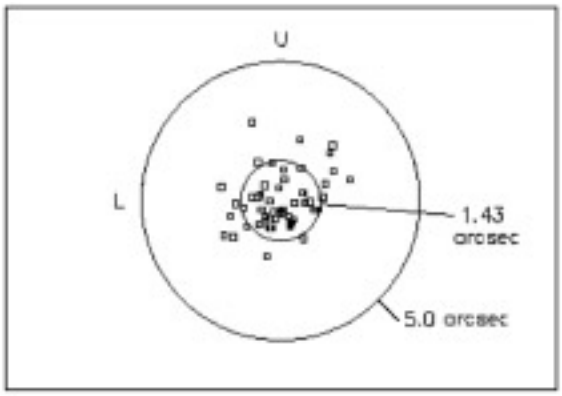
KPNO
Operations

WIYN—Still Getting Better!

Charles Corson, Dave Sawyer, and George Jacoby

The December 1999 and March 2000 *NOAO Newsletter* reported improvements in the performance of the WIYN telescope and noted that further work was in progress. We report here on some new results.

- The tertiary mirror support was designed to be supported by an airbag system, but the original design never worked. Instead, the tertiary was supported on hard points and the dominant optical errors were removed via the active optics support system of the primary, leaving high-order aberrations in the optics and some instability with position. We installed a new airbag system during the August shutdown and noted immediate reductions in wavefront errors of about ~15%.
- Though a statistical analysis of the delivered image quality (DIQ) is not yet available, observers report an increase in the frequency of 0.5 to 0.7″ images (in 5 to 20 minute exposures) since September. We will report current seeing statistics in a future newsletter.
- An autofocus Shack-Hartmann device has been put into routine operation to track the telescope focus errors with normal guide stars. During a recent run, the focus sensor maintained the telescope focus in 0.7″ seeing for over three hours.



Open-loop tracking and target acquisition have been significantly improved at WIYN with an improved pointing model. The residual pointing error scatter diagram from TPOINT shows an all-sky rms error of only 1.43″ (59 random sky points).

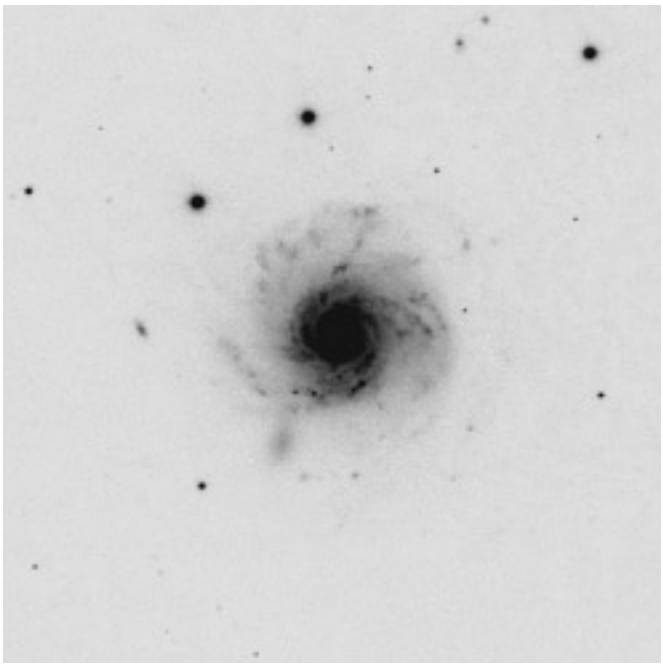


Image sizes of 0.36″ FWHM are seen in this 225-second I-band exposure of NGC 7620, a nearly face-on Sc-type spiral galaxy, which was observed with Mini-Mosaic by M. Bershady (Wisconsin) and colleagues as part of a program supported through NOAO time to study galaxy disk distortions. A companion 225-second R-band exposure taken during the same observing run in 2000 October showed 0.40″ images.

continued

WIYN continued

- Telescope pointing also affects the DIQ via tracking errors, a particular problem for altitude-azimuth telescopes. Pointing was improved significantly at WIYN by using an improved model for tilt in the azimuth axis. The all-sky pointing error was reduced from ~5″ to ~1.5″. The improved open-loop tracking was evident when Elliott Horch and William Van Altena (Yale) noted 0.26″ images with their speckle camera for 0.5-sec exposures at 6475Å.

While it is too soon to assess how much better the images at WIYN are now, predictions suggest that the median DIQ will drop about 0.1″, to below 0.7″. Can the image quality be further improved? The answer is probably yes. We are aware of several major heat sources on the telescope that are degrading the dome seeing. A project scheduled for the coming year is aimed specifically at removing unnecessary heat.

Other major improvements planned at WIYN during the coming year include:

- Hydra upgrade to speed up positioner by more than a factor of 2. Setup times should decrease from 25 minutes to 10 minutes.

- Development of the Cassegrain (f/13.5) port to allow three instruments to be always "live" at the flip of the tertiary mirror.

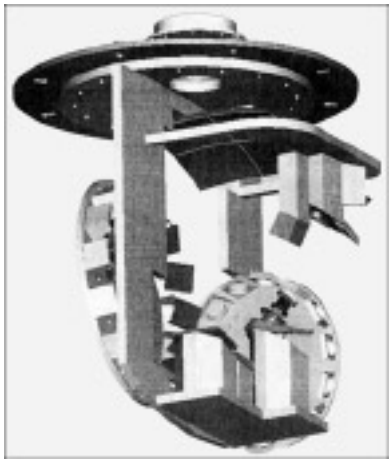
An IR Multi-Object Spectrometer for KPNO

Bruce Bohannan, Richard Green, and John W. MacKenty

STScI , Goddard Space Flight Center (GSFC), and KPNO have begun a collaboration to build an infrared multi-object spectrometer using micro-mirror arrays. IRMOS, the InfraRed Multi-Object Spectrometer, will be a pathfinder instrument for the Next Generation Space Telescope (NGST) and will offer resolutions ranging from 300 to 3000 in the 1- to 2.5-µm bands. Now nearing the end of its design phase, IRMOS will be deployed on Kitt Peak in 2002.

The innovative aspect of IRMOS is the demonstration of micro-mirror arrays (MMA), micromechanical electrical systems also known as digital mirror devices (DMD). IRMOS will use a commercial Texas Instruments DMD with 16-µm square aluminum mirrors in an 848×600 array. The common application of these devices in video projectors leads to a critical feature—that they must be free of defects, which makes them excellent as a programmable spectrograph "slit." The array will be used in reflection, where each mirror is individually addressed to synthesize entrance slits of almost any shape required. Electrostatic actuation latches mirrors into *on* or *off* states, where they can be held essentially

continued



IRMOS is an infrared multi-object spectrometer proposed by John Mac Kenty (STScI) as a facility instrument for Kitt Peak.

IRMOS continued

indefinitely (whereas the array is refreshed at 1 kHz in projection displays). Slits in a variety of sizes in multiples of 0.20″ (at the Mayall 4-m) and numbering from a few to more than a hundred can be tailored to targets in less than a minute.

A 1- to 5-μm multi-object spectrometer was selected as one of three science instruments proposed for NGST. Prototypical science programs required spectroscopy at 0.1″ spatial resolution over "as large a field of view as possible," a reflection of the relatively low space density of "interesting" objects. The design field-of-view of the NGST-MOS is 4.1′ × 2.7′. Micro-mirror arrays are the perfect device for achieving multi-object spectroscopy in a space environment, where aperture masks and fiber systems are not viable. For NGST, MMAs with array sizes of 1K square are required. GSFC is now developing prototype devices to identify technology challenges and to limit design phase space.

John MacKenty (STScI) is the principal investigator for IRMOS. Personnel at STScI are undertaking the design of optics, software, and electronics. GSFC is responsible for instrument design, fabrication, and system integration. KPNO is providing design support, telescope time, science operations support, and a Rockwell HgCdTe 1024-square detector.

Please contact John MacKenty (*mackenty@stsci.edu*) for more information.

Protecting the Dark Skies around Kitt Peak

John Glaspey and Richard Green

Kitt Peak has benefited greatly from the City of Tucson and Pima County lighting codes that minimize the impact of the lights from the metropolitan area. Kitt Peak is actually located in the Tohono O'Odham Nation, some 50 miles west of Tucson. We are pleased to report that lighting for the new sports field at the Indian Oasis Baboquivari High School has been carried out keeping in mind the protection of dark skies. Lights were added to the football field of the new site of the high school in Topawa, about 17 miles by air from Kitt Peak. Jerry Carlyle, Director of Operations for the school district, requested information from KPNO as to what type of lights would have the least negative impact on the scientific operations at the observatory.

Jerry Carlyle, Director of Operations for the Indian Oasis Baboquivari Unified School District, was instrumental in ensuring that the lights installed at the new high school sports field did not brighten the relatively dark skies of Kitt Peak.

Once the lights were installed, we were treated to a demonstration of how the new lights looked as viewed from Kitt Peak. The results are impressive. Although the lighted field could clearly be seen from the mountain, the lights themselves were carefully aimed and well shielded, so that light is directed onto the ground, not into the sky. While we made no quantitative measurements, the impact of the new facility on observing will clearly be negligible.

We compliment Mr. Carlyle and the administration of the School District on their neighborly concern for the scientific productivity of Kitt Peak.