WIYN Observatory

Wisconsin Indiana Yale NOAO

Newsletter

Volume 1, Issue 2, May 2006

Director's News

Everyone I know is super busy and totally caught up in the details of making it through the day or through the week. Nevertheless, we need to stop every once in a while, take a breath, and examine our personal universe. Sure, there are the daily frustrations and painfully difficult aspects of life; we all face those. Progress never seems to be as fast as we would like. And, thankfully, every day there are those wonderful moments that we live for. But, overall, how is the balance? Are we moving toward our goals at an acceptable pace? Many years ago (well, not *that* many!), Caty Pilchowski gave me some very useful advice toward answering this question: don't look back over the last few weeks or months, but integrate over a longer time span, say 1-2 years. You've got to average out the noise. Very scientific…

The paramount reason for WIYN's existence is to provide many of the observing facilities that the Consortium scientists require to meet their research and educational needs. Over the last 6 years, WIYN has initiated many projects to satisfy those requirements, mostly in the form of new instrumentation. Several are complete: WTTM, the Hydra re-build, Cassegrain IAS, Sparsepak, access to NIRIM and OPTIC. For the currently active projects, these newsletters serve to describe their status. And sure, none of them is going as fast as we would like. But, overall, when I look back over the last couple of years, I think the balance has been very good.

As you read the articles submitted by the WIYN staff, try to remember where these projects were a year ago, or maybe two, and I think you'll agree that WIYN is moving toward its goals at a lively pace.~

WIYN Science News

Steve Howell

The three university partners of WIYN, Wisconsin, Yale, and Indiana, have completed their semester 2006B time allocation submissions. The new web form seemed to work well, and only one bug was found by Indiana University. NOAO TAC panels met in early May to determine the fate of the community access to WIYN. Over the next few weeks, Di Harmer and I will get out the boxing gloves, lock ourselves away, and formulate the 2006B semester WIYN schedule. A final version is expected in early June.

WIYN Science Highlights

Using WIYN Hydra spectroscopy, Dr. S. Kafka (former Indiana University graduate student and now REU director at CTIO) and collaborators discovered a very unusual Hα emission line profile in the short period interacting binary star AM Herculis. Their work (*The Astronomical Journal* 2006, 131, 2673) details the triple peaked line profile observed (Fig. 1). It makes a convincing argument that the best interpretation is stellar activity on the low mass M star secondary. This observational study provides the first and best proof of solar-like star-spots and flare activity on a secondary star in such a binary.

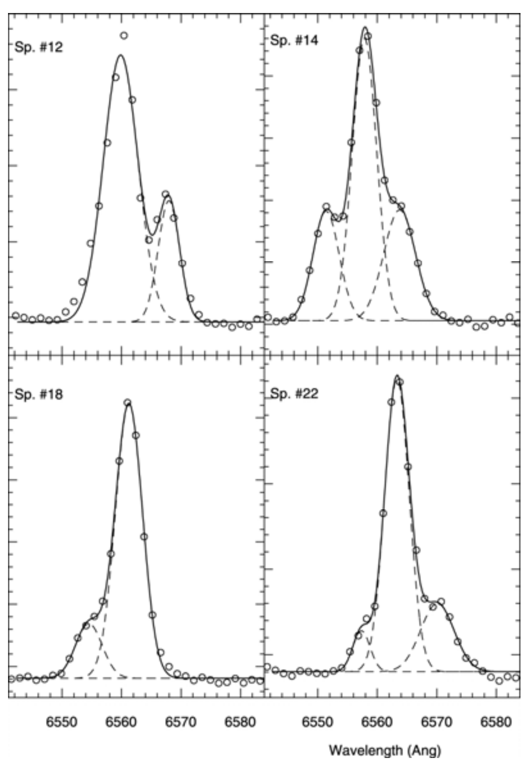

Figure 1: Examples of decomposition of the AM Herculis Hα line profile into two or three Gaussian components. Dashed lines are the individual Gaussians, and solid lines are the sums.

S. Crawford and Wisconsin collaborators have identified a population of luminous compact blue galaxies (LCBGs) in two galaxy clusters. Using narrowband images taken with the WIYN telescope and the Hubble Space Telescope, the authors analyzed their surface densities and clustering properties to find that they comprise a statistically significant portion (42% and 53%, respectively) of the

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WIYN Telescope Report

Heidi Schweiker

Stormy weather ahead as monsoon season approaches.

We are approaching monsoon season at Kitt Peak National Observatory which spans June through September, peaking in mid-July and August. The risk of lightning strikes on the mountain top is high during this time. It is important to remember that if you can hear thunder, there is a risk of lightning strike. Observers and personnel should stay indoors in a safe place, away from doors, computers and phones. The WIYN control room couch area is a safe place to wait out storms. Safe shutdown procedures for the WIYN 3.5-m facility are being revisited and will be published to technical staff in the coming weeks.

0.9-m Operations

The annual 0.9-m consortium meeting will be held this year in Chicago on May 19, 2006. This is a chance for the partners to get together to discuss any operational issues, as well as funding and plans for the coming fiscal year (July 2006 – June 2007).

Improvements have recently been completed on the 0.9-m house, including new drapes and upgrades in the bathroom. Important information and phone numbers have also been posted in both the 0.9m and WIYN houses.~

WIYN Operations

Charles Corson

In January, final steps to fine-tune the WIYN telescope mount and encoders were performed to improve pointing and open-loop tracking. As of April, pointing is now solidly at 1-2 arcsec RMS, with 100% of the 200 data points over the entire sky falling well within a 5 arcsec bulls-eye. Open-loop tracking was measured at less than 0.18 arcsec per minute over a 40 minute test, 10 degrees from zenith, to the north. Shorter tests of 5 to 20 minutes measured less than 0.1 arcsec per minute errors.

HYDRA's gripper, which grabs the fiber's buttons, has undergone a mechanical overhaul. The gripper had become worn after twelve years of service. During the HYDRA II upgrade, the gripper mechanism was not replaced, but simply transferred to the new X/Y positioner. In the months following, most of the mechanical hardware was replaced on the gripper. The last component, the linear z-axis, was replaced this April. This replacement resolves a number of reliability issues and ensures that HYDRA II can continue to provide reliable service in the years to come.

WIYN Operations, *Continued*

Analysis of the WIYN Nasymth port's scattered light performance has been completed. A number of key issues were identified for the full one degree field of view. WIYN staff are now looking at options for an improved baffle design. A number of the scattered light issues can be addressed by a revision of the secondary and tertiary baffle designs. This will improve scattered light performance for MiniMo and QUOTA fields of view. Solutions for the full one-degree field of view are more difficult. It is possible that all specular scattering can be eliminated, with the possibility of some vignetting. Scattered light overall can be reduced by roughly a factor of ten over the full one-degree field of view.

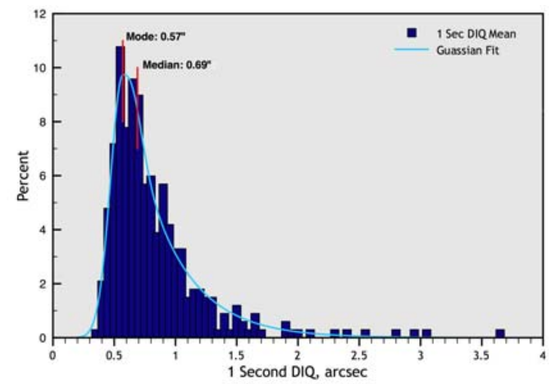


Fig. 1: DIQ Histogram, R-Band 2004 through April 2006

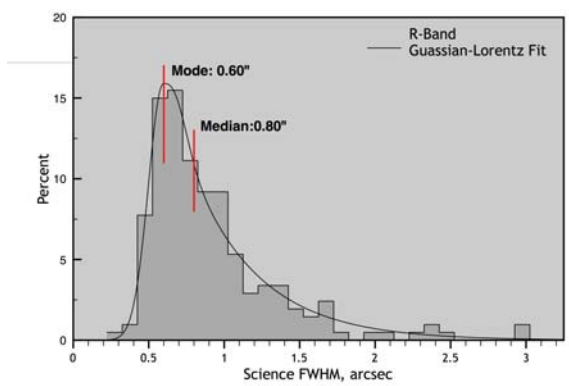


Fig. 2: Histogram of image quality values obtained via science images at WIYN R-Band, 2004—April 2006

I have recently re-compiled the WIYN Delivered Image Quality statistics, or DIQ. A complete discussion of the measurements and the results can be found on the WIYN web page at http://www.noao.edu/wiyn/DIQ.pdf. WIYN can now judge the DIQ statistics (Fig. 1) in comparison to that obtained during real science via a database of science image seeing values that is maintained. The histogram of these values (Fig. 2) indicates a median science FWHM of 0.80 arcsec, and a modal value of 0.60 arcsec, very similar to the DIQ modal value. All values stated here are for the R-Band only, and cover the time period of 2004 through April 2006.~

WHIRC Is Under Construction...

Margaret Meixner (STScI, PI) & Patricia Knezek (WIYN, co-I)

Figure 1: The dewar casing for WHIRC without the cold plate as machined by the Johns Hopkins University Instrument Development Group (JHU/IDG).

The WIYN High Resolution Near-Infrared Camera, or WHIRC, is an instrument that is being built as a collaborative effort by the Space Telescope Science Institute (STScI), WIYN, the Johns Hopkins University (JHU), the University of Wisconsin, and NOAO. WHIRC will be mounted on WTTM and will provide nearly diffraction-limited imaging (with 0.1” pixels) over a field of view of ~3.3 arcminutes. This resolution is well matched to the resolution of QUOTA, allowing for complementary optical and near-infrared studies.

Margaret Meixner (STScI) is the Project Scientist. Instrument design, fabrication, assembly, and testing are being coordinated through the Instrument Development Group (IDG) at JHU. The MONSOON controller is being contributed by NOAO. STScI, Wisconsin, WIYN, and NOAO are contributing to the software development. The project is fully funded, and passed its hardware and electronics critical design review in July of 2005. The software development plan passed an interim review in February of 2006.

Recent progress includes the release of NSF funds for a successful proposal led by Ed Churchwell at Wisconsin to partially fund WHIRC. These funds will reimburse WIYN for the bulk of the cost of the IR detector array, and fund much of the hardware and optics for WHIRC. Some labor is also included. As a result, WHIRC has begun its construction phase (see Figure 1).

The team has procured all of the optics, which require long lead times. The team has also finalized with the vendor a design for the dichroic that will be used to send most of the optical light to the WTTM tip-tilt mirror, while allowing the near-infrared light to pass through to the detector.

The WHIRC team has received bids for the selected filters. A total of 13 filters will be available, including the standard broadband J, H, and K_s and a selection of narrowband galactic and extragalactic filters (see Table 1 for a listing of the filters). The vendors were unwilling to sign up to the stringent specifications for the narrowband filters without a significant increase in cost. The SAC discussed the impact of the specifications that the vendor would sign up to and concluded that there would be too much wavelength overlap between the galactic and extragalactic filters. Thus, they recommended that the extragalactic filters be shifted to slightly higher wavelengths such that the overlap would be at no more than the 1/4 power point. This recommendation has been passed along to the WHIRC team. Recently, however, a detailed ghosting analysis revealed a potential issue with ghosting. Procurement of the filters is on hold until the options have been studied and a solution is identified.

Table 1: Filter selected for WHIRC

Science Use	**Filter**	**λ_0 (μm) CWL**	**$\Delta\lambda/\lambda$**	**FWHM (microns)**
Galactic galaxies, high-z	**MKO J**	**1.25**	**0.128**	**0.16**
Galactic galaxies, high-z	**MKO H**	**1.635**	**0.177**	**0.29**
Galactic galaxies, high-z	**MKO K_s**	**2.15**	**0.149**	**0.32**

Science Use	**Filter**	**λ_0 (μm) CWL**	**$\Delta\lambda/\lambda$**	**FWHM (microns)**
Galactic	**HeI**	**1.083**	**0.01**	**0.0108**
Galactic	**Pa β**	**1.28395**	**0.01**	**0.012839**
Galactic	**[FeII]**	**1.64629**	**0.01**	**0.016463**
Galactic	**H_2**	**2.12**	**0.01**	**0.0212**
Galactic	**Br γ**	**2.16**	**0.01**	**0.0216**
Galactic galaxies	**CO**	**2.295**	**0.01**	**0.02295**
galaxies	**Pa β cont/red-shift ~4500 km/s**	**1.30321**	**0.01**	**0.0130321**
galaxies	**[FeII] cont/red-shift ~4500 km/s**	**1.67098**	**0.01**	**0.0167098**
galaxies	**Br γ cont/red-shift ~4500 km/s**	**2.1924**	**0.01**	**0.021924**
high-z	**Low airglow 100 Ang. Wide**	**1.061**	**0.013**	**0.013793**

During the February T&E, some initial testing of WTTM was completed. These tests were done through remote commanding of WTTM, a new software implementation that is necessary for WTTM to interact optimally with WHIRC. The two primary sets of tests indicated that (1) it will be possible to perform some dither patterns (~5” moves per dither) using the WTTM tip-tilt mirror, and (2) it may be possible to commission the WTTM focus sensors to allow for continuous focus-tracking. All of this is very good news to the WHIRC team.

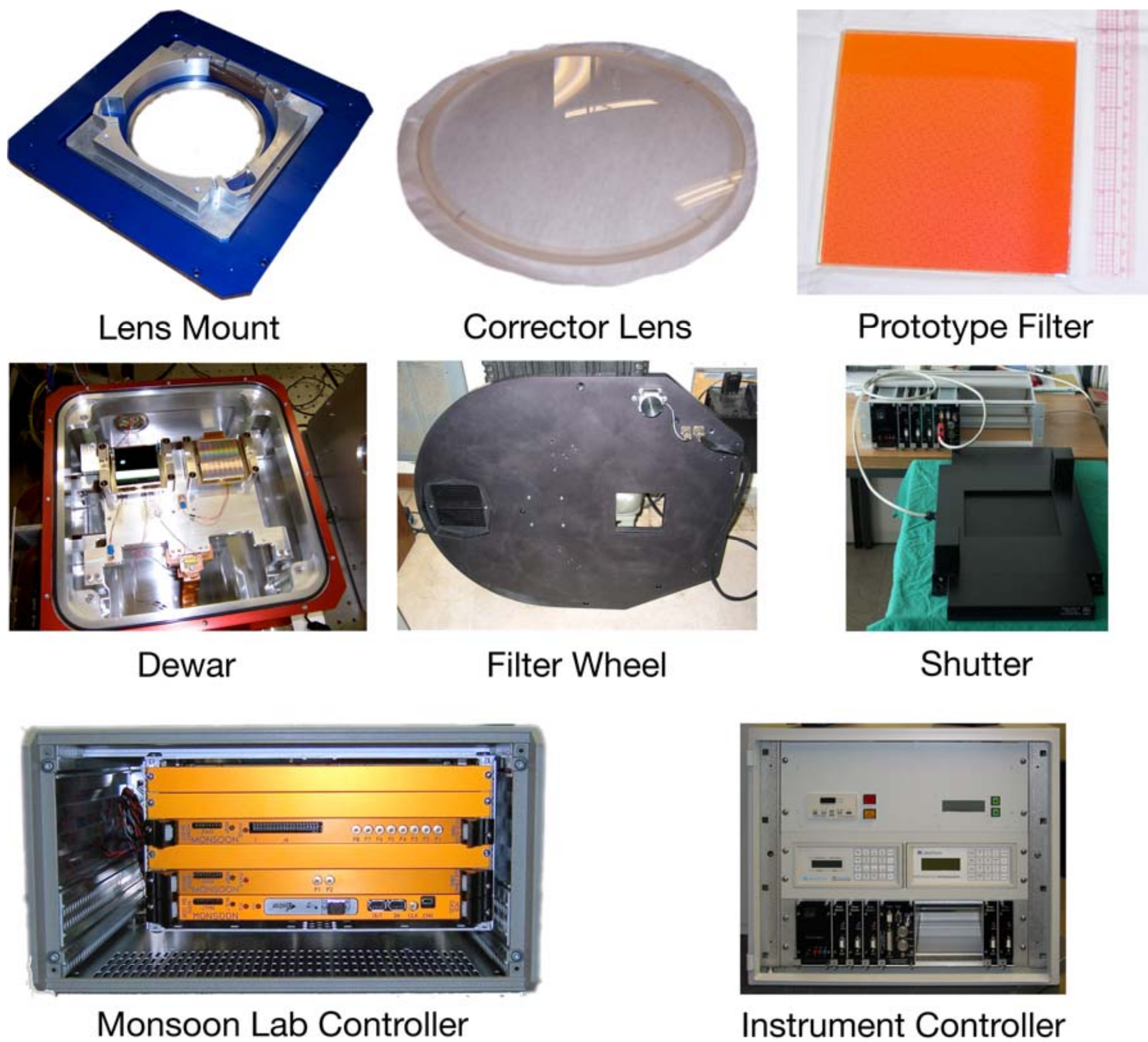
The WHIRC team is currently finalizing the electronics layout for the WHIRC system, including connectors, pin-outs, and so forth. This is a necessary step to allow the completion of the WHIRC MONSOON system, so they are interfacing with NOAO to facilitate this process. We hope the final MONSOON system will be ready to go with in the next few months.~

QUOTA and ODI News

George Jacoby & Daniel Harbeck

As reported in the March Newsletter, we were waiting for a few key parts before we could begin to test QUOTA. These were the corrector lenses, the filter wheel, and the Sloan science filters. More importantly, we also had not yet demonstrated the OTA detectors or the MONSOON CCD controller. As of mid-May, though, we have received the lenses and the filter wheel, and both are undergoing final testing before acceptance (See figure below). Also, we successfully demonstrated that the MONSOON electronics can read out the OTA CCDs, and that the CCDs work at some level. Because this development only occurred in the last couple of days, we have not begun to optimize the CCD performance. We will enter that phase soon, and should be able to report their characteristics in the next Newsletter. We also have begun developing the software to perform the fast guiding that is unique to OT CCDs, and have shown that the analysis phase of the guide loop runs at 1000 Hz, easily exceeding the speed requirement.

The NOAO Newsletter for June 2006 has a more extensive description of the status of QUOTA and ODI. We are currently planning to hold the ODI Preliminary Design Review (PDR) around June 29. This will be a major milestone in the life cycle of the project, as it simultaneously serves as the Critical Design Review (CDR) for the optical corrector. At that point, the project begins to make major purchases for the lenses and filters for ODI, funded largely through our TSIP award.~



QUOTA parts in the WIYN lab: The lens mount for two corrector lenses (one is shown). One will serve as the window of the dewar. The filter wheel will carry up to eight filters. The Bonn shutter allows very short exposures with homogeneous illumination of the focal plane. The instrument control box will deliver telemetry, control the focal plane temperature, and the filter wheel interface.

Bench Upgrade Project

Matthew Bershady (U. Wisconsin) & Patricia Knezek (WIYN)

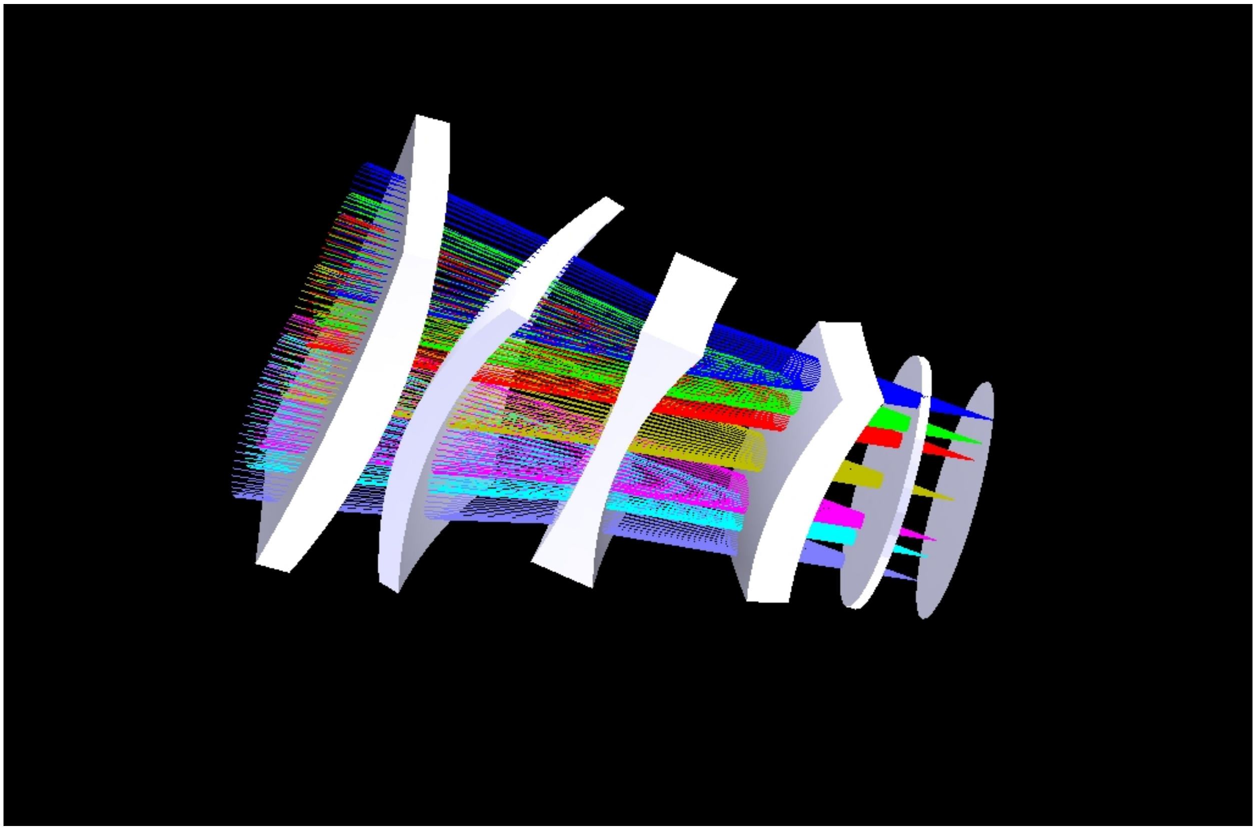


Figure 1: Solid rendering of the 4-element, tilted, all-glass, all spherical corrector for the new Bench collimator, showing clear and physical apertures. (Two ellipsoidal disks at right represent fiber slit and filter planes.) The model optimization, final specification, and initial tolerancing were completed on 14 April 2006. Credit: C. Harmer.

The Bench Upgrade Project has been very active over the past several months, with a second visit in mid-April by the Project Scientist, Matt Bershady. The highlights during this time include the completion of the first phase of the optical design, beginning work on the opto-mechanical design, and the on-sky testing of our new, high-density Volume Phase Holographic (VPH) grating – the second from CSL.

Optical design. In mid-April, optical designer, Charles Harmer, completed the optimization and initial tolerancing of his clever off-axis collimator and corrector design. This unique approach (see Figure 1) removes vignetting of the fiber foot, balances the placement of the spatial pupil in the system, and captures more of the light, while preserving image quality to within 10% of an ideal system. With the excellent broadband coatings now available, the throughput improvement is expected to be over a factor of two (!) for fibers near the end of the slit.

Mechanical design. With help of mechanical engineer Joe Keyes, we have begun developing a solid model of the spectrograph and a concept-level design for the collimator + corrector housing. This marks a new phase of the project – one that will allow us to move forward towards fabrication and a layout of the upgraded system in the spectrograph room.

VPH testing. With a heroic effort from Di Harmer and Gene McDougall, we were able to test the new 3300 l/mm VPH grating from Centre Spatial de Liège (CSL) during April Testing and Engineering time on the 3.5m telescope – 6 weeks after the grating arrived from Liège. Many thanks are due also to Gary Poczulp, Roger Repp, and Ron Harris for "coming through" with a quick, but superb test-jig for the largest astronomical VPH grating ever made! On-spectrograph tests of the un-coated grating at 510 nm revealed excellent image quality, super-blaze diffraction-efficiency nearly twice that of the on-order echelle (with much less vignetting!), but with some enhanced scattered light. On-sky measurements yield an absolute calibration, yielding a peak throughput of 10% for the total system (including telescope and atmosphere at 1 airmass, see Figure 2). We expect performance will improve 10-20% with application of suitable AR coatings, which we are now exploring. These results augur a promising future for VPH gratings on WIYN.

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WIYN Science News, *cont'd from page 1*

Figure 2: The WIYN 3.5-meter telescope showing the HYDRA Multi-fiber spectrograph front end attached to the side port. The metal cable coming from the instrument contains the fiber bundle that is routed to the telescope basement and connects to the bench mounted spectrograph.

Butcher-Oemler (BO) galaxies in both clusters and that their spatial distributions are best characterized by a shell model (*The Astrophysical Journal* 2006, 636, 13).

Selected objects from the ChaMPlane (Chandra Multiwavelength Plane) Survey toward the Galactic anticenter were spectroscopically observed at WIYN. The objects were optically identified using the NOAO Mosaic cameras and other instruments. A. Rogel and collaborators from Indiana University and other institutions reported their findings (*The Astrophysical Journal Supplement Series* 2006, 163, 160). They presented spectroscopy for 1069 objects: including 5 new cataclysmic variables, 4 Be stars, 14 lithium-absorption stars, 182 stellar coronal sources (primarily dMe stars), and 30 new quasars.

Continuing the work on the Local Group Galaxies, P. Massey and collaborators presented a detailed photometric study of stars in M31 and M33. WIYN Hydra spectroscopy (Fig. 2) was used to examine the brightest likely members of M31. The spectra identify 34 newly confirmed members, including B-A supergiants, the earliest O star known in M31, and two new luminous blue variable candidates whose spectra are similar to that of P Cygni. For more details, see the full article (*The Astronomical Journal* 2006, 131, 2478).

If you have a WIYN Science Highlight, send it along to Steve Howell at howell@noao.edu or contact a member of the *WIYN Newsletter* staff listed below.~

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Bench Upgrade Project, *cont'd from page 5*

New Detector/Controller/Dewar for the Bench Spectrograph. The KPNO engineering staff reports that progress continues toward characterizing a replacement CCD and controller for the Bench. Currently, we are using a 20-yr old KPNO controller after the Arcon died. It is running T2KA, a 2Kx2K CCD, after T2KC died. Engineering soon will be validating the performance of a Lincoln Laboratory 2Kx4K with an NOAO MONSOON controller. The controller has been assembled and tested by Tom Wolfe. A mount for the CCD is being designed by Derek Guenther. In related news, Mike Lesser has demonstrated very promising performance for the 2.6Kx4K CCDs from our OTA foundry run. The first of these should be available by the time of the next Newsletter. These CCDs should be suitable for the Bench if the Lincoln CCD does not meet our expectations.~

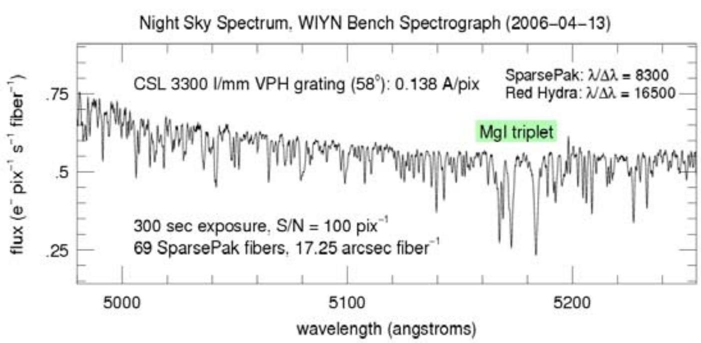

Figure 2: The night sky spectrum near full moon at R = 8300 in 5 minutes integration using SparsePak and the new 3300 l/mm VPH grating from CSL. Note the strong, narrow MgIb solar features at ~517 nm. Standard-star measurements indicate a peak total system throughput of 10%. Dome-flat comparisons to the echelle at the same central wavelength (middle 11th order) yielded about a factor of two increase in throughput at close to the same dispersion.