

**Annual Report for Period:**03/2011 - 02/2012**Submitted on:** 02/29/2012**Principal Investigator:** Walter, Donald .**Award ID:** 0750814**Organization:** South Carolina St Univ**Submitted By:**

Walter, Donald - Principal Investigator

**Title:**

A Partnership in Observational and Computational Astronomy

### Project Participants

#### Senior Personnel

**Name:** Walter, Donald**Worked for more than 160 Hours:** Yes**Contribution to Project:**

Walter continued in Year 4 to conduct ground and space-based research on RV Tauri and Semi-regular stars with Co-PIs Cash and Howell. An additional collaborator from POCA partner NOAO now includes Kenneth Hinkle, who was a Co-I on a proposal to NASA for Kepler Cycle 4 time. Cash took the lead on that proposal with Walter and Hinkle as Co-Is.

Walter presented research and education posters at the January 2012 AAS meeting as described elsewhere in this report. He carried out three observing runs at the Coude Feed telescope at KPNO during Year 4 of POCA. Those spectroscopic results are being prepared for presentation in two separate publications, one with new Kepler data and one combining years of ground-based data on different stars than the Kepler set.

Walter attended the Kavli Institute for Theoretical Physics conference on the campus of the University of California, Santa Barbara, in October 2011. The title of the conference was 'The Impact of Asteroseismology across Stellar Astrophysics'. Walter was able to make contact with several modeling groups and is currently exploring a future collaboration with one of the groups.

Walter also attended the First Kepler Science Conference at NASA Ames in December 2011. He was able to interact with other researchers and discuss common issues with their Kepler data.

Walter and Cash visited NASA Ames in May 2011 to work with the Kepler Guest Observer Office on the procedures to reduce and interpret their Kepler data.

Walter worked with several undergraduates during the summer 2011 astronomy internship program at SC State as well as conducting research during the academic year with POCA undergrad Charles Kurgatt as described under his accomplishments.

Walter collaborated with Sean Brittain at Clemson to recruit students into the POCA and Clemson programs. They both were present with a booth exhibit at the joint meeting of the National Society of Black/Hispanic Physicists in Austin, Texas, during September 2011. This resulted in one application to the POCA summer 2012 internship program from a student at South University in Baton Rouge. Additionally, Walter attended the national meeting of the Society for the Advancement of Chicano and Native Americans in Science (SACNAS) meeting in San Jose, California, in October 2011. He presented an exhibit booth that highlighted POCA undergraduate and graduate programs in astronomy at SC State and Clemson. From this, three students from Puerto Rico have applied to the SC State summer 2012 program and one student considered but did not apply to Clemson for graduate school.

Walter was heavily involved in local recruitment into the physics program at SC State. He took the lead in organizing a 4-day workshop on astronomy for 25 teachers and high school students in June of 2011. He organized a Saturday Physics Visitation Day on November 5, 2011, for 32 high school students and 20 parents and teachers. He gave additional talks and presentations to school groups from around the state as described elsewhere. He also took the lead in organizing the 2011 Meeting of Astronomers in South Carolina. This took place on the campus of SC State and included 38 participants from 10 institutions. Additionally he worked with the SC State Public Relations and Research office to develop several TV programs and advertisements on the POCA program.

Walter was successful in Year 3 as a PI on a proposal to use NASA's Kepler Observatory to observe RV Tauri and Semi-regular variables. POCA Co-PIs Cash and Howell were also Co-Is on the Kepler proposal. The first set of data from Kepler arrived in late

January 2011 and will be a major part of the Year 4 research.

Walter also conducted ground-based research on RV Tauri and Semi-Regular stars in Year 3 as well as Years 1 and 2. He has conducted observing runs on the Coude Feed Telescope in October 2009, as well as January, May and October of 2010. The next run is planned for late March 2011. Additionally, Walter and undergraduate E. Nesmith are using the 1.3 meter Robotically Controlled Telescope at KPNO to gather BVR photometry of these stars simultaneous with Kepler's on-orbit observations.

Walter and undergraduate students are working with Howell on the spectra of these variable stars and combining their results with the photometric work of Cash and her students. A total of three poster presentations at the AAS meeting in January 2011 dealt with this work.

Walter has worked with other members of the POCA team to carry out recruitment activities on the national and local level and a teacher workshop at SC State as described in detail in the Outreach section of this report.

Walter served as mentor to two SC State Tier I (basic level) interns in the summer of 2010, and will mentor 2 or more in the summer of 2011. During the academic year 2010-11, he has served as mentor to undergraduates E. Nesmith and J. Lalmansingh as they conducted astronomical research for course credit.

As PI, Walter has been responsible for the day-to-day operation of the project including oversight of the work by Co-PIs and others involved in the project as well as all financial and administrative tasks.

Walter was the main point of contact and responsible for communication among the partner institutions, Co-PIs, collaborators and students.

**Name:** Howell, Steven

**Worked for more than 160 Hours:** Yes

**Contribution to Project:**

Dr. Howell has moved from NOAO to NASA Ames and has become the Deputy Project Scientist for the Kepler Mission but remains a Co-PI on the POCA project. He continues to work with Walter and Cash on their research. In Year 4 he has used his observing time on the 4meter telescope at KPNO to acquire spectra of several of the stars too faint for Walter to obtain with the Coude Feed Telescope. He is a coauthor with Walter and Cash on two separate papers in preparation.

Through Year 3, Dr. Howell is the Co-PI on this project from the National Optical Astronomy Observatory (NOAO). He continues to serve as the mentor to the SC State faculty and students for research and a point of contact for access to KPNO facilities. He encouraged Walter and Cash to submit a Kepler proposal and made important contributions to the proposal as a Co-I. He has also made significant contributions as a coauthor on the paper that Walter and Cash are preparing.

Howell visited SC State in April 2009 and April 2010 to assist in the writing of a research paper, plan for student summer research projects and future faculty work on the project.

During the summer of 2010, Dr. Howell served as mentor to two (2) SC State Tier II (experienced) astronomy interns at NOAO as he had done in the summer of 2009 to a different (third) SC State student.

**Name:** Leising, Mark

**Worked for more than 160 Hours:** Yes

**Contribution to Project:**

In Year 4, as in Years 1-3, Dr. Leising served as the Co-PI on this project from Clemson University (CU). He handles financial and administrative matters related to the subaward. He coordinates faculty and student participation at and with CU, including SC State access to CU observing facilities at KPNO and elsewhere.

Leising was instrumental in recruiting the first SC State POCA undergraduate, Jared Lalmansingh, to successfully apply to the Clemson graduate physics program. Leising is currently the research advisor to Jared who is working on modeling of supernovae.

In Year 4 Leising coordinated the visit by SC State summer interns to Clemson. The students and faculty toured the campus, conducted a remote observing session and participated in a meeting at which Clemson and SC State faculty and students gave a total of 10 talks. He also helped coordinate a visit by two Clemson graduate students (Shaun Hampton and Jared Lalmansingh) to

SC State to speak about 'What Graduate School is Really Like' to 16 State undergraduates and three faculty members.

Leising visited SC State in September 2008 to speak to POCA students and coordinated a visit to SC State by a two Clemson graduate students on March 25, 2010. These grad students spoke to SC State faculty members, POCA undergrads, members of the Society of Physics Students and others. Leising coordinated visits to the Clemson campus by SC State POCA students and faculty during the summers of 2008 and 2009. He and other Clemson faculty recruited two African-American students who were accepted into the Clemson graduate program in astronomy and are the first two POCA fellowship recipients under this award. In the summer of 2009 he mentored a Tier II (experienced) astronomy intern from SC State.

**Name:** Smith, Daniel

**Worked for more than 160 Hours:** Yes

**Contribution to Project:**

Dr. Daniel Smith, Co-PI from SC State, had developed several POCA-funded cosmology laboratory exercises and computer simulations and demonstrations during Years 1-4 including one in which the jackknife statistical technique has been applied to calculate two-point correlation function error bars.

In Year 4 he has given a presentation entitled 'Large Scale Structure for Undergraduates' at the combined conference of National Society of Black/Hispanic Physicists in Austin, Texas, in September 2012. The American Association of Physics Teachers has accepted his workshop 'Cosmology in the Classroom' as part of its summer 2012 meeting in Philadelphia, Pennsylvania.

He presented some results at the January 2011 national meeting of the American Association of Physics Teachers. He is currently enhancing his cosmology website with these exercise. More details can be found elsewhere in this report. During each of the summers of 2008, 2009, 2010 and 2011, Smith conducted sessions on extragalactic astronomy and cosmology with the POCA Tier I students and will do so again in 2011.

He continues to be active in recruiting physics majors to the SC State program through talks and visits to groups on campus and in the region.

**Name:** Cash, Jennifer

**Worked for more than 160 Hours:** Yes

**Contribution to Project:**

Dr. Jennifer Cash, POCA Co-PI from SC State, was the lead on a proposal submission to Cycle 4 of the NASA Kepler Guest Observer program in January 2012. She collaborated with PI Walter and a new NOAO collaborator, Kenneth Hinkle. They propose to study RV Tauri and Semi-regular variables in the Kepler field.

In earlier POCA years, her involvement with computational methods in astronomy led to a collaboration with Clemson faculty members outside of the physics and astronomy department described below. That collaboration has continued and she was part of a booth exhibit at the International Conference for High Performance Computing, Networking, Storage and Analysis' in Seattle, Washington, in November 2011. Her display dealt with the Kepler light curve analysis she has been conducting.

Cash has continued to participate in outreach and recruitment activities on campus and around the state. Her role as the Campus Director for the South Carolina Space Grant Consortium gives her additional opportunities to promote POCA and astronomy.

Cash has conducted research in Years 1-3 on the analysis of the light curves of RV Tauri and Semi-regular stars using AAVSO data. She and her students have successfully modeled several of these objects. Her research results were part of three posters at the January 2011 AAS meeting in addition to AAS meetings in 2009 and 2010.

Cash is also a Co-I on the successful Cycle 2 Kepler Proposal with Walter and Howell. They are preparing their results for publication.

Cash has been the research mentor to a new pair of Tier I interns in each of the summers of 2008, 2009, 2010 and four summer interns in during the summer of 2011. Several of them have contributed to poster presentations at AAS and other meetings.

Cash expanded her collaborations with Clemson University in 2010, albeit outside of the POCA astronomical group. She is now a Co-PI on an NSF EAGER award to Clemson entitled 'TIGER - Tight Integration of Grid Enabled Researchers'. She has become the SC State point of contact to the rest of the campus for training and other opportunities supported by Cyber-Infrastructure. Her

own research in time series analysis of these variable stars will be expanded by this collaboration so that she can explore a large range of parameter space and effectively visualize the results, something that is currently not possible with the modeling resources available to her.

**Name:** Mayo, Elizabeth

**Worked for more than 160 Hours:** Yes

**Contribution to Project:**

Dr. Mayo has been the Planetarium Manager, an Assistant Professor of Physics and a Radio Astronomer at SC State. She has contributed to this project in a number of ways.

She submitted a paper that has been accepted by AJ based on her Ph.D. dissertation work on magnetic fields in star forming regions. It was recently published as: Mayo, E. and Roland, T., 2012, AJ, 143, 32; 'Very Large Array H I Zeeman Observations of the Cygnus X Region: DR 22 and ON 2'.

Mayo has taught radio astronomy to Tier I students in each of the first three summers of this program, 2008, 2009 and 2010. She has conducted POCA outreach activities from 2008-2011. This includes planetarium shows, talks to school groups and observing sessions.

Mayo left South Carolina State University in the summer of 2011 to pursue other interests. She is preparing an additional publication based on her Ph.D. work. If that publication is submitted prior to the end of POCA, it will be supported by POCA funds.

**Name:** King, Jeremy

**Worked for more than 160 Hours:** No

**Contribution to Project:**

Dr. King participated in the summer 2011 visit by SC State students and faculty to the Clemson campus. He continues to provide input into recruiting and possible faculty and student collaborations between Clemson and SC State. In the past he has submitted proposals to NSF that included partnering with SC State to observe objects of interest with the 1.3-meter RCT at KPNO. Additionally, King and his graduate student, E. Bubar, invited SC State undergrad J. Lalmansingh and PI Walter to observe with Bubar on the 4-meter in November 2008. This trip was the seminal event in motivating Lalmansingh to choose the astronomy option as a physics major at SC State. Lalmansingh is now a graduate student in astronomy at Clemson.

**Name:** Mighell, Kenneth

**Worked for more than 160 Hours:** No

**Contribution to Project:**

Dr. Mighell has collaborated on this PAARE project since its beginning in 2008 in his role as the NSF REU Site Director at KPNO. This has included coordinating the participation of a total of three SC State summer interns at KPNO. In the summer of 2010 he took an even more active role by assisting Howell in directing the research of E. Nesmith and J. Lalmansingh. This was preceded by his visit with Howell to SC State in April 2010 to plan the student's summer work. Mighell was coauthor on both student posters at AAS in January 2011. Mighell has also provided research suggestions to Walter and Cash in Year 4 and made them aware of resources available for their work on RV Tauri and Semi-regular variables.

**Name:** Hartmann, Dieter

**Worked for more than 160 Hours:** Yes

**Contribution to Project:**

Dr. Hartmann conducted a remote observing session with visiting SC State summer interns in July 2011. From the the Clemson campus, he remotely logged into the SARA South Telescope located at CTIO in the South Hemisphere. He demonstrated to the students how to conduct a remote observing session in real time, an activity the students found to be very exciting. Additionally, Hartmann is the M.S. thesis advisor to POCA graduate student Shaun Hampton who is conducting research on Hawking radiation from black holes.

**Name:** Brittain, Sean

**Worked for more than 160 Hours:** Yes

**Contribution to Project:**

Dr. Sean Brittain worked with Tier II POCA intern from SC State Charles Kurgatt in the summer of 2011. Kurgatt worked on measuring spectro-astrometric signals of CO emission from disks around young stars. Additional details are provided under

Kurgatt's section.

Brittain was also involved in a number of recruitment activities, including helping to recruit SC State physics major Jared Lalmansingh to successfully apply to the Clemson graduate program in astronomy. He worked with Walter at a POCA and Clemson recruitment booth at the combined meeting of the National Society of Black/Hispanic Physicists in Austin, Texas, in September 2011. Additionally, he provided materials for the POCA and Clemson booth at SACNAS in San Jose, California, in October 2011.

## Post-doc

### Graduate Student

**Name:** Bryngelson, Ginger

**Worked for more than 160 Hours:** Yes

**Contribution to Project:**

Ms. Ginger Bryngelson, a fourth-year PhD student doing research in astronomy, has served as the POCA graduate student mentor to the new, POCA first-year graduate students, helping them get settled in Clemson, and providing advice and tutoring for the core courses. She continued in this capacity through the Spring 2011 term. In the fall of 2011 Mr. Shaun Hampton became the POCA graduate mentor.

**Name:** Carter, Jessica

**Worked for more than 160 Hours:** Yes

**Contribution to Project:**

Ms. Jessica Carter graduated from Valdosta State University with a BS in astronomy in May 2010, and matriculated in August 2010. She was recruited beginning the previous summer, when she worked with Mark Leising in the SARA REU internship program at Clemson. She is member of the first cohort, consisting of two graduate students, to receive a POCA graduate stipend. She receives additional support from the Clemson Physics & Astronomy department in the form of a tuition waiver. She completed a successful Fall semester in courses and began research activities. Unfortunately she took a medical leave in the spring of 2011, but returned in the fall of 2012 to complete coursework. In the spring of 2012 she is a part-time graduate student and as such is not covered by the POCA fellowship.

**Name:** Hampton, Shaun

**Worked for more than 160 Hours:** Yes

**Contribution to Project:**

Mr. Shaun Hampton received a BS in Chemistry from UNC-Chapel Hill, and entered Clemson's graduate program in August 2010. He was recruited following contacts with UNC faculty. He is member of the first cohort, consisting of two graduate students, to receive a POCA graduate stipend. He receives additional support from the Clemson Physics & Astronomy department in the form of a tuition waiver. He completed a successful first three semesters and is now in his fourth semester as a POCA graduate student. He is studying Hawking radiation from black holes with Professor Dieter Hartmann (POCA Senior Personnel) for a M.S. thesis project. Shaun is also the POCA graduate mentor during the 2011-12 academic year. He has assisted both the two new POCA graduate students, Lalmansingh and Delgado-Navarro, and also is available as a mentor to the three minority undergraduates who recently transferred into the Clemson physics program.

**Name:** Lalmansingh, Jared

**Worked for more than 160 Hours:** Yes

**Contribution to Project:**

Jared Lalmansingh is the first undergraduate to complete the B.S. in physics with the astronomy option at South Carolina State University. He is also the first POCA undergraduate to 'move up in the POCA pipeline' from SC State to POCA partner Clemson University's graduate program in physics and astronomy. He has successfully completed one semester of core courses and is enrolled in the second semester. He is doing research as time allows on supernova modeling with Professor Mark Leising (POCA Co-PI).

**Name:** Delgado-Navarro, Adriana

**Worked for more than 160 Hours:** Yes

**Contribution to Project:**

Adriana Delgado-Navarro (B.S. U. of Florida) began her PhD studies in Fall 2011. Her prior degree was in astronomy, so she is

studying 600-level physics courses to prepare for Clemson core course. In the Fall 2011, she did quite well and will be well-prepared for the 800-900 level courses in Fall 2012. She, like all the other POCA students, is enrolled in and attends our weekly astrophysics seminar. Each student gives one talk per semester, in addition to attending.

### Undergraduate Student

**Name:** Davis, Graham

**Worked for more than 160 Hours:** Yes

**Contribution to Project:**

Graham Davis is a physics major who selected the astronomy option. He held a POCA scholarship in the 2008-09 year and the 2009-10 year. He was a POCA Tier I (basic level) research intern in the summer of 2008 and presented his results in a student poster at the January 2009 meeting of the American Astronomical Society. He held a second POCA Tier II (experienced) internship in the summer of 2009 at SC State. In May of 2010 he decided to pursue a career with the military rather than complete his degree at SC State.

**Name:** Durant, Patrick

**Worked for more than 160 Hours:** Yes

**Contribution to Project:**

Patrick Durant's involvement with the project ended in Year 2.

Patrick Durant is a physics major who was a POCA Tier I (basic level) research intern in the summer of 2008 and presented his results as a student poster at the February 2009 meeting of the National Society of Black Physicists. He was a summer 2009 POCA Tier II intern under the mentorship of Co-PI Howell at NOAO. He presented the results of research as the lead author of a poster at the January 2010 meeting of the American Astronomical Society. After long and careful consideration, he has decided to pursue the medical physics option rather than astronomy.

**Name:** Lalmansingh, Jared

**Worked for more than 160 Hours:** Yes

**Contribution to Project:**

Jared Lalmansingh is a physics major with an astronomy option. When he graduated in May 2011, he was the first physics major at SC State to graduate with an astronomy option.

Jared has participated in a variety of ways under the POCA award.

He spent the summer of 2009 as a Tier II intern at Clemson University work with Co-PI Leising. He spent the summer of 2010 at KPNO as a Tier II intern working with Co-PI Howell. After both of these internships he presented posters as the first author at AAS meetings in January 2010 and 2011 respectively.

Lalmansingh has also observed on the 4-meter at KPNO with Clemson graduate student E. Bubar and presented at several statewide conferences. Additionally, he has carried out research during the academic year under the guidance of PI Walter.

**Name:** Nesmith, Eva

**Worked for more than 160 Hours:** Yes

**Contribution to Project:**

Eva Nesmith has held summer internships as a POCA Tier I (summer 2009) and Tier II (summer 2010) under the mentorship of Co-PIs Cash and Howell respectively. She also conducted research during the academic year under PI Walter, including a project during Year 4 to use the RCT to acquire BVR photometry of variable stars from the ground while Kepler is observing them on-orbit.

Nesmith has twice presented posters as the AAS meetings (January 2010 and 2011) and the annual Meeting of Astronomers in South Carolina in 2010 and will do so again in March 2011.

Ms. Nesmith graduated as a math major in May 2011. While she had a strong interest in returning to SC State to receive a second degree, this one in physics with the astronomy option, she ultimately chose to take time off and seek employment.

**Name:** Pryor, Alexis

**Worked for more than 160 Hours:** Yes

**Contribution to Project:**

Alexis Pryor joined the POCA project in October 2009 when she changed her major to physics with the astronomy option. She has received a POCA scholarship since then and was a Tier I summer intern at SC State in the summer of 2010, working with PI Walter on the spectroscopy of RV Tauri stars. In the spring of 2011 she decided to change her major to business and leave the POCA project.

**Name:** Jamison, Keisha

**Worked for more than 160 Hours:** Yes

**Contribution to Project:**

Keisha Jamison was a Tier I POCA astronomy intern at SC State during the summer of 2009. She worked under the direction of Co-PI Cash on RV Tauri light curves. At the end of the summer, she decided to remain a math major and no longer pursue astronomy.

**Name:** Julien, Osei

**Worked for more than 160 Hours:** Yes

**Contribution to Project:**

Osei Julien was a Tier I astronomy intern at SC State during the summer of 2009. He worked under the direction of PI Walter on the spectra of RV Tauri stars. At the end of the summer, he decided to remain a major in Electrical Engineering Technology and no longer pursue astronomy.

**Name:** Pugh, Bryan

**Worked for more than 160 Hours:** Yes

**Contribution to Project:**

Bryan Pugh is a transfer student from a local junior college. He entered SC State in the fall of 2010 as a sophomore physics major with an astronomy option. He has received a POCA scholarship since he joined the program. Pugh was a Tier I intern in the summer of 2010, working with Co-PI Cash modeling light curves of RV Tauri stars. He was a coauthor on a poster at the AAS meeting in January 2011. He was a Tier II student researcher in the summer of 2011, working with Co-PI Cash on Kepler light curves. He has continued as a POCA scholarship recipient during the 2011-12 academic year and is progressing toward his degree. He will return to SC State in the summer of 2012 as a Tier II intern.

**Name:** Maina, Edwin

**Worked for more than 160 Hours:** Yes

**Contribution to Project:**

Edwin Maina is a SC State double major in math and computer science with a strong background in physics. He accepted a Tier I POCA summer 2010 internship at SC State where he conducted research under the guidance of Co-PI Cash. After the summer, he decided to no longer pursue astronomy.

**Name:** Kurgatt, Charles

**Worked for more than 160 Hours:** Yes

**Contribution to Project:**

Charles Kurgatt is a physics major who was exploring astronomy as an option. He spent the summer of 2010 as a Tier I student working with PI Walter examining the spectra of RV Tauri and Semi-regular stars. He was a coauthor on a poster presentation at the AAS meeting in January 2011. During the 2010-11 academic year he decided to switch from the pure physics B.S. to the physics with an astronomy option.

During the summer of 2011, Kurgatt worked as a Tier II intern under the mentorship of POCA Senior Personnel, Dr. Sean Brittain at Clemson on measuring spectro-astrometric signals of CO emission from disks around young stars. The goal of this project was for him to measure the mass of the star and inclination of the disk from these measurements. Charles learned how to reduce high-resolution infrared spectroscopy, fit models of gas emission from disks, and interpret chi-squared minimization contours.

During the academic year 2011-12 he has continued at SC State as an astronomy option and conducted independent research under PI Walter examining photometric data from the RCT telescope and conducting spectral classification of RV Tauri and

Semi-regular stars to be used in an upcoming publication. He will return to SC State in the summer of 2012 as a Tier II intern.

**Name:** Davis, Joshua

**Worked for more than 160 Hours:** Yes

**Contribution to Project:**

Joshua Davis was a physics major with an astronomy option prior to the POCA award. He held a Tier I internship in the summer of 2008, working with Co-PI Cash modeling light curves. He held a POCA scholarship in the fall of 2008 and was a coauthor on a poster at the AAS meeting in January 2009. Unfortunately he left school during the fall 2008 term.

**Name:** Banks, Ne'Cuana

**Worked for more than 160 Hours:** Yes

**Contribution to Project:**

Ne'Cuana Banks was a physics major who selected the astronomy option and received a scholarship from PAARE in the Fall 2008 semester. She participated in a number of student skill building sessions, attended talks by visiting speakers and other activities such as observing sessions. Unfortunately, she left school at the end of the fall 2008 term.

**Name:** Martinez, Maria

**Worked for more than 160 Hours:** Yes

**Contribution to Project:**

Maria Martinez is a student from Sacramento Community College in Sacramento, California. She was recruited by PI Walter during his booth exhibit at the SACNAS meeting in September-October 2010. She came to the SC State campus during the summer of 2011 as a Tier I intern, conducting research with Co-PI Cash on Kepler light curves. She returned to her home institution and presented her work to her fellow students and faculty members. Her summer experience has motivated her to continue her studies with the eventual goal of acquiring a Ph.D. in astronomy. She attended the January 2012 AAS meeting. She said 'The AAS meeting most definitely inspired me to continue my path towards astrophysics.' She will return to SC State in the summer of 2012 as a Tier II intern.

**Name:** Hernandez, Guillermo

**Worked for more than 160 Hours:** Yes

**Contribution to Project:**

Guillermo (Will) Hernandez is a physics major at Montclair State University in Montclair, New Jersey. He was recruited by PI Walter during his booth exhibit at the SACNAS meeting in September-October 2010. He came to the SC State campus during the summer of 2011 as a Tier I intern, conducting research with Co-PI Cash on Kepler light curves. He returned to Montclair and presented his work to his fellow students and faculty members where it was well received. He attended the January 2012 AAS meeting and will return to SC State in the summer of 2012 as a Tier II intern.

His comment on the summer 2011 experience was: 'It was one of the best educational experiences of my life! It gave me the motivation to continue on my education path because it gave me a glimpse as to what I can do with a degree in astrophysics.'

Will expressed his excitement after the AAS meeting: 'Amazing experience! To be among all the physicists and physics majors (both at undergrad and graduate level) was great and helped me feel as if even though my school has a small physics department, there are others out there with the same passion I have for the stars.'

**Name:** Starkey, Ciera

**Worked for more than 160 Hours:** Yes

**Contribution to Project:**

Ciera Starkey is a physics major from Tennessee State University. She came to SC State in the summer of 2011 as a Tier I intern, conducting research under the guidance of Co-PI Cash on Kepler light curves. Before coming to the program she admitted her main interest was in medical physics, but that she would like to see what astronomy was like. She completed her work at returned to Tennessee State University in the fall of 2011. Unfortunately Tennessee State has decided to discontinue its physics degree program. Presumably Ciera will be able to complete her B.S. in physics at the school, but her future involvement in astronomy does not appear to be an option.

**Name:** Gott, Andrew

**Worked for more than 160 Hours:** Yes



**Contribution to Project:**

Andrew Gott is a senior physics major at POCA Collaborating Institution Western Kentucky University. He used the RCT to acquire multicolor photometry and present a poster on the supernova in M101 at the January 2012 AAS meeting. This poster was entitled 'UBVRI Optical monitoring of the Supernova 2011fe in Pinwheel Galaxy with the 1.3-meter Robotically Controlled Telescope.' For this work he was selected as one of the undergraduate Chambliss award winners. His travel to AAS was supported by the POCA award as part of its research partnership with Western Kentucky and in support of the RCT.

**Name:** McKay, Myles

**Worked for more than 160 Hours:** Yes

**Contribution to Project:**

Myles McKay entered SC State University in the fall of 2011 as a freshman majoring in physics with the astronomy option. He is a POCA scholarship awardee. He will become a Tier I summer intern at SC State during the summer of 2012.

**Name:** Terry, Marina

**Worked for more than 160 Hours:** Yes

**Contribution to Project:**

Marina Terry is an SC State undergraduate majoring in nuclear engineering. She expressed an interest in learning more about astronomy, so she was awarded a POCA stipend during the fall 2011 term to conduct research under Co-PI Cash on Kepler light curves. Her work assisted PI Walter and Cash in preparing and presenting their research at the January 2012 AAS meeting. While Marina's work product was very good, she and the SC State faculty agreed that because of time commitments in the spring of 2012 she would not continue her POCA work.

**Technician, Programmer****Other Participant****Research Experience for Undergraduates****Organizational Partners****Clemson University**

Clemson has successfully recruited two underrepresented minority students into their graduate program in the Fall of 2010 and two more in the Fall of 2011. They have also recruited within their existing graduate student pool, a 4th year Ph.D. student to serve as a mentor to the incoming POCA students. Both of these accomplishments help achieve one of the primary objectives of the POCA project, to increase diversity in the Ph.D. portion of the pipeline. While the POCA award provides stipends to the students, Clemson has provided tuition waivers. In Year 4 one of the new graduate students was the first SC State undergrad to enter 'through the POCA pipeline'.

Additionally, Clemson faculty have assisted PI Walter on his national recruiting trips by accompanying him on these trips, by providing handout materials for the POCA display and by following up with recruitment emails and phone calls to prospective graduate school candidates.

Clemson astronomers, specifically Co-PI Mark Leising, served as the research mentor to SC State summer 2009 intern Jared Lalmansingh. Clemson astronomer Sean Brittain served as a summer 2011 mentor to SC State student Charles Kurgatt. The work of Leising and Lalmansingh resulted in a student poster at the January 2010 AAS meeting.

Five SC State summer interns and two professors visited Clemson in July 2011. They toured the campus, participated in a real-time, remote access observing session and listened to a total of 10 talks by faculty and students from both institutions.

Four SCSU students and three professors visited Clemson in July 2009 to discuss their summer's work, hear about research opportunities from graduate students and faculty, get to know Clemson, and hear more directly from students what graduate school is like. Talks by students and faculty at both institutions were given. A similar event in July of 2008 included two faculty members and three POCA summer interns from SC State.

Clemson has also sent speakers to SC State. This has included a visit by Co-PI Leising in September 2008 and two Clemson graduate students in March 2010. In Year 4, two Clemson graduate students visited SC State and spoke to 16 undergraduates and three faculty members on 'What Graduate School is Really Like'.

### **Western Kentucky University**

Astronomers at Western Kentucky University (WKU) have worked with SCSU astronomers to prepare the 1.3 meter telescope, also known as the Robotically Controlled Telescope (RCT), for research use under the PAARE award. SCSU and WKU have collaborated with other schools over the years in the management of the telescope. Lightning strikes in the summer of 2008 resulted in multiple equipment failures and an extended period of down time. The facility was restored to normal use and has been scientifically productive several years. PI Walter is working with an SC State student to begin regular use of the RCT to acquire BVR photometry of RV Tauri type stars. Beginning in the summer of 2012, SC State POCA summer interns will learn how to use the telescope, including how to submit observing requests and how to retrieve the data.

During Year 4, Western Kentucky undergraduate, Andrew Gott, conducted research using the RCT, obtaining multicolor photometry of the M101 supernova. He was an undergraduate Chambliss Award winner. His travel to AAS was funded by the POCA award as part of our collaboration with Western Kentucky.

### **National Optical Astronomy Observatory**

A new POCA collaborator from NOAO, Kenneth Hinkle, has begun work during Year 4 with Cash and Walter in the submission of a Kepler Guest Observer Cycle 4 proposal to NASA. Cash is the lead, Walter and Hinkle are collaborators.

NOAO personnel Co-PI Howell and Senior Personnel Mighell have collaborated on this project in a number of ways. They have helped coordinate and plan both student research and faculty research.

Howell has now moved to NASA Ames to become the Deputy Project Scientist for Kepler. However, during the first three years of the project, up to 20% of Howell's time at NOAO was allocated by the Director of NOAO to the POCA/PAARE project. Howell has provided archival spectra from the Coude Feed telescope that contributes significantly to the RV Tauri research at SC State. He has helped SC State faculty members organize their research project through near-term and long-term planning. He has also provided training and guidance in the use of the Coude Feed telescope at KPNO by Walter. Howell provided the initial suggestion and subsequent support in the writing of a Cycle 2 Kepler observing proposal with Walter as the PI. This proposal was awarded observing time and the first data set arrived in February 2011.

Howell has worked with a total of three SC State POCA Tier II (experienced) summer interns, one in the summer of 2009 and two in summer of 2010. All three of these students gave presentations at the AAS meetings in January 2010 and 2011 respectively. One of students, Jared Lalmansingh, is now a graduate student in the Clemson physics and astronomy department.

Mighell is the NSF REU Site Coordinator at KPNO and helped SC State coordinate the three POCA Tier II summer interns to work at KPNO. In February of 2009, Mighell spoke to one of the students at a national meeting and helped motivate him to participate. In the summer of 2010 he took on additional duties with the two visiting POCA interns, overseeing a portion of the research work.

Howell conducted a research visit to SC State in April 2009. Both Howell and Mighell visited SC State in April 2010 to conduct research, talk with students and plan future activities.

### **Other Collaborators or Contacts**

Dr. James Payne of Orangeburg-Calhoun Technical College assists the SC State POCA project with K-14 outreach, teacher workshops and balloon launches.

Mr. Bryan Fogle, an Instructor of Physical Science at SC State, assists the SC State POCA project with K-12 outreach, teacher workshops, balloon launches and recruitment.

Dr. Paul Gueye of Hampton University collaborated with SC State astronomers and other physics faculty members to install and train in the use of the Geant4 software. During Year 4, he visited the campus in April 2011 to conduct a 2-day workshop. While this software has applications in astrophysics as well as health and medical physics, it has not been put to use by any SC State faculty members to date.

Co-PI Cash has developed a new collaboration in Year 3 of POCA with a group of computer scientists at Clemson University that will enhance her astronomical research.

'Tight Integration of Grid Enabled Researchers(TIGER)' will implement and evaluate a 'campus bridge' model that addresses the growing need for Cyber-Infrastructure (CI) support for researchers at campuses of every size requiring resources that may not be of petascale size, but that outstrip the infrastructure that can be supported at most institutions. The project is managed at Clemson, but includes other colleges and universities.

The TIGER project will provide Cash and her team the training and resources needed to expand the scale of their modeling efforts to explore a large range of parameter space and effectively visualize the results of their time series analysis of RV Tauri and Semi-regular variables. Additionally, Cash will serve as the SC State point of contact for faculty and student training and awareness of the opportunities afforded by this and related projects.

Walter has developed a student balloon payload program at SC State that studies the meteorological and ozone properties of the troposphere and lower atmosphere. This program was initially developed under an NSF Geodiversity award. The POCA award has used the infrastructure of this program to launch balloons as part of its recruitment, outreach and teacher training. This in turn has led to interest by group of researchers at the University of Michigan who have included Walter and SC State in their Earth Science satellite proposal that involves student research and outreach. At the current time, this proposal is pending.

### Activities and Findings

#### **Research and Education Activities:**

February 28 - March 3, 2011: Although Walter did not attend, he was lead and coauthor on a total of four posters and one oral talk at the 'Telescopes from Afar' conference in Hawaii. Colleagues from collaborating institution Western Kentucky University and Villanova gave these presentations. Walter was lead author on the poster 'Narrow-band Imagery with the 1.3-meter Robotically Controlled Telescope (RCT). More details on the conference including abstracts can be found at: <http://tfa.cfht.hawaii.edu/>

March 26, 2011: SC State and POCA hosted the 2012 Meeting of Astronomers in South Carolina (MASC) with a total of 38 faculty, postdocs, grad students, undergraduates and amateur astronomers from 10 institutions in attendance. A total of 16 talks and 5 posters were presented including talks by POCA faculty D. Smith and D. Hartmann and POCA students Jared Lalmansingh, Eva Nesmith and Bryan Pugh.

March 30 - April 2, 2011: Dr. Walter used the Coude Feed Telescope at KPNO on three good observing nights out of four to acquire spectra in the blue (3700 - 5100 angstroms) and red (6400-9000 angstroms) of a number of RV Tauri, Semiregular and peculiar stars.

May 16-19, 2011: PI Walter continued the POCA project's long term study of RV Tauri and Semiregular variables with another successful observing run at KPNO using the Coude Feed Telescope. Three nights out of four were useful, with one night lost to weather. Blue spectra (3700-5100 angstroms) were obtained including stars that were simultaneously being observed from space by NASA's Kepler Observatory as part of a program lead by Walter, Cash and Howell.

July 12-13, 2011: Two SC State faculty and five POCA students traveled to Clemson for a tour of the campus, a real-time, remote login session with the SARA South telescope and a set of 10 talks by faculty and students from the two institutions.

October 10-13, 2011: Walter traveled to KPNO to again observe RV Tauri and Semi-regular stars with the Coude Feed telescope. He had four nights out of four of excellent weather and good observing. Blue (3700 - 5100 angstroms) and red (6400-9000 angstroms) spectra were acquired.

October 24-26, 2011: PI Walter attended the Kavli Institute for Theoretical Physics conference on the campus of the University of California, Santa Barbara. The title of the conference was 'The Impact of Asteroseismology across Stellar Astrophysics'. Walter was able to make contact with several modeling groups and is currently exploring a future collaboration with one of the groups.

November 14-17, 2011: Co-PI Cash was part of a booth exhibit at the International Conference for High Performance Computing, Networking, Storage and Analysis' in Seattle, Washington. Her display dealt with the Kepler light curve analysis she has been conducting.

January 8-12, 2012: Two SC State faculty and four POCA-funded students traveled to the AAS meeting in Austin, Texas, to attend various sessions and to present a total of three posters as described in the 'One-time Publications' section of this report.

### Findings:

Mayo's published work: Mayo, E. and Troland, T. 2012, AJ, 143, 32; 'Very Large Array H I Zeeman Observations of the Cygnus X Region: DR 22 and ON 2' has contributed to a better understanding of the role magnetic fields play in star formation. Specifically from the abstract:

We have used the Very Large Array to study the Zeeman effect in 21 cm H I absorption lines from two star-forming regions in the Cygnus X complex, DR 22 and ON 2. We measure the line-of-sight magnetic field toward these regions, finding  $B_{\text{los}} = -84 \pm 11 \text{ mG}$  toward the DR 22 H II region and  $B_{\text{los}} < 50 \text{ mG}$  toward each of the two H II regions in ON 2. We interpret these results in terms of two different models. In one model, we assume that the H I Zeeman effect is a measure of magnetic fields in the associated molecular clouds. If so, then the DR 22 molecular cloud is magnetically subcritical, that is, magnetically dominated. The ON 2 molecular clouds are magnetically supercritical. In a second model, we assume that the H I Zeeman effect is a measure of magnetic fields in photon-dominated regions where the gas has been compressed (and the field amplified) by absorption of stellar radiation. We find that this second model, where the measured field strength has been affected by star formation, accounts well for the DR 22 H I Zeeman effect. This same model, however, overpredicts the magnetic field in ON 2. ON 2 may be a region where the magnetic field is energetically insignificant or where the field happens to lie nearly in the plane of the sky.

### Training and Development:

May 10-11, 2011: Drs. Cash and Walter traveled to the NASA Ames Research Center to work with astronomers in the Kepler Guest Observer Office, learning how to analyze their Cycle 3 Kepler data. They examined light curves of stars taken by the Kepler Observatory as part of their NASA-funded study with colleague Dr. Steve Howell who is the Deputy Project Scientist for Kepler.

May-July, 2011: A total of six undergraduates participated in the summer internship program funded by POCA at SC State and Clemson. The POCA Undergraduate Summer Internship Program is similar to NSF REU programs, but is designed to be a multiyear experience with each summer building on the skills developed previously. Unlike most REU programs, the POCA program begins with students after their freshman or sophomore years when they generally have little or no previous research experience. These are known as Tier I students. Returning students, known as Tier II, participate for a second or third summer at a more advanced level. During the summer of 2011, 3 Tier I and 2 Tier II students conducted research at SC State. At Clemson, Tier II student Charles Kurgatt was mentored by Dr. Sean Brittain as described elsewhere. More information on the program can be found at:

<http://physics.scsu.edu/paare/students/reu.html>

August 16, 2011 - May 15, 2012: POCA undergraduate, Charles Kurgatt, conducted research as independent study courses during the academic year. He examined RCT images and spectroscopic data from the KPNO Coude Feed Telescope. His results will be part of a future paper that includes him as a coauthor.

### Outreach Activities:

June 27-30, 2011: POCA sponsored a workshop for 11 teachers and 14 students from high schools in South Carolina and Georgia. This workshop was designed to acquaint the teacher and student participants with subject matter, educational resources, information on Project Lead the Way and student career opportunities in the fields of astronomy, astrobiology, atmospheric science and physics. Teachers and students participated in hands-on activities related to these fields and took back information for future participation by other teachers and students. Their culminating event included a balloon launch with a radiosonde and ozonesonde that traveled 100,000 feet into the atmosphere before bursting and returning to earth via parachute. More details can be found at the POCA website:

<http://physics.scsu.edu/paare/events/workshop2011/index.html>

The teachers and students subsequently helped recruit attendees to the POCA-funded Physics Visitation Day described below.

September 22-24, 2011: PI Walter, Co-PI Smith and Senior Personnel Brittain traveled to Austin, Texas, for the combined National Society of Black/Hispanic Physicists conference. A POCA recruitment booth was manned by Walter and Brittain and a talk was given by Smith

October 28-29, 2011: PI Walter traveled to San Jose, California, to man a recruitment booth at the Society for the Advancement of Chicanos and Native Americans in Science (SACNAS).

November 5, 2011: POCA and the physics area of SC State sponsored a Physics Visitation Day on campus to recruit high school students. A total of 32 high school students and 20 parents and teachers from around the state participated in hands-on activities related to medical physics, motion, light, cosmology, ultraviolet radiation and ozone as well as a discussion on the SC State balloon research program.

November 7, 2011: Two Clemson POCA graduate students, Shaun Hampton and Jared Lalmansingh, traveled to SC State to talk to 16 SC State undergrads and three faculty members about 'What Grad School is Really Like'.

A number of miscellaneous outreach activities during Year 4 were conducted on campus and at other schools and resulted in a total of 242 students and teachers being exposed to astronomy and the physics program at SC State. These ranged in nature from tours of the physics labs, to sunspot observing, to talks about the research conducted under POCA.

Throughout Year 4, SC State POCA faculty worked closely with the SC State public relations department to promote POCA and the astronomy program. This included two TV spots in the metropolitan areas of South Carolina, several newspaper articles with statewide coverage and print advertisement.

### **Journal Publications**

Mayo, E.A. and Troland, T.H., "Very Large Array H I Zeeman Observations of the Cygnus X Region: DR 22 and ON 2", *Astronomical Journal*, p. 32, vol. 143, (2012). Published, 10.1088/0004-6256/143/2/32

### **Books or Other One-time Publications**

Walter, D., Brittain, S., Cash, J., Hartmann, D., Howell, S., King, J., Leising, M., Mayo, E., Mighell, K. and Smith, D., "Year 4 of the NSF-funded PAARE Project At SC State", (2012). Online Conference Abstract, Published  
Editor(s): American Astronomical Society, AAS Meeting #219,

Bibliography:  
2012AAS...21934803W

Walter, Donald K., Howell, S.B.; Cash, J.L., "Spectral Variations of RV Tauri and Semi-Regular Variables Observed with Kepler", (2012). Online Conference Abstract, Published

Editor(s): American Astronomical Society, AAS Meeting #219, #348.03  
Bibliography: 2012AAS...21934803W

Gott, Andrew; Strolger, L., Consortium, RCT, "UBVRI Optical monitoring of Supernova 2011fe in Pinwheel Galaxy with the 1.3-meter Robotically Controlled Telescope", (2012). Online Conference Abstract, Published

Editor(s): American Astronomical Society, AAS Meeting #219, #242.24  
Bibliography:  
2012AAS...21924224G

### **Web/Internet Site**

**URL(s):**

<http://physics.scsu.edu/paare/>

**Description:**

This serves as the main project website and includes current and past events, projects, reports, pictures and related materials.

A link to our summer REU program describing Years 1-4 can be found at:

<http://physics.scsu.edu/paare/students/reu.html>

A site with downloads for the simulations developed by Co-PI Smith is:

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

## Other Specific Products

### **Product Type:**

#### **Teaching aids**

### **Product Description:**

"Large Scale Structure of the Universe for Nonscience Majors" is a laboratory exercise discussed in previous annual reports that has been upgraded. The lab leads students through the determination of distances to stars, and distances to galaxies, using data from the web. Students compare these distances to the earth-sun distance, then they compare star distances to galaxy distances. Part two of the non-science majors lab requires students to download data from the Sloan Digital Sky Survey (SDSS) website to make a wedge plot ( $3 \text{ degrees} < \text{dec} < 3 \text{ degrees}$ ) of LSS out to  $z = 0.05$ , and to comment on the structure.

### **Sharing Information:**

The results of the use of the lab were presented at the January 2010 meeting of the American Astronomical Society as a poster entitled "City-City Correlations Lab to Introduce Galaxy-Galaxy Correlations" (American Astronomical Society, AAS Meeting #215, #466.15; Bulletin of the American Astronomical Society, Vol. 41, p.508 Publication Date: 01/2010). It can be downloaded at: <http://physics.scsu.edu/~dms/cosmology/simulations.html>

This lab is used at SC State each semester in the course, Physical Science 153, Earth and Space Science Laboratory. It is also used for the graduate level physics course for students working on their masters degree in education, P 507, which is taught once every two years. Additionally, it is used in teacher workshops for the K-12 community.

The lab has been demonstrated to our POCA partners at Clemson University and will be demonstrated to colleagues at other institutions, it was presented at a national meeting and posted for distribution on our SCSU PAARE website.

### **Product Type:**

#### **Teaching aids**

### **Product Description:**

A Year 4 update to "Large Scale Structure of the Universe for STEM Majors" is the latest version of the exercise entitled "Large Scale Structure of the Universe" in previous reports.

The LSS lab for STEM majors consists of the lab for non-science majors (see above) plus a third part on calculating and understanding the correlation function. Students are supplied data on the distances between cities including night time images from space of the United States, and instructed in calculating the correlation function. They then plot the correlation function and compare its interpretation to the interpretation of a correlation function for SDSS galaxies. In Year 3 of POCA this lab was enhanced by introducing the jackknife statistical technique used to calculate the two-point correlation function error bars for the cities and galaxies.

### **Sharing Information:**

This lab was substantially updated in Year 4 from the results that were presented at the January 2010 meeting of the American Astronomical Society as a poster entitled "City-City Correlations Lab to Introduce Galaxy-Galaxy Correlations" (American Astronomical Society, AAS Meeting #215, #466.15; Bulletin of the American Astronomical Society, Vol. 41, p.508 Publication Date: 01/2010). The updated version can be downloaded at: <http://physics.scsu.edu/~dms/cosmology/simulations.html>

Currently the lab is used at SCSU in the course, Physics 223, General Physics Lab III. Additionally it is used with the POCA summer astronomy interns as an exercise in their study of cosmology.

The lab has been demonstrated to our POCA partners at Clemson University and will be demonstrated to colleagues at other institutions, it was presented at a national meeting and posted for distribution on our SCSU PAARE website.

Dr. Smith will present this lab as part of a workshop in Year 5 "Cosmology in the Classroom" that has been accepted for presentation at the AAPT in Philadelphia, Pennsylvania, in the summer of 2012.

### **Product Type:**

#### **Teaching aids**

### **Product Description:**

Minor updates in Year 4 to "Dark Matter Structure of the Universe Lab" which was piloted in Year 3 in the SC State lab course for non-science majors, PSC 153 "Earth and Space Science Lab".

Students learn, by completing this lab, that speculations about the nature of dark matter have a quantitative basis. From simulations they observe the effect that increasing the fraction of dark matter in the universe has on the type of structures that evolve. They also observe from simulations how cold dark matter structures differ from hot dark matter structures. To conclude the lab, students are asked to compare hot and cold dark matter simulations against a 3D plot of SDSS data (that they are able to rotate within the Mathematica player) to determine which dark matter particle is most likely responsible for the galaxy distribution.

**Sharing Information:**

The updated version of this will be part of a Year 5 workshop led by Dr. Smith that has been accepted for presentation at the summer 2012 AAPT meeting in Philadelphia, Pennsylvania. The most recent version can be downloaded from:

<http://physics.scsu.edu/~dms/cosmology/simulations.html>  
under the name "Dark Matter Lab."

**Product Type:**

**Teaching aids**

**Product Description:**

"Dark Matter - Skeleton of the Universe Lab" was developed and piloted in Year 3 of POCA.

This lab takes less than an hour, and is designed as a demonstration for students (or others) who have no prior introduction to cosmology. For that reason, an instructor must provide context for the lab, including showing images of galaxies, explaining the three pillars of observational cosmology (expansion, cosmic microwave background, and He abundance), and stating the current distribution of matter-energy in the universe (dark energy, 70%; dark matter, 25%; ordinary matter, 5%). The lab begins with students making a two-dimensional plot of the galaxy distribution ( $z < 0.05$ ) using SDSS data, after which they are asked to compare their plot to one provided where the galaxies are distributed randomly. Finally, students run the 3D simulation comparing hot and cold dark matter and are asked which most likely caused the galaxy distribution.

**Sharing Information:**

This will be presented as part of a workshop by Dr. Smith that has been accepted for presentation at the summer 2012 meeting of the AAPT in Philadelphia, Pennsylvania. The most recent version can be downloaded at: <http://physics.scsu.edu/~dms/cosmology/simulations.html> under the link "Short Dark Matter Lab"

### Contributions

**Contributions within Discipline:**

Year 4 contributions within the discipline:

Mayo's published work: Mayo, E. and Troland, T. 2012, AJ, 143, 32; 'Very Large Array H I Zeeman Observations of the Cygnus X Region: DR 22 and ON 2'. Has contributed to a better understanding of the role magnetic fields play in star formation as described in the Findings section of this report.

Smith's work on laboratory exercises in cosmology for non-science majors and STEM majors has contributed to new approaches to teaching cosmology to both groups.

Walter served on the NASA Kepler Guest Observer Cycle 3 proposal review panel as the Chair of Panel 2: Variable Stars.

**Contributions to Other Disciplines:**

**Contributions to Human Resource Development:**

Year 4 project contributions to human resource development include increasing diversity in the student population in astronomy as well as continuing to strengthen faculty development at SC State.

SC State and Clemson together recruited two underrepresented minorities into the graduate astronomy program at Clemson during Year 4. This included one Hispanic female and one black male. This added to the two African-American students (one female, one male) recruited by Clemson during Year 3.

Clemson mentored one black undergraduate student from SC State during the summer of 2011.

SC State mentored 5 undergraduates during the summer of 2011. This included 1 white male, 1 black male, 1 Hispanic male, 1 Hispanic female and 1 African-American female.

A total of three SC State faculty members (Cash, Smith, Walter) received support in Year 4. They continued their professional development and skills through travel, training and having funds to upgrade their research and educational resources. Additionally, Cash, Smith and Walter received summer salaries and release time during the academic year. This was critical to the success of the project since SC State is not a research institution and faculty members typically teach four or five courses per semester for a total of eight or nine courses within the academic year.

#### **Contributions to Resources for Research and Education:**

The POCA project has supported physical, institutional and information resources at SC State. POCA has funded the purchase of 5 linux desktops and several Windows and Mac laptops at SC State during Years 1-4 that reside in a limited-access lab. These are in use not only for POCA student and faculty research, but are used by the SC State physics area to teach courses in image analysis and other upper level physics classes taken by physics and other majors.

POCA also funded the purchase of a SUN workstation in Year 1 to serve as the main physics server (<http://physics.scsu.edu>). This site houses the POCA web site (<http://physics.scsu.edu/paare>), it disseminates educational products developed by Co-PI Smith as described elsewhere in this report and provides access to applications and other information for participation in various POCA and physics activities at the university. Additionally, it serves as the site for the entire physics program at SC State.

#### **Contributions Beyond Science and Engineering:**

#### **Conference Proceedings**

#### **Special Requirements**

**Special reporting requirements:** None

**Change in Objectives or Scope:** None

**Animal, Human Subjects, Biohazards:** None

#### **Categories for which nothing is reported:**

Contributions: To Any Other Disciplines

Contributions: To Any Beyond Science and Engineering

Any Conference



# Figure 1

2011 POCA Undergraduate Summer Interns

Maria Martinez (top) and Ciera Starkey (bottom)



## Figure 2

2011 POCA Undergraduate Summer Interns

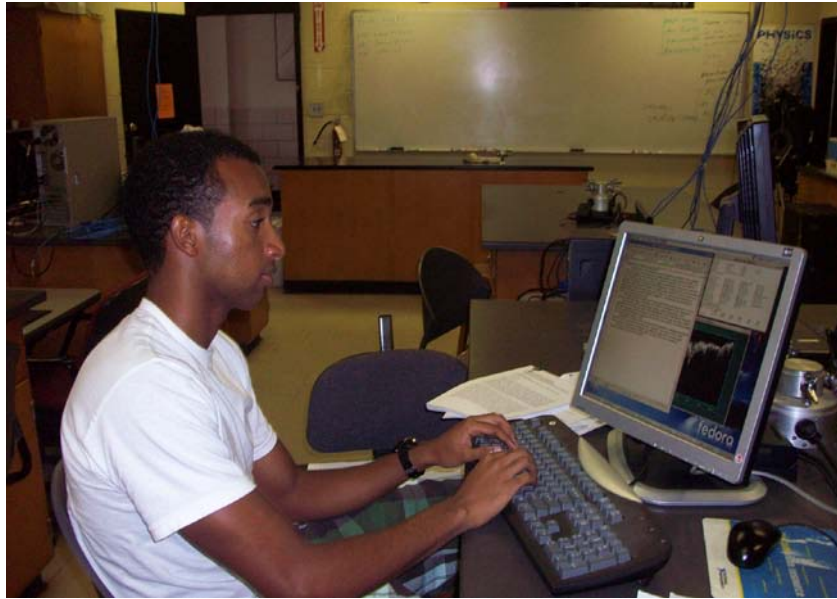
Will Hernandez (top) and Bryan Pugh (bottom)



## Figure 3

2011 POCA Undergraduate Summer Interns

Charles Kurgatt (top) and Jared Lalmansingh (bottom)





**Figure 4**

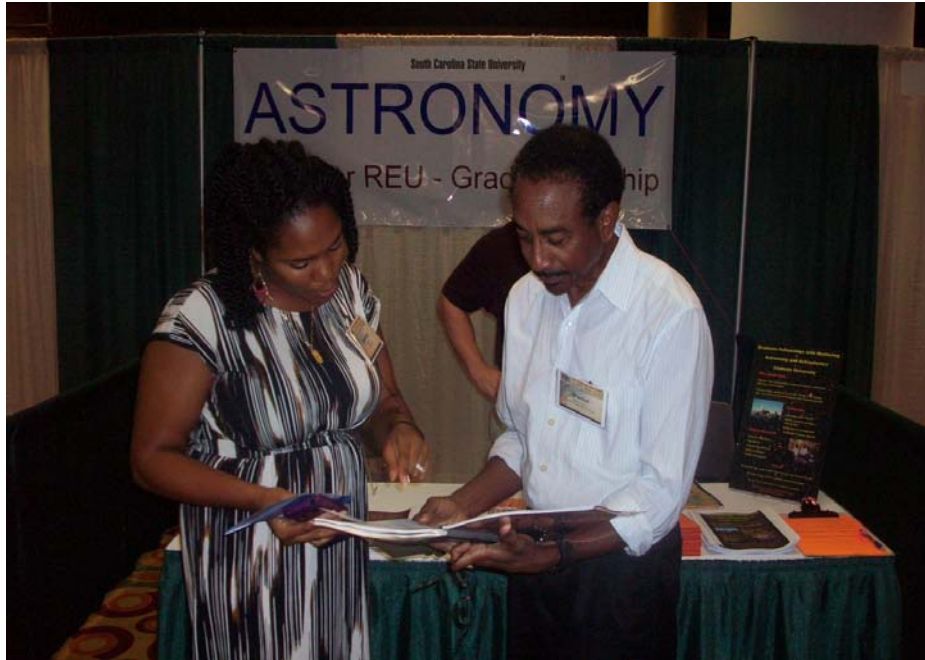


**Dieter Hartmann demonstrates the remote use of the SARA South Telescope.**



**CU & SCSU students and faculty enjoy lunch after talks and a tour of campus.**

**Figure 5**



**Dan Smith (right) and Sean Brittain (partially hidden) talk to a student (left) at the POCA exhibit during the NSBP meeting in Austin, Texas**



**Shaun Hampton (left, in black) and Jared Lalmansingh (right, in orange) talk to SCSU Undergraduates about “What Grad School is Really Like”**