



# SARA OBSERVATORY NEWSLETTER

Issue #10

Autumn 2004

Florida Institute of Technology  
East Tennessee State University

University of Georgia  
Valdosta State University

Florida International University  
Clemson University

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## From the Editor's Desk

Ken Rumstay, VSU

Greetings, and welcome to the latest edition of the SARA Newsletter! It has certainly been an exciting six months since our last number, both within the SARA consortium and in the world of astronomy.

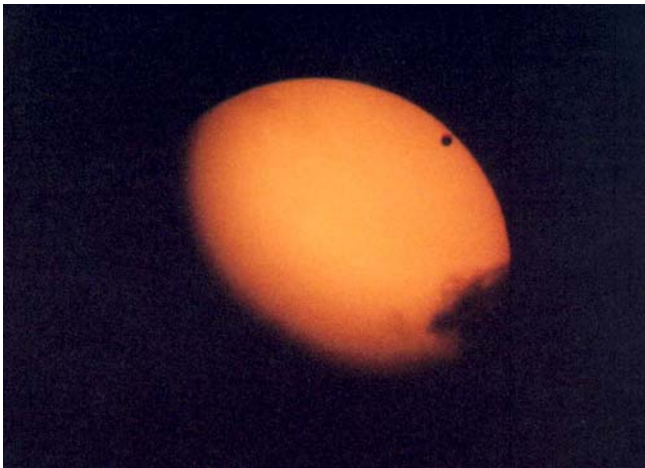
First and foremost, of course, was the astronomical event of the year (and perhaps of the decade!). On the morning of June 8<sup>th</sup> the planet Venus transited the Sun's disk. This was literally a once in a lifetime event; the last transit of Venus occurred in 1882. The event was visible throughout Europe, but in the United States only viewers on the east coast were positioned to see it, and at some of the SARA schools the skies were cloudy. But most of those fortunate enough to see the transit were keenly aware that they were seeing something not seen by anyone now living. If you were not of their number fear not, there will be another transit of Venus on the afternoon of June 12, 2012!

Many astronomical meetings were held during the second half of 2004; two of them were of special interest to SARA and we report on them in this issue. East Tennessee State University, a charter member of SARA, sponsored its first international astronomical conference in July. *The Nature and Evolution of Disks Around Hot Stars* was a great success; we congratulate newly-hired astronomer Richard Ignace of ETSU for a job well done, and we welcome him to SARA. In October the Fourth Annual Georgia Regional Astronomy Meeting was held on the campus of Berry College in Rome, Georgia.

The SARA consortium conducted its tenth Research Experiences for Undergraduates program this summer. The SARA astronomers were again privileged to work closely with some of this country's most promising undergraduates.

But of course it was the weather across the southeastern U.S. which made major headlines this year. Four major hurricanes made landfall during the late summer. Hurricanes Charley, Frances, and Jeanne wreaked havoc throughout Florida, causing extensive damage to the campus of the Florida Institute of Technology. Some of our members suffered damage to their homes and, for the first time in SARA's fifteen years of existence, we did not have an autumn meeting of the Board of Directors.

As we near the end of 2004, we look forward to a new year which, we hope, will bring a more benign climate!



Venus nears the Sun's limb as the historic transit of 2004 June 8 draws to a close. Chase Rollins, Valdosta State University astronomy major and participant in SARA's 2004 REU program, obtained this image. (Photo by Chase Rollins)



Valdostans awoke early on June 8<sup>th</sup> for a once in a lifetime chance to view the transit of Venus! (Photo by Ken Rumstay)

## The 2004 SARA REU Program

Ken Rumstay, VSU

During the summer of 2004 SARA operated its tenth annual Research Experiences for Undergraduates (REU) program. Funded by the National Science Foundation (grant AST-0097616), each year this program brings talented undergraduates from around the country to the six SARA institutions for a summer of astronomical research. As suggested by the table below, our students engaged in a variety of observational and theoretical projects which spanned a broad range of celestial phenomena.

As is the case each year, the program began with a meeting of all the students and faculty mentors. Held on May 28<sup>th</sup> and 29<sup>th</sup> at the Florida Institute of Technology in Melbourne, this first gathering allowed everyone in the program to become acquainted. The mentors presented brief summaries of their research programs, and the students were advised in matters of scientific ethics, professional conduct, and the dissemination of research results.

Our students spent the ensuing eight weeks at the six SARA schools, pursuing their chosen research. Regardless of topic, each made the trip to Arizona to observe with the SARA 0.9-m telescope. This trip is the highlight of the program for most students! Some have difficulty adjusting

to a nighttime work schedule, but most would agree that the Kitt Peak experience is well worth the effort.

A second group meeting was held July 30<sup>th</sup> and 31<sup>st</sup> at Valdosta State University. This workshop provided a venue in which each student presented the fruits of his or her labors. Each in fact reported on their results *twice*, in the two modes in which presentations are made at professional scientific meetings. At the Friday session each gave a fifteen minute oral presentation. These were quite professionally done; nobody seemed in the least ill at ease! Saturday morning was devoted to a poster session, and the posters were also of outstanding quality. The program officially ended that evening with a barbecue at my home.

Usually at least half of our students present their work at the meeting of the American Astronomical Society held the following January. Unfortunately, at the end of this summer no funds remained in the REU budget to support student travel. Chase Rollis and T.J. Wark have already reported on their work at November's Division for Planetary Sciences meeting in Louisville. The program for January's AAS meeting, to be held in San Diego, has just been released and it looks as though none of our 2004 students will be in attendance. However, more than a dozen REU alumni appear on the author list, and I look forward to meeting with them again! I'll report on that meeting in our next issue.

### 2004 SARA-REU Participants

Name	Home Institution	Faculty Mentor
Andrew J. Benker	University of Nebraska at Lincoln	Dr. Loris Magnani (UGA)
	<i>The Gas to Dust Ratio at High Galactic Latitude</i>	
Joshua C. Dolence	Florida Institute of Technology	Dr. Matthew A. Wood (FIT)
	<i>Zeus-MP on FIT's Linux Beowulf Cluster</i>	
Cooper J. Downs	University of California at Santa Cruz	Dr. James R. Webb (FIU)
	<i>Time Series Analysis of Microvariability in Blazar 0716+71</i>	
Heather L. Greene	Augsburg College	Dr. Matthew A. Wood (FIT)
	<i>Simulations of Superhumps in a Cataclysmic Variable Systems</i>	
Naydene R. Hays	Seattle University	Dr. Caroline E. Simpson (FIU)
	<i>Arp 213: An Optical Survey</i>	
Katie D. Hicks	Guilford College	Dr. Gary D. Henson (ETSU)
	<i>BVRI Photometry of Post-AGB Stars</i>	
Jennifer E. Kissenger	Florida Institute of Technology	Dr. Terry D. Oswalt (FIT)
	<i>Follow-up Observations on Potentially Pulsating Cool White Dwarfs</i>	
Karen L. Menezes	University of Texas at Austin	Dr. Terry D. Oswalt (FIT)
	<i>Observations of a Newly Discovered Eclipsing System</i>	
Amanda J. Moffett	East Tennessee State University	Dr. Beverly J. Smith (ETSU)
	<i>Phase Lags in the Optical-Infrared Light Curves of AGB Stars</i>	
Yelena Pelinskaya	Lehigh University	Dr. J. Scott Shaw (UGA)
	<i>Difficulties in Designing an Automated Scheme for Classification of Variable Stars</i>	
Chase M. Rollins	Valdosta State University	Dr. Martha A. Leake (VSU)
	<i>Asteroid Photometry: 741 Botolphia</i>	
Thomas J. Wark	Rowan University	Dr. Martha A. Leake (VSU)
	<i>Asteroid Photometry: 727 Nipponia</i>	

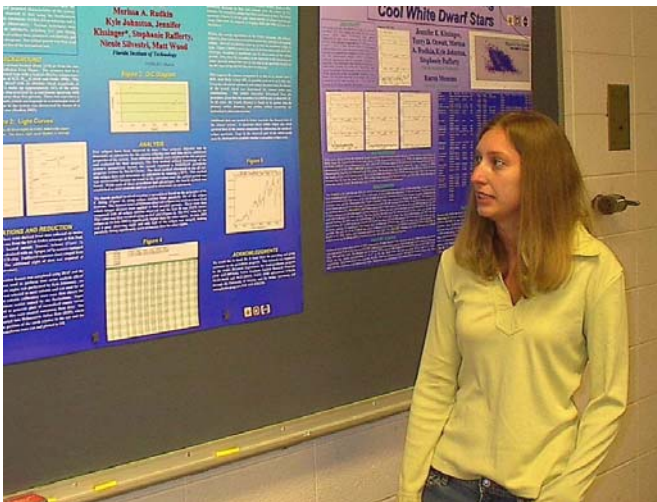




REU Program director Matt Wood sets up a laptop to run a computer simulation. *(Photo by Ken Rumstay)*



Yelena Pelimskaya locates her native homeland for the group during a coffee break on Saturday. *(Photo by Ken Rumstay)*



Karen Menezes describes a newly-discovered eclipsing binary system during the poster session.. *(Photo by Ken Rumstay)*



Chase Rollins describes his photometric observations of the minor planet 741 Botolphia. *(Photo by Ken Rumstay)*



REU students and mentors enjoy a Saturday luncheon at a local Chinese restaurant. *(Photo by Ken Rumstay)*



Students and faculty assiduously take notes during an oral presentation on Friday. *(Photo by Ken Rumstay)*

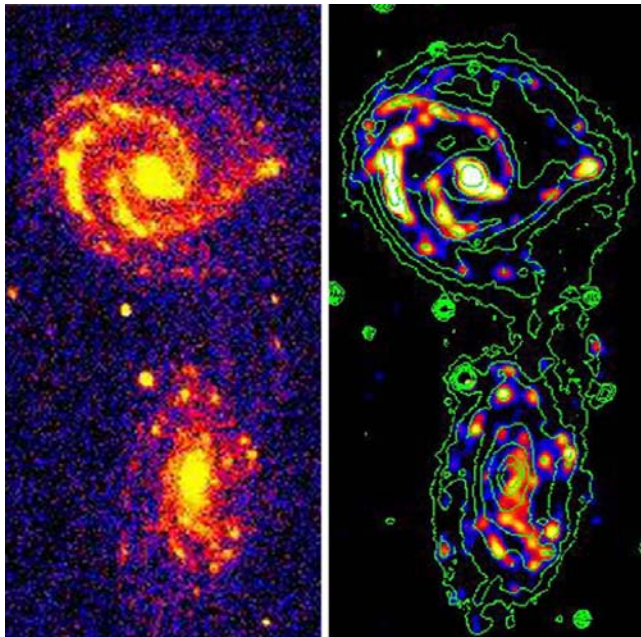
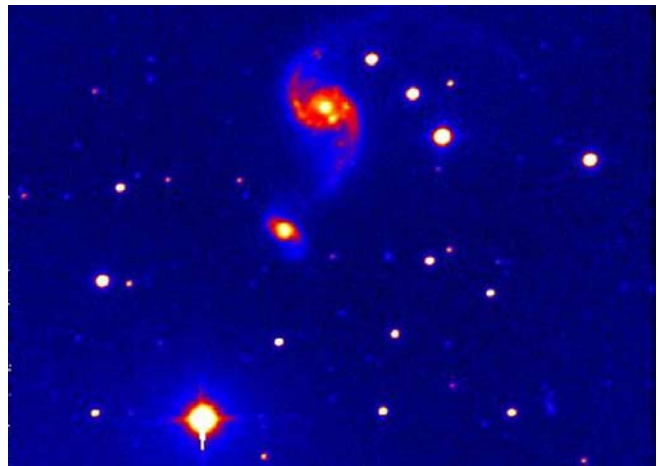
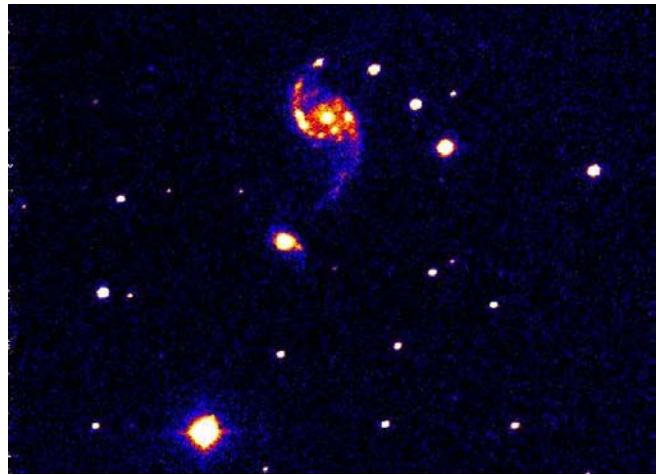


## SARA Observations of Interacting Galaxies

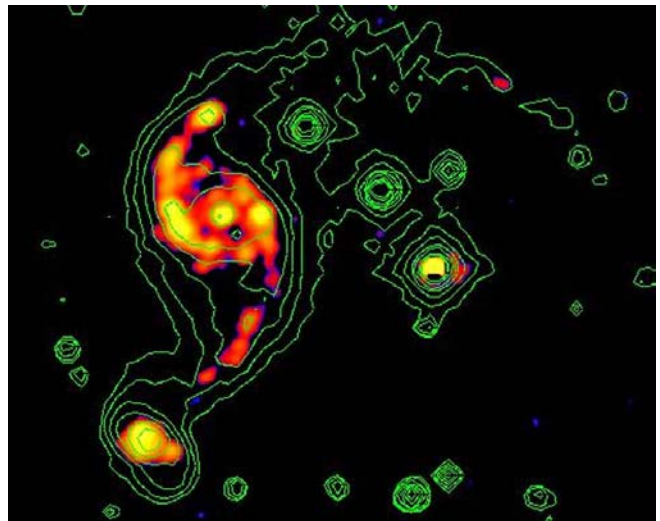
Beverly Smith, ETSU

The Spitzer Space Telescope, launched in August 2003, is one of NASA's Great Observatories. Observing at wavelengths between 3.6 and 160 microns, it covers the infrared regime with a sensitivity unparalleled by previous infrared telescopes. At shorter wavelengths the GALEX ultraviolet satellite, launched in April 2003, operates from 135 to 280 nanometers. These two telescopes provide dramatically different views of the Universe, with Spitzer detecting cool stars and interstellar dust heated by hot young stars and GALEX seeing hot newly-formed stars directly.

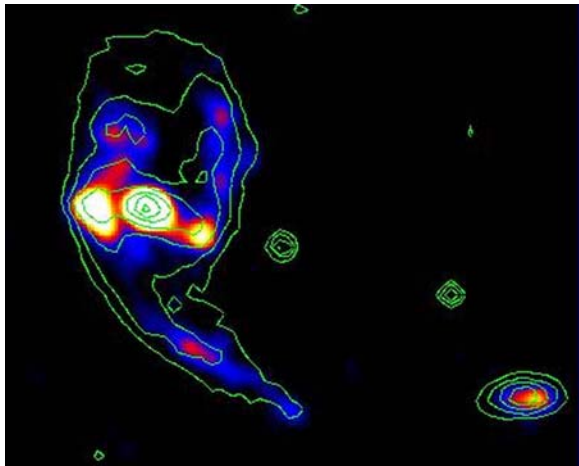
Beverly Smith and Mark Giroux (ETSU) are part of a group of astronomers who are using Spitzer and GALEX to study star formation and interstellar matter in faint tidal features in three dozen interacting and colliding galaxy systems. To help interpret these Spitzer and GALEX images, they have been using the SARA 0.9-m telescope to obtain narrowband optical images of their sample galaxies in the redshifted H $\alpha$  emission line. These SARA images provide a third independent look at star formation in these features, since H $\alpha$  arises from ionized gas surrounding hot young stars. The comparison between the infrared, ultraviolet, and visible images provide detailed information about the nature of the star formation and interstellar matter in tidal tails and bridges.



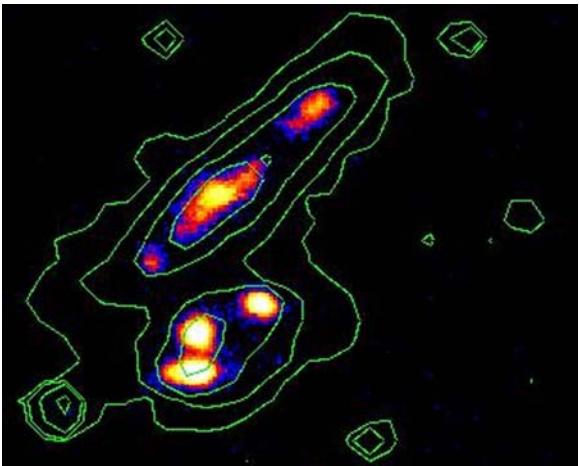
The interacting system Arp 271 (NGC 5426/27); north is up and east is to the left. On the left is an H $\alpha$  (plus continuum) image. The image on the right has been smoothed and has had the continuum emission removed; R band contours have been superimposed. Note the HII region in the bridge, as well as the large concentration of star formation in the distorted western spiral arm of the northern galaxy NGC 5427. (All images in this article by Bev Smith)



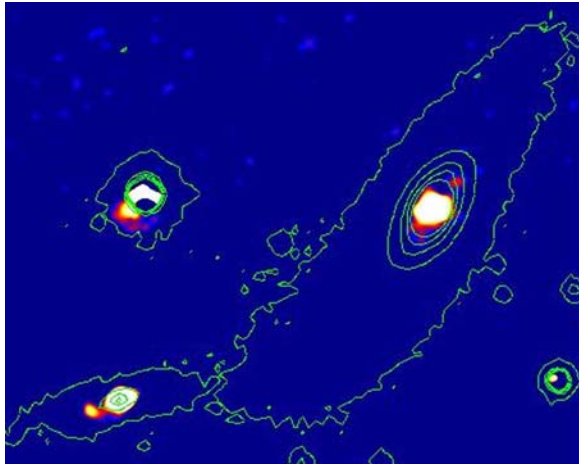
H $\alpha$  (top) and R continuum (center) images of Arp 82 obtained with the SARA 0.9-meter telescope. The smoothed continuum-subtracted H $\alpha$  image at bottom has R-band contours superimposed. H-alpha is seen throughout the disk of NGC 2535 (the larger galaxy to the north), the inner disk of NGC 2536, along the bridge, and at the base of the northern tail of NGC 2535. A possible clump of H-alpha is also seen at the end of the northern tail.



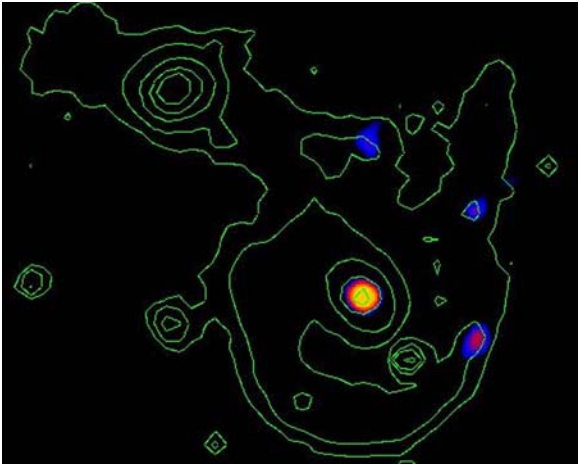
Continuum-subtracted smoothed H $\alpha$  map of Arp 72 with R band contours superimposed.



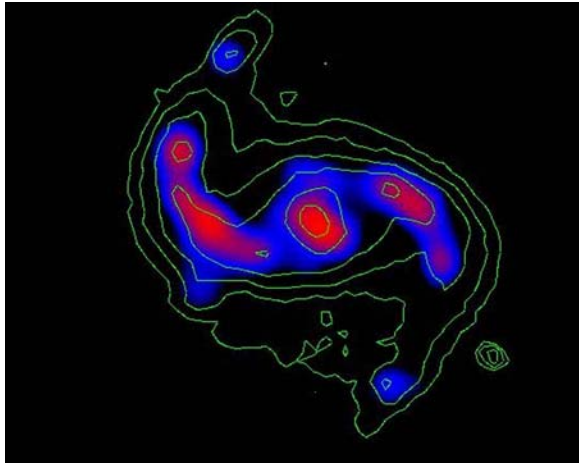
Continuum-subtracted H $\alpha$  map of Arp 202 with R band contours superimposed.



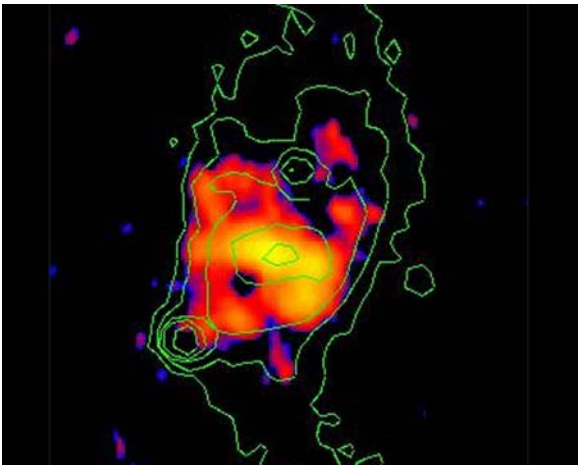
Continuum-subtracted H $\alpha$  map of Arp 89 with R band contours superimposed. Star formation is observed in the nuclear regions of the two galaxies, as well as within a concentration southeast of the smaller galaxy's nucleus.



Continuum-subtracted H $\alpha$  map of Arp 107, with R band contours superimposed. Only four sources are detected in H $\alpha$ : the nucleus of the main (Seyfert 2) galaxy and clumps #10, #21, and #26 around the ring.



The continuum-subtracted H $\alpha$  map of Arp 305/NGC 4017. No H $\alpha$  emission was detected from the bridge source in this shorter integration time H-alpha image.



Larger scale continuum-subtracted H $\alpha$  map of Arp 305/NGC 4016 with R band contours superimposed. H $\alpha$  is detected inside NGC 4016.

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## Observatory Director's Report (Summary)

Jim Webb, FIU

This has been a very interesting six months at SARA, and I have both bad news and good news to report.

The bad news first. We have yet to take delivery of a new large format CCD. Our observatory was attacked by a colony of ants just days before the REU participants began to arrive! The ant colony nested and eventually short-circuited a control card, nearly causing a fire! The end result was that the card that contained the pointing feedback loop was sent away for repair. This made observing during the REU months very educational for the students since we generally had to look for the fields and identify them. Members of the SARA consortium were of course attacked by weather: the entire state of Florida dealt with a succession of hurricanes. Melbourne suffered nearly a direct hit from Hurricane Frances: it knocked out power to FIT and crashed the SARA web pages and list server, and also damaged the homes of several SARA faculty.

The good news is that we are comfortably operating the SARA telescope remotely (sometimes from the comfort of our own homes) and nearly always getting useful data. The telescope is fully subscribed; every night in which an ROA (Remote Observing Assistant) was available was allocated for research. Roughly 55% of the scheduled nights were used, a total of 78.5 nights. Nights not scheduled included the August shutdown and nights when no ROA's were available. Of the 45% not used, 29% were due to weather, 6.2% due to equipment failure, and 10% were not used for other causes; in some cases no report was filed.

Many observers took advantage of our new policy which allows (when weather conditions are stable) seasoned observers to continue observing after the ROA has left the mountain. We encountered no cases in which the telescope was endangered, and we intend to continue this policy.

When everything is functioning, the telescope works great! Before the summer "ant attack" pointing was within a few arc seconds. As a result of damage to a control card due to ant activity, the pointing was way off during the REU visit. We were able to use the telescope and get good data, but the pointing had no feedback loop so long slewing maneuvers left objects as much as two (6 arcminute) fields out of the field of view if the camera. Target acquisition thus required a little searching, which turned out to be great training for the REU students, but a bit of a waste of time for the faculty mentors. During the August shutdown, the board was repaired and the pointing is currently back to its few arc seconds precision. The pointing model seems to have helped considerably with pointing accuracy as well. The auto guider is now used regularly by observers.

The newly acquired weather station is excellent, even better than the last one. It is a "Weather link 5.4" and has a very nice graphical interface. This should give us accurate weather information in an easy to read fashion. During a short period of time after the September startup the weather station was not responding, and we noticed that humidity

differences between our dome and the 4-meter dome were very large. As of this writing, Matt Bradstreet had fixed the weather station and it is currently on-line again.

The new SARA video is completed, and it is extremely well done! It tells the story of the SARA observatory, as did our first video, and contains segments on each member university, a segment on observatory construction, and a segment on the REU program. Terry Oswalt narrated the SARA observatory segment, and Jim Webb wrote a large portion of the narration of the pictures. Matt Wood did a great job on the REU program segment, as did student Vanessa Wilkat. The video appropriately ends with Matt Wood's "SARA song".

A wide variety of astronomical research is conducted at the SARA observatory. Micro-variability observations of Blazars (Webb, FIU) are routinely done in conjunction with the Dark Sky Observatory. Photometric observations of Seyfert galaxies (Rumstay, VSU) are made in support of large campaigns, while white dwarfs (Oswalt, FIT) and pulsating variable stars (Henson, ETSU) are also monitored. Super-humping variables are observed as part of WET campaigns (Wood, FIT), while binary star light curves are observed (Van Hamme, FIU and Shaw, UGA). Galaxies are imaged (Smith, ETSU) and asteroids are observed photometrically and spectroscopically (Leake, VSU). And programs designed to search for and monitor gamma-ray bursts (Hartmann, CU) are important and exciting.

In view of this success, the SARA board has discussed the possibility acquiring another instrument. A second telescope would be chosen to increase sky coverage (southern hemisphere), to increase temporal coverage (longitude), or to increase aperture. In order to acquire another instrument, it is necessary to expand the consortium to include a few more universities in the Southeast. While these discussions are still in their preliminary stages, the addition of perhaps two new member universities would give SARA the financial stability to acquire a 0.9-meter in South America, or to perhaps gain remote access to a telescope in Australia or South Africa. The idea of a larger aperture telescope, perhaps at Kitt Peak, has also been discussed. Individual SARA board members are investigating and gauging the interest of several schools in Georgia and Florida who might be interested in joining.

Here is a list of action items which we need to address.

1. Take delivery of a large format CCD camera.
2. Possible expansion of SARA to include one or two additional member institutions.
3. Possible acquisition of a second telescope.
4. Fabrication of a new secondary mirror, and other measures to improve image quality.

Scott Shaw took on the task of investigating tube cooling at the last board meeting. We currently have a quote from ACE and have scheduled a few nights in December to do the work. No one has investigated alternative funding for Secondary mirror fabrication. This is a major project and someone who has the time needs to be the driving force behind this project if we really expect developments.



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## The Nature and Evolution of Disks Around Hot Stars

Richard Ignace, ETSU

A meeting focusing on the disks around hot stars (primarily single massive stars) was hosted by East Tennessee State University (ETSU) in the Carnegie Hotel for the dates of 7-9 July 2004. This was the first international astronomy meeting held at ETSU. There were approximately 50 participants. Although the majority of participants were from American institutions, there were attendees representing institutions from over one dozen nations.

The format of the meeting was rather novel. For each of the three days, there were four review talks held in the morning session. The lunch break was followed by an open discussion session, another break, and then an optional "focus session". The focus sessions were more specialized, somewhat more tutorial, giving a summer school flavor to the workshop. Attendance for the focus sessions was very high. Finally, posters were displayed for the entire event.

Abstracts and a schedule of talks can be found on the web at [www.etsu.edu/physics/astronomy](http://www.etsu.edu/physics/astronomy). The Carnegie served as the meeting location and as accommodation for nearly every participant. The workshop was very successful in many respects. The narrow focus of the meeting kept the attendance at a relatively small level. Having nearly all participants staying at the same location, combined with the meeting format, led to a cozy and congenial atmosphere for research discussions.

The talks ranged from disks around forming stars to disks around evolved hot stars. There were several clear major themes. On the theory side, it seems that magnetic fields are increasingly key for understanding several kinds of observational data, ranging from X-ray emissions to disk structure. Considerations of how magnetic fields couple to standard line-driven winds are being modeled both semi-analytically and numerically (via MHD simulations). The models have bearing on a variety of observational diagnostics, from line profile shapes that sample the circumstellar flow dynamics to X-rays emissions (in terms of hardness, emission measure, and variability). The Be stars were a common subject of talks, discussion sessions, and focus sessions, mainly because of increasing evidence that the Be disks are Keplerian (or nearly so). It is a tremendous challenge to understand how to generate Keplerian disks around Main Sequence or post-Main Sequence stars that are rotating at sub-Keplerian speeds. Magnetic fields may be necessary. The effort would be greatly helped if Be stars were rotating close to break-up (in excess of 90% of break-up). Line widths have suggested more modest rotation speeds below 70% of break-up, but there are recent claims that line widths can asymptote to this level owing to the effect of equatorial gravity darkening, even if a star rotates much faster than the 70% level. A clear understanding of the formation and evolution of Be disks

remains elusive; however, advances in the volume and quality of data continue to push the models forward.

Especially interesting for researchers of hot stars have been renewed efforts and new successes in directly detecting their magnetic fields. Using spectral co-adding techniques that have been applied to lower mass stars, there are now several hot stars with modest surface field strength values of around 100 Gauss. Interestingly, some of these are Be stars. It is clear that this kind of data will continue to act as a catalyst for continued studies of magnetic effects for circumstellar dynamics and angular momentum transport, and for the influence of magnetic fields on stellar evolution. Clearly, a major future effort will be required to connect the models for stellar interiors with those pervading stellar winds, to understand how and why disks form during the observed evolutionary states.

Future prospects for obtaining spatially resolved images for a variety of disk systems appears to be just over the horizon. The focus session of the final day of the meeting concentrated on optical/IR/mm interferometry. Already a few Be star disks have been resolved. Now some fast rotating hot stars are being resolved, with relevance for understanding disk formation and stellar interiors. Interferometry of Achernar ( $\alpha$  Eri) had been reported previously, and during the focus session, preliminary results for the resolved shape of Regulus ( $\alpha$  Leo) revealed that this star is quite non-spherical, consistent with expectations for von Zeipel's gravity darkening.

Thus, the participants left the meeting with a sense of excited anticipation for future studies of disks around hot stars, on both the theoretical and observational fronts.



Many of the approximately fifty astronomers participating in the "Hot Disks" meeting at ETSU brought their families along to enjoy summer in the mountains of Tennessee. By all accounts the meeting was highly successful! (Photo by Richard Ignace)

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## The 2004 Georgia Regional Astronomy Meeting

Ken Rumstay, VSU

The Third Annual Georgia Regional Astronomy Meeting was held October 22<sup>nd</sup> and 23<sup>rd</sup> at Berry College in Rome. The 2002 brainchild of Drs. Chris De Pree (Agnes Scott College) and Loris Magnani (University of Georgia at Athens), these meetings were established to provide a local venue in which Georgia astronomy faculty and students could meet, trade ideas, and discuss their research activities.

After a social gathering on Friday evening, the scientific session began Saturday morning. Seven oral presentations were made: *A Program to Monitor Flux Variations in Selected Active Galactic Nuclei* (Ken Rumstay, Valdosta State University), *High Resolution H52 $\alpha$  VLA Observations of SGR B2 Main* (Christopher De Pree, Agnes Scott College), *MER Atmospheric Results: Pancam and Mini-TES* (Michael Wolff, Space Science Institute, Boulder), *The Remotely-Accessed Research and Educational Dark-Sky Instrument (RRED-I) Project: A Status Report* (Joseph H.

Jones, North Georgia College and University), *A Search for M-type Eclipsing Binaries in Large Databases* (J. Scott Shaw, University of Georgia), and *Teaching Astronomy by Telling Stories and Going Places* (Paul Wallace, Berry College). During coffee breaks attendees had the opportunity to examine two poster presentations: *A High-Latitude Molecular Shell in Pegasus-Pisces* (Loris Magnani, University of Georgia) and *A Multiwavelength Investigation of Unidentified EGRET Sources* (Paul Wallace, Berry College).

After dinner at a local restaurant we returned to the Berry campus, where the Harlow Shapley Lecture Program provided us with a fine after-dinner speaker: Dr. Laurence Fredrick of the University of Virginia. In *The Great Impactor* he described a faint red dwarf star discovered to be nearly on a collision course with our solar system.

I would personally like to thank Paul Wallace, Associate Professor of Astronomy and Physics at Berry College, for hosting a fine meeting. Everyone there had a good time, and we look forward to The Fourth Georgia Regional Astronomy Meeting next October!



Participants at the Third Annual Georgia Regional Astronomy Meeting at Berry College. (Photo by Ken Rumstay)

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Kenneth S. Rumstay, Editor

The SARA web page is [www.saraobservatory.org](http://www.saraobservatory.org)  
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