institutions implement to bring the issues of imposter syndrome to the students’ attention?
- How do non-academics (e.g., administrators) perceive imposter syndrome differently from academics?
- How do advisors (and even administrators) act that perpetuate the problem? Alleviate the problem?
- One way to combat imposter syndrome is to make “accurate, realistic assessments” of one’s performance [4]. Should this assessment be comparative

with respect to others? Or to previous personal performance?

• The other end of the self-assessment spectrum from imposter syndrome is the Dunning-Kruger effect,⁴ which, roughly, describes the situation when people lack the ability to assess their incompetence and so over-estimate their ability. With this in mind, is a little imposter syndrome suffering “healthy,” especially for researchers?

Bumper Stickers (and Conclusions)

The strongest consensus of the small-group discussions was that people need to know about imposter syndrome. It is useful to learn that there is a well-known and well-studied name for any self-doubt one has felt, is feeling, and/or will feel. Hopefully, it is also comforting to know that others feel this way. The majority of the bumper stickers for MIT’s hypothetical Imposter Syndrome Awareness Week encapsulate this. For example, this article’s title “I! mposter” can be read as embracing: “I am an imposter! But so are you! (And if everyone is an imposter, then imposter is the new normal.)” Or as affirming: “I != imposter. I am not an imposter!” Either interpretation acknowledges the issue and suggests a way to handle it. Other slogans in this vein were pretty self-explanatory: “Imposters unite!”; “Feel like an imposter? So do I! We are the 99%.”; or “Imposters Welcome!” One professor related what she was told when she started at MIT: “fake it until you make it.” An administrator shared her favorite quote by Eleanor Roosevelt: “no one can make you feel inferior without your consent.” A group thought it would be useful to display posters of well-known MIT faculty that did not get accepted to MIT as undergraduates (but still obviously succeeded).

In the synthesis, we presented the idea of being the worst on the team. “Legendary jazz guitarist Pat Metheny has a stock piece of advice for young musicians: ‘always be the worst guy in every band you’re in.’” [6]. First, being surrounded by and working with people at a higher level of skill stretches and improves one’s ability. Second, “attempting to be the worst actually stops you from selling yourself short. [. . .] Acknowledging outright that you’re not the best wipes away the fear of being discovered for the not-best person you are.” For MIT undergraduates, the message would be that they chose to come to MIT for the challenge and the quality of the education; they should focus

on that and keep track of their absolute (not relative⁵) improvement.

All students should know that the zone of proximal development [7] is uncomfortable. When a person is pushing to learn something new, s/he is ripe to feelings of frustration and incompetence. On the other side of the problem, the answer may seem obvious, and likely, the person moves quickly on to the next problem. So the cycle repeats. Researchers likely spend most of their time in the problem-solving stage and not much in the glowing success phase.

In addition, researchers, and other highly educated people, may be too knowledgeable for their own good, in the sense that the more one knows, the more one understands how much more there is to know. It is pretty easy to feel ignorant. However, it is a researcher's job not to know but to find out what is unknown. This requires a careful balance of confidence that one can figure out the problem and of openness to being wrong because not every avenue of investigation leads to fruition and not every result stands up to new data.

Fostering an environment where people know about imposter syndrome will also help people feel comfortable talking about it. There were several senior MIT professors in attendance that had never heard about imposter syndrome but realized that it was exactly what they had felt as graduate students. Basically, no one knows what anyone else is feeling. Often research careers are isolating. Researchers typically sit by themselves and work on something specialized. They have no idea what someone else would feel like doing exactly what they are doing, and there are not many people doing exactly what they are doing, especially nearby.

Lastly, the attendees determined that it is crucial for people to have a community that can help keep self-assessment reasonable. Though advisors' actions weighed heavily into what the respondents to Gerritsen's informal survey thought would help imposter syndrome, reliance on a single individual can lead to a skewed perspective. It is important that the community be realistic since no one trusts someone who always rains praise. (Unfortunately, people may trust someone who always criticizes.) The community must help the imposter syndrome sufferer give appropriate weights to successes and failures. Too often failures weigh more heavily than successes; people tend to focus on them disproportionate to their merit.

Malleable Mindset May Be the Key

There are two views of ability: fixed and malleable [8]. People who have a fixed mindset think that ability and intelligence are innate and cannot be changed—one just grows and learns until one reaches the predetermined limit. They view success as sign of their inherent skills. Failure is a sign of having attempted something beyond one's abilities and that one is not smart enough to "get it." People with fixed mindsets tend to under-achieve because they fear attempting and failing, showing they have reached their limit.

People who think that ability and skills can be improved through effort have malleable mindsets. Success comes with effort, and failure can be overcome with hard work. People with malleable mindsets are more successful because they can handle momentary failure.

Embracing the idea that hard work can improve one's abilities leads to the view that struggle is the way one improves. So to really have a malleable mindset, one must observe and monitor self-improvement. This is the metric and assessment that can keep a person from mistaking herself/himself as an imposter.

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The Committee on the Status of Minorities in Astronomy

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