

Annual Report for Period:03/2010 - 02/2011

Submitted on: 02/14/2011

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 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.

He is a coauthor on the paper submitted by Cash in 2010 and described elsewhere.

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 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 Cash has submitted.

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:

Dr. Leising is 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 visited SC State in September 2008 to speak to POCA students and coordinated a visit to SC State by 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. Smith had developed several cosmology laboratory exercises and computer simulations and demonstrations during Years 1-3 including one in which the jackknife statistical technique has been applied to calculate two-point correlation function error bars. 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 and 2010, Smith conducted sessions on extragalactic astronomy and cosmology with the POCA Tier I students and will do so again in 2011.

Name: Cash, Jennifer

Worked for more than 160 Hours: Yes

Contribution to Project:

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. She submitted a paper to AJ and is currently working with her Co-Is on revisions to the paper in response to referee comments.

Cash is also a Co-I on the successful Cycle 2 Kepler Proposal with Walter and Howell. In the months ahead she will be applying the techniques she has previously developed to the Kepler data.

Cash has been the research mentor to a new pair of Tier I interns in each of the summers of this program, 2008, 2009, 2010. They have all 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 is 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 to AJ in 2010 based on her Ph.D. dissertation work on magnetic fields in star forming regions. She and her coauthor are preparing a response to comments by the referee.

Mayo has taught radio astronomy to Tier I students in each of the three summers of this program, 2008, 2009 and 2010. She will

continue to do so in the summer of 2011

Mayo has conducted outreach activities throughout the life of this project and will continue to do so. This includes planetarium shows, talks to school groups and conducting observing sessions.

Name: King, Jeremy

Worked for more than 160 Hours: No

Contribution to Project:

Dr. King will continue 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. This trip was the seminal event in motivating Lalmansingh to chose the astronomy option as a physics major at SC State.

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.

Name: Hartmann, Dieter

Worked for more than 160 Hours: No

Contribution to Project:

Dr. Hartmann is preparing for SC State's participation in future optical follow-ups to Gamma Ray Bursts. This will include access to the KPNO 1.3-meter telescope known as the Robotically Controlled Telescope (RCT). SC State has guaranteed observing time on the telescope as one of the members of the consortium that manages the RCT.

Name: Brittain, Sean

Worked for more than 160 Hours: No

Contribution to Project:

Dr. Brittain is preparing to integrate physics majors from SC State and Clemson into his research program studying gas in disks around young stars. These students will collaborate with education majors at Clemson to develop curriculum for the Emerging Scholars program related to the origin of the Solar System. Additionally, Britain has been successful in helping to recruit SC State physics major J. Lalmansingh to apply to the Clemson graduate program in astronomy.

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 as necessary.

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.

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 Fall semester in courses and began research activities.

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 graduates in May 2011, he will be 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 current project 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 at 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 will graduate as a math major in May 2011. She has been so motivated by the POCA project that she will return to SC State in the fall of 2011 to pursue a second degree, this time as a physics major with an astronomy option. She will continue her research as a Tier II intern at SC State in the summer of 2011.

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.

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 and will be a Tier II intern at SC State in the summer of 2011.

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 is 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. He is applying to POCA for a Tier II internship in the summer of 2011.

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.

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. 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.

Additionally, Clemson faculty have assisted PI Walter on his national recruiting 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. Their work was presented at the January 2010 meeting of the American Astronomical Society and a possible publication from that work is in progress.

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.

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 for over a year. 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 2011, SC State POCA summer interns will learn how to use the telescope, including how to submit observing requests and how to retrieve the data.

National Optical Astronomy Observatory

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.

Up to 20% of Howell's time is being allocated by the Director of NOAO to the POCA/PAARE project. Howell has provided archival spectra

from the Coude Feed telescope that contribute 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, E. Nesmith, is graduating as a math major in 2011 but has been so inspired by her astronomy experience, including the work with Howell, that she is returning to SC State in the fall of 2011 to pursue a second degree, this time as a physics major with an astronomy option.

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. Paul Gueye of Hampton University is collaborating with SC State astronomers and other physics faculty members to install and train in the use of the Geant4 software. He will visit the campus in April 2011 to conduct a 2-day workshop. This software will be used by SC State students and faculty for applications in astrophysics as well as health and medical physics.

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.

Activities and Findings

Research and Education Activities:

March 6, 2010: Three SC State POCA faculty and two POCA-funded undergraduates attended the annual Meeting of South Carolina Astronomers (MASC) at the College of Charleston in Charleston, South Carolina. The students presented posters as described elsewhere in this report.

March 25, 2010: Two Clemson PhD students, Ms. Ginger Bryngelson and Mr. Shelton Simmons, visited SC State to meet with the Society of Physics Students. They discussed graduate school in Physics and Astronomy, including undergraduate background needed, application and admissions processes, funding prospects, etc. They also described their research in, respectively, astronomy and atmospheric physics.

April 2010: NASA awarded Walter, Cash and Howell, 12 months of observing time on the Kepler Observatory to study RV Tauri and Semi-regular variables that are in Kepler's field of view.

April 6-9, 2010: Co-PI Howell and Collaborator Mighell, both from NOAO, visited SC State to confer with POCA faculty (Cash, Mayo, Smith, Walter) and students. Activities included work on a research paper, talks to students, planning for summer student projects and future directions of faculty research.

May 18-22, 2010: PI Walter acquired five nights of data on the Coude Feed telescope at KPNO. Blue and red spectra were obtained of RV Tauri and Semi-regular variables that are part of the long-term study of these objects under the POCA project.

September 21-22, 2010: Co-PI Cash presented a poster: 'A Partnership in Observational and Computational Astronomy at SC State University' at a conference at Clemson University entitled: 'Modeling Advanced Materials and Systems Biology: Building Capabilities and Collaborations for Cyber-Enabled Discovery'. This conference was designed to bring together a wide range of researchers with potential applications to grid and high-end computer.

October 18-21, 2010: PI Walter acquired two nights of usable data out of four nights spent on the Coude Feed telescope at KPNO. The blue and red spectra obtained are part of the long-term study of these objects under the POCA project.

November 15-18, 2010: Co-PI Cash attended the SuperComputing 2010 conference in New Orleans and was part of a collaborative exhibitor display with computer scientists from Clemson University. Her part of the exhibit included a poster entitled 'Automating Light Curve Analysis'.

January 9-13, 2011: A total of five posters were presented at the American Astronomical Society meeting by POCA faculty and students. They are described in the section under 'One-time Publications'

January 11, 2011: Co-PI Smith presented 'Correlation Functions for Large Scale Structure Simulations on a PC' at the Winter 2011 meeting of the American Association of Physics Teachers. It is not included in the 'One-time Publications' since the proceedings have not yet been published.

Findings:

Findings on the role that magnetic fields play in star formation are included in the paper submitted to the 'Astronomical Journal' by Dr. Elizabeth Mayo of the SC State POCA project and her thesis advisor Dr. T. Troland of the University of Kentucky. The paper is currently under review and specific findings will be reported once the paper has been accepted for publication

Co-PI Cash has submitted a paper to the 'Astronomical Journal' that is currently under review. The research addresses issues involved in the application of various fitting techniques (eg. fourier and wvz) to light curve data for RV Tauri and Semi-regular variable types. The specific findings will be reported once the paper has been accepted for publication.

Training and Development:

- May 10-28, 2010, SC State University, Orangeburg, SC

SC State POCA Tier II (experienced) summer interns J. Lalmansingh and E. Nesmith received training from PI Walter in preparation for their summer internship with Co-PI Howell at KPNO. Topics covered included IRAF, atomic physics and astronomical spectroscopy.

- June 1 - August 7, 2010, NOAO, Tucson, AZ

SC State physics major (astronomy option) J.Lalmansingh and math major E. Nesmith spent their Tier II summer internship and training under Howell and Mighell at NOAO.

- May 31 - July 23, 2010, Orangeburg, SC

SC State physics majors C. Kurgatt, A. Pryor and B. Pugh along with math/computer science major E. Maina were trained in basic research skills including how to write and present research results, background astronomy and either IRAF or IDL training (depending on the research team to which they will be assigned).

- August 16, 2010 - May 15, 2011, Orangeburg, SC

SC State state physics major J. Lalmansingh and math major E. Nesmith conducted research training under PI Walter by taking upper-level research courses during the fall and spring semesters. Their work was a continuation of their summer research and resulted in poster presentations at the AAS meeting in January 2011. In the spring of 2011, Nesmith began training in the use of the 1.3-meter RCT telescope at KPNO while Lalmansingh continued his work from the previous semester on BOK stars in the Kepler field of view.

Outreach Activities:

A variety of outreach and recruitment activities took place in Year 3.

April-November 2010

POCA faculty members at SC State participated in a total of 8 events statewide with 480 participants including students, teachers and parents. These events included talks at schools, balloon-launches, a teacher workshop and a Physics Visitation Day for high school students and their parents. A significant number of the students were members of honors or gifted and talented programs.

July 13-15, 2010, Teacher Workshop, Orangeburg, SC

POCA co-sponsored a 3-day workshop on earth and space science for middle and high school teachers. A total of 9 teachers and 2 high school students attended this intensive workshop that met all day and in the evening. Hands-on activities covered the fields of astronomy, astrobiology and atmospheric science. The culminating event was the launch of a meteorological balloon with an ozone detector that rose to nearly 100,000 feet before bursting and parachuting to the ground. The teachers from this group were instrumental in recruiting high school students to attend the Physics Visitation Day in November 2010.

October 1-2, 2010 SACNAS Conference, Anaheim, CA

PI Walter attended the national meeting of the Society for the Advancement of Chicanos and Native Americans in Science (SACNAS). A POCA booth was set up that advertised the POCA summer astronomy internship program at SC State and the POCA graduate fellowships at Clemson University. Walter and Co-PI Leising followed up with interested students in the weeks after the conference.

November 13, 2010, Physics Visitation Day, Orangeburg, SC

POCA sponsored a Physics Visitation Day at SC State that included 17 high school students and 12 parents and teachers. The physics faculty and students gave a variety of presentations including talks, hands-on activities by the participants, a tour of the new science building and a planetarium show.

February 2011

A packet with a cover letter, flyers and a poster describing the POCA undergraduate astronomy internships for the summer of 2011 was mailed to 40 physics programs at HBCUs and other minority institutions. Additionally, direct contact, email and phone calls were made to individuals who expressed an interest in the summer internship program either locally or at the national SACNAS meeting.

Journal Publications

Mayo, E.A. and Troland, T.H., "VLA HI Zeeman Observations of the Cygnus X Region: DR22 and ON2", *Astronomical Journal*, p. , vol. , (2011). Submitted,

Cash, J., Nesmith, E., Howell, S. Templeton, M. and Walter, D., "Photometric Light Curve Analysis of RV Tauri Stars Using AAVSO Data", *Astronomical Journal*, p. , vol. , (2011). Submitted,

Books or Other One-time Publications

Walter, D.K., Kurgatt, C, Howell, S. and Cash, J, "Spectral Variations of Three RV Tauri Stars", (2011). Conference Proceedings, Published
Editor(s): American Astronomical Society, AAS Meeting #217, #342.12
Collection: Bulletin of the American Astronomical Society, Vol. 43, 2011
Bibliography: 2011AAS...21734212W

Cash, J., Pugh, B. and Maina, E., "Light Curve Analysis of TT Oph and UZ Oph", (2011). Conference Proceedings, Published
Editor(s): American Astronomical Society, AAS Meeting #217, #342.11
Collection: Bulletin of the American Astronomical Society, Vol. 43, 2011
Bibliography: 2011AAS...21734211C

Nesmith, E., Howell, S., Walter, D., Cash, J. and Mighell, K., "The Correlation Between the Photometric Variability and Spectra of Seven RV Tauri and Semi-Regular Stars", (2011). Conference Proceedings, Published
Editor(s): American Astronomical Society, AAS Meeting #217, #342.13

Collection: Bulletin of the American Astronomical Society, Vol. 43, 2011
Bibliography: 2011AAS...21734213N

Lalmansingh, J., Howell, S., Walter, D., Cash, J. and Mighell, K., "A Spectral and Lightcurve Study of 50+ Blue Stars from the Burrell-Optical-Kepler-Survey (BOKS)", (2011). Conference Proceedings, Published
Editor(s): American Astronomical Society, AAS Meeting #217, #140.11
Collection: Bulletin of the American Astronomical Society, Vol. 43, 2011
Bibliography: 2011AAS...21714011L

Walter, D., Brittain, S., Cash, J., Hartmann, D., Howell, S., King, J., Leising, M., Mayo, E., Mighell, K. and Smith, D., "POCA Update: An NSF PAARE Project", (2011). Conference Proceedings, Published
Editor(s): American Astronomical Society, AAS Meeting #217, #145.10
Collection: Bulletin of the American Astronomical Society, Vol. 43, 2011
Bibliography: 2011AAS...21714510W

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 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 the laboratory exercise discussed in previous annual reports. 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 degrees <dec< 3 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:

"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:

The results of this 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>

Currently the lab is used at SCSU each fall term 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.

Product Type:**Teaching aids****Product Description:**

"Dark Matter Structure of the Universe Lab" was piloted in Year 3 in the SC State lab course for nonscience 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:

This lab will be further tested in the Spring of 2011. It will be demonstrated at a future meeting of AAPT as well at teacher workshops at SC State. It 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 lab will be further tested and presented at a future meeting of the AAPT and at teacher workshops at SC State. It can be downloaded at: <http://physics.scsu.edu/~dms/cosmology/simulations.html> under the link "Short Dark Matter Lab"

Contributions

Contributions within Discipline:

Year 3 contributions within the discipline:

Mayo's work on better understanding the role magnetic fields play in star formation is a contribution that has been submitted to the 'Astronomical Journal' and currently is under peer review.

Cash's publication has been submitted to the 'Astronomical Journal' and is under peer review. Once it is published it will contribute to a better understanding of RV Tauri and Semi-regular variables.

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

Walter served on the NSF PAARE review panel for the latest round of PAARE proposals.

Walter has been selected to serve on the NASA Kepler Cycle 3 proposal review panel.

Contributions to Other Disciplines:

PI Walter was invited to present at the 'Invitational Working Conference on Building Diversity in the Ocean Sciences', December 9 - 10, 2010, at North Carolina State University. He was asked to give a talk about his involvement in attempts to increase diversity within the space sciences, including his work with POCA. The workshop was hosted by the Centers for Ocean Sciences Education Excellence (COSEE)-SouthEast, which is supported by NSF, NOAA, Sea Grant and the Office of Naval Research.

Contributions to Human Resource Development:

Year 3 of the project has contributed to human resource development with regard to diversity in astronomy through results at all three partners, Clemson, NOAO and SC State.

Clemson has recruited two African-American students (one male, one female) as first year astronomy graduate students.

NOAO mentored two SC State students during the summer of 2010 and both went on to present their research results at AAS in January 2011.

The SC State POCA project has provided opportunities for research, teaching and mentoring in astronomy at SC State, a Historically Black College/University located in rural South Carolina with an enrollment of approximately 4,000 students. Over 90% of the student population is African-American.

POCA provided financial support in the form of scholarships and/or stipends to three students who are physics majors with the astronomy option, a fourth physics major, a math major and a dual major in math and computer science. All of these students conducted research (two of them at NOAO) and all but one of them had their results presented at the January 2011 meeting of the AAS.

A total of four SC State faculty members (Cash, Mayo, Smith, Walter) received support in Year 3. 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 courses per semester for a total of eight courses within the academic year.

Contributions to Resources for Research and Education:

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 Resources for Research and Education

Contributions: To Any Beyond Science and Engineering

Any Conference

Figure 1

Clemson POCA Graduate Students in the Fall of 2010

(l to r)

Ginger Bryngelson, Shaun Hampton and Jessica Carter



Figure 2

POCA Student and Faculty at the AAS Meeting in January 2011

(l to r)

Donald Walter, Jared Lalmansingh, Ken Mighell and Jennifer Cash

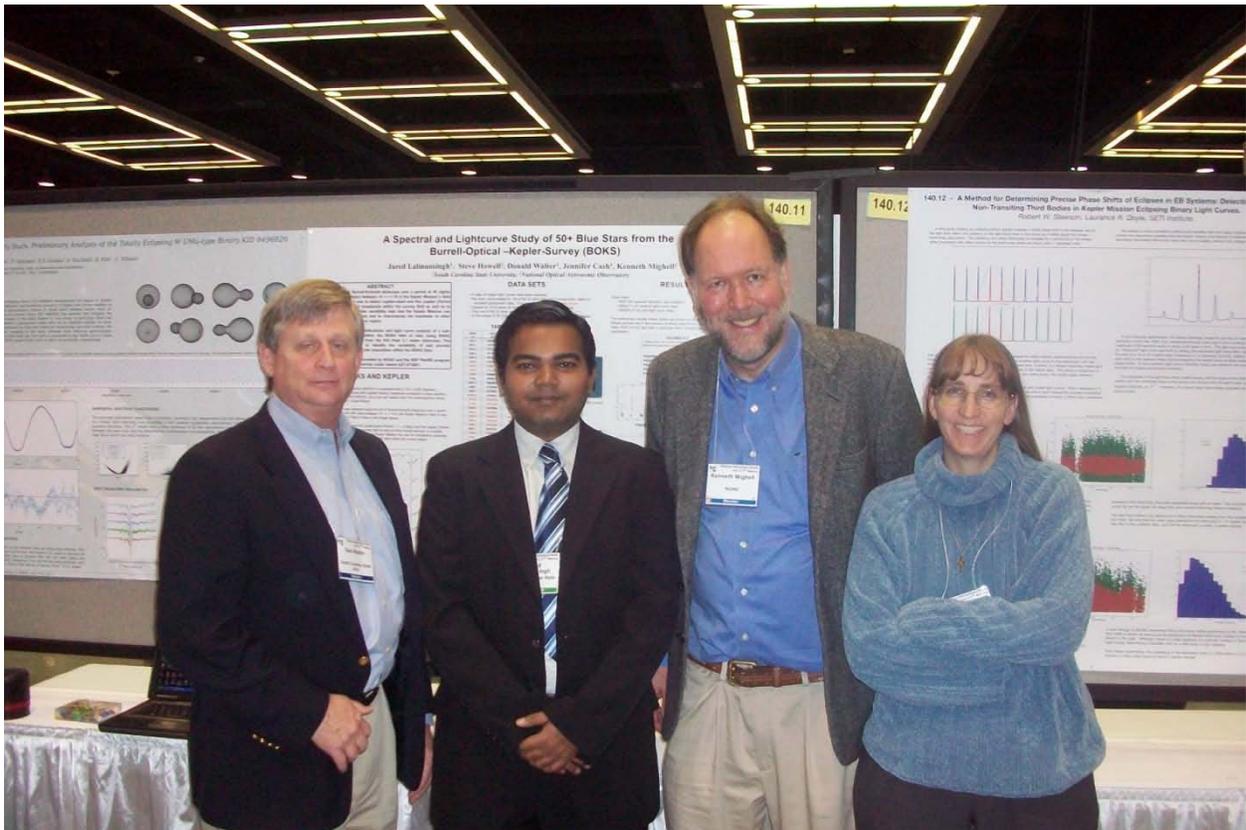


Figure 3

POCA Student and Faculty at the AAS Meeting in January 2011

(l to r)

Eva Nesmith and Steve Howell

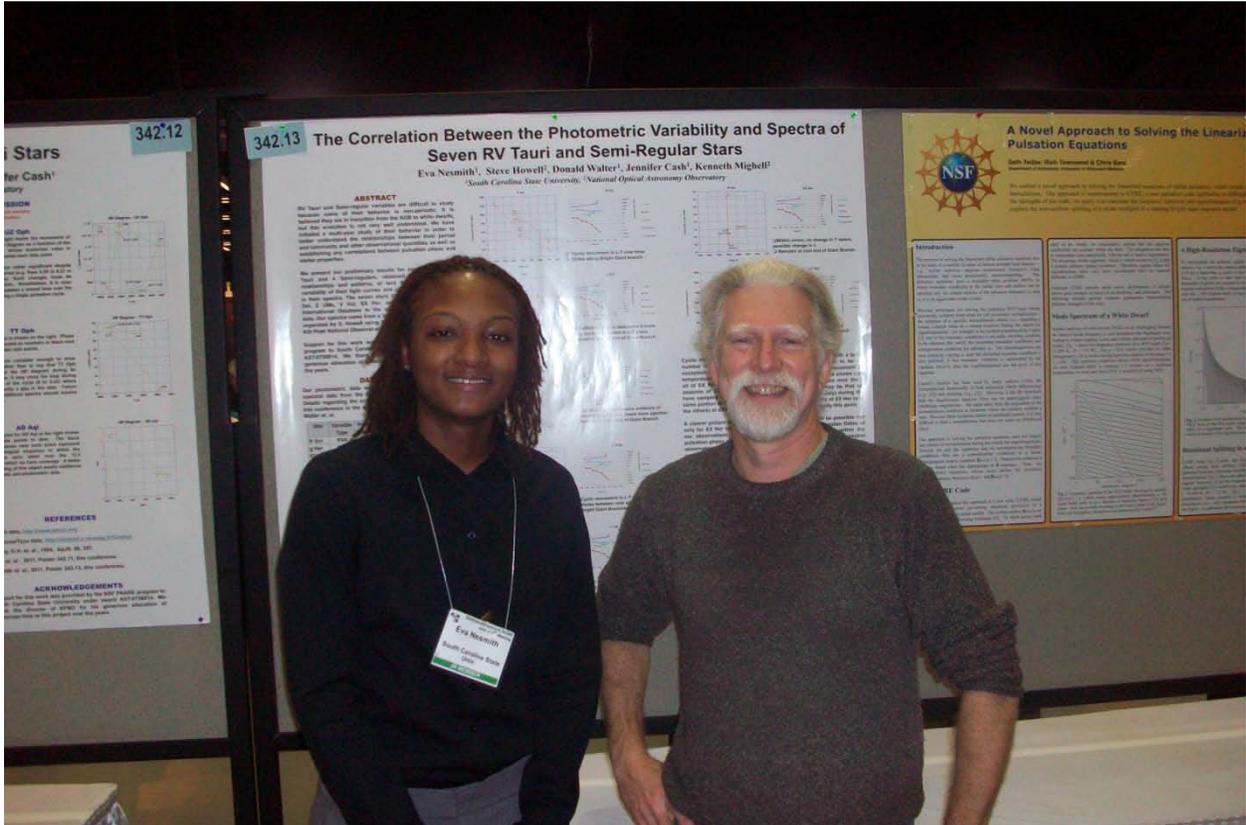


Figure 4

POCA Tier I Summer Interns and Faculty at SC State in July 2010

(l to r)

Edwin Maina, Jennifer Cash and Bryan Pugh examine light curves of RV Tauri stars.



Figure 5

POCA Tier I Summer Interns at SC State in July 2010

Alexis Pryor (top) and Charles Kurgatt (bottom) examine spectra of RV Tauri stars.

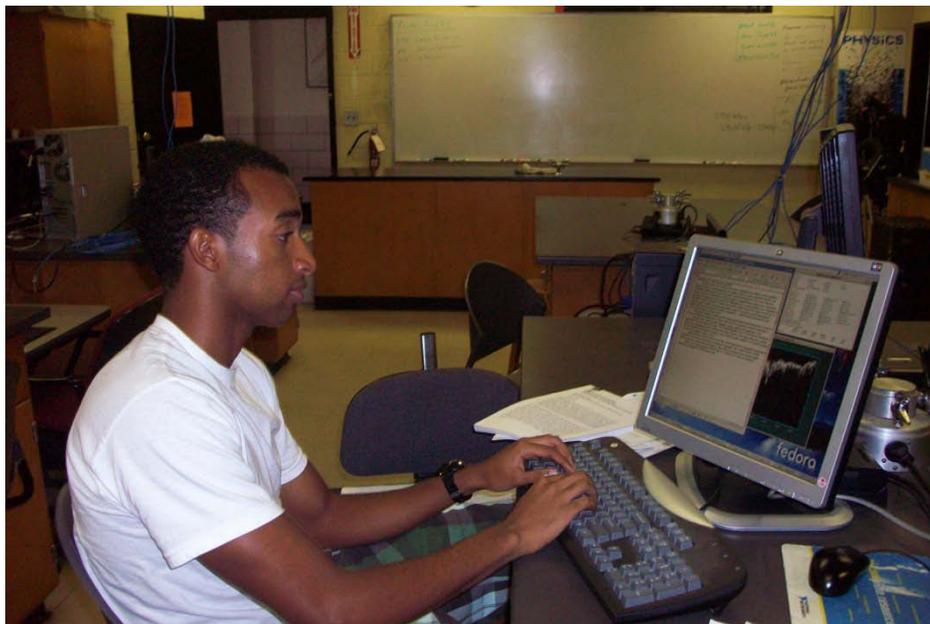


Figure 6

POCA Teacher Workshop at SC State in July 2010

High school student (top) and teachers (bottom) construct “edible” organic molecules from candy while studying comets and their role in astrobiology.

