Preview of Award 0750814 - Final Project Report

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Cover

Federal Agency and Organization Element to Which Report is Submitted:	4900
Federal Grant or Other Identifying Number Assigned by Agency:	0750814
Project Title:	A Partnership in Observational and Computational Astronomy
PD/PI Name:	Donald Walter, Principal Investigator Jennifer Cash, Co-Principal Investigator Steven B Howell, Co-Principal Investigator Mark D Leising, Co-Principal Investigator Daniel M Smith, Co-Principal Investigator
Recipient Organization:	South Carolina State University
Project/Grant Period:	03/01/2008 - 09/30/2015
Reporting Period:	03/01/2015 - 09/30/2015
Submitting Official (if other than PD\PI):	Donald Walter Principal Investigator
Submission Date:	01/04/2016
Signature of Submitting Official (signature shall be submitted in accordance with agency specific instructions)	Donald Walter

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Accomplishments

* What are the major goals of the project?

The specific goals of POCA are to:
1. Enhance faculty research at South Carolina State University (SCSU) that leads to collaborative activities and an increase in peer reviewed publications including SCSU faculty serving as first authors
2. Increase the use of small telescopes at the National Optical Astronomy Observatory (NOAO) by all three partners for research and training in line with one of the recommendations of the NSF AST Senior Review Committee
3. Increase the number of underrepresented minorities pursing graduate degrees in astronomy, specifically those entering the program at Clemson University (CU)
4. Increase the number of undergraduates at SCSU engaged in astronomical activities, including an increase in the number of physics majors in the astronomy option
5. Share research facilities at KPNO in such a way that students, faculty and research scientists at all three institutions participate and derive benefits
6. Develop and distribute to the community at large inquiry-based, laboratory exercises and web-based activities related to cosmology
7. Enhance and expand the existing outreach programs to the K-12 community through museum displays, planetarium shows and public observing sessions at the Stanback Museum and Planetarium at SCSU and the planetarium at CU

* What was accomplished under these goals (you must provide information for at least one of the 4 categories below)?

Major Activities:

We note that the reporting period for this final report is only 7 months long and is at the end of a no cost extension period. Only limited funds were available to pursue activities that accomplish the original goals of the 2008 PAARE award to SC State.

Goal 1: Achieved through the following:

- Cash and Walter were coauthors in two conference proceedings related to their research into RV Tauri and Semiregular variables using Kepler data

- Walter has received training from Clemson collaborator Brittain in the analysis of spectra from the Keck observatory that is part of Brittain's long term study of Ae/Be stars. This will allow Walter, Cash and students to participate in future work which will lead to publications.

- Smith served as a session presider at the national meeting of the American Association of Physics Teachers (AAPT) in July 2015.

- Walter served as a reviewer (September 2015) and panel chair (April 2015) for NASA, and reviewer for NSF (April 2015) proposal review.

Goal 2: Achieved through the following:

- Faculty at both Clemson and SC State continue to use the SARA telescopes (North and South) and the 1.3 meter Robotically Controlled Telescope at Kitt Peak and are preparing publications based on the data collected at the KPNO Coude Feed telescope by Walter prior to the closing of the facility in November 2013.

Goal 3: Achieved through the following:

- Clemson graduated a PAARE-funded hispanic female with her M.S. degree in physics and astronomy during this reporting period. Her thesis was on the topic of novae (see elsewhere in this report).

- Two SCSU students (1 African-American female and 1 white male with disabilities) graduated with B.S. degrees in physics with the astronomy option. One is seeking employment in STEM education and the other is applying to graduate school in astronomy.

Goal 4: Achieved through the following:

- Two SCSU students (1 African-American female and 1 white male with disabilities) graduated with B.S. degrees in

physics with the astronomy option. One is seeking employment in STEM education and the other is applying to graduate school in astronomy.

- Three new physics majors, all African-American (2 male, 1 female) were recruited and funded to participate in astronomy activities during this reporting period.

- SCSU undergraduate McKay engaged in another summer internship during this reporting period. This time he interned at the Space Telescope Science Institute during the summer of 2015. He presented his results at the NAC III meeting in the fall and will present as the lead author during the AAS 2016 winter meeting.

Goal 5: Achieved through the following:

- See Goal 1 above

- See Goal 2 above

Goal 6: Achieved through the following:

- Smith continuted to enhance existing lab activities and simulations as posted to his website at http://physics.scsu.edu/~dms/cosmology/simulations.html

- Smith presented results funded by this PAARE project at the Winter 2016 meeting of the AAPT

Goal 7: Achieved through the following:

- Work in this area has been significantly reduced since the planetarium director at SC State left the university and the PAARE project nearly 5 years ago and no replacement has been hired by SC State due to the current fiscal environment. However, the SC State PI and CO-PIs continued to conduct a limited number of outreach activities through talks to schools and visiting groups.

- Smith co-hosted and organized a STEM-day visit by a group of prospective students and their parents in March 2015

- Cash hosted a Tier I, CATS Workshop with the Center for Astronomy Education (CAE) on the campus of SC State in June 2015

Specific Objectives:

Significant Results:

Key outcomes or Other achievements:

* What opportunities for training and professional development has the project provided?

- The CAE workshop cohosted by Co-PI Cash trained 11 K-14 teachers

- One graduate student at Clemson (Delgado-Navarro) was supported by PAARE to complete her training and research toward her M.S. in astronomy

- One graduate student at Clemson (Delgado-Navarro) was supported by PAARE and completed a "Certificate in Engineering and Science Education" including methods, current topics, research, and pedagogy.

- Undergraduate McKay held a summer intership at the Space Telescope Science Institute

- 3 other SC State undergraduates received training in various software, mathematical or physics topics as part of a PAARE-funded activity

- PI Walter received training by Clemson Faculty Member Brittain in the method of data analysis used as part of Brittain's study of Ae/Be stars

* How have the results been disseminated to communities of interest?

- Undergraduate McKay gave an oral presentation at the NAC III meeting at Howard University in September 2015

- Co-PI Smith presented at the Winter 2016 AAPT national meeting on work supported by PAARE during the reporting period

- 2 posters (PI Walter, Undergraduate McKay) were presented at the January 2016 AAS national meeting on work supported by PAARE during the reporting period

- Webpostings to the following sites

http://physics/scsu.edu/paare

http://physics.scsu.edu/~dms/cosmology/simulations.html

Supporting Files

	Filename	Description	Uploaded By	Uploaded On
(Download)	POCA-pics-final-2015.pdf	Pictures of PAARE-funded students at Clemson and SC State Universities.	Donald Walter	01/02/2016

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Products

Books

Book Chapters

Inventions

Journals or Juried Conference Papers

Licenses

Other Conference Presentations / Papers

Smith, D. M., Jr. (2016). *Cosmological Parameter Estimation from CMB Data for Undergrads*. 2016 Winter Meeting of the American Association of Physics Teachers. New Orleans, Louisiana. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

Hartig, E.; Cash, J.; Hinkle, K.; Lebzelter, T.; Mighell, K. J.; Walter, D. K. (2015). *Kepler and the Long Period Variables*. Why Galaxies Care about AGB Stars III: A Closer Look in Space and Time. Proceedings of a conference held 28 July-1 August 2014, at University Campus, Vienna, Austria.. Vienna, Austria. Status = PUBLISHED; Acknowledgement of Federal Support = No

Hartig, E.; Cash, J.; Hinkle, K.; Lebzelter, T.; Mighell, J.; Walter, D. K. (2015). *Kepler and the Long Period Variables*. The Space Photometry Revolution - CoRoT Symposium 3, Kepler KASC-7 Joint Meeting, Toulouse, France. Toulouse, France. Status = PUBLISHED; Acknowledgement of Federal Support = No

McKay, M; Osten, R; and Stelzer, B (2016). *Magnetic Activity of Ultracool Dwarfs*. 227th Meeting of the American Astronomical Society. Kissimmee, Florida. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

Walter, D; Brittain, S; Cash, J; Hartmann, D; Hinkle, K; Ho, S; Howell, S; King, J; Leising, M; Mighell, K; and Smith, D. (2016). *The NSF PAARE Projects at SC State*. 227th Meeting of the American Astronomical Society. Kissimmee, Florida. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

Other Products

Other Publications

Patents

Technologies or Techniques

Thesis/Dissertations

Delgado-Navarro, Adriana. *The Impact of Extinction on the Inferred Galactic Nova Rate*. (2015). Clemson University. Acknowledgement of Federal Support = Yes

Websites

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Participants/Organizations

What individuals have worked on the project?

Name	Most Senior Project Role	Nearest Person Month Worked
Walter, Donald	PD/PI	2
Cash, Jennifer	Co PD/PI	1
Howell, Steven	Co PD/PI	0
Leising, Mark	Co PD/PI	1
Smith, Daniel	Co PD/PI	1
Hinkle, Kenneth	Co-Investigator	0
Mighell, Kenneth	Co-Investigator	0
Brittain, Sean	Faculty	1
Hartmann, Dieter	Faculty	1
King, Jeremy	Faculty	0
Delgado-Navarro, Adriana	Graduate Student (research assistant)	3
Aleruchi, Matthew	Undergraduate Student	2

Eleby, Johnae	Undergraduate Student	3
Jones, Gabrielle	Undergraduate Student	4
McKay, Myles	Undergraduate Student	7
Pugh, Bryan	Undergraduate Student	3
Red, Wesley	Undergraduate Student	3

Full details of individuals who have worked on the project:

Donald Walter
Email: dkw@physics.scsu.edu
Most Senior Project Role: PD/PI
Nearest Person Month Worked: 2

Contribution to the Project: Project management (financial, reporting, supervision, planning); faculty research; mentor undergraduates; dissemination of project results at meetings and through publications; writing additional proposals related to the field; served as reviewer of proposals for NSF and NASA; completed closeout of POCA project at end of the final no-cost extension.

Funding Support: NSF new PAARE Project - AST - 1358913 overlaps in goals and activities with the 2008 PAARE project

International Collaboration: Yes, Austria
International Travel: No

Jennifer Cash
Email: jcash@physics.scsu.edu
Most Senior Project Role: Co PD/PI
Nearest Person Month Worked: 1

Contribution to the Project: Faculty research on RV Tauri and Semiregular variables; use of Kepler and ground-based data; outreach activities including K-12 talks; mentors undergraduates including serving as faculty sponsor of campus Society of Physics Students

Funding Support: NSF new PAARE Project - AST - 1358913 overlaps in goals and activities with the 2008 PAARE project

International Collaboration: Yes, Austria
International Travel: No

Steven B Howell
Email: howell@wiyn.org
Most Senior Project Role: Co PD/PI
Nearest Person Month Worked: 0

Contribution to the Project: Collaborated with Walter and Cash on reduction and analysis of Coude Feed spectra and Kepler light curve study.

Funding Support: None

International Collaboration: No
International Travel: No

Mark D Leising
Email: lmark@clemson.edu
Most Senior Project Role: Co PD/PI
Nearest Person Month Worked: 1

Contribution to the Project: Managed Clesmon subaward; mentored one PAARE-funded graduate student as she completed her MS work; helped with close-out of POCA award as part of the last no-cost extension.

Funding Support: None

International Collaboration: No

International Travel: No

Daniel M Smith
Email: dsmith@scsu.edu
Most Senior Project Role: Co PD/PI
Nearest Person Month Worked: 1

Contribution to the Project: Development of curricula products, specifically cosmology-related lab activities and web simulations; dissemination of products at national conferences (AAPT); faculty sponsor to campus Society of Physics students; recruitment of high school students

Funding Support: NSF new PAARE Project - AST - 1358913 overlaps in goals and activities with the 2008 PAARE project

International Collaboration: No
International Travel: No

Kenneth Hinkle
Email: hinkle@noao.edu
Most Senior Project Role: Co-Investigator
Nearest Person Month Worked: 0

Contribution to the Project: Collaborative research & writing of paper on Kepler light curve analysis of RV Tauri and Semiregular variables published in two European conference proceedings (see Products)

Funding Support: None

International Collaboration: Yes, Austria
International Travel: No

Kenneth Mighell
Email: mighell@noao.edu
Most Senior Project Role: Co-Investigator
Nearest Person Month Worked: 0

Contribution to the Project: Collaborative research and writing of paper on Kepler light curves of RV Tauri and Semiregular variables which was published in two European conference proceedings (see Products)

Funding Support: None

International Collaboration: Yes, Austria
International Travel: No

Sean Brittain
Email: sbritt@clemson.edu
Most Senior Project Role: Faculty
Nearest Person Month Worked: 1

Contribution to the Project: Trained SC State faculty (and in the future students) in the analysis techniques used in his study of Ae/Be stars so that they can participate in this work under the new POCA II award from NSF

Funding Support: None

International Collaboration: No
International Travel: No

Dieter Hartmann
Email: hdieter@CLEMSON.EDU
Most Senior Project Role: Faculty
Nearest Person Month Worked: 1

Contribution to the Project: Served on thesis committee of PAARE graduate student who completed her MS work; continued to use SARA telescopes as part of the small-telescope usage project Goal 2.

Funding Support: None

International Collaboration: No
International Travel: No

Jeremy King
Email: jking2@clemson.edu
Most Senior Project Role: Faculty
Nearest Person Month Worked: 0

Contribution to the Project: Continued use of SARA telescopes as part of Goal 2 of the POCA project and assisted in developing ideas for collaborative work with SC State.

Funding Support: None

International Collaboration: No
International Travel: No

Adriana Delgado-Navarro
Email: adelgad@clemson.edu
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 3

Contribution to the Project: PAARE fellowship; Completed her M.S. thesis and graduated from Clemson with her M.S. in Physics and Astronomy. See "Products" for thesis details. Also earned a Certificate in Engineering and Science Education including methods, current topics, research, and pedagogy.

Funding Support: Clemson graduate school funds supplement PAARE fellowship

International Collaboration: No
International Travel: No

Matthew Aleruchi
Email: maleruch@scsu.edu
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 2

Contribution to the Project: assisted Co-PI Cash in developing coursework material for physics and astronomy courses

Funding Support: in addition to PAARE funding, he received scholarship money from SC State and used his personal funds to remain in school

International Collaboration: No
International Travel: No

Johnae Eleby
Email: jeleby@scsu.edu
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 3

Contribution to the Project: PAARE undergraduate scholarship recipient; conducting research on RV Tauri and Semiregular variables under the mentorship of CO-PI Cash; graduated from SCSU in May 2015 with BS in physics & astronomy option; currently seeking employment in field of science education

Funding Support: None

International Collaboration: No
International Travel: No

Gabrielle Jones
Email: jonesgabrielle0189@gmail.com
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 4

Contribution to the Project: provided programming support to Co-PI Cash on Kepler light curve project;

Funding Support: personal funds for tuition and fees to supplement PAARE stipend.

International Collaboration: No
International Travel: No

Myles McKay
Email: mckaymyles@yahoo.com
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 7

Contribution to the Project: PAARE undergraduate scholarship recipient; assists Co-PI Cash with physics and astronomy outreach; president of campus chapter of the Society of Physics majors; participated as a summer 2014 intern at the National Radio Astronomy Observatory in Charlottesville, VA.; conducts research with PI Walter; completed summer 2015 internship at Space Telescope Science Institute

Funding Support: Summer Internship funded by NAC

International Collaboration: No
International Travel: No

Bryan Pugh
Email: legends@sc.rr.com
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 3

Contribution to the Project: PAARE undergraduate scholarship recipient; Semiregular variables under mentorship of PI Walter; graduated in May 2015 from SCSU with a BS in physics & the astronomy option; employed teaching part time in physics at local community college; applying for graduate program in physics and astronomy.

Funding Support: None

International Collaboration: No
International Travel: No

Wesley Red
Email: wesleyred@yahoo.com
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 3

Contribution to the Project: physics major preparing for future astronomy research under tutorship of Co-PI Cash

Funding Support: own funds and SC State scholarship supplements stipend from PAARE

International Collaboration: No
International Travel: No

What other organizations have been involved as partners?

Name	Type of Partner Organization	Location
Clemson University	Academic Institution	Clemson, SC
National Astronomy Consortium (NAC)	Other Nonprofits	Charlottesville, VA
National Optical Astronomy Observatory (NOAO)	Other Nonprofits	Tucson, AZ
National Solar Observatory (NSO)	Other Nonprofits	Tucson, AZ
Villanova University	Academic Institution	Villanova, PA
Western Kentucy University	Academic Institution	Bowling Green, KY

Full details of organizations that have been involved as partners:

Clemson University

Organization Type: Academic Institution
Organization Location: Clemson, SC

Partner's Contribution to the Project:
In-Kind Support
Facilities
Collaborative Research

More Detail on Partner and Contribution: Clemson and SC State collaborate in the use of small telescopes at KPNO and through undegraduate student research projects. A Clemson graduate student completed her M.S. thesis and graduated as part of the PAARE project during the past year . Clemson faculty have trained SC State faculty and in the future SC State undergraduates in the analysis of data specific to the Ae/Be star research which is ongoing.

National Astronomy Consortium (NAC)

Organization Type: Other Nonprofits
Organization Location: Charlottesville, VA

Partner's Contribution to the Project:
Other: Student Internships & Dissemination

More Detail on Partner and Contribution: NAC promotes diversity in astronomy. SCSU is a member of the NAC. Walter serves on the NAC's Advisory Board. Student Myles McKay has been funded because of the NAC in the summers of 2014 and 2015 for internships at NRAO and STScI.

National Optical Astronomy Observatory (NOAO)

Organization Type: Other Nonprofits
Organization Location: Tucson, AZ

Partner's Contribution to the Project:
Collaborative Research

More Detail on Partner and Contribution: SC State has collaborated with research astronomers at NOAO during the past year including two publications from conferences in Europe as indicated in the "Products" section of this report

National Solar Observatory (NSO)

Organization Type: Other Nonprofits
Organization Location: Tucson, AZ

Partner's Contribution to the Project:
Collaborative Research

More Detail on Partner and Contribution: NSO astronomer Matt Penn included Walter at SC State in a proposal with other collaborators that has been funded by NASA to study the solar eclipses of March 2016 in Indonesia and the August 2017 eclipse in the United States.

Villanova University

Organization Type: Academic Institution
Organization Location: Villanova, PA

Partner's Contribution to the Project:
Facilities
Collaborative Research

More Detail on Partner and Contribution: SC State partners with Western Kentucky University and Villanova in the management of the 1.3meter Robotically Controlled Telescope (RCT) at Kitt Peak. All three institutions provide in-kind technical support for the facility. The telescope provides ground-based photometeric and imagery data for faculty and students in research, education and outreach.

Western Kentucy University

Organization Type: Academic Institution
Organization Location: Bowling Green, KY

Partner's Contribution to the Project:
Facilities
Collaborative Research

More Detail on Partner and Contribution: SC State partners with Western Kentucky University and Villanova in the management of the 1.3meter Robotically Controlled Telescope (RCT) at Kitt Peak. All three institutions provide in-kind technical support for the facility. The telescope provides ground-based photometeric and imagery data for faculty and students in research, education and outreach.

What other collaborators or contacts have been involved?

Thomas Lebzelter and Erich Hartig from the University of Vienna were coauthors (Hartig the lead) on two publications from European conferences based on previous work on Kepler light curves of Semiregular stars. The previous work and these two new publications included PI Walter and Co-PI Cash as coauthors

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Impacts

What is the impact on the development of the principal discipline(s) of the project?

The confrenence publications and the completion of an MS thesis described elswhere help advance our understanding of semiregular stars and novae.

The cosmology labs and simulations developed will help convey to undergraduates, both STEM and non-STEM, a better understanding of the concepts of dark energy, dark matter, the Big Bang and related topics.

What is the impact on other disciplines?

Nothing to report.

What is the impact on the development of human resources?

- During the reporting period a total of 1 M.S. degree in physics and astronomy was awarded to a graduate student funded by PAARE (1 student).

- A total of 6 undergraduates (5 African-American, 1 Caucasian classified as disabled) majoring in physics at SC State, were supported and trained under this PAARE award during this reporting period.

- Two (1 African-American female, 1 Caucasian male classified as disabled) of the 6 undergraduates graduated with a B.S. degree in physics with the astronomy option from SC State.

What is the impact on physical resources that form infrastructure?

PAARE supports SCSU's participation in the Robotically Controlled Telescope (RCT) Consortium which in turn provides access to the 1.3 meter RCT at Kitt Peak.

Hardware and software support described below futher supports the physics area's Computational Physics Lab, Room 306 Davis Hall, on the campus of South Carolina State University. The computational lab is providing support to other physics projects in the department (and potentially to faculty in biology and chemistry) through the shared used of the color printer, linux machines and UNIX server as described below.

What is the impact on institutional resources that form infrastructure?

The support PAARE provides for the Computational Physics Lab and the UNIX server physics.scsu.edu can potentially serve to attract other research projects to the department as this is the only computational lab in the sciences on campus. The SCSU administration has included the Computational Physics Lab and the PAARE-supported RCT resource as part of its publicity and documentation used in promoting the research capabilites of the university to industry and other potential partners.

For example, Co-PI Cash uses the computational physics resources from PAARE for a NASA project on which she is the lead. She is developing an interactive web resource for general public understanding of variable stars and the Kepler project. Another NASA-supported project for an upcoming satellite misson uses the resources of the computational lab as well. An NSF HBCU-UP award to the physics area makes use of the physics server and the computational lab hardware and software. The CAE workshop in June 2015 used the lab as its training facility.

What is the impact on information resources that form infrastructure?

PAARE purchased 5 linux workstations as well as several Mac and Windows laptops in previous years that are used for teaching and research.

PAARE provides financial assistance to the upkeep of the physics UNIX web and mail server (http://physics.scsu.edu). We note that the physics UNIX server is the only one on campus that the Computer Center allows to be operated independantly of their staff. This is due to the secure and robust nature of the physics server and its extensive use in research.

A Mac workstation was previously funded by PAARE for Smith to develop his products. A Mac laptop was previously purchased by PAARE for Walter who uses it for image analysis of the Coude spectra that are a part of this project.

PAARE previously supported the purchase of a color laser printer that is used to generate brochures and other recruitment materials for the physics area and the Department of Biological and Physical Sciences.

PAARE previously supported the purchase of an IDL minilab license, KaleidaGraph and other software that is used along with the hardware by Cash, Walter, Smith and others in research and teaching, such as in the physics course P 338 "Scientific Image Analysis" and other physics classes and research courses. These resources provide the physics undergraduates with experiences that will be helpful in graduate school or on the job. In many cases, this is the only opportunity on campus to acquire such skills.

What is the impact on technology transfer?

Nothing to report.

What is the impact on society beyond science and technology?

The CAE workshop helped train K-14 teachers who will carry this knowledge into their classrooms.

Talks to the K-12 community and the general public by all the faculty at both institutions further develop the publics understanding about science and the need for public funding of these endevours.

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Changes/Problems

Changes in approach and reason for change

- No changes to report. This 7-month no cost extention period was used to continue and in some cases complete the training and education of graduate and undergraduate students. Faculty have further advanced the goals of the project through continuted collaborations, new activities and alternative funding for the future. The project has now ended with the end of this reporting period.

Actual or Anticipated problems or delays and actions or plans to resolve them

Nothing to report.

Changes that have a significant impact on expenditures

Nothing to report.

Significant changes in use or care of human subjects

Nothing to report.

Significant changes in use or care of vertebrate animals

Nothing to report.

Significant changes in use or care of biohazards

Nothing to report.

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Figure 1

Adriana Delgado-Navarro, PAARE graduate fellow, graduating with her M.S. in astronomy from Clemson University in May 2015.

Figure 2

Myles McKay, SCSU and PAARE undergrad interned at STScI in 2015 and will present his results at the 227th meeting of the AAS in January 2016.