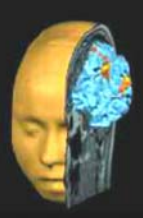
Diversity in Astronomy in the Coming Decade: Leveraging Partnerships with Minority Serving Institutions

Keivan Stassun & Kelly Holley-Bockelmann

Vanderbilt University
Fisk University



Fisk-Vanderbilt
Master's-to-Ph.D. Bridge Program

Jedidah Isler, astrophysics

Nothing worthwhile is ever easy.
We just help make it possible.

you can
Reach for the Ph.D.
tú puedes

physics and astronomy

biomedical sciences • materials science • imaging science

Who should apply

- Students with undergraduate majors in physics, biology, chemistry, computer science, math, and other science disciplines
- Students motivated to pursue the Ph.D., but who require additional course work, training, and/or research experience

How the program works

- Earn a master's degree at Fisk University, with full funding support.
- Along the way, receive valuable research experience with caring, dedicated mentors.
- Get fast-track admission to one of the participating Vanderbilt Ph.D. programs, with full funding support.

www.physics.vanderbilt.edu/bridge

FISK UNIVERSITY

VANDERBILT

Helen Jackson, imaging science

John Rigueur, materials science

Vincent Alexander, biophysics

Nashville, Tennessee

Fisk-Vanderbilt Masters-to-PhD Bridge Program

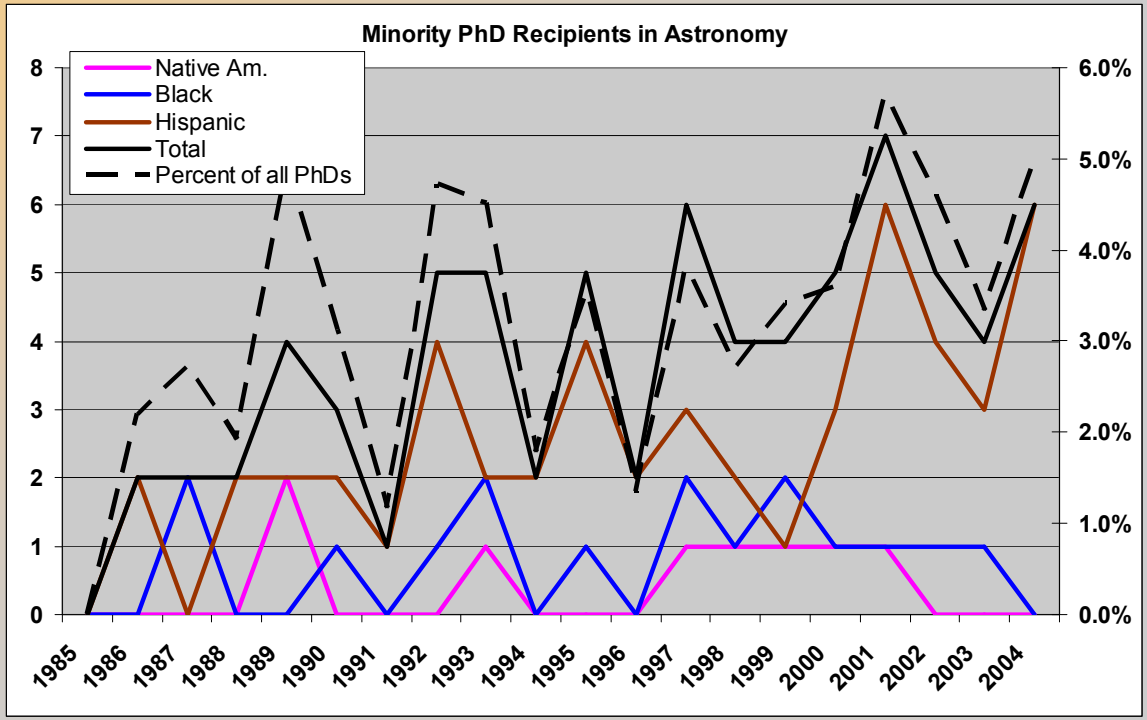
Get the preparation you need to earn a PhD

1. Earn a Masters degree in physics or biology at Fisk, with full funding support.
2. Get valuable, paid research experience.
3. Receive preparation for the GRE.
4. Get fast-track admission to the Vanderbilt PhD program, with full funding support.
   - Physics & Astronomy
   - Biology
   - Biomedical sciences
   - Materials science

www.fisk.edu/bridge
www.vanderbilt.edu/gradschool/bridge

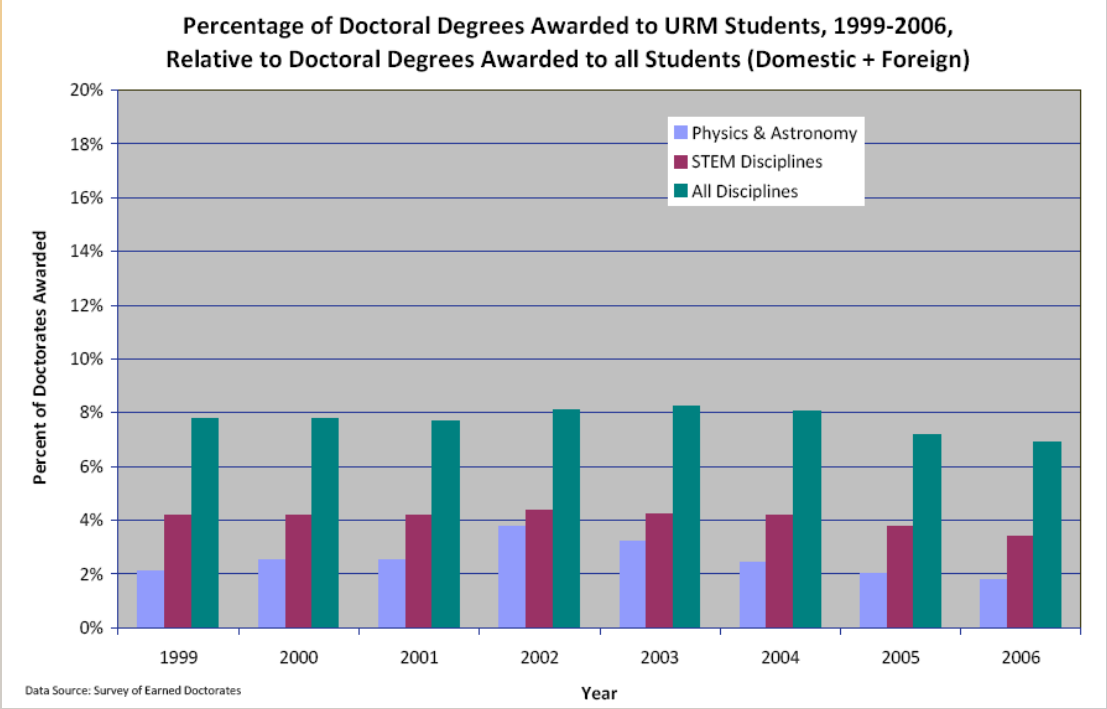
Astronomy context

- Order-of-magnitude issue:
  - 27% of population
  - 2.5% of astronomy faculty
  - 17 individuals
- Average among PhD granting institutions:
  - 1 every 13 years



Astronomy context

- Other related statistics:
  - 50% of physics and astronomy PhDs go to non-domestic students
  - Physics and astronomy underproduce minority PhDs relative to other fields
- Timescale to achieve parity:
  - 75±15 permanent jobs per year
  - 60% attrition of all PhDs
  - Parity requires ~40 minority PhDs per year
  - 3% turnover per year
  - At this pace, achieve parity overall in 30-35 years.



Where are the minorities in science?

Top producers of Black physics baccalaureates are all HBCUs.

- Top 10 producers of Black physics baccalaureates are all HBCUs.
- Just 20 HBCUs produce 55% of Black physics baccalaureates.
- Future PhDs: HBCUs are the top 8, and are 20 of the top 50, baccalaureate origin institutions of future African American PhDs in STEM fields.

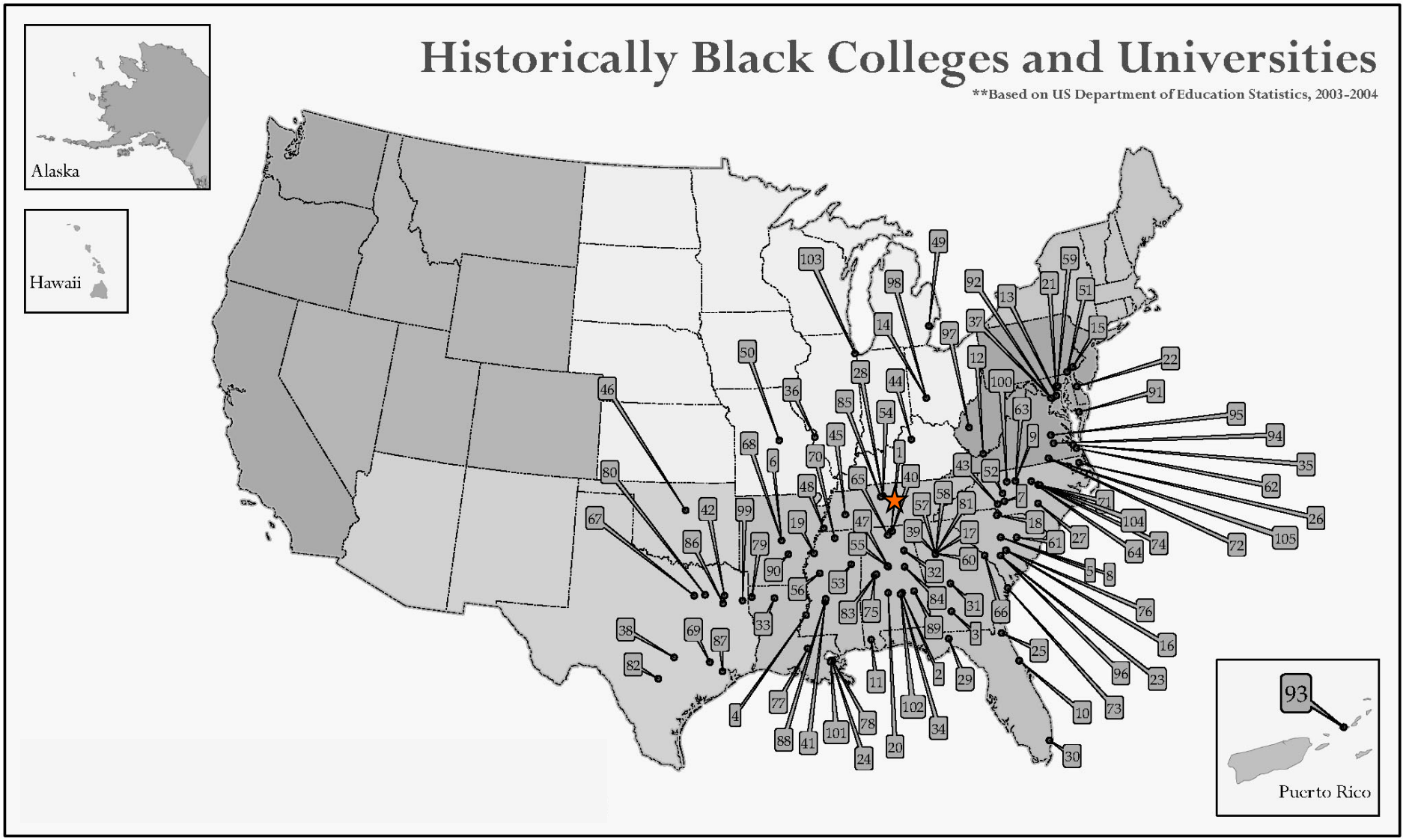
Universities that awarded the most physics bachelor's to African Americans.

Physics departments in these twenty universities awarded more than 55% of all physics bachelor's degrees earned by African Americans since 1998.

Alabama A&M University
Benedict College
Chicago State University
Delaware State University
Dillard University
Fisk University
Florida A&M University
Grambling University
Hampton University
Jackson State University
Lincoln University
Morehouse University
Morgan State University
Norfolk State University
North Carolina A&T State University
Southern University and A&M College
Spelman College
Tennessee State University
Tuskegee University
Xavier University

The physics departments on this list reported conferring 15 or more bachelor's degrees to African Americans between 1998 and 2007.

Source: AIP Statistical Research Center, Enrollment & Degrees Survey


Historically Black Colleges and Universities
**Based on US Department of Education Statistics, 2003-2004
Alaska
Hawaii
Puerto Rico
93

The opportunity in allied fields

Large numbers of minority baccalaureates in physics, computer science, engineering.
(see Norman et al. Decadal white papers)

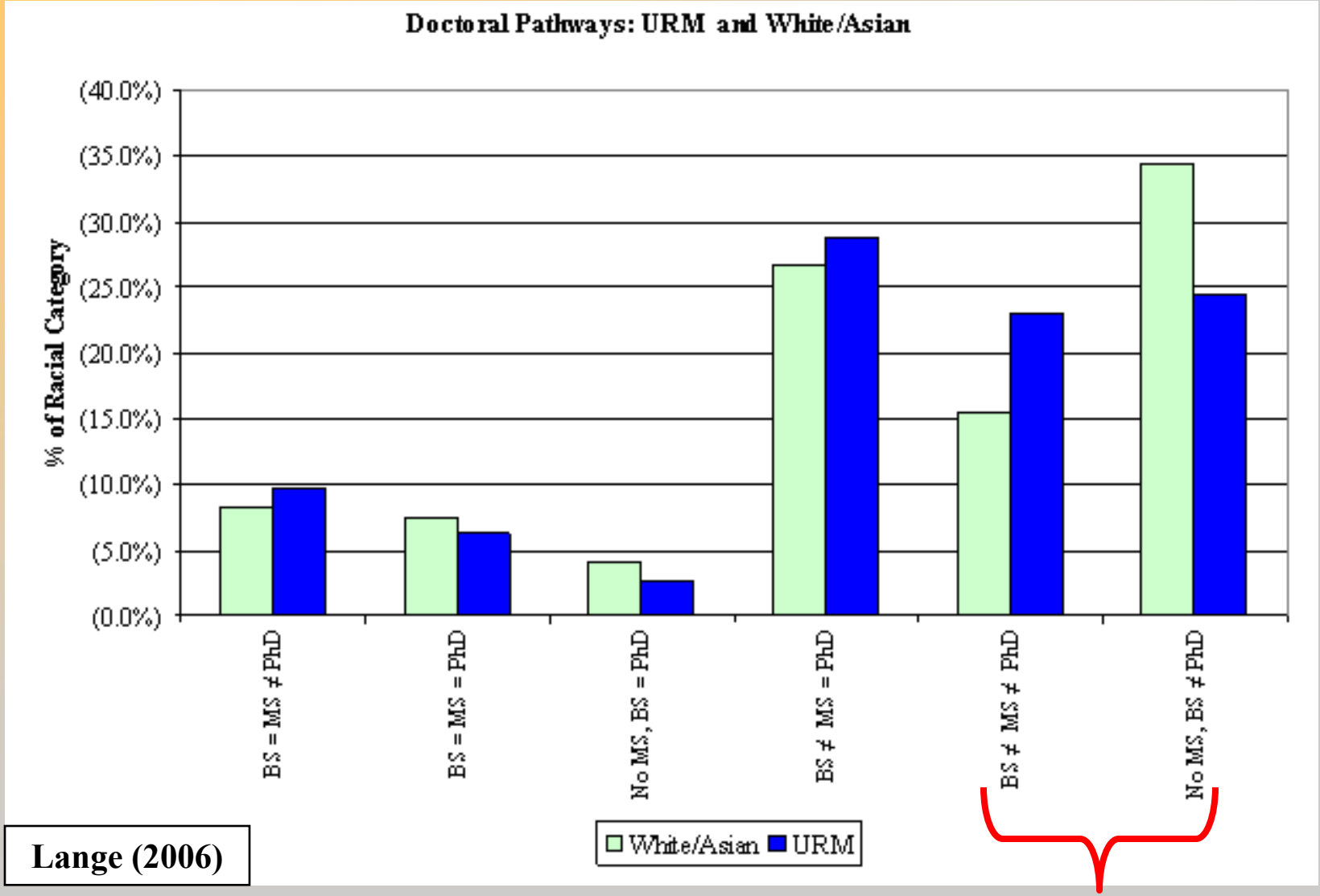
- Nationwide, 17,813 minority bachelors degrees in these fields (in 2006).
  - •20.2% of these went on to MA degree.
  - •1.6% went on to PhD.
- At minority-serving institutions, 30.1 minority degrees per institution (compare to 9.0 for majority institutions).
- "On-ramps" to astronomy: Instrumentation, data-intensive applications.

Emerging importance of the Masters degree

(see Norman et al. Decadal white papers)

- Between 1987 and 2006:
  - 79% increase in number of minority institutions offering MA in physics, computer science, engineering.
  - 533% increase in number of minorities earning MA in these fields.

Emerging importance of the Masters degree



Lange (2006)

Underrepresented minorities ~50% more likely to earn Masters en route to PhD.
More institutional transitions, with less guidance.

Fisk-Vanderbilt
Master's-to-Ph.D. Bridge Program

physics and astronomy

biomedical sciences • materials science • imaging science

Jedidah Isler, astrophysics

Nothing worthwhile is ever easy.
We just help make it possible.

you can
Reach for the Ph.D.
tú puedes

Who should apply

- Students with undergraduate majors in physics, biology, chemistry, computer science, math, and other science disciplines
- Students motivated to pursue the Ph.D., but who require additional course work, training, and/or research experience

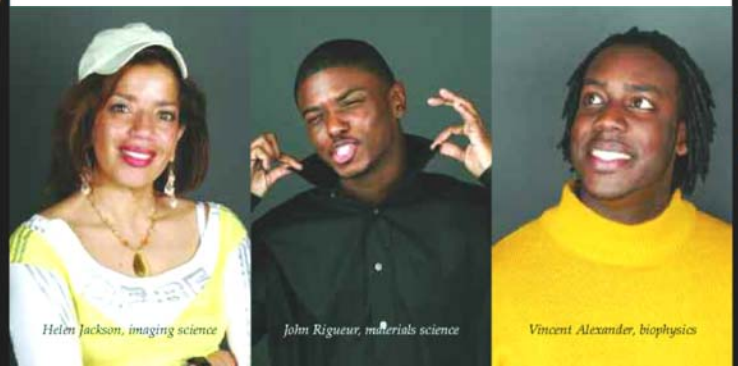
How the program works

- Earn a master's degree at Fisk University, with full funding support.
- Along the way, receive valuable research experience with caring, dedicated mentors.
- Get fast-track admission to one of the participating Vanderbilt Ph.D. programs, with full funding support.

www.physics.vanderbilt.edu/bridge

FISK UNIVERSITY

VANDERBILT



Helen Jackson, imaging science

John Rigueur, materials science

Vincent Alexander, biophysics

Nashville, Tennessee

Fisk-Vanderbilt Masters-to-PhD Bridge Program

Get the preparation you need to earn a PhD

1. Earn a Masters degree in physics or biology at Fisk, with full funding support.
2. Get valuable, paid research experience.
3. Receive preparation for the GRE.
4. Get fast-track admission to the Vanderbilt PhD program, with full funding support.
   - Physics & Astronomy
   - Biology
   - Biomedical sciences
   - Materials science

Masters-to-PhD Bridge Program

Program requirements and benefits:

- Joint advising committees: Involvement of potential PhD advisors from the start, enhanced communication and tracking of progress
- Requirement of coursework at Vanderbilt: Become known to Vanderbilt faculty, complete PhD requirements
  - Masters degree requirements: Classical Mechanics, Quantum Mechanics I, Electricity and Magnetism I, Statistical Mechanics, Electives
  - PhD degree requirements: Above, plus E&M II and Quantum II (physics) or Stars, Galaxies, Radiative Processes (astronomy), Electives
- Requirement of research at Vanderbilt: Demonstrate ability in the lab, develop faculty advocates
  - Areas of joint Vanderbilt/Fisk research: Observational astronomy, computational astrophysics, detector development ("astro-materials")
- "Professionalization": Seminar on academic culture, participate in professional meetings, "Bridge Club"

Note: Not a "back door": Must satisfy same PhD requirements as all PhD students.

Masters-to-PhD Bridge Program

Key considerations: "Theory" behind the program
(in partnership with Columbia University Center for Institutional and Social Change)

- Focus on facilitating successful MA to PhD transition through mentor/mentee relationships. *Research based institutional partnerships*.
- Truly recruit. Focus on *unrealized potential*.
- Take risks. Erect scaffolds of support to ensure success. *Monitor "second derivative" of student performance*.
- Tap into and connect with the broader community. *Leverage professional and social networks*.

Identifying Unrealized Potential: Emerging Practice

What roles are we looking for?

- Students with commitment and academic potential
- Productive, creative, entrepreneurial researchers
- Effective teachers and mentors
- Transformational leadership?

What qualities predict success?

- Passion
- Initiative, “fire in the belly”
- Hard work
- Success in relevant courses
- Persistence in the face of hardship

A critical next step: Tracking and systematizing Bridge Program selection practices

Identifying Unrealized Potential: Emerging Practice

- Holistic and informal
- Range of inputs and criteria
  - Performance in relevant coursework
  - Personal statement
  - Letters of recommendation
  - Interviews, informal interactions at conferences
  - Leadership, community service

Leveraging Social and Professional Networks

- Bridge Program faculty leverage their networks to link students to opportunities
  - Cultivate multiple relationships
  - Identify research and fellowship opportunities
  - Vouch for students in a highly credible way
- This faculty support helps to broaden students' networks and social capital
- Connect to other collaborations, professional networks and associations to broaden Bridge Program impact

Critical Challenges

- Building insights, knowledge and practices into departmental architecture
- Strengthening and supporting mentoring relationships
  - Faculty
  - Peers
- Navigating traditional and innovative conceptions of merit
- Developing success metrics that track institution- and profession-level change

Metrics of success: Money

Table 2: Funding Received to Date Supporting Bridge Students and Faculty

Agency	Program	Years	Lead Faculty (PI in boldface)	Amount
NSF	CAREER	2004-09	**K. Stassun (Vanderbilt)**	$1M
NASA	MUCERPI	2004-07	**A. Burger (Fisk)**, E. Collins (Fisk), D. Ernst (Vanderbilt), S. Morgan (Fisk), K. Stassun (Vanderbilt)	$800K
NSF	CREST/Materials Sci.	2004-14	**E. Collins (Fisk)**, A. Burger (Fisk), W. Lu (Fisk), S. Morgan (Fisk), R. Mu (Fisk)	$9.4M
DoE, DHS, DoD, NASA	Materials Science	2004-09	**A. Burger (Fisk)**	$3.5M
NSF	REU	2004-10	**E. Collins (Fisk)**, A. Burger (Fisk), S. Morgan (Fisk)	$600K
NSF	REU	2007-10	**D. Ernst (Vanderbilt)**, K. Stassun (Vanderbilt)	$300K
NSF	PAARE	2008-13	**K. Stassun (Vanderbilt),** A. Burger (Fisk), K. Holley-Bockelmann (Vanderbilt), M. Watson (Fisk)	$2.2M
NSF	CAREER	2009-14	**K. Holley-Bockelmann (Vanderbilt)**	$1.1M
NSF	I3	2009-14	**K. Stassun (Vanderbilt)**	$1.2M
Vanderbilt Provost	VIDA[1]	2007-16	**K. Stassun (Vanderbilt)**	$4M
Vanderbilt A&S Dean	Biological Sciences[2]	2008-11	**D. Webb (Vanderbilt)**, J. Ike (Fisk), K. Stassun (Vanderbilt)	$150K
Fisk Provost	Physics/ Biology[3]	2004-14	**E. Collins (Fisk)**, S. Morgan (Fisk), J. Ike (Fisk)	$937K

$25.1M

Metrics of success: Human capital

- Since 2004:
  - 34 Bridge students
  - 31 Underrepresented minorities (all US citizens)
  - 59% female
  - 91% retention rate
- Since 2006:
  - Fisk is top producer of Black MA degrees in physics
- In 2010-11:
  - Vanderbilt becomes top producer of minority PhDs in physics, astronomy, materials science

Table 1: Fisk-Vanderbilt Masters-to-PhD Bridge Program Students to Date

Student	Ethnicity/ Gender*	Admit Year	Undergraduate Institution	Discipline	Current Institution / Status
T. LeBlanc	H/M	2004	UMET, Puerto Rico	Astronomy	Vanderbilt (NASA Fellow)
J. Harrison	A/M	2004	Chicago State Univ.	Materials	Case Western (IGERT fellow)
H. Jackson	A/F	2004	Fisk University	Physics	Wright State (USAF Co-op)
J. Rigueur	A/M	2004	Fisk University	Physics	Vanderbilt (IGERT fellow)
V. Alexander	A/M	2005	Florida A&M Univ.	Physics	Dropped out, status unknown
J. Bodnarik	W/F	2005	USAF Academy	Astronomy	Vanderbilt (NASA Co-op)
M. Harrison	A/F	2005	Xavier University	Materials	Vanderbilt (IGERT fellow)
J. Isler	A/F	2005	Norfolk State Univ.	Astronomy	Yale (NSF graduate fellow)
E. Jackson	A/M	2005	Norfolk State Univ.	Materials	Vanderbilt (IGERT fellow)
J. Jones	A/F	2005	Grambling State U.	Materials	Vanderbilt (IGERT fellow)
T. Yan	H/M	2005	UMET, Puerto Rico	Biology	Vanderbilt
L. Zambrano	H/F	2005	UMET, Puerto Rico	Astronomy	Dropped out (now at UTB)
D. Foster	A/M	2006	UMBC	Astronomy	Vanderbilt
A. Ruffin	A/F	2006	Tennessee State U.	Physics	Oak Ridge National Lab
D. Campbell	A/M	2006	Rhodes College	Physics	Vanderbilt
R. Santos	H/M	2006	UMET, Puerto Rico	Physics	Vanderbilt
E. Walker	A/F	2006	Alabama A&M U.	Materials	Vanderbilt (IGERT fellow)
J. Cooper	A/F	2007	Rust College	Biology	U Chicago
D. Gunther	W/F	2007	Austin Peay State	Materials	Vanderbilt
L. Palladino	W/F	2007	Hofstra U.	Astronomy	Vanderbilt
C. Mack	A/M	2007	UNC Chapel Hill	Astronomy	Vanderbilt
A. Parker	A/M	2007	Austin Peay State	Physics	Wright State
S. Haynes	A/F	2007	Tennessee State U.	Astronomy	Fisk (MS expected 2010)
E. Morgan	A/F	2007	Tennessee State U.	Astronomy	Fisk (MS expected 2010)
F. Bastien	A/F	2008	U. Maryland	Astronomy	Fisk (MS expected 2010)
F. Colazo	H/M	2008	Fisk University	Astronomy	Fisk (MS expected 2010)
L. Jean	H/F	2008	U. New Hampshire	Biology	Fisk (MS expected 2010)
B. Kamai	N/F	2008	U. Hawaii	Astronomy	Fisk (MS expected 2010)
J. Harris	A/F	2008	Grambling State U.	Astronomy	Fisk (MS expected 2010)
S. Lawrence	A/F	2008	Clark U.	Biology	Fisk (MS expected 2010)
M. Richardson	A/M	2008	Fisk University	Astronomy	Fisk (MS expected 2010)
S. Satchell	A/F	2008	Saint Paul's U.	Biology	Fisk (MS expected 2010)
B. Cogswell	A/F	2009	Florida State U.	Physics	Fisk (MS expected 2011)
M. Williams	A/M	2009	Morehouse Univ.	Astronomy	Fisk (MS expected 2011)

*Ethnicity/Gender: H=Hispanic, A=African American, N=Native American, W=White, F=Female, M=Male.

Metrics of Success: Human Capital