NSO National Solar Observatory

From the NSO Director's Office

Steve Keil

Working with a broad segment of the solar community, NSO has focused its efforts this past year on the Advanced Technology Solar Telescope (ATST) design and development (D&D) phase proposal. The ATST is currently envisioned as a 4-meter, off-axis, reflecting telescope equipped with adaptive optics (AO), active thermal control, and low-scattered-light optics. It will be designed to work from the near UV (~300 nm) to 35 μm. A versatile set of reconfigurable polarization optics, filters, and spectrographs will be developed as focal plane instrumentation and will permit spectroscopy, narrow-band imaging, and polarimetry in the visible, near-IR, and thermal-IR.

The first goals of the development and design phase will include establishing telescope requirements based on science objectives, site survey and selection, fleshing out the telescope concept, and technical trade studies for critical components (e.g., primary mirror, heat rejection and cooling systems, and adaptive optics). Following a successful concept design review, a preliminary design will be developed and reviewed. The last phases of the D&D effort will be to develop the final design for the telescope and instrumentation. One of the major objectives of the D&D phase is to provide a well-costed proposal for ATST construction and operation. There will be substantial emphasis on selecting, designing, and costing the instrumentation needed to meet the science objectives. You can obtain additional information at the ATST Web site at *http://www.sunspot.noao.edu/ATST*. If you would like to read the proposal for the telescope, send an e-mail to *nso@noao.edu*.

The joint NSO, New Jersey Institute of Technology/Big Bear Solar Observatory (NJIT/BBSO), Kiepenheuer Institute for Solar Physics (KIS), and USAF Research Laboratory proposal to develop high-order adaptive optics systems for the Dunn Solar Telescope (DST) on Sacramento Peak, the 64-cm Big Bear Solar Observatory telescope, and the planned 1.5-m GREGOR telescope on Tenerife has been funded by the NSF/MRI (Major Research Instrumentation) program. The proposal includes cost sharing of about $1M by NJIT, NSO, and KIS. Recruitment of staff and design development for the high-order systems have begun. The program will result in AO systems for each of the telescopes with approximately 80 degrees of freedom. It will also serve as proof-of-concept for a scalable AO design for the much larger ATST. A low-order (24 degrees of freedom) system is currently available to support high-resolution observations at the DST.

NSO and the High Altitude Observatory (HAO) have begun a team effort to upgrade the Advanced Stokes Polarimeter (ASP) to match the resolution limit of a dedicated AO system.

The first round of public outreach exhibits at the NSO Visitor Center in Sunspot, NM, will soon be complete. The exhibits cover topics ranging from general galactic and extra-galactic astrophysics to the role of the Sun in sustaining life on Earth. Properties of light, the solar system, the Sun and stars, and telescopes are discussed. Most of the demonstrations are hands-on and have proven to be very popular with school groups and the public. There will soon be a light feed for a live solar image and a solar spectrum inside the center. NSO is now making movies of the full-disk Hα patrol available in near real-time at its Web site (*http://www.sunspot.noao.edu/)*. The

continued

Director's Office continued

exhibits represent a joint effort of NSO, Apache Point Observatory, and the US Forest Service. The effort is led by Ray Smartt.

Programmatic separation of NSO from NOAO is reinforced in NSO's Provisional Program Plan for FY 2001. The plan, available at *http://www.nso.noao.edu*, outlines NSO's strategy for completing SOLIS and GONG^{++}, for continuing telescope operations, and for starting on the ATST program. ATST site testing instrumentation is being developed using NSO base funding and should be ready for deployment this coming spring.

We're pleased to announce the hiring of Brady Jones for our computer system administrator position at Sacramento Peak. Jones will be responsible for computing and network system operations and maintenance at the Peak. He and his wife come to us from St. Louis, where Brady has worked for the Air Force and Citibank Mortgage. Brady's SUN Solaris and Windows NT experience should serve him well at NSO.

Sankarasubramanian Kasiviwanathan (Sankar) has recently joined the Sac Peak staff as a postdoctoral research associate. Sankar was a graduate summer research assistant at NSO in 1999 and received his Ph.D. this year from the Indian Institute of Astrophysics in Bangalore. He has a sound background in solar instrumentation and experience with polarimetry in particular. Sankar will work with Thomas Rimmele and Michael Sigwarth on reducing spectro-polarimetric data recorded recently at the DST using the adaptive optics system. He will also participate in the development, testing, and scientific use of a new, high-resolution polarimeter that is currently under development at NSO, in collaboration with HAO.

We also welcome to the NSO–Tucson staff Elena Malanushenko as a KPVT observer and data analyst. Elena has worked as an observer and staff member at the Crimean Astrophysical Observatory and is completing her doctoral dissertation on observations of solar activity in He I 1083 nm. In addition to her observing and data reduction duties, she will continue her research and collaborate with Harry Jones on new studies of the 1083 nm line.

New NSO Users' Committee

Steve Keil

The membership of the NSO Users' Committee has changed with the start of the new fiscal year. Members of the new committee are:

Thomas Ayres, Chair (Colorado, CASA)
Thomas Berger (Lockheed Martin, Palo Alto)
Timothy Brown (High Altitude Observatory/NCAR)
Philip Goode (New Jersey Institute of Technology/Big Bear Solar Observatory)
Ernest Hildner (Space Environment Center, NOAA)
Donald Jennings (NASA Goddard Space Flight Center)
Kimberly D. Leka (Colorado Research Associates)
Douglas Rabin (NASA Goddard Space Flight Center)
Edward Seykora (East Carolina)
Gregory Ginet, *ex-officio* (Air Force Research Laboratory/VSBS)
Daniel Weedman, *ex-officio* (National Science Foundation)

Thomas Duvall (NASA/GSFC at Stanford), Richard Shine (Lockheed Martin), and Rita Sagalyn (Air Force Research Labs/VSBS) have completed their terms on the committee. We wish to thank them for their contributions as members during the past three years.

NSO 20th Annual International Summer Workshop

Michael Sigwarth

The 20th NSO–Sac Peak Summer Workshop on "Advanced Solar Polarimetry—Theory, Observation, and Instrumentation" was held 11–15 September 2000 at Sunspot, NM. There were 80 participants, more than half of whom were from overseas—China, Finland, France, Germany, India, Japan, Netherlands, Russia, Saudi Arabia, Spain, and Switzerland.

Solar activity and variability are driven and controlled by magnetic fields. Polarimetry—analysis of the polarization state of light from the Sun induced by the presence of magnetic fields in the solar atmosphere—is one of the most important tools for obtaining information on the magneto-hydrodynamic processes on the Sun.

The previous NSO summer workshop on solar polarimetry was held ten years ago. Since then, major progress has been made and new research fields in this area have opened. Theoretical models and "numerical experiments" have become important tools for understanding and predicting fundamental physical processes involving solar magnetic fields. In the past, most polarimetric investigations were based on the Zeeman effect. Atomic polarization and the Hanle effect have since become important tools for investigating very weak magnetic fields on the solar surface. The goal of this year's workshop was to present an overview of new research areas and the latest results and developments, including instrumentation, and to develop a perspective on solar polarimetry for the next decade.

Michael Knölker (HAO) opened the workshop with provocative comments, encouraging theoreticians, observers, and instrumentalists to go beyond the boundaries that are often based on traditions descended from the "solar grandfathers." High-resolution polarimetry, for example, should no longer focus on the photon mean free path, but on the MHD scale models that are predicted to be significant for the formation of flux tubes as small as a few kilometers.

The solar community acknowledges that the time is ripe for new, sophisticated instrumentation like the Advanced Technology Solar Telescope (ATST), with a minimum 4-m aperture and fully corrected by a high-order AO system, which is being pursued by NSO and its partners. Other key issues are the need for three-dimensional numerical MHD codes, the need to measure the vector magnetic field in the corona which may well be a potential source of surprises, and the need for extremely high spatial and spectral resolution in polarimetric measurements.

20th NSO Summer Workshop participants in front of the Sunspot Astronomy and Visitor Center. (Photo by T. Brown, NSO)

continued

NSO Workshop continued

The workshop was thematically organized in the following sessions: New Instrumentation, Weak Polarization and Coronal Magnetic Fields, IR Polarimetry and the Physics of Active Regions, MHD Simulations, High-Resolution Polarimetry and the Physics of Flux Tubes, and the Analysis of Stokes Profiles.

A. Van Ballegooijen (Harvard) concluded the meeting with a summary of the scientific discussions that took place during the four-day workshop. The quality of contributions during the week was *perhaps* most aptly described by Rob Rutten (Utrecht): "There was no boring talk so that I could take a nap."

There were several social events during the workshop, including a classic Sac Peak barbeque; an evening slide show by Bill Livingston (NSO), Cao Wenda (Beijing), and Yuanyong Deng (Beijing) of their recent "seeing" tour of the Himalayas; and an evening picnic on the gypsum dunes at White Sands National Monument.

This successfully stimulating week of scientific exchange was made possible by the tireless efforts of Rebecca Coleman and members of the local organizing committee, as well as the NSO–SP staff who kept everything running smoothly from behind the scenes. The workshop was sponsored by NSO, the National Science Foundation, National Aeronautics and Space Administration, and the US Air Force Office of Scientific Research through its European and Asian offices. The workshop proceedings will be edited by M. Sigwarth and published in the ASP Conference Series. A more extensive version of this article, with details on the session discussions, can be found at *http://www.sunspot.noao.edu/INFO/MISC/WORKSHOPS/index.html*.

Workshop participants "on the beach" at White Sands National Monument.

SOLIS

Jack Harvey

The SOLIS project continues to make progress toward initial operational capability in 2001. Major milestones since the last newsletter include the following:

- Power has been applied to the drive motors of the mount, which is now temporarily located at the GONG prototype site a few kilometers from the Tucson offices.
- Uncertain delivery of custom CCD cameras for the highest priority instrument, the Vector Spectromagnetograph (VSM), is a matter of serious concern. Several options to acquire usable cameras are being explored. The positive aspects of this situation are that the vendor demonstrated a fully functioning front-side illuminated CCD that exceeded performance requirements, and that construction of the first camera housing and its contents appears to be making good progress.
- The VSM entrance window was mounted in its cell and then tested for birefringence and wavefront distortion; it met optical requirements. Completion of the silicon secondary mirror of the VSM telescope was delayed by a problem with pits and scratches in final polishing, which was solved by the vendor. The main housing of the VSM is being machined at a local shop and is on schedule. Numerous VSM mechanisms are being exercised under software control, and the cooling system is an active area of work. A commercial data acquisition board has been programmed to receive the huge flow of data from the VSM.
- The Integrated Sunlight Spectrometer was little used because of the summer monsoon and also because the heliostat light feed was not working correctly. Both of these impediments have been removed and observations intended to cross-calibrate with existing monitoring programs are planned for the near future.
- The objective lens of the Full Disk Patrol (FDP) has been assembled, tested, and mounted. The 1083 nm birefringent filter is being modified for use in the FDP. Design of the tunable filter covering 390–670 nm is complete, as is the design of all of the mechanical portions of the FDP. Many components are now being built. A shutter system, made available by the kind cooperation of the solar group at Lockheed Martin, has been duplicated and successfully tested. Delivery of the CCD cameras for the FDP is expected momentarily, and some custom optics are still on order.
- The software group is testing the flow of data from the VSM through to quick-look reduced magnetograms. This is being done using a simulated full disk magnetogram with polarized spectral line profiles at every arcsecond of the disk. A problem with implementing the Storage Area Network (SAN) that stores data was identified and is being resolved with the vendor of the SAN.

Three REU summer students completed their work that supported SOLIS activities. Two engineers from China visited the SOLIS project and assisted with filter design and software issues. Prof. T. Sakurai, Director of the Solar Division of the National Astronomical Observatory of Japan, is visiting NSO and has proposed a new method for resolving the azimuth ambiguity that affects transverse magnetic field measurements. Contacts have been made with experts in Stokes profile inversions at HAO to foster cooperation in using their community codes to reduce SOLIS data.

McMath-Pierce East Auxiliary Telescope Upgrade Nears Completion

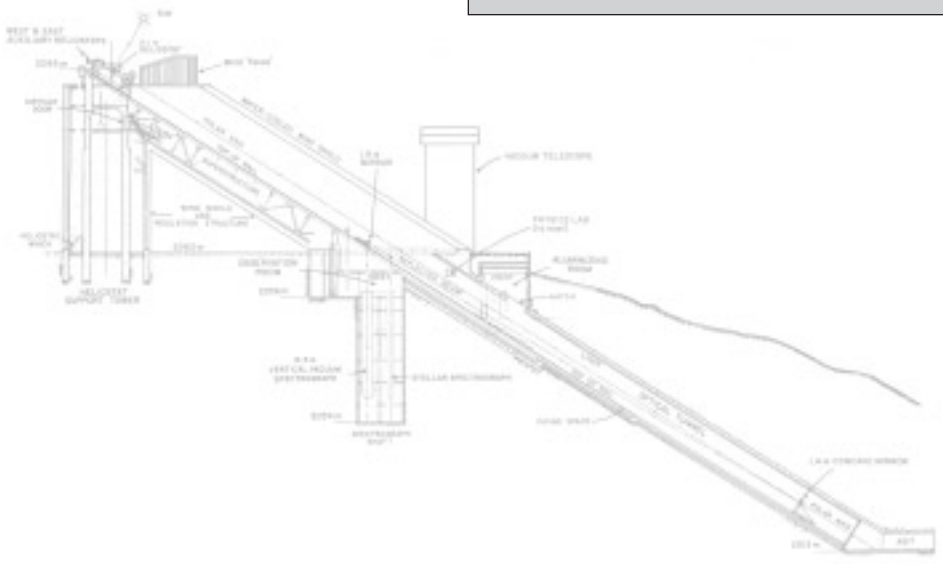
Claude Plymate, Teresa Bippert-Plymate, Christoph Keller, and Andrew Potter

The McMath-Pierce east auxiliary telescope (McMPE) upgrade is nearing completion. All of the major refits and upgrades are completed. The final details are now being addressed. The original right ascension (RA) bearing has been replaced and a second bearing was added to help support the polar axis. All new digital drives and encoders have been installed in both the RA and declination axes. Gone is the old weight-dangling-from-the-RA cable wrap preload. In its place is a new chain-driven electrical preload. The telescope is now fully computer controlled. The #2 (imaging) mirror focus and collimation adjustments have been motorized with encoders installed for easy, in-the-observing-room collimation and computer-controlled slew-to-focus. There is also a remote control console in the FTS room. This upgrade was funded by a NASA grant for a proposed near-earth object (NEO) follow-up study and was carried out by DFM Engineering, Inc., in Longmont, Colorado.

Funds have just been received from NASA for a prototype camera system. This CCD camera will be used with the McMPE for the proposed near-earth object astrometry project. The objective of this study will be to refine the orbits of newly discovered objects, and improve and maintain the orbits of known near-earth objects.

How to Contact the National Solar Observatory

The Web	http://www.nso.noao.edu
Questions	nso@noao.edu
E-mail a Staff Member	first initial+last name@noao.edu



NSO Observing Proposals

Dick Altrock

The deadline for submitting observing proposals to the National Solar Observatory is 15 February 2001 for the second quarter of 2001. Forms and information are available from the NSO Telescope Allocation Committee at P.O. Box 62, Sunspot, NM 88349 for Sacramento Peak facilities (*sp@sunspot.noao.edu*) or P.O. Box 26732, Tucson, AZ 85726 for Kitt Peak facilities (*nso@noao.edu*). A TeX or PostScript template and instruction sheet can be e-mailed at your request; obtained by anonymous FTP from *ftp.sunspot.noao.edu* (cd *observing_templates*) or *ftp.noao.edu* (cd *nso/nsofor*ms); or downloaded from the WWW at *http://www.nso.noao.edu/*. A Windows-based observing-request form is also available at the WWW site. Users' Manuals are available at *http://www.sunspot.noao.edu/telescopes.html* for the SP facilities and *http://www.nso.noao.edu/nsokp/nsokp.html* for the KP facilities.

NSO Telescope/Instrument Combinations

Dunn Solar Telescope (SP):

Echelle Spectrograph
Universal Spectrograph
Horizontal Spectrograph
Universal Birefringent Filter
Fabry-Perot Filter System
Advanced Stokes Polarimeter
Slit-Jaw Camera System
Correlation Tracker
Branch Feed Camera System
Horizontal and Vertical Optical Benches for visitor equipment
Optical Test Room

Evans Solar Facility (SP):

40-cm Coronagraphs (2)
30-cm Coelostat
40-cm Telescope
Littrow Spectrograph
Universal Spectrograph
Spectroheliograph
Coronal Photometer
Dual Camera System

Razdow (KP):

Hα patrol instrument

Hilltop Dome Facility (SP):

Hα Flare Monitor
White-Light Telescope
20-cm Full-Limb Coronagraph
White-Light Flare-Patrol Telescope (Mk II)
Sunspot Telescope
Fabry-Perot Etalon Vector Magnetograph
Mirror-Objective Coronagraph (5 cm)
Mirror-Objective Coronagraph (15 cm)

McMath-Pierce Solar Telescope Facility (KP):

160-cm Main Unobstructed Telescope
76-cm East Auxiliary Telescope
76-cm West Auxiliary Telescope
Vertical Spectrograph: IR and visible gratings
Infrared Imager
Near Infrared Magnetograph
CCD cameras
1-m Fourier Transform Spectrometer
3 semi-permanent observing stations for visitor equipment

Vacuum Telescope (KP):

Spectromagnetograph
1083-nm Video Filtergraph