

## THE 1996 SARA RESEARCH EXPERIENCES FOR UNDERGRADUATES PROGRAM

**G. D. Henson**

Department of Physics  
East Tennessee State University  
Johnson City, Tennessee 37614 USA  
hensong@access.east-tn.edu

**T.D. Oswalt**

**M.A. Wood**

Department of Physics and Space Sciences  
Florida Institute of Technology  
Melbourne, Florida 32901 USA  
oswalt@tycho.pss.fit.edu  
wood@kepler.pss.fit.edu

**J.S. Shaw**

Department of Physics and Astronomy  
University of Georgia  
Athens, Georgia 30602 USA  
jss@juno.physast.uga.edu

**K.S. Rumstay**

Department of Physics, Astronomy and Geology  
Valdosta State University  
Valdosta, Georgia 31698 USA  
krumstay@grits.valdosta.peachnet.edu

**J.R. Webb**

Department of Physics  
Florida International University  
Miami, Florida 33175 USA  
webbj@servax.fiu.edu

*Received: 1997 January 2*

### I. INTRODUCTION

In May 1995 the Southeastern Association for Research in Astronomy (SARA) was awarded a two year grant from the National Science Foundation to host a Research Experiences for Undergraduates (REU) Program. Seven students participated in the first year of the program, working with mentors at all five SARA institutions during summer 1995. The 1995 program activities and student research projects are described by Rumstay (1996). The 1995 pilot program was very successful and funding was continued for 1996 with Dr. Terry Oswalt as the director.

Building on the experience gained during the first summer program and more preparation time in 1996, a national recruiting effort was mounted. Recruiting posters were sent to almost every undergraduate academic institution in the U.S. and a SARA-REU website was initiated ([http://pss.fit.edu/SARA\\_REU.html](http://pss.fit.edu/SARA_REU.html)). Over 200 completed

TABLE 1. 1996 SARA REU Participants

Student Name	Student Institution	Faculty Mentor	Faculty Institution
Jesse Chuhta	Colo. Sch. Mines (CO) <i>A Search for Binary Stars in Open Clusters</i>	Scott Shaw	Univ. Georgia
Emily Howard	Univ. Denver (CO) <i>Multifrequency Observations of Blazars</i>	Jim Webb	Florida Int'l Univ.
Christy Magill	Johnson Comm. C. (KS) <i>Balmer-Line Imaging of Galactic HII Regions and Monitoring Continuum Emission from Active Galaxies</i>	Ken Rumstay	Valdosta St. Univ.
Nathan Miller	G. Adolphus C. (MN) <i>SPH/MD Simulations and Visualizations of Accretion Disks</i>	Matt Wood	Florida Tech
Brian Rebel	Grinnell College (IA) <i>Near-Infrared Photometry of Mira Variables</i>	Gary Henson	East Tenn. St. Univ.
Rica Sirbaugh	Mid. Tenn. Univ. (TN) <i>Determination of the White Dwarf Luminosity Function</i>	Terry Oswalt	Florida Tech
Stephanie Sublett	U.C. Berkeley (CA) <i>Florida Tech Student Research Radio Telescope System</i>	Mike Thursby	Florida Tech

applications were received from nearly every U.S. state and even from a few non-U.S. sites. All of the applications were reviewed by every prospective mentor. This review process was a monumental task, but it worked extremely well in identifying the best possible candidate matches for the mentors. Ultimately, seven students were accepted into the program. Their names, mentors and research projects are listed in Table 1. Descriptions of the research projects will not be provided here since the actual student papers can be found elsewhere in this special proceedings issue. In addition to this SARA sponsored group, two students and another faculty member from ETSU were invited to join the program activities. Dr. Mike Castelaz, through an REU supplement to a separate grant, sponsored Brian Heaton and Kevin Crowe in a project on Spectroscopy of Mira Variable Stars. All the 1996 participants are pictured in Figure 1.

Although many suggestions from the 1995 program were incorporated for 1996, the basic format remained essentially the same. Individual mentors and students were allowed to establish their own time frames for eight to ten week appointments, with each student staying and working at his/her mentor's institution. Two group workshops, one held in early June and the other in late July, were attended by everyone. The first workshop served mainly to introduce participants to each other and the research projects on which they would be working. During the second workshop the students presented the results of their efforts.

Based on comments from the 1995 participants, it was decided that the workshops should be less structured, with more free time for socializing. Two days of activities were planned since travel between the SARA institutions can itself require a

## THE 1996 SARA REU PROGRAM



full day. To provide a means of group interaction outside the workshops, an Internet list-server was established for SARA-REU participants during the 1995 program. The 1996 students were added to this server and contributed to the traffic immediately, with messages concerning everything from spots on CCD images to tastes in music. All students and mentors remain on the SARA list-server indefinitely, as long as they continue to use it.

A primary component of the summer's activities is the opportunity for each student to travel to Kitt Peak, Arizona to use the SARA Observatory. Even if a student's research project did not require the use of this facility, he/she could still assist in the work of the mentor responsible for the observing run. The trip to Kitt Peak is always the highlight of the summer for both students and mentors.

### II. THE FIRST WORKSHOP

The first workshop was hosted by Dr. Scott Shaw on June 6-7 at the University of Georgia in Athens, Georgia. The first day began with a brief welcome and introduction to SARA by Dr. Shaw. Dr. Ken Rumstay then described the activities that took place during the 1995 program for the benefit of the students and new mentors. This was followed by several short presentations from current and past mentors on their research areas. Dr. Loris Magnani (UGA) described radio observations of the interstellar medium; Dr. Gary Henson (ETSU) talked about the nature of pulsating stars; Dr. Ken Rumstay (VSU) explained the astrophysics of HII regions and active galactic nuclei; Dr. Jim Webb (FIU) talked about the confusing subject of Blazars; Dr. Scott Shaw (UGA) discussed the importance of binary stars in clusters.



FIGURE 1. 1996 SARA REU participants. Front, from left: M. Castelaz, J. Webb, S. Shaw, K. Rumstay, G. Henson, M. Wood, M. Thursby, T. Oswalt. Back row: K. Crowe, B. Heaton, E. Howard, J. Chuhta, C. Magill, B. Rebel, N. Miller, S. Sublett, R. Sirbaugh.

*photo by T. Oswalt*

In addition to mentor presentations on the various research topics the students would be exposed to over the summer, this workshop included a unique session on science ethics. Dr. Clark Wolf of the UGA philosophy department, an ethics specialist, presided over a two hour afternoon discussion on ethical issues relevant to the students and mentors. Dr. Wolf went so far as to assign homework for participants even before the workshop began. With the use of various web sites on the internet, he asked participants to review literature on the recent controversy over the construction of a major observatory site on Mt. Graham in Arizona. The controversy involved both environmental concerns (red squirrel habitat, e.g.) and religious concerns of native American Indians. The discussion began with more typical issues relevant to conduct as a professional and a scientist (peer review, scientific credit, e.g). Compared to a two-day role-playing 1995 ethics component, the response to this more science specific session was much more positive. The ethics discussion ended the official agenda for the first day and participants were free to explore the UGA campus or pursue a wide range of activities from swimming to Frisbee football. A spirited game of basketball was enjoyed by several students and faculty, an excellent way to work up an appetite for dinner.

The second day of the workshop began with the completion of mentor presentations on their research areas. Dr. Terry Oswalt (FIT) described his work with white dwarfs, the "stellar graveyard", followed by Dr. Matt Wood (FIT) discussing computer modeling of cataclysmic variable accretion disks. In preparation for student trips to Kitt Peak, Dr. Mike Castelaz (ETSU) gave a detailed presentation on the operation of the observatory and telescope and demonstrated the use of a CCD camera with MIRA control and image processing software. The middle of the day was devoted to giving students an introduction to IRAF, the image processing software which many students would use in their projects. These sessions were directed by UGA graduate student Sangeeta Mysore and allowed the students to perform simple tasks with IRAF on real CCD images. Since the program students had varied backgrounds in physics and astronomy, the last formal workshop session was a description of the mainstay of astronomical data acquisition, photometry. Dr. Oswalt gave an excellent lecture on the collection and proper reduction of photometric data. Participants were free in late afternoon to enjoy a few leisurely hours. Survivors of the first day's athletic events continued with more Frisbee, football, basketball or explored the university's bookstore.

An informal dinner party at the home of Dr. Shaw ended the second day's planned activities, but not the socializing between mentors and students. Impromptu music sessions and sing-alongs are a common feature at SARA gatherings and most of the REU program students proved to be willing, if not always able, participants. Drs. Webb and Wood provided the instruments and impetus for several after dinner sessions back at our conference center lodgings (see Figure 2).

### III. VISITS TO THE SARA OBSERVATORY

Mentor-student teams conducted observing runs at the SARA Observatory in May, June and July. Although there were some computer glitches and stretches of poor weather, all the students were able to participate in doing CCD photometry at the telescope. Even those students with theoretical or instrumental based projects enjoyed their turn at the controls (see Figure 3). The experience was not complete, however, without a turn at helping to maintain the observatory (see Figure 4). Not all of the Kitt Peak adventures were limited to the observatory. Several teams visited with the KPNO REU students in Tucson; one group even took an interesting day trip across the border



FIGURE 2. Matt Wood, Gary Henson (in back), Emily Howard, Rica Sirbaugh and Jim Webb keep the rest of the hotel awake at the first 1996 SARA workshop. *photo by T.Oswalt*



FIGURE 3. Stephanie Sublett left her radio telescope in Florida to do some visual observing at the SARA Observatory. *photo by K. Rumstay*

to Nogales, Mexico. The students continue to comment on the thrill of working at a major national observatory site.

#### IV. THE SECOND WORKSHOP

The second workshop was hosted by Dr. Gary Henson and held July 21-22 at East Tennessee State University in Johnson City, Tennessee. Getting to this workshop turned out to be an extremely social event for several of the non-ETSU participants. Ten mentor-student pairs from Florida and Georgia endured an all day drive in one van, arriving after midnight. However, all were present and alert the next morning as Dr. Oswalt began this workshop with a summary presentation on the first two years of the SARA REU program. This was followed by student oral presentations on their research projects. Brian Rebel, Brian Heaton and Kevin Crowe led off with a group presentation "All You Ever Wanted to Know about Miras;" Jesse Chuhta presented "Binaries in Clusters;" Emily Howard presented "Blazars;" Christy Magill presented "HII Regions and AGN;" Stephanie Sublett presented "An F.I.T. Radio Telescope;" Rica Sirbaugh presented "Photometry of White Dwarfs;" and Nathan Miller presented "Theory of Something." The talks were well prepared and even adding enough time to answer questions the student presentations were finished by midafternoon. The group retired to

the hotel where the mentors took time off to hold a brief SARA business meeting, while the students were able to wind down from the nervous excitement of their presentations.

The second day began with a session on astronomy and science education given by Dr. Harry Powell of the ETSU physics department. Dr. Powell demonstrated several useful activities used primarily by middle school science teachers in instructing students about astronomical phenomena. This was followed by a poster session, which allowed students and mentors to get a closer look at each others' research. Other interested students, faculty, and administrators from ETSU also attended. For the final morning activity, students were asked to evaluate their SARA REU experience. In addition to an informal discussion, students were provided with a list of topics upon which they might make written comments to help improve the program.

Before adjourning for an afternoon picnic, each SARA REU student was presented with an "official" high quality knit shirt bearing the SARA logo, and the



FIGURE 4. Rica Sirbaugh mops up after an observing run at the SARA Observatory.

*photo by T. Oswalt*

## **THE 1996 SARA REU PROGRAM**



traditional group photo was made (Figure 1). Everyone then traveled to Warriors Path State Park on the Holston River to enjoy a picnic of fried chicken, play on a professional Frisbee golf course, and use up any remaining energy in a series of volleyball games.

Only one student had completed the summer appointment by the time of the second workshop, so the program was not over yet. It was back into the van for the long trip to their respective institutions for another week or two of work on projects.

### **V. AFTER THE SUMMER**

Although a few students completed their projects and final paper by the end of their ten week appointment, many students continued to work with their mentors after returning home. Through the Internet list-server or by direct e-mail they worked to produce the papers found in this special proceedings issue, or just continued to collaborate in some way. In addition, as this manuscript is being prepared, most of the 1996 students are preparing for a trip to the January 1997 AAS meeting in Toronto, Canada. Partial travel funds were available within the REU budget to help support student travel to present their work at this meeting. Traffic on the SARA-REU list-server remains strong and student access to the list-server will be maintained indefinitely.

The multi-site program that SARA has developed has been very successful in its first two years. Evaluations from students have been very positive and we believe the program has provided a quality experience for our students. We recently submitted a successful proposal to the NSF to continue the program for another four years and look forward to many more years of working with deserving students.

### **VI. ACKNOWLEDGMENTS**

This project was supported by the SARA Research Experiences for Undergraduates Summer Internships Program, which is funded by the National Science Foundation (AST 94-23922).

### **VII. REFERENCES**

Rumstay, K. 1996, IAPPPC 64, 1-8.