# Report of the Users Committee of the National Solar Observatory (NSO) 10 May 2013

To: Dr. Stephen L. Keil, Director National Solar Observatory

## Introductory Remarks

The NSO Users Committee (UC) met 20-21 March at NSO in Tucson, Arizona. In this time of transition for NSO, the lively discussion covered a wide gamut, focusing on the bright future of ATST and NISP but mindful of the challenges facing the NSO today. The UC thanks NSO for hosting the meeting with its customary graciousness, and we express appreciation to Priscilla Piano and the NSO administrative staff for their excellent logistical coordination.

It is a pleasure for the UC to express its gratitude to Dr. Stephen Keil for his three terms of leadership as NSO Director, guiding NSO from an uncertain future to the threshold of a new era with the start of construction on ATST. The UC looks forward to an effective partnership with the next Director, Dr. Valentín Martínez Pillet, and we wish Dr. Keil the best in his future endeavors.

At a time when travel for federal employees is often difficult, it was particularly welcome that the NSF was represented both by NSO Program Officer Dr. Craig Foltz and by his successor, Dr. David Boboltz. The UC thanks Dr. Foltz for his service and wise counsel and looks forward to working with Dr. Boboltz.

The NSO management team was well represented during non-executive sessions throughout the meeting. The UC also requested and was granted the opportunity to hold an open discussion session with the NSO staff in Sunspot and Tucson. We thank Sanjay Gosain, Tom Schad, and Rudi Komm for presenting engaging lunchtime scientific talks.

Last but not least, we are proud to recognize the extended contribution of Dr. K. D. Leka to the Users Committee and the community we represent. Dr. Leka will be stepping down after fifteen years of service on the UC, which she ably chaired for six years.

*Committee members participating (full membership)*: Braun, Casini, Choudhary, DeForest, Henney (by video link), Leka, Lin, McAteer, Rabin (chair), Reinard, Foltz (ex officio)

## Advanced Technology Solar Telescope (ATST)

It was a great and long-anticipated pleasure for the Users Committee to see in photographs the rapid progress of construction at the ATST site. The UC particularly congratulates NSO Director Keil, Project Director Rimmele, and Project Manager McMullin on reaching this milestone, but we recognize that bringing ATST to this point was a massive and joint effort of the entire NSO staff. We also pause to remember the contributions of the late Jeremy Wagner as Project Manager during years when the realization of ATST was by no means certain.

McMullin presented a summary of the provisional conclusions of the NSF Re-baseline review of ATST cost and schedule. A significant conclusion of the re-baseline review, which included a probabilistic risk and contingency analysis, is that about \$46M over the baseline budget will be required to complete ATST in July 2019, 16 months after the original project end date. It is expected that this additional funding will be requested in the near future.

These provisional conclusions highlight what the UC sees as a major challenge to NSO in its efforts to support and strengthen its user community during the transition to ATST/NISP: to ensure that the scientific vitality and corporate knowledge of its users and staff can be maintained in the face of a delayed ATST and a difficult funding climate that may well become even more difficult. As McMullin notes, NSO has not received its requested and planned MREFC funding in any year of the ATST project. As much as NSO and the UC hope that ATST will be completed according to the proposed rebaseline, a completion date in 2020 cannot be ruled out. In that context, the plan embodied in the NSF 2012 Portfolio Review-to divest the McMath-Pierce Telescope in 2013 and the Dunn Solar Telescope in 2017—could result in a loss of observing access for the U.S. solar physics community far longer than envisioned in the ATST baseline plan. The UC does not question the need to divest or close these telescopes, nor does it minimize the budgetary constraints facing NSO. It is nonetheless the obligation of the UC to point out the impacts (discussed under separate headings below) of multi-year gaps between the potential closure of current facilities and the advent of ATST operations. With full respect for conscientious external reviews of the NSO portfolio, the UC believes that the NSO Director should be accorded as much flexibility as possible in managing the timing of facility divestments within the available budget as the date of ATST operations becomes better known.

The UC was pleased to hear that NSO is developing requirements, milestones, schedule, staffing, and budget for the ATST Data Center, which will be integrated with NISP as the NSO Data Center. As Rimmele noted, data handling and access may be the most challenging component of ATST operations, and is—understandably, given the primary challenges of reaching the construction phase—significantly "behind the curve" in development. As well, any feasible budget for the Data Center will be well below, as a percentage of project cost, the data-associated budgets for space telescopes or for ground-based projects such as the Large Synoptic Survey Telescope. The UC applauds the early efforts of NSO to cultivate partnerships that could enhance the data distribution and analysis capabilities of ATST. The UC also asks to be included at the earliest opportunity in the reviews that NSO will conduct of the requirements and plans for the NSO Data Center.

The UC was impressed with the report by Tritschler on the ATST Service Mode Operations Test Case at the Dunn Solar Telescope (DST). This is discussed further under a separate heading below.

The UC wishes to reaffirm a request from an earlier report, that a representative of the ATST Science Working Group make a presentation at future UC meetings. We believe that close cooperation between the SWG and the NSO user community, as represented by the UC, will be increasingly important in the run-up to ATST operations.

### NSO Integrated Synoptic Program (NISP)

According to Recommendation 9.12 of the NSF Portfolio Review,

AST and NSO should develop a plan for the NSO Integrated Synoptic Program (NISP) that includes GONG and SOLIS but that limits AST funding to no more than \$2M (FY17) annually. Expanded partnerships for operations should be sought, and the plan should be completed in time for implementation in the FY16 budget. If a partner cannot be found, NISP should be divested entirely.

NISP funding of \$2M annually would represent a cut of 50% from the current NSF funding level. The NSO Users Committee wishes to state emphatically that such a cut—or even more drastically, divestiture of NISP—would fundamentally undermine the scientific foundation of the National Solar Observatory. The greatest progress in solar and heliospheric physics over the last two decades has

come from the recognition that the heliosphere is a coupled system: from the interior of the Sun, to surface activity, to flares and coronal mass ejections and their effects on space weather at the Earth and beyond. NASA's Solar Dynamics Observatory is in the fourth year of a mission designed to last five years. It could last another decade (as has the SOHO mission), or parts of it could fail next week. There are no plans for a space-based instrument to replace SDO's Helioseismic and Magnetic Imager. Absent GONG and SOLIS, the worldwide solar physics and space weather communities could realistically be deprived of measurements absolutely essential to research and forecasting. If NISP were divested and operated by purely operational organizations, from where would arise the scientific progress that alone enables better forecasting in the future? In short: *NISP is a unique, increasingly vital national resource, and NSO is the right organization to lead it.* The UC echoes the Assessment Report of the NSO Visiting Committee (February 2012) in recommending that NSF accord high priority to finding a way to sustain the scope and stable operation of NISP. It makes operational and financial sense for one scientific organization to take the lead in serving ground-based solar synoptic data to a range of national users in a "one-stop shop," to the extent possible. We encourage NSO to envision and develop such a role for NISP, building on its existing strengths.

The presentation by NISP Director Hill demonstrated to the UC that NISP is taking a commendably proactive role in planning for the migration of the NISP Data Center (currently 600 TB and 272 CPU cores) to the new NSO Headquarters in Boulder and for integration with ATST into the NSO Data Center.

The UC suggests that NSO consider establishing a Science Working Group (SWG) for NISP as a peer of and partner to the ATST Science Working Group. NISP is an essential part of NSO that produces a wide range of data products and serves a highly diverse community. The NISP SWG would help to define and prioritize the scientific goals of NISP and would complement our committee's focus on user services.

## Synoptic Optical Long-term Investigations of the Sun (SOLIS)

The Committee was pleased to note progress in several areas since the last UC meeting:

- The Vector Spectromagnetograph (VSM) guider is close to implementation and will provide superior (<0.5 arcsec) accuracy.
- The VSM software pipeline has been improved and streamlined; the time required for polarization calibration has been reduced by a factor of 8.
- NISP has been responsive to user requests for unique data products such as polarized spectral line profiles.
- The Full Disk Patrol (FDP) is installed and provides observations in the core and wings of H $\alpha$  and He II 1083 nm. The tunable visible filter will be installed later this year.
- The Integrated Sunlight Spectrometer (ISS) is operational, and data access through the NISP Data Center is increasing.

Hill requested advice from the UC on two SOLIS-related issues: the relative importance of implementing vector magnetic field measurements using the chromospheric line Ca II 8542 Å, and the relocation of SOLIS. The UC believes that 8542 Å measurements are worthwhile but that higher priority should be given to the completion of the VSM guider, improvements to VSM reduction software, and a continuing effort to ensure that the solar physics community is fully informed about

SOLIS data products and has the easiest possible access to them. Of the options presented to us concerning the relocation of SOLIS, the UC favors relocation to the GONG Farm in Tucson because of the comparatively modest transition costs and ease of staff access for focused improvements. However, we note that SOLIS is a complex suite of instruments that is currently operational and available to support users and missions. We urge NSO to consider carefully the timing of relocation with respect to events such as the upcoming launch of the IRIS mission.

#### **Global Oscillations Network Group (GONG)**

Hill reported that all GONG sites are operational, producing helioseismic, magnetic, and Ha data. Raw data transfer now takes place in near real time via the internet. This may lead to calibrated helioseismic data products within days instead of months, a boon to the user community. The UC was pleased to hear that zero-point issues with the GONG magnetograms have been resolved. Ha images are being delivered to the Air Force Weather Agency (AFWA) within 30 seconds on average; AFWA has also requested access to GONG magnetograms and white light images. The Air Force has further expressed interest in GONG as an eventual replacement for the Solar Observing Optical Network (SOON) and ISOON (Improved SOON) systems. The NOAA Space Weather Prediction Center (SWPC) uses hourly GONG magnetograms to drive a crucial space weather forecasting tool, the ENLIL magnetohydrodynamic model for the propagation of coronal mass ejections. In light of these high-priority operational needs, it is dispiriting to note the 50% cut in AFWA funding for GONG for 2013-2014 and the absence of a firm funding commitment from NOAA. NSO has been aggressive in seeking non-NSF funding for GONG operations; the budgetary stringency faced by government agencies is beyond the control of NSO or the UC. Nevertheless, it is the responsibility of the UC to reaffirm the high value of GONG observations both to the user community we represent and to military and civilian agencies responsible for protecting assets vulnerable to space weather events. We hope that the importance of NISP as a national asset will enable funding agencies to work together to ensure its long-term availability.

### Kitt Peak Facilities

#### **McMath-Pierce Solar Telescope**

The exploration of the solar infrared spectrum beyond 2.5 µm is a fundamental component of the scientific rationale for the all-reflecting ATST. The McMath-Pierce Telescope can acquire observations over the full range of atmospheric transmission, from UV to far infrared, including the highly diagnostic lines of the CO molecule near 4.7 µm and Mg I lines near 12 µm which have the highest known magnetic sensitivity in the solar spectrum. McMath-Pierce Telescope Scientist Penn presented a selection of recent research results that highlighted both thermal infrared observations and unique long-term records such as Livingston's measurements of spectral line strengths and sunspot magnetic fields. In the transition to ATST, the McMath-Pierce is the only facility capable of supporting instrument development and, crucially, ongoing scientific vitality and the training of ATST-era researchers, over the full range of solar infrared science.

NSO hosted a workshop in February 2013 to explore the formation of a non-NSO consortium to operate the McMath-Pierce. A plan emerged from this workshop that envisions a four-year ramp-down of direct NSO support for the McMath-Pierce, from \$172K in FY 2014 (about 2% of the total NSO operational budget), to under \$100K in FY 2016, to zero in FY 2018 and beyond. The UC is not qualified to judge the likelihood that a consortium will succeed in accumulating the resources necessary to implement this plan. However, we believe that the plan deserves a chance to succeed and that it has

little or no chance to succeed if NSF support for the McMath-Pierce operations is mandated to be zero in FY 2014. For example, it typically takes at least one year from the time a proposal is received by NASA until funding is delivered, and a suitable proposal opportunity in a given research area may only arise once a year. Reviewers of such a proposal will almost certainly not recommend funding without a reasonable belief, grounded in information from NSO, that the telescope will remain operational at least until funding could be delivered.

The UC therefore respectfully recommends that the NSO Director work with NSF/AST to plan a rampdown of McMath-Pierce operations that enables solar infrared research and instrument development at the telescope through FY 2017. We stress that the motivation for this recommendation is not the nonsolar science that a McMath-Pierce consortium would be able to achieve, however worthy that might be. Rather, the aim is to prevent halting for more than half a decade the scientific and instrumental progress of a solar scientific area that has formed a central part of the raison d'être for ATST since its conception. Such a gap would greatly reduce NSO's ability to support and expand an infrared user base for a newly operational ATST. It is worth emphasizing that a gap of several years is more consequential than delaying the aspirations of established scientists; it can "nip in the bud" the development of graduate students who cannot wait 3-5 years for the chance to acquire thesis data.

### Sacramento Peak Facilities

#### **Dunn Solar Telescope (DST)**

The Dunn Solar Telescope is absolutely central to NSO's plans for an effective transition to ATST. The DST is a testbed for both instrument development and operational models, as well as the foremost U.S. telescope for high angular resolution solar observations. As ATST may not become operational until late in FY 2019, and funding for ATST Operations and Management may not ramp up until FY 2015, it is vital to the NSO user community that the DST remains fully operational at least through the end of FY 2017, as embodied in the current NSO Long Range Plan. NSO recently hosted the first meeting to explore divestment of the DST and the Sacramento Peak site. The UC was encouraged by what appeared to be wide-ranging interest by outside groups. As in the case of the McMath-Pierce Telescope, the UC's interest in divestment plans is motivated by the positive role an orderly divestment can play in minimizing the gap between the availability to users (including students) of current NSO telescopes and the advent of ATST operations.

As mentioned above, the UC heard a report by Tritschler on the ATST Service Mode Operations Test Case at the Dunn Solar Telescope (DST). We commend Tritschler and the service mode team (including Beck, Criscuoli, Reardon, and Uitenbroek) on a highly successful experiment that required extraordinary effort in planning and coordination. The experiment was the more challenging because DST instrumentation was not designed for service mode observing. NSO plans to apply lessons learned from this experience to a second service mode experiment in November 2013 and twice per year thereafter. The UC strongly endorses these plans and in fact recommends that the DST transition primarily to service mode observing as rapidly as the experiments warrant. The UC was impressed by the complexity of service mode observing and expects that the efficiency of the model will increase gradually, and only with experience. This is a powerful argument for keeping the DST operational for as long as possible, because increases in service mode efficiency will reap immediate operational dividends for ATST.

We recognize that NSO faces a challenge in allocating limited resources between sustaining the DST, with undoubted benefits to ATST, and the need to bring ATST to full operational status. However, what

is true of infrared observations from the McMath-Pierce Telescope is equally true of high-resolution observations from the DST: a two-year or longer gap in access is more damaging to the U.S. solar physics community invested in this high-priority science than it would be to a much larger community such as extragalactic astronomy. When a researcher in a small community is forced to set aside one area of research, it is hard to reverse course and return to that area, particularly when funding is shrinking, and it is by no means certain that other qualified scientists will be ready to "plug the hole." This again argues for NSF/AST and NSO working together to give the NSO Director as much flexibility as possible in implementing the transition between current observational facilities and ATST.

## NSO's Transition to New Headquarters

Keil briefed the UC on current plans for NSO's transition to a new headquarters location on the campus of the University of Colorado, Boulder (CU). It will be challenging to negotiate and manage this relocation in the midst of budgetary uncertainties and the need to maintain effective operations of NSO's current observing assets. Although the UC looks forward to the benefits to NSO and the U.S. solar physics community of a close and mutually supportive relationship between NSO and a leading university, we have no specific recommendations concerning relocation.

Respectfully submitted,

Douglas Rabin, chair (NASA Goddard Space Flight Center) Douglas Braun (NorthWest Research Associates) Roberto Casini (High Altitude Observatory, NCAR) Debi Prasad Choudhary (California State University at Northridge) Craig DeForest (Southwest Research Institute) Carl Henney (Air Force Research Laboratory) K. D. Leka (NorthWest Research Associates) Haosheng Lin (Institute for Astronomy, University of Hawaii) James McAteer (New Mexico State University) Alysha Reinard (Space Weather Prediction Center, NOAA)

Craig Foltz (ex-officio, NSF)