The California-Arizona Minority Partnership for Astronomy Research and Education (CAMPARE):
A New Model for Promoting Minority Participation in Summer Astronomy Research Programs

Alexander L. Rudolph, Cal Poly Pomona

REU Site Directors in Astronomy Meeting
Northern Arizona University
May 19, 2014
Why CAMPARE?

<table>
<thead>
<tr>
<th></th>
<th>2000</th>
<th>2040</th>
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<tbody>
<tr>
<td>Non-white</td>
<td>43%</td>
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<tr>
<td>Hispanic</td>
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<tr>
<td>Non-white</td>
<td>29%</td>
<td>44%</td>
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<tr>
<td>Hispanic</td>
<td>12%</td>
<td>22%</td>
</tr>
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</table>

California

United States

• “Little progress has been made in increasing the number of minorities in astronomy.” – 2010 Decadal Survey

• Black Americans, Hispanic Americans, and Native Americans constitute 27 percent of the U.S. population, yet they account for only 4 percent of astronomy PhDs awarded in the United States and only 3 percent of faculty members

• One of the top approaches they recommend to overcome this underrepresentation is, “Partnerships of community colleges and minority-serving institutions with research universities and with national centers and laboratories”

• “Federal agencies should encourage projects that establish collaborations between research universities and community colleges or other institutions that do not have research programs.” – President’s Council of Advisors on Science and Technology (PCAST), Feb 2012
Why CAMPARE?

<table>
<thead>
<tr>
<th>Year</th>
<th>Percent of doctorates awarded to URM students</th>
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<tr>
<td>1999</td>
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<td>2000</td>
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<td>2001</td>
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<td>2004</td>
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<td>2005</td>
<td>3%</td>
</tr>
<tr>
<td>2006</td>
<td>3%</td>
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</table>

Data Source: Survey of Earned Doctorates
California is a great place to create this program
The CSU is the place to find URm students

<table>
<thead>
<tr>
<th>Southern Calif.</th>
<th>CSU</th>
<th>UG Enrollment</th>
<th>Hisp enrollment</th>
<th>%Hisp</th>
<th>URM enrollment</th>
<th>%URM</th>
<th>HSI</th>
<th>MSI</th>
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<td>Bakersfield</td>
<td></td>
<td>6863</td>
<td>3088</td>
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<td>3651</td>
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<td>4017</td>
<td>1197</td>
<td>29.8</td>
<td>1289</td>
<td>32.1</td>
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<td>Dominguez Hills</td>
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<td>5445</td>
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<td>67.4</td>
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<td>33.8</td>
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<td>32.8</td>
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<td>38.0</td>
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<tr>
<td>Los Angeles</td>
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<td>17399</td>
<td>9465</td>
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<td>10491</td>
<td>60.3</td>
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<td>Northridge</td>
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<td>36.4</td>
<td>14096</td>
<td>44.2</td>
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<tr>
<td>Pomona</td>
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<td>6615</td>
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<td>7332</td>
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<td>San Bernardino</td>
<td></td>
<td>14884</td>
<td>7233</td>
<td>48.6</td>
<td>8632</td>
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<td>San Diego</td>
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<td>8332</td>
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<td>San Luis Obispo</td>
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<td>2570</td>
<td>14.5</td>
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<td>3225</td>
<td>34.0</td>
<td>x</td>
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<tr>
<td><strong>Total South</strong></td>
<td></td>
<td><strong>219251</strong></td>
<td><strong>76900</strong></td>
<td><strong>35.1</strong></td>
<td><strong>90070</strong></td>
<td><strong>41.1</strong></td>
<td>11</td>
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<td>Percentage of CSU enrollment</td>
<td></td>
<td>61.0</td>
<td>69.2</td>
<td>67.9</td>
<td></td>
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</table>

| CSU Total   | 359404 | 111124 | 30.9 | 132627 | 36.9 | 14 | 4 |

*http://nces.ed.gov*
CAMPARE Mission Statement

• The mission of the California-Arizona Minority Partnership for Astronomy Research and Education (CAMPARE) program is to advance undergraduate Astronomy research and education among Hispanic and other minority students, in order to promote their participation and advancement in Astronomy and closely related fields, and increase their numbers in PhD programs in those fields.

• CAMPARE provides paid summer internships to students from one of 20 “home institutions” (CSU campuses or community colleges, almost all HSIs) to work at one of the research institutions in the CAMPARE network.

• CAMPARE is currently funded by the PAARE program of the Astronomy Division of the National Science Foundation.

• We hope to get NSF REU funding in the future.
What makes CAMPARE different from a regular REU?

1. the creation of a **network** of community colleges and comprehensive universities (home institutions) from which the students are recruited, which comprise the CAMPARE program
2. the mechanisms of **recruitment** of students to the CAMPARE program
3. the participation of **multiple world class research institutions** (including one REU site – SETI) in the CAMPARE program
4. the careful recruitment of research **mentors** who are experienced and motivated to work with CAMPARE students
5. the creation of an **alternate education track** for students who wish to pursue education or public outreach as a career
6. the creation of a well-designed and robust **mentoring and professional development program**, to provide mentoring to the CAMPARE students at every stage of the program, and at every level, with the overall goal of helping them develop a career plan and persist in that plan
CAMPARE: a network of STEM research opportunities for underserved undergraduates

- 22 home institutions
- 14 CSU campuses
- 8 community colleges
- 19 Hispanic Serving Institutions

- 10 Research institutions
- 8 in California
- 7 in Southern California
- 2 in Arizona

15-20 students per year

Institutions:
- Cal State Long Beach
- Cal State Dominguez Hills
- San Diego State Univ.
- Cal State San Bernardino
- Cal State Northridge
- Cal State Los Angeles
- Cal State Fullerton
- Cal Poly Pomona
- Cal State San Marcos
- San Jose State Univ.
- Sonoma State University
- El Camino College
- Santa Monica College
- MiraCosta College
- Mt. San Antonio College
- Cal State Long Beach
- Cal State Dominguez Hills
- San Diego State Univ.
- Cal State San Bernardino
- Cal State Northridge
- Cal State Los Angeles
- Cal State Fullerton
- Cal Poly Pomona
- Cal State San Marcos
- San Jose State Univ.
- Sonoma State University
- El Camino College
- Santa Monica College
- MiraCosta College
- Mt. San Antonio College
- SETI Institute
- Northern Arizona Univ.
- University of Arizona
- JPL/Caltech
- UCI, UCLA, UCSD, UCR, UCSB
CAMPARE: Where is it?
49 participants over 5 years
Recruitment of **students** and **mentors** is key to the success of the CAMPARE program

**Home Institutions**
- Alex Rudolph, Cal Poly Pomona
- Matt Povich, Cal Poly Pomona
- Josh Smith, Cal State Fullerton
- Susan Terebey, Cal State LA
- Damian Christian, Cal State Northridge
- Gerardo Dominguez, CSU San Marcos
- Prashanth Jaikumar, CSU Long Beach
- Carol Hood, CSU San Bernardino
- Eric Sandquist, San Diego State Univ.
- Michael Kaufmann, San Jose State
- Doug Singleton, Cal State Fresno
- Bill DeGraffenreid, Sac State
- Lynn Cominsky, Sonoma State
- Gary Fouts, Santa Monica College
- Arturo Hernandez, El Camino College
- Rica French, MiraCosta College
- Phu Tran, Norco College (Riverside)
- Ron Armale, Cypress College
- Michael Hood, Mt. San Antonio College
- Takashi Nakajima, Palomar College
- Eric Lara, College of the Canyons

**Research Institutions**
- Chris Impey, Arizona
- John Bieging, Arizona
- Ed Prather, Arizona
- Josh Eisner, Arizona
- Don McCarthy, Arizona
- Yancy Shirley, Arizona
- Nathan Smith, Arizona
- Daniel Apai, Arizona
- Cynthia Phillips, SETI Institute
- Adrian Brown, SETI Institute
- Jean Chiar, SETI Institute
- Lori Fenton, SETI Institute
- Gerry Harp, SETI Institute
- Peter Jenniskens, SETI Institute
- Franck Marchis, SETI Institute
- Rachel Mastrapa, SETI Institute
- Richard Quinn, SETI Institute
- Jenny Tieu, JPL/Caltech
- Davy Kirkpatrick, JPL/Caltech
- Amanda Mainzer, JPL/Caltech
- Joseph Masiero, JPL/Caltech

**CAMPARE**
California-Arizona Minority Partnership for Astronomy Research and Education
Recruiting and mentoring takes a lot of **time and effort**

- We visit a large number of clubs and other groups every fall, to promote CAMPARE
  - Physics, Chemistry, and Geology Clubs
  - Society of Hispanic Scientists and Engineers
  - National Society of Black Engineers
  - Society of Women Engineers
  - American Institute of Aeronautics & Astronautics
  - Engineering Council

- In addition, mentors at the home institutions work with applicants on their application materials
9 research institutions allow for a wide variety of research projects

**Planetary Science/Astrobiology**
- Morphology and Classification of Martian Dunes
- Infrared Spectroscopy of Solar System Ices
- CAMS: A Ground-based Meteoroid Orbit Survey
- Formation Mechanisms for Dunes Observed on Titan
- Space Environment Viability of Organics
- A Proper Motion Search for Nearby Objects using WISE
- SETI with the Allen Telescope Array
- Small Body Science with NEOWISE
- Image Analysis of Outer Solar System Moons

**Astronomy**
- IR Variability in Young Stars: a Multiyear Study
- Radio Study of the California Molecular Cloud
- Optical Photometry of Recent Supernova Explosions
- Mapping M17 (Omega Nebula) with the Arizona Sub-millimeter Telescope
- Multiwavelength Observations of Outflows in the Carina Nebula

**Astronomy Education and Public Outreach**
- Astronomy Camp and Astronomy Education Research
CAMPARE: Who has participated?

49 students from many different majors and schools have participated in CAMPARE:
- Physics and Astronomy, Geology, Math, Computer Science, Biology, Zoology
- Aerospace, Computer, Electrical, and Mechanical Engineering
Demographic Breakdown of CAMPARE Participants 2010-2014 (N=49)

Gender:
- Women: 51%
- Men: 49%

Ethnicity:
- Hispanic: 45%
- White: 41%
- African American: 8%
- Asian: 4%
- Dual: 2%
Students present at national meetings such as the American Astronomical Society (AAS) meetings in Seattle, Austin, Long Beach, and Washington, DC, the American Geophysical Union (AGU) meetings in San Francisco, and LPSC in The Woodlands, Texas.

Stephanie Zajac (above) was selected as one of the winners of the Chambliss Astronomy Achievement Student Award competition, “given to recognize exemplary research by undergraduate students who present posters at the semi-annual AAS meetings.”
They even have fun
CAMPARE: Where are they now?

Of the 18 participants who have graduated since CAMPARE began:

- 12 are pursuing or have a graduate degree (M.S. or Ph.D.)
- 7 are in Ph.D. programs (UCLA, UCR, USC, U. Rochester, Georgia Tech, Kent State)
- Most of the others are pursuing a variety of STEM careers

<table>
<thead>
<tr>
<th>Student</th>
<th>Major</th>
<th>Post-graduation activities/plans</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amber Butcher</td>
<td>Geology</td>
<td>PhD program, Department of Earth Sciences, USC</td>
</tr>
<tr>
<td>Mario Cabrera</td>
<td>Physics</td>
<td>PhD program, Astronomy, University of Rochester</td>
</tr>
<tr>
<td>Heather Chilton</td>
<td>Physics</td>
<td>PhD program, Earth and Atmospheric Sciences, Georgia Tech</td>
</tr>
<tr>
<td>Greta Cukrov</td>
<td>Physics</td>
<td>PhD program, Chemical Physics, Kent State</td>
</tr>
<tr>
<td>Clint Hawkins</td>
<td>Physics</td>
<td>Nuclear Propulsion Officer Candidate Program (NUPOC), U.S. Navy</td>
</tr>
<tr>
<td>Courtney Lemon</td>
<td>Physics</td>
<td>Education Programs Assistant, American Institute of Physics</td>
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<tr>
<td>Nicole Sanchez</td>
<td>Physics</td>
<td>Fisk-Vanderbilt Master’s-to-PhD Program, Astronomy</td>
</tr>
<tr>
<td>Remington Sexton</td>
<td>Physics</td>
<td>PhD program, Astronomy, UCR</td>
</tr>
<tr>
<td>Alec Vinson</td>
<td>Physics</td>
<td>PhD program, Astronomy, UCLA</td>
</tr>
<tr>
<td>Jill Walker</td>
<td>Biology</td>
<td>PhD program, Astrobiology, Georgia Tech</td>
</tr>
<tr>
<td>Stephanie Zajac</td>
<td>Physics</td>
<td>MS, Astronomy Instrumentation, SUNY Stony Brook</td>
</tr>
</tbody>
</table>
CAMPARE has had a positive impact on the CPP Physics program
Key takeaways for others wishing to start such a program

- A full **partnership** between the research institutions (REU sites) and MSIs/HSIs is necessary
- **Start slow**, to build relationships and allow careful selection of mentors and students
- Recruitment and mentoring (of both students and research mentors) are key
- Building relationships, recruiting and mentorship all take a great deal of **time**
- Regional networks work well
CAMPARE and the SETI REU: a model partnership

• In 2009, the SETI Institute approached me (as a faculty member at an HSI who used to work at SETI) to ask if I would help them recruit more minority students for their REU program

• I had just started CAMPARE with CPP and Arizona, and saw this as a way to use our new model to start a new partnership with an existing REU program

• By following the advice on the previous slide, we grew from 3 students the first year, to a total of 22 students over 5 years, including 7 this summer (2014)

• Based on our early success, we were able to build 4 slots for CAMPARE students into the most recent SETI REU renewal
Key takeaways for funding agencies

- Programs, like CAMPARE, to address minority recruitment into STEM, are expensive and take time to develop and succeed
  - Recruiting
  - Mentoring
  - Administration
- Public universities (like CSU) are the place to find large numbers of underrepresented minority (URM) students, but these universities cannot self-fund such programs
- Most UG students at MSI/HSIs don’t have grad school on their radar; programs like CAMPARE can be critical to their seeing grad school as an option
- Funding agencies must have a long-term commitment to such programs, and not expect “self-sufficiency”
- HSIs (not just MSIs) are the place to find Hispanic students interested in STEM
HSIs enroll a much larger number of Hispanic students compared to MSIs

<table>
<thead>
<tr>
<th></th>
<th>Fall 2011</th>
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<tbody>
<tr>
<td></td>
<td>UG Enrollment</td>
</tr>
<tr>
<td>All CSU (23)</td>
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<tr>
<td>MSIs (4)</td>
<td>50782</td>
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<td></td>
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<tr>
<td>HSIs (14)</td>
<td>233386</td>
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CAMPARE : a National Model?

• CAMPARE was started as a way to create summer research opportunities for URM and female students to promote their involvement in astronomy (or a related field), and help them get into PhD programs in those fields.

• We have been successful in the creation of a network of summer research opportunities in astronomy, planetary science, and astrobiology, and in expanding those opportunities to a wide, and growing, group of students.

• It is still too early to declare success in having these underrepresented students complete PhDs and continue on to the profession, but the early results look promising, and we are just beginning to “fill the pipeline”.

• It will take another 5+ years to see the impact of a program like CAMPARE on the profession.

• I am looking forward to the questions and discussion with all of you to explore what we can learn and adapt from programs like CAMPARE in the broader, national context.
Cal-Bridge: a CSU-UC bridge program in Physics and Astronomy
Cal-Bridge Mission Statement

• The mission of the Cal-Bridge program is to increase the number of underrepresented minorities (URM), especially Hispanics, and women completing bachelors and PhD degrees in astronomy, physics, or closely related STEM fields. Students selected for the program will become “Cal-Bridge Scholars”

• The program is modeled after the highly successful Fisk-Vanderbilt Master’s-to-PhD program

• Five years of funding for Cal-Bridge has been recommended by the program officer as part of the NSF S-STEM program

• We will pursue additional funding sources, including the NSF PAARE program, the UCOP, and the CSU Chancellor’s Office
What is Cal-Bridge?

• Cal-Bridge provides scholarship funding, mentoring, professional development opportunities, and research opportunities, to help Cal-Bridge Scholars complete their degree in Physics, and successfully enter a PhD program in Astronomy at one of five southern California UC schools (UCLA, UCSD, UC Irvine, UC Riverside, UC Santa Barbara)

• The program is open to students at participating CSU and community college campuses in Southern California

• Faculty from both the CSU and UC campuses participate in all aspects of the program from selection, to mentoring, to assisting in the application process to a PhD program
Cal-Bridge is geographically concentrated
Key Elements of Cal-Bridge

• **Three years of full scholarship funding:** last two years of undergraduate and first year of graduate tuition and fees

• **Assignment of two mentors:** one from a participating UC campus, one from the student’s home CSU campus

• **Extensive mentoring in academics and professional development** to assist in students in completing their bachelor’s degree and in applying for graduate school

• **Summer and academic year research opportunities** at the participating UC campuses

• **Opportunities to present results at regional and national conferences**

• **Admission to Cal-Bridge will not guarantee** admission to a UC PhD program; however, the plan is to “fast-track” students into these programs
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