WIYN OBSERVATORY

WISCONSIN INDIANA YALE & NOAO

Newsletter

July 2008

Director's News

An Excellent Trip

In the last newsletter, I reported that WIYN was interviewing candidates to take over as WIYN Director. I am thrilled to be able to direct you to page 6 of this newsletter where the new Director is announced. Go ahead—take a look. Pierre is very fortunate to inherit an excellent support team.

Consequently, this column is my last as Director of America's premier 4-meter class observatory. These last eight years have been an excellent trip! At the April Board meeting, I noted that it's been an "E-Ticket Ride" (if you aren't old enough to know what that means, check it out on Wikipedia). Thanks to WIYN, I've had amazing opportunities, from working closely with the NSF and the directors of all major observatories in the US, to learning how to design and develop custom CCDs. I've even squeezed in an occasional research project using WIYN.

For many reasons, it's time for another leader. Pierre brings a fresh perspective and new creative solutions, with abundant energy to implement his ideas. He is an excellent choice, and I will support him in whatever way he wishes. On September 22, I will pass along the ceremonial shovel that was used in the 1992 WIYN groundbreaking (see the July 2007 *Newsletter*).

By the time September 22 rolls around, the Bench upgrade will be complete, WHIRC will be a routine instrument, QUOTA will have had a major run at the telescope, and ODI will be 18 months away. These instruments offer fantastic opportunities, but they bring challenges. Please help Pierre succeed in every way possible. Bill and Ted said it best: "Be excellent to each other!"

~ George Jacoby

Science News

Young Cool Stars Divided on Issue of Rotation

Søren Meibom (Harvard-Smithsonian CfA)

As part of the WIYN Open Cluster Study (WOCS), my collaborators R. Mathieu (University of Wisconsin), K. Stassun (Vanderbilt University), and I have combined extensive spectroscopic and photometric surveys of late-type stars in the 150 Myr open cluster M35 (NGC 2168). The objective was to learn about the rotational evolution of single stars and stars in close binaries. A decade-long radial-velocity survey for cluster membership and binarity was carried out using the WIYN 3.5-meter telescope equipped with the Hydra multi-object spectrograph. A five-month photometric time-series survey for stellar rotation was done with the WIYN 0.9-meter telescope equipped with the 2kx2k CCD camera. This photometric program relied heavily on queue-scheduled observations taken by a long list of 0.9-meter observers (the author gives a big thank you to them all).

We reported rotation periods for 441 stars and found that 310 are late-type members of M35 (Meibom et al. 2008, submitted

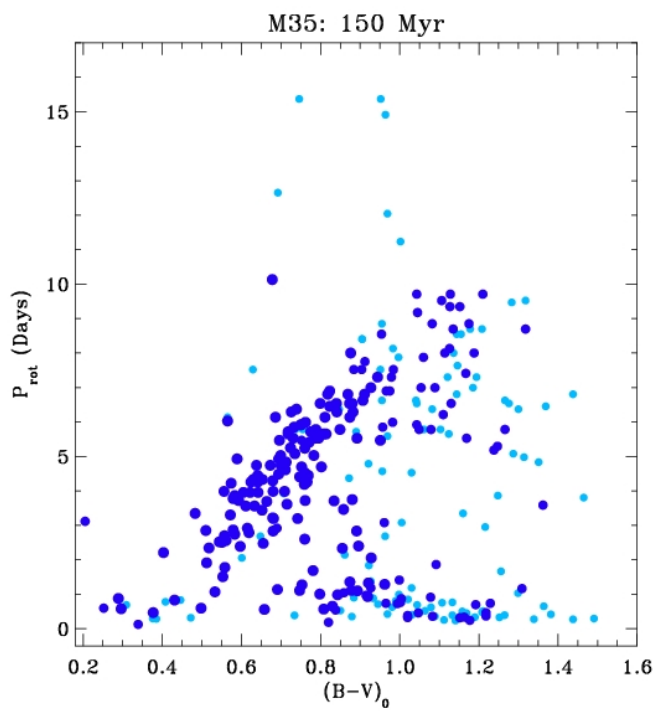


Figure 1: The distribution of stellar rotation periods with (B-V) color index for 310 members of M35. Dark blue plotting symbols are used for radial-velocity members of M35, and light blue for stars that are photometric members only.

Continued on Page 2

The WIYN Observatory is owned and operated by the WIYN Consortium, which consists of the University of Wisconsin, Indiana University, Yale University, and the National Optical Astronomy Observatory (NOAO).

Science News, *continued*

to ApJ). The distribution of rotation periods for cluster members spans more than two orders of magnitude from ~0.1–15 days, with the shortest and longest periods not constrained by the sampling frequency and the time-span of the survey. With an age bridging the gap between the zero-age main-sequence and the Hyades, and with ~6 times more rotation periods than measured in the Pleiades, these new data permit detailed studies of early main-sequence rotational evolution of late-type stars.

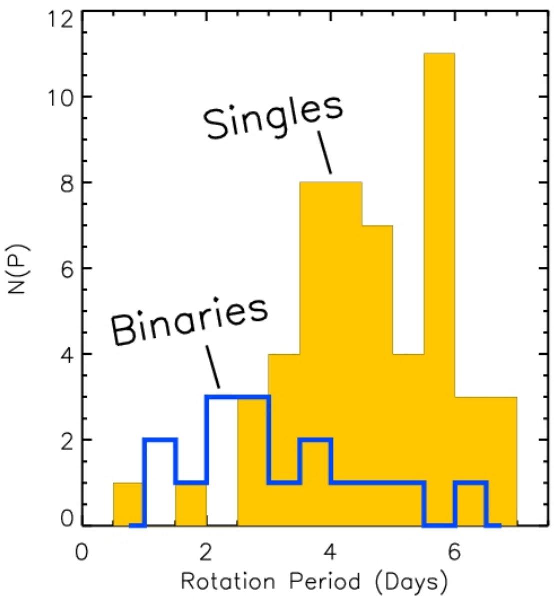


Figure 2: Rotation period distributions for single stars (yellow histogram; mean of 4.64 days, median of 4.70 days) and binary primary stars excluding all tidally synchronized binaries (blue histogram; mean of 2.95 days, median of 2.83 days). The mean and median rotation periods of the sample of binary primary stars fall 1.7 days and 1.9 days, respectively, short of the mean and median of the single star sample. The difference is significant at the 99.9% level.

Figure 1 shows that nearly 80% of the 310 rotators lie on two distinct sequences in the color-period plane, and define clear relations between stellar rotation period and stellar color (mass). The M35 color-period diagram enables us to determine the timescale for the transition between the two rotational states as a function of stellar mass, ~60 Myr and ~140 Myr for G and K dwarfs, respectively.

These timescales are inversely related to the mass of the convective envelope, and may offer valuable constraints on the rates of internal and external angular momentum transport and on the evolution rates of stellar dynamos. From a comparison to the Hyades, we found that our data for stars on the "slow" (diagonal) sequence confirm the Skumanich (1972) spindown time-dependence for G dwarfs, but suggest that K dwarfs spin down more slowly. Furthermore, the locations of the rotational sequences in the M35 color-period diagram support the use of rotational isochrones to determine ages for coeval stellar populations. We used such gyrochronology to determine a "gyro-age" of M35 of 134 Myr with a formal uncertainty of 3 Myr. The M35 rotation data were also used to evaluate new color dependencies for the rotational isochrones. Finally, we found the photometric variability of stars in M35 to be stable over the ~5-month duration of the photometric survey, suggesting a similar stability in the sizes, numbers and configurations of stellar spots and spot groups.

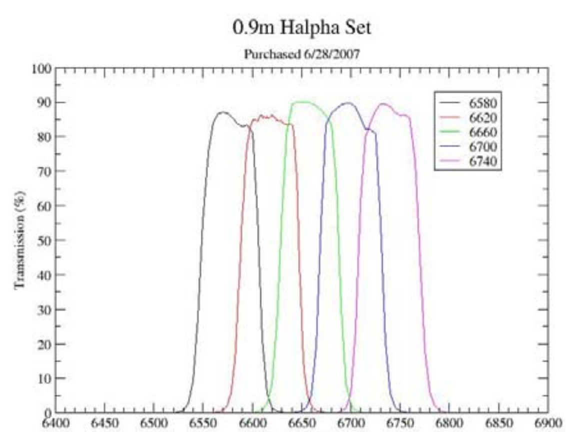
The effects of binarity in clusters are discussed in Meibom et al. 2007. The long baseline radial-velocity survey allow them to compare the rotation period distributions of solar-type single stars and primary stars in close binaries (0.1 AU < a < 5 AU) in M35. The authors found that the primary stars in the close binaries rotate faster than the single stars, on average (see figure 2).

The differences in the means and medians between the period distributions are statistically significant at the 99.9% level or higher. The faster rotation among the primary stars in close binaries is not due to tidal synchronization as tidally evolved stars are excluded from this comparison. This result is interesting in the context of different early-evolution accretion processes and star-disk interactions for single stars and stars in close binaries. Finally, we predict that the unusually slow rotation of 10 stars in M35 (they lay above the diagonal sequence in figure 1) is due to tidal synchronization with the orbital motion of a close companion. This prediction is based on one binary with an equal orbital and rotation period of ~10 days and a B-V color of 0.67.~

New Filters for the WIYN 0.9-meter

Heidi Schweiker

Last fall, we purchased a set of five new 4-inch filters to be used with S2KB. These new filters are a set of H-α filters and are currently available for use at the 0.9meter telescope. See the plot at right for wavelength coverage. A previously awarded NSF PREST grant funded the purchase.~



WHIRC

Dick Joyce (NOAO), Margaret Meixner (STScI, PI), & Heidi Schweiker (WIYN)

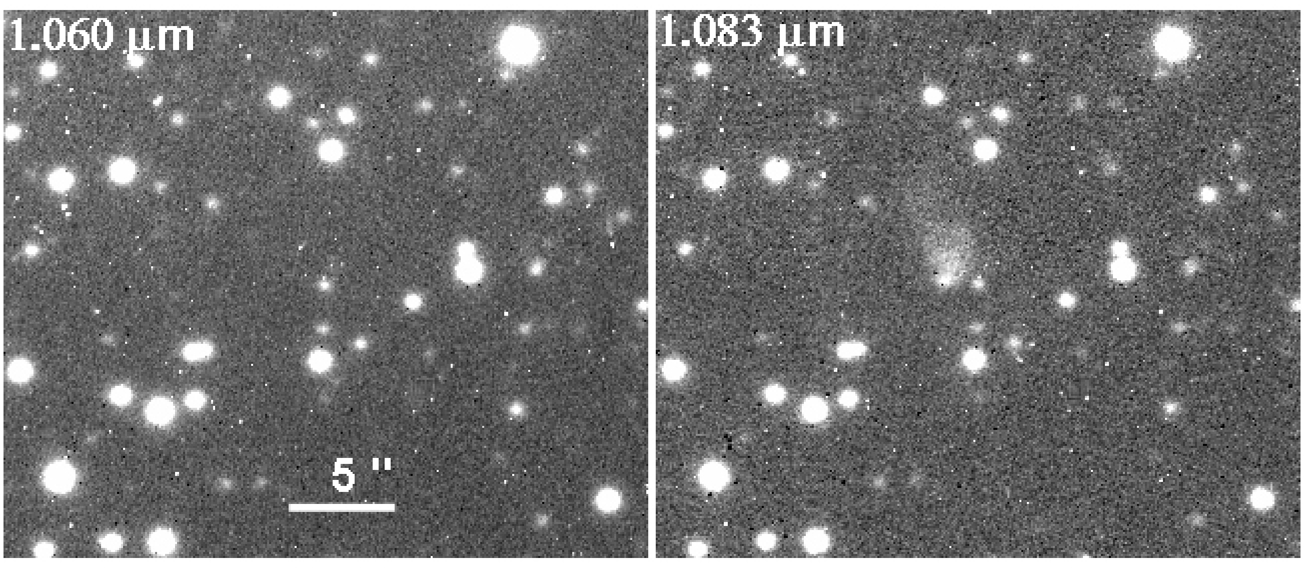
The WIYN High-Resolution Infrared Camera (WHIRC) was used in April and May for shared-risk science observing by scientists from all of the WIYN partner institutions. Initial reports indicate that the observers were very pleased with both the instrument performance and relative ease of operation using the WHIRC observing interface. Commissioning of WHIRC is nearing completion. Following the January 2008 observing run, the operational readout mode and detector bias were established, and subsequent commissioning runs have been used to obtain sensitivity meaurements, establish calibration and observing procedures,and complete the observing interface.

During the May engineering run, significant progress was made in the integration of WHIRC with WTTM, and it is now possible to carry out WHIRC offsets while maintaining WTTM guiding. While the use of WHIRC with WTTM in active tip/tilt mode is not being supported for observations in 2008B, we will continue to characterize the performance and establish observing protocols during upcoming engineering and science verification runs.

The combination of high spatial resolution and the large complement of narrowband filters make WHIRC a scientifically powerful instrument. Narrowband imaging is similar to optical CCD imaging in that the individual exposure times can be long and the performance is driven by long-term stability, read noise, and dark current. Initial observations through several of the WHIRC narrowband filters have been very encouraging. The figure shows observations of a suspected final-flash star through the "low airglow" (1.060 μm) and He I (1.083 μm) filters.

The two remaining commissioning issues are the excess read noise associated with the instrument rotator, and demonstrating the required flatfielding precision through all of the filters. NOAO engineer, Maureen Ellis, is continuing to lead the effort on the noise issue. Principal Investigator Margaret Meixner and Ryan Doering at Space Telescope Science Institute are working on characterizing the flatfielding, particularly in compensating for the pupil ghost.

Documentation on WHIRC, including a link to the current version of the User Manual, can be found at *www.noao.edu/kpno/manuals/whirc/WHIRC.htm*.~



Images of the field near CK Vul in the "low airglow" (left panel) and He I (right panel) narrowband filters. Two 600s images were taken in each filter, dark subtracted, and combined. The images are approximately 0.5 arcsec FWHM. The sky background and dark current in the "low airglow" filter is less than 2 e/s. The star approximately 1 arcsec W of the nebulosity is ~ 18 mag. Credit: D. Joyce, P. Knezek, and H. Schweiker.

WIYN 0.9-meter Telescope Consortium Seeks New Partners

The WIYN 0.9-meter Telescope Consortium is seeking new partners for their next contract period. The contract term will run from 1 July 2009 through 30 June 2015.

The WIYN 0.9-meter telescope, housed on Kitt Peak, currently uses NOAO's S2KB and MOSAIC imagers, and is building its own new Half Degree Imager (HDI) with monolithic 4Kx4K, high and flat U-response CCD, with 30'x30' field.

Besides classical observing, partners have access to the Observatory's special observing modes (the synoptic, photometric, and opportunity queues).

Please visit *www.noao.edu/0.9m/* to learn more about the WIYN 0.9-meter telescope and the consortium. Anyone interested in further information should contact Andy Layden (layden@baade.bgsu.edu) and Con Deliyannis (con@astro.indiana.edu).~

QUOTA Lives!

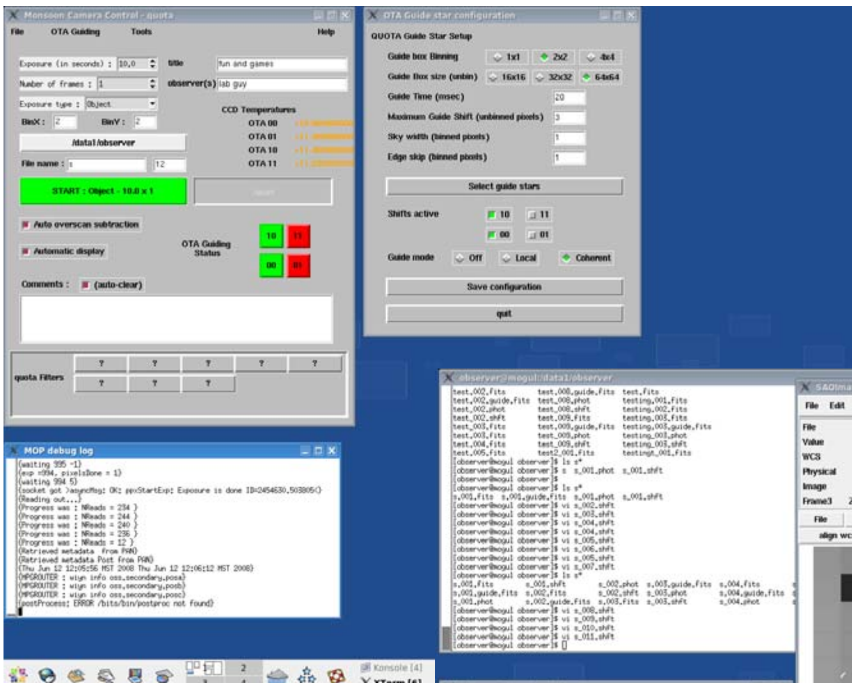
Steve Howell & George Jacoby

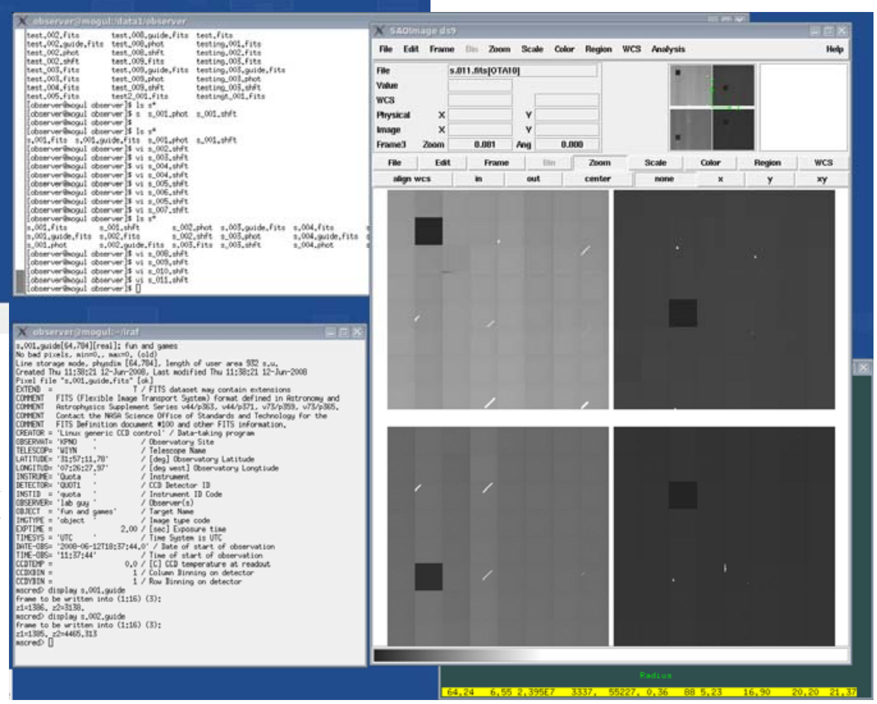
Hey! Remember QUOTA? The instrument is nearing its laboratory completion and will be tested at WIYN in late July. QUOTA is a Quad-OTA camera built as a prototype for the WIYN One-Degree Imager (ODI). The focal plane consists of four approximately 4096 X 4096 orthogonal transfer CCD detectors of the same size and design as those to be used in ODI. To refresh your memory about this new imager, see past editions of this *Newsletter* at http://www.noao.edu/wiyn/.

The current version of QUOTA is far beyond what we previously tested at WIYN and is very close to being a Mini-ODI type instrument. QUOTA uses four Lot-3 thick OTCCDs (OTAs) in the focal plane, one of which is Lumigen coated. While the QE of these thick devices is not as high as that of a thinned CCD, QUOTA promises to provide a very nice imager at WIYN in terms of precursor tests and science for ODI. The MONSOON controlled camera can take static images as well as fast-guided images. It can use up to eight guide stars per OTA, and perform local or coherent guiding. This means that it can collect fast photometry for up to 32 stars at a time.

Active guiding of the individual OTAs can be switched on or off, and the user GUI (MOP) interface allows the user considerable flexibility in the use of the camera. QUOTA can guide at rates up to 30 Hz, depending on the number, location, exposure time, and details of the selected guide star parameters.

The figure shows a recent screen shot from the lab where we are testing all the modes and abilities of QUOTA.





QUOTA user interface in the NOAO laboratory (two screens) .

The figure shows the MOP and guide star configuration GUI on the left and a DS9 display of a full QUOTA image on the right. The other open windows are a MOP debug window, and user and IRAF sessions. Note that in this image, the OTAs on the right show round "guide stars" (lab illuminated pinholes) while those on the left are trailed as they have been shifted during the guiding process. The diagonal trail here was caused by a software bug that set x=y at all times – it has since been fixed. The four dark "cells" (one per OTA) are the cells containing the "guide stars."

The Lot-3 OTAs are cosmetically very nice and have an apparent read noise of ~6 electrons with a gain of ~1.2 e-/ADU.

We have completed the software and MONSOON tests in the lab and are well prepared for our two T&E runs in late July at WIYN. We wish to thank Dave Sawyer, Nick Buchholz, and Dave Mills for their exceptional work on QUOTA over the past few months, making it possible to go to WIYN and begin observatory testing and engineering.~

ODI News: ODI is Coming!!

Daniel Harbeck & George Jacoby

At the time of this writing, Pete Marenfeld of NOAO is printing the posters to be presented at the SPIE meeting in Marseille, France. As we reported in the last *Newsletter,* the ODI team will present four papers during that meeting. Unlike other astronomical conferences, SPIE papers are due a month before the conference, and the submitted papers are now posted on the ODI webpage. Go to *www.wiyn.org*,click on the instrumentation tab and navigate to ODI Publications. They provide a good overview on the state of ODI for the interested reader. The posters are also published on the same web page.

Figure 1: Instrument maker, Ron Harris, standing behind the aluminum Atmospheric Dispersion Compensator (ADC) housing (Part Number ODI-ME-02-1037). Three triangular shaped outrigger blocks will bolt to the housing to form the main structural component to which filter mechanisms and axles, ADC cells, and dewar will mount. When complete the housing will weigh 170 lbs with overall dimensions of 37" across the flats by 6.26" thick. The housing is about 70% complete with about 72 hours of machining time remaining. Credit: G. Muller.

We will extend the trip to Marseille with a stop at SESO, our optics vendor located at nearby Aix-en-Provence, to monitor the progress on the ODI optics work. The four wedges for ODI's atmospheric dispersion compensator are nearing completion. The remaining two lenses for ODI are scheduled for delivery by November. In the meantime bid packages were sent out for the anti-reflection coatings of the lenses and excellent responses were received from various vendors. We have selected one vendor and are in the process of negotiating the details of the contract; we will report more as soon as this contract is finalized.

Two items on ODI vendors are noteworthy. The contract between WIYN and the University of Hawaii for the Stargrasp CCD controller is now signed, and the agreement with the University of Bonn to deliver ODI's shutter is finalized and awaiting signatures. While we were iterating the contract to harmonize US and European legal language, Klaus Reif and his team in Bonn had already started to work on our shutter.

The NOAO machine shop is continuously busy with the instrument support package. A centerpiece of ODI, the ADC housing is currently being fabricated (see the figures). Attached to this element will be the filter mechanism, shutter, and dewar on one side, and the rotator interface at the other side.

Unfortunately, on the OTA detector effort, our wafer foundry DALSA had a mishap with the first half of the Lot 4 production run that would have made the detectors prone to early degradation—they have re-done this wafer set for us. However, we had to absorb a delay of two months in the wafer production. The first 24 wafers have now been delivered to STA and testing begins on June 16. At the same time, the vendor for the detector carrier ceramics postponed the delivery due to a larger military order. On the bright side, Mike Lesser at Imaging Technology Labs is now able to run OTA detectors with their setup, which is an important step in their processing and characterization effort. They are also set up to process OTA detectors at a faster pace than initially anticipated. As a bottom line, the OTA detectors are a truly new technology development part of ODI, and as such their timely delivery and integration remains the biggest risk item in the ODI project.~

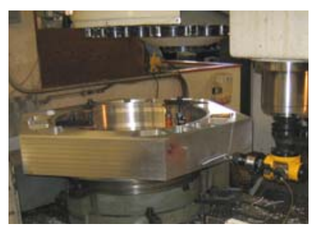


Figure 2: The ADC housing on the Hurco CNC machine being drilled with a newly acquired right angle boring head. Without this boring head, this drilling operation would have to be manually drilled on another machine. Credit: G. Muller.

ODI Is Coming!!...as the bumper sticker says. What sounds like a nice punch line is actually becoming a reality, and one that requires careful advance planning. ODI is scheduled for installation and commissioning at the WIYN telescope in less than two years. This still sounds far away, but will impact WIYN observers very soon. According to the ODI Science Requirements Document, ODI will be permanently mounted at the WIYN port. Consequently, it will displace the Instrument Adapter System (IAS) from its current location. The IAS hosts all facility instruments (except Hydra), including WHIRC, SparsePak, and all optical imagers. Current plans call for Hydra and the IAS to share the Hydra port, but details of this operational concept are yet to be determined.

Installation of ODI, and with it the displacement of the IAS, is planned to start in February 2010, and nighttime commissioning is scheduled to begin in April 2010. The availability of instruments will be especially restricted in 2010A, when a substantial amount of time and personnel will be dedicated to ODI commissioning activities.

WIYN staff, the ODI team, and the WIYN Science Advisory Committee are working closely together to plan the details of how actual operations might look in 2010A. We will do our best to keep our community as informed about actual plans as possible. Please do not hesitate to contact your WIYN representative or us if you have questions about the process.

With ODI's appearance in the semester 2010A, the semester 2009A will be the last "A" semester in which WIYN operates in its usual mode. Therefore, principal investigators should plan their next round of WIYN proposals keeping the schedule impacts of ODI in mind.

PERSONNEL NEWS

WIYN bids farewell to **Joe Keyes** who is leaving in July to return to school. Joe has been with WIYN for over four years. During that time, he has worked on several projects including QUOTA, ODI, and the Bench Spectrograph upgrade.

Joe says that he particularly enjoyed working on QUOTA "because I learned most everything I know about practical engineering from that project."

Joe will be working on his PhD in biomedical engineering at the University of Arizona. Our best wishes go with him, and our thanks for all his help.

Joe Keyes Leaving WIYN

New Director for WIYN

Pierre Martin has been selected as the new WIYN Director. His directorship will commence on September 22. Pierre comes to WIYN from the Canada-France-Hawaii Telescope, where he has served as Director of Science Operations for the past five years.

Martin said that he was "honored and very excited at the idea of working with and for" the WIYN staff. "With its outstanding staff," he said "the current suite of instruments and, with the strong commitment of the partners in making sure that the observatory continues to offer opportunities to pursue frontier astrophysical research, I strongly believe that WIYN has a very bright future ahead. Indeed, I expect all of us to have a great time!"

We are delighted to welcome Pierre to our team, and feel that it is a real credit to WIYN that we were able to attract such an ambitious, energetic, and capable person to take on the challenges of our organization. ~

WIYN Newsletter Staff

Patricia Knezek, Science Editor *pknezek@wiyn.org*	Sheryl M. Falgout, Editor, Design & Layout *sfalgout@wiyn.org*

The *WIYN Newsletter,* contacts list, and miscellaneous information about WIYN Observatory may be viewed on our Website at *www.noao.edu/wiyn/.*

A Research Adventure for Tucson Educators

Eric Hooper (University of Wisconsin-Madison)

Ever watch a science show on television and think, "Wow, I'd like to do that!"—whether it's about space flight, dolphins, or volcanoes? Now imagine non-astronomers thinking the same about our field. While the public may enjoy many illuminating astronomy talks and striking web pages, opportunities to actively engage in research at any level are rare, and can be challenging to execute in a meaningful way. Hence, we all jumped at a good opportunity to involve Tucson educators in a WIYN research observing project.

Three Girl Scouts of the USA (GSUSA) leaders and Tucson (TUSD) teachers with a strong bent for science education joined astronomers for two nights of observing on the WIYN 0.9-meter telescope. Carolyn Hollis (GSUSA, TUSD), Susan Hollis (GSUSA, TUSD), and Samantha Sims (TUSD), dove into all aspects of observing a set of quasars with the S2KB imager, working closely with me. Simultaneously, University of Wisconsin astronomer, Marsha Wolf, observed the same objects using Sparsepak and the Bench Spectrograph on the WIYN 3.5-meter.

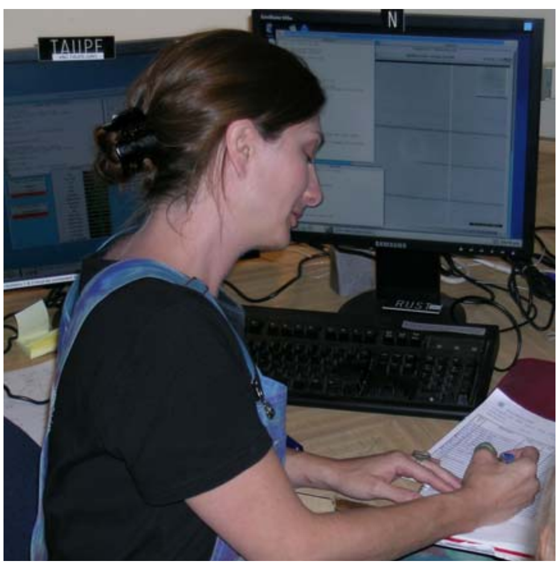


Figure 1: Tucson teacher Samantha Sims filling in the log book. Credit: E. Hooper.

Helping to fill the dewar, typing in coordinates, taking images, keeping a log, watching the weather, observing calibrators, collecting flats and biases, even starting to analyze the data, and talking about the rationale for each step, kept everyone busy. However, once the science targets were in the bag, we had a little time to exercise the instrument's 20 arcmin field of view on a few targets more visually compelling than point sources. These included nearby galaxies and nebulae—images which will find their way into classrooms and Girl Scout activities. Even minor glitches proved useful as group problem-solving exercises that can be turned into lessons.

Wolf and Kitt Peak Observing Associate, Karen Butler, greeted the educators at the WIYN 3.5-meter during their afternoon calibrations and explained the other part of the science project. "We're studying quasars and the galaxies in which they live using a spectrograph that can look at the various parts of the system simultaneously," explained Wolf. However, she pointed out that given the way she has to use the instrument, she can't calibrate the brightness of the variable quasar component. The educators and I had the job of making this calibration with the other telescope.

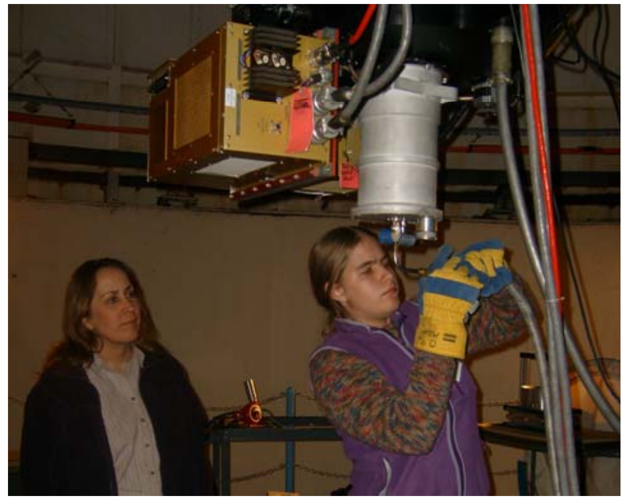


Figure 2: Marsha Wolf (l) and Susan Hollis (r) filling the dewar with LN2. Credit: S. Sims

"To be immersed in this setting, and having time to talk about the educational issues and the kids and getting it across … I am so charged up!" exclaimed Carolyn Hollis. We started discussing educational applications with the natural inclination of astronomers to explore data quantitatively, from altering display parameters, to measuring the sky background, and even some simple photometry of the target quasars. We used the Yale Observatory iMAge Manipulation Application (Yomama), a simple but powerful image display and analysis program written expressly for educational applications by David Goldberg (now at Drexel).

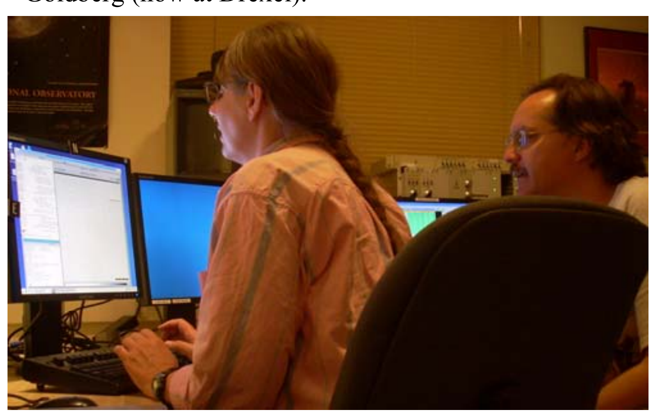


Figure 3: Carolyn Hollis (l), in the driver's seat at the WIYN 0.9-m, as Eric Hooper (r) looks on. Credit: S. Sims

The educators divided these activities by level for their varied students, from third graders through high school Girl Scouts. All three educators also converged on the

A Research Adventure for Tucson Educators, *cont'd*

use of our images to convey ideas about color, from the meaning of intensity values in images of different colors, how to make a true color image, to the need for false color images to represent non-visible radiation. As nascent lessons began to take shape, Susan Hollis pointed out that "we can work with these images on our own also using Gimp, clean them up, combine them."

Manipulating digital images of stunning natural objects provides a segue into art education. Samantha Sims explained that "some of the students come in with a real fear of artistic expression, but if you give them some parameters and a platform to ease them into their creative expression, sometimes it works a lot better." To complete the loop, beautiful celestial images created by students can catalyze an interest in astronomy. Many of these ideas may find expression not only in the classroom but also in a planned national Girl Scout astronomy-themed "Destinations" program for older girls.

Figure 4: Color composite of images of the Veil nebula taken with the WIYN 0.9-m telescope, using Yomama software. Credit: E. Hooper.

Several elements contributed to the success of the venture. First, the project was relatively modest in scope and straightforward in execution, which afforded an opportunity to explore and discuss in a relaxed environment, while still retaining some research urgency.

It also benefited from active and enthusiastic participants, scientists interested and experienced in education and outreach, and the help and support of KPNO and WIYN staff and administration, plus the NOAO Office of Public Affairs and Educational Outreach.

Finally, we would not have gotten off the ground without the financial and logistical support of University of Arizona astronomer Don McCarthy and his NIRCam/JWST education and outreach program for Girl Scouts, plus our University of Wisconsin-Madison collaborator and overall Principal Investigator of the project, Andy Sheinis.~

Family Night at WIYN 0.9-meter: A Huge Success

Hillary Mathis

As the largest telescope with an eyepiece open for Family Night, the WIYN 0.9-meter was very popular with NOAO and NSO employees and their families. Visitors started showing up at 4:30 pm and were treated to a view of the moon. Patricia Knezek talked about the 0.9-meter facility as we ushered people toward the eyepiece.

signs of thinning, it was decided to tackle another object in the sky. The second target was M53, a globular cluster that wowed the visitors. Late in the evening, and with a line of 20-30 people eagerly waiting for their chance to take a look, it was announced that the festivities were coming to a close.

A huge success: Large crowds of Family Night visitors waited in long lines to look through the WIYN 0.9-m eyepiece.

As the afternoon progressed, the sky grew darker and the crowds grew larger, with long lines forming outside the dome. The crowd waited patiently for a chance to see Saturn through the eyepiece. Many wondered if what they were seeing was real —they couldn't believe how sharp the image was. With the crowds showing no

Everyone had a great time and wished they could stay longer and see more objects—perhaps next time. Family Night was sponsored by the NOAO Employees Association and made possible by the efforts of many employee volunteers. We thank everybody who contributed to the huge success of this event. ~