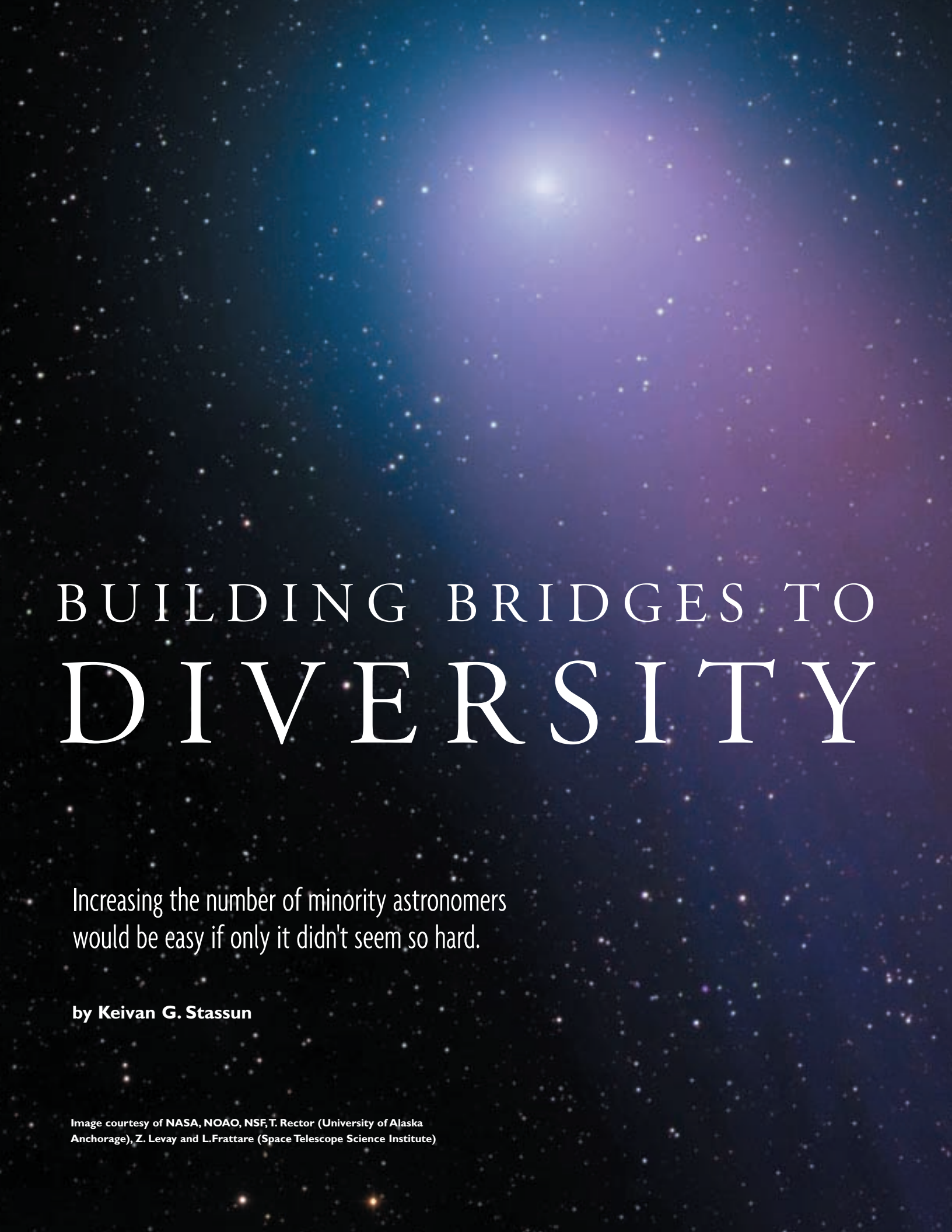


BUILDING BRIDGES TO DIVERSITY

Increasing the number of minority astronomers would be easy if only it didn't seem so hard.

by Keivan G. Stassun

Image courtesy of NASA, NOAO, NSF, T. Rector (University of Alaska Anchorage), Z. Levay and L.Frattare (Space Telescope Science Institute)

Here's a fact that you can use to test whether you're a glass-half-empty or glass-half-full kind of person: The number of minorities awarded the Ph.D. in astronomy and astrophysics nationally over the past twenty years averaged just four individuals per year. To put this another way, each of our astronomy/astrophysics Ph.D.-granting programs (there are about fifty of them) produce an average of one minority Ph.D. recipient every thirteen years.

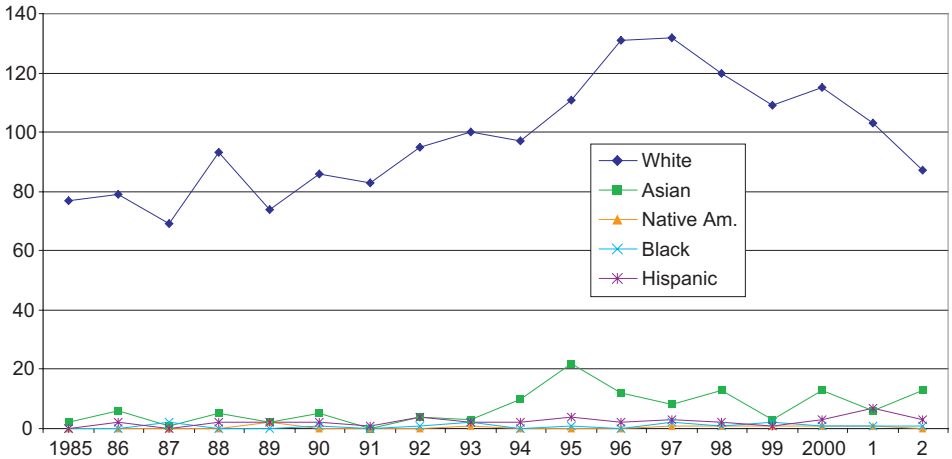
It doesn't have to be this way. After all, astronomy may be the most well suited of all the sciences for its ability to enthrall the public and to inspire the next generation of scientists. The images we produce are awe-inspiring and majestic, the phenomena we study grand and fantastic. Even the places we work—mammoth observatories high atop remote mountains—are strange and romantic. Given the universal appeal and broad public support for astronomy, one might expect that our profession should have no difficulty attracting talented individuals representing a broad cross-section of our multicultural society.

"Astronomy is among the least representative of the sciences in terms of the ethnic makeup of its practitioners."

Sadly, this is not the case. In fact, astronomy is among the least representative of the sciences in terms of the ethnic makeup of its practitioners. Under-represented minorities—which in the sciences are Hispanic-, African-, and Native-Americans—comprise more than 25% of the U.S. population yet represent less than 3% of professional astronomers. Currently, of the more than 650 professional astronomers at Ph.D.-granting institutions in the U.S., seven are African-American, nine are Hispanic-American, only one is Native American.

I certainly wouldn't blame you for seeing the glass as half-empty. But there is a positive side. The glass-half-full perspective is this: if every astronomy Ph.D. program committed to graduating just two minority students every thirteen years, we could increase the national production of minority Ph.D. recipients in astronomy by 100%!

This may seem sarcastic, or glib, especially after that litany of depressing statistics. But I sincerely do believe there is cause for optimism. Doubling the number of minorities earning the Ph.D. in astronomy is a reachable goal. But achieving this goal requires asking open-minded, critical questions about how we have traditionally gone about doing things and a willingness to accept that some of the answers may be, at least at first, difficult to hear.



Astronomy PhD Attainment: US citizens and permanent residents (1985-2002)
Data source: Survey of Earned Doctorates (NSF/NIH/USED/NEH/USDA/NASA) (See SPECTRUM Newsletter, June 2004)

Where are the minorities?

If you have enough water-cooler discussions about diversity in our profession, you're bound to hear the view expressed that the lack of diversity simply reflects a lack of minorities in the higher-education pipeline. This is certainly a reasonable statement—but it is wrong. The notion that "there just aren't any minorities" (to recruit, to admit, to train, etc.) is a common misconception,

and an insidious one that reinforces the status quo and that promotes gradualism with respect to diversity efforts.

In fact, large—and largely untapped—pools of minority talent in physics and astronomy do exist, and they exist already within the higher-education pipeline. One simply needs to know where to look.

Since any career in astronomy begins with physics, consider the following specific question: Which institutions in the U.S. produce the largest number of African-Americans with baccalaureate physics degrees? The answer: Historically Black Colleges and Universities (HBCUs). In fact, the top ten producers of African-American physics bachelor's degrees are all HBCUs. Xavier University, a small liberal-arts HBCU in Louisiana, by itself graduates an average of fifteen African-American physics majors every year, more than all of the Big Ten schools combined.

Similar statistics apply for other minority groups. For example, Hispanic baccalaureate degrees in physics are predominantly produced by an analogous group of schools known as Hispanic Serving Institutions (e.g., University of Texas, El Paso). HBCUs, Hispanic Serving Institutions, and Tribal Colleges and Universities—collectively known as "minority-serving institutions" (MSIs)—are where most minority physics undergraduates are to be found. Two-year colleges have also become very important gateway institutions for minorities in higher education; indeed, roughly 50% of all minorities in higher education now start out at community colleges, many of which now also carry the designation of MSIs.

Why so few?

Why is there such a large disparity between the number of minorities with undergraduate degrees in physics, and the number of minorities in our graduate programs? The American Astronomical Society's Committee on the Status of Minorities in Astronomy (CSMA) recently convened a panel of physics faculty from MSIs to address this question. The answers they provided, which I will do my best to summarize here, have two related criticisms. (Warning: This story is about to get worse before it gets better.)

The first has to do with a general lack of relationship-building between astronomy graduate programs and physics undergraduate programs at MSIs. Put simply, physics students at MSIs are often explicitly encouraged to pursue career opportunities outside of academia. The reasons for this are not those that might at first come to mind (e.g., financial incentive). Rather, it reflects a general perception among faculty at MSIs that our graduate programs do not provide environments suitably committed to their students' success.

A specific concern expressed by the MSI faculty is the apparent mismatch between their own efforts—efforts that aggressively and deliberately help students achieve—and

CMSA resources

Considerable information and resources are available through the website of the American Astronomical Society's Committee on the Status of Minorities in Astronomy. Located at *www.aas.org/csma*, the CSMA site also contains detailed statistics by ethnicity, gender, and institution for the past twenty years, as well as all back issues of the SPECTRUM newsletter. — *K. G. S.*

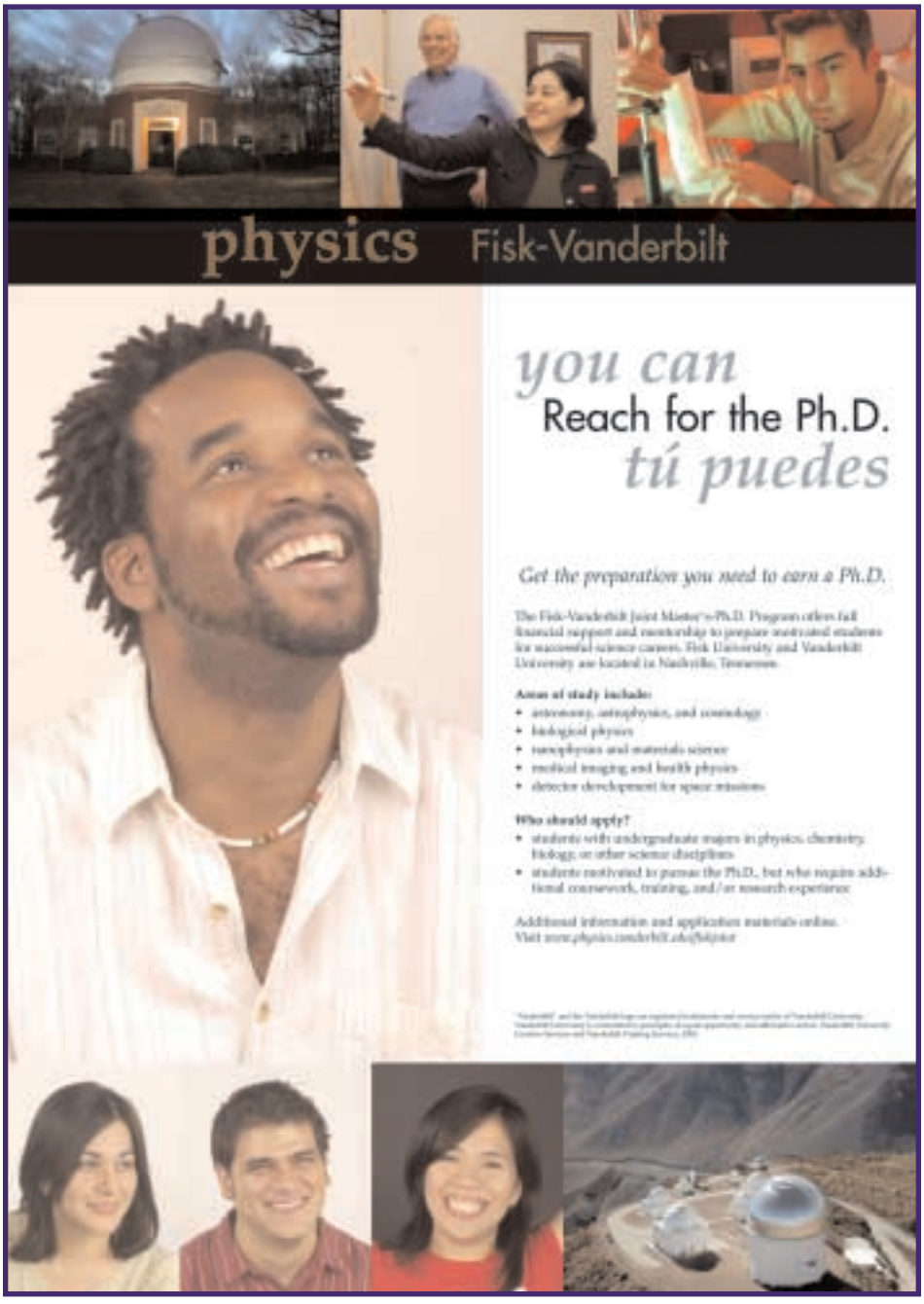
the graduate programs where they might send their students—which are often perceived as being both more passive (in terms of mentoring and support) and more hostile (e.g., competitive). The MSI faculty described their efforts to develop continually a nurturing, attentive environment, and described their reluctance to recommend to their students those graduate programs that they do not know to be similarly nurturing, similarly proactive to the educational and professional needs of the students. After all of the effort that these faculty invest in the success of their students, they will not abandon those students—especially those whom they regard as the most promising—by sending them to environments that are, by comparison, neglectful. That neglect can come in a number of forms, including: an indifferent attitude on the part of faculty toward student progress; a static curriculum

"The notion that 'there just aren't any minorities' is a common misconception."

that does not reflect changing standards of teaching; and the lack of deliberate professional preparation for a future in academe (e.g., training in teaching).

In short, our graduate programs must do a better job of demonstrating to the faculty advisors of students at MSIs that their students will be "taken care of." At its heart this is an issue of trust, trust that comes from forging relationships with our MSI colleagues based on a shared commitment to nurturing student success. It may come as a surprise to learn that our counterparts in industry are often perceived as doing a better job in this regard. However, as pointed out by the MSI faculty panelists, one need only look at the mentoring programs that are commonly found in the private sector for evidence of an approach that differs—in structure if not in spirit—from many of our graduate programs.

A second issue raised in our panel discussion with MSI faculty is the need for smoother "handoffs" to the Ph.D.-granting institutions. Some students, particularly those from smaller institutions with fewer resources, may not always emerge from those institutions fully "Ph.D. ready." This can



On the Road *by David J. James*

The Fisk-Vanderbilt NASA Roadshow brings the excitement of astronomy to Tennessee schools and community centers, particularly those serving under-represented groups. The centerpiece of the Roadshow is a mobile, inflatable planetarium from StarLab that can be set up in a school gymnasium. The concept is to provide a free and fun-filled educational activity to the public while providing undergraduates in the FASST program and graduate students in the Fisk-Vanderbilt Masters-Ph.D. Bridge program with valuable experience as educators and in communicating science to the public.

In essence, the Roadshow allows city-bound teachers and students to experience the night sky as if they were out in the open countryside. From the moment they crawl through the access tunnel on hands and knees, to the moment the interior lights are dimmed, each person entering the planetarium dome feels the excitement of being on a kind of virtual field-trip.

The central projector is capable of simulating the sky for one Earth day. Starting with the midday Sun, allowing it to set in the west, the interior lights are slowly dimmed to reveal the majesty of the sparkling stars above. As each participant's eyes become dark-adapted, the audience is treated to a tour of the night sky from constellations like Orion the Hunter and Scorpius the Scorpion, to the mighty Great Bear (or Big Dipper) and its famous association with Polaris, the North Star. Depending on the time of month and the seasons, the Moon and some of the nine planets become visible as they play out their celestial ballet. Finally, after about half an hour of star-hopping and navigating the night sky, the projector brings the Sun full circle allowing it to rise on the eastern horizon into the midday position again, thus completing one Earth-day inside the dome. Question and answer sessions usually take place during the show so that by the end of the planetarium experience, everyone knows, among other things, what the difference between a planet and a star is, how to tell the planets apart, what the Milky Way is, and why the Moon appears to change shape during the month.

David James and students in the Roadshow StarLab planetarium. Photo courtesy of B. Kingsley.

Students and teachers alike respond with great enthusiasm to the Roadshow. Photo courtesy of D. James.

Using an adaptable model for the show content, the Roadshow serves a broad audience—from K-12 children through adults. From a basic introduction to the night sky to the detailed properties of celestial phenomena, we are able to maintain the interest of even the most fertile imaginations, while reserving the most complicated shows for the more advanced physics high-school students. Equally important, the Roadshow provides a valuable training experience for pre- and in-service teachers.

We plan over the next year to expand the Roadshow to include additional hands-on activities to complement the planetarium experience. This will include a solar telescope and a number of interactive demonstrations that will all be transported along with the planetarium in a visually attractive trailer colorfully decorated with astronomical images. In this way, we hope to provide a permanent and recognizable presence within the community that parents, teachers, and children can look forward to year after year.

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result from an undergraduate curriculum that is diffuse with respect to specialization in the major (e.g., a liberal arts curriculum), the unavailability of advanced-level courses required for entrance to a doctoral program, insufficient exposure to undergraduate research experiences, incomplete preparation for the GRE, and other factors. Some of these other factors are less quantifiable, but important nonetheless, such as letters of recommendation written by MSI faculty unknown to graduate admissions committees. Too often, students from MSIs believe that their graduate applications will be "dead on arrival" for any of the above reasons (and they may very well be right in that belief).

Every year we miss the opportunity to recruit dozens of smart, capable minority physics students into our graduate programs. Does this mean that we should admit students into graduate programs for which they are not yet academically prepared to succeed? Of course not. What it does mean is that there is a need for programmatic approaches that help promising students bridge the gaps in their preparation so that they may become "Ph.D. ready."

Doing right by the students

One promising approach is to link graduate programs at Ph.D.-granting institutions with Masters-degree programs at MSIs, providing a path—a bridge—to the Ph.D. degree that may be more appropriate, more suitable, and, indeed, more attractive, for many students, particularly those who earned their undergraduate degrees from MSIs. One such program is the Fisk-Vanderbilt Masters-Ph.D. Bridge program in physics and astronomy.

In this program, students are initially admitted to the physics Masters degree program at Fisk University, an HBCU located two miles from Vanderbilt University in Nashville, Tennessee. Upon completion of the Masters degree, students receive fast-track admission into the Vanderbilt Ph.D. program in physics and astronomy. Importantly, students in the Bridge program are co-mentored by a joint committee of Fisk and Vanderbilt faculty, including the student's research advisor at Fisk and the student's future Ph.D. advisor at Vanderbilt.

The Fisk masters curriculum—which can include both Fisk and Vanderbilt courses through a cross-registration agreement between the two universities—is tailored to each student to ensure that (a) any deficiencies in undergraduate preparation are addressed, and that (b) students emerge from the program ready for Ph.D.-level work. This includes: frequent one-on-one mentoring with Fisk and Vanderbilt faculty, providing an opportunity to ensure that satisfactory progress is being made and to identify any issues early on; immediate and ongoing participation in graduate research with Fisk and Vanderbilt faculty, providing students with a superb opportunity to connect with possible Ph.D. advisors; GRE preparation; regular social interactions with both Fisk and Vanderbilt students, making for a gradual transition between institutional cultures; and mentored experiences in teaching and service in connection with two related undergraduate and outreach programs.

"Frequent one-on-one mentoring with faculty provides opportunity to ensure that satisfactory progress is being made and to identify any issues early on."

As the result of active recruiting—largely through participation with the National Society of Black Physicists (NSBP), the National Society of Hispanic Physicists (NSHP), and the Society for the Advancement of Chicanos and Native Americans in Science (SACNAS)—the Fisk-Vanderbilt Masters-Ph.D. Bridge program enrolled five minority students in its first year: two in nanophysics, one in biophysics, and two in astrophysics. Now entering its second year, the program is preparing to admit a second cohort of four students (three of them minorities). Currently funded by NASA and NSF for a period of five years, this program is still in its infancy, but promising.

To be sure, the Fisk-Vanderbilt Bridge program is not for all students, nor is it intended to be. Students with strong undergraduate backgrounds will usually want to enter a Ph.D. program directly, and will not seek nor require this type of bridging opportunity. In these cases, the Bridge program can play an important recruiting role, conveying as it does a serious commitment to student success. Indeed, in the year since partnering with Fisk to develop the Bridge program, Vanderbilt University has witnessed a significant increase in the number of strong minority students applying directly to the Ph.D. program in physics and astronomy. Of the 23 Ph.D. students newly admitted for the Fall 2005 term, four are under-represented minorities. Together with the students walking the Fisk-Vanderbilt bridge, this represents a total cohort of twelve minority students now on the path to the Ph.D. in physics and astronomy.

It cannot be overstated that this joint venture, like any other, is only possible because of the strong relationship of trust that has been forged between the Fisk and Vanderbilt faculty. Questions of admissions, curriculum, advising, research, and satisfactory progress can be contentious, particularly when multiple institutions are involved, each with its own status quo and bureaucratic inertia. Overcoming these obstacles can only be accomplished through trust, mutual respect, and a shared commitment to "doing right by the students."

Enhancing the Pipeline

As part of our efforts to increase the number of minorities prepared for careers in astronomy and space science, we have also developed two ancillary programs, one for undergraduate training and one for K-12 and community outreach.

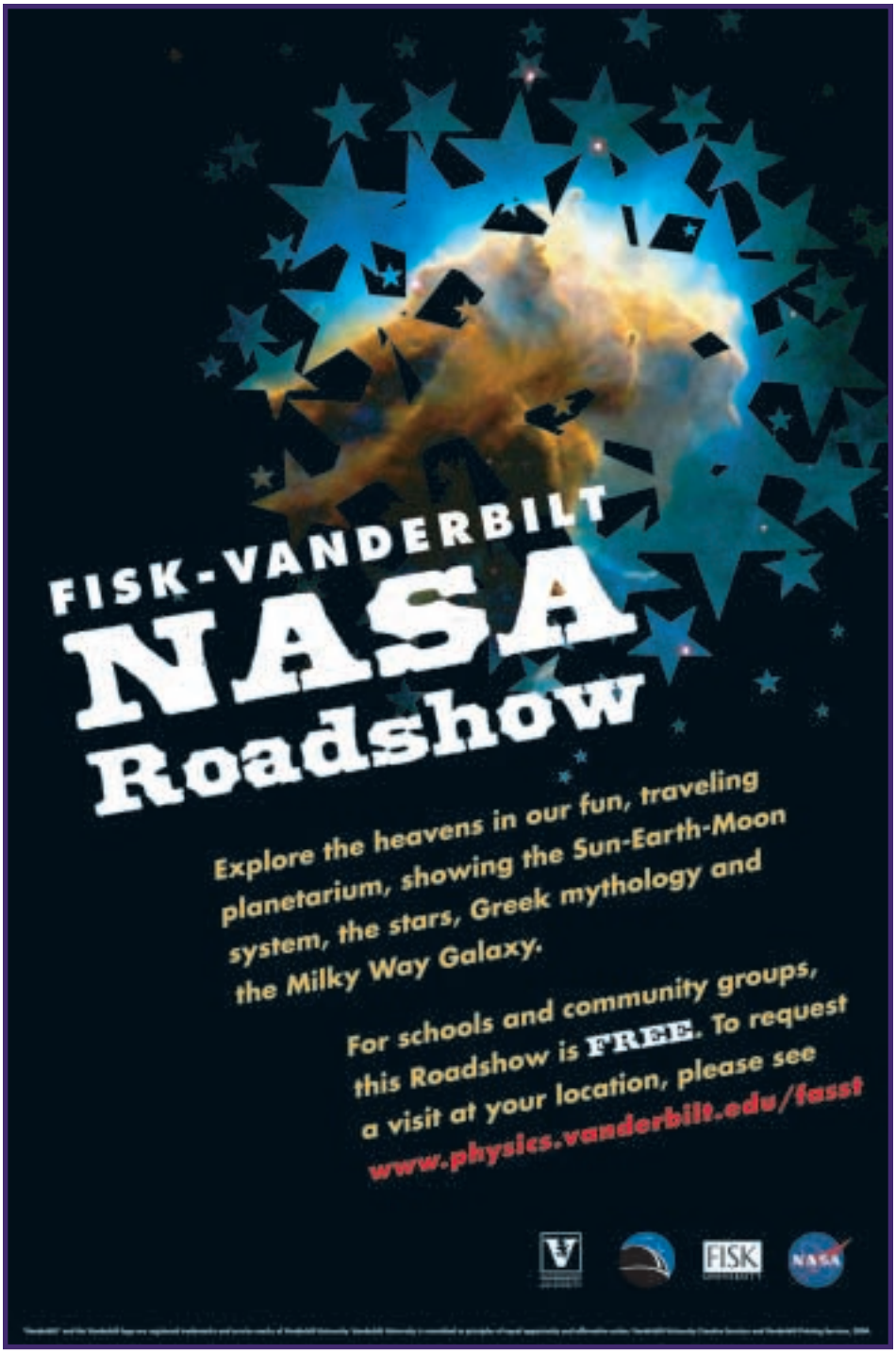
The undergraduate program—FASST (Fisk Astronomy and Space Science Training) program—includes a new astronomy minor as part of the Fisk physics major, summer research experiences, and active mentoring in preparation for graduate school. Each year, two Fisk undergraduates are selected to receive scholarships in support of their participation in the FASST program.

> **"Ability and genius are strangely catholic in their tastes, regard no color line or racial inheritance."**

The outreach component is the Fisk-Vanderbilt NASA Roadshow (see "On the Road"). Undergraduates in the FASST program and graduate students in the Fisk-Vanderbilt Masters-Ph.D. program are key to the success of the Roadshow, providing them with valuable experience as ambassadors for science and as role models for the children with whom they interact. In its first year, the Roadshow has already reached more than 3,000 children in K-12 schools throughout Tennessee. Of these, more than 60% have been from under-represented minority backgrounds.

In his 1939 essay "The Negro Scientist," Fisk alumnus W.E.B. DuBois writes: "One may say in answer to all this: so what? After all, there are plenty of white men who can be trained as scientists… But the point is that ability and genius are strangely catholic in their tastes, regard no color line or racial inheritance. They occur here, there, everywhere, without rule or reason. The nation suffers that disregards them. There is… a great deal of unusual and extraordinary ability, undiscovered, unused, and unappreciated. And in no line of work is ability so much needed today as in science."

The Fisk-Vanderbilt partnership is fundamentally built on this spirit of optimism. We believe that, working together, we can meet the challenge of doubling the number of minorities earning the Ph.D. in astronomy, not only because it is the right thing to do but because it is necessary that we do so. We can meet the challenge of increasing diversity in science, of building a profession that reflects the ever-changing face of our society, of developing the full potential of the next generation of seekers and explorers. We can do this, and we must, not just for minorities in science—but for science.



Promotional poster for the popular Fisk University and Vanderbilt University astronomy Roadshow. Illustration courtesy of the author.

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