

The National Solar Observatory (NSO) Users Committee Report

March 2016

To: Dr. Valentin Pillet, Director
National Solar Observatory

Introductory Remarks

The NSO Users Committee (UC) met 17-18 June 2015 at NSO/Boulder. The UC thanks Director Pillet, Dr. Thomas Rimmele, Dr. Steven Berukoff, Dr. Mark Rast, Dr. Kevin Reardon, Dr. Frank Hill, Dr. Han Uitenbroek, and Dr. Matthew Penn (by telecon) for their comprehensive presentations and the impressive work behind them. We appreciated the remote participation by NSO Program Officer Dr. David Boboltz.

We are grateful to Priscilla Piano for her always-seamless coordination of the meeting logistics, carried out among many other responsibilities. We enjoyed a lunchtime talk by NSO astronomer Dr. Alexei Pevtsov on the status of SOLIS, including its new data products and their application to the modeling of coronal magnetic fields and the solar wind.

To better match NSO's renewal, our report will continue to focus on key user-related capabilities and issues rather than the traditional sites.

The chair of the committee apologizes to NSO for the lateness of this report, for which he alone is responsible.

Committee members participating: Braun, Casini, Henney, Lin, McAteer, Rabin (chair), Reinard, Boboltz (ex officio)

Plaudits

The UC was buoyed by NSO's accomplishments and progress on many fronts, including

- Impressive progress in construction of the Daniel K. Inouye Solar Telescope (DKIST)
- NSO's resourcefulness in keeping the Dunn Solar Telescope (DST) available as a productive telescope and key transition resource
- NSO's high-profile community engagement as host of "The Sun's Chromosphere in the Era of ALMA, IRIS, and DKIST" in March 2016 and the American Astronomical Society Solar Physics Division (SPD) meeting in June 2016
- Impending announcements for a joint tenure-track faculty position at NSO and the University of Colorado Boulder (CU) and the first George Ellery Hale Postdoctoral Fellowship at CU.
- Dr. Rast's report of major progress on the development of the Critical Science Plan organized by the DKIST Science Working Group
- A vigorous staff and user science program maintained in a challenging environment of staff transitions, telescope construction, and funding uncertainties

The UC wishes to thank Dr. Richard Radick for volunteering to assist with DST operations in Emeritus status.

Review of Previous Findings

We summarize Dr. Pillet's response to findings of the previous UC meeting in narrative form rather than repeating the text of the findings.

NSO has responded to the challenge of devising a sustainable NSO Integrated Synoptic Program (NISP) within severe budgetary constraints by actively engaging OMB, OSTP, NSF, and NOAA on the importance of NISP assets in a coordinated national space weather program. These activities fed into the FY16 Presidential budget request and are expected to influence the upcoming report of the inter-agency Space Weather Operations, Research, and Mitigation (SWORM) task force.

Evidence of progress in defining DKIST service mode operations and a Science Data Management Plan was reported in separate presentations.

Dr. Pillet reported that maintaining service mode access to both the DST and the McMath-Pierce Solar Telescope (McMP) has proven to be unrealistic within budgetary constraints. NSO is concentrating on supporting the New Mexico State University (NMSU) consortium in their goal of filling the gap with respect to the DST.

Dr. Pillet reported that, although Education and Public Outreach (EPO) has not ramped up as quickly as hoped, significant progress in education and community engagement has been made, as reported below.

NSO Staff Evolution

Dr. Pillet reviewed plans for the evolution of the NSO staff. It is expected that in 2017 there will be 60 full-time equivalent (FTE) positions in Boulder and 33-35 FTE in Maui, with minimal scientific presence in Sunspot and Tucson.

Daniel K. Inouye Solar Telescope

Dr. Rimmele reported on the status of DKIST and its operational plan. Site and telescope construction is 55% complete as against 57% planned. Operations are planned to begin in July 2019. Areas of concern that are difficult to quantify include ongoing audits by the NSF Office of Inspector General and legal proceedings at the Hawaii Supreme Court. Actionable concerns include the complex "waterfall" of integration, test and commissioning (IT&C) activities that pose schedule risk, and delays in starting construction of the Remote Operations Building (ROB), complicated by the delayed adoption of the new Cooperative Agreement (hoped to begin in July 2015). This is perhaps the most pressing near-term problem because the ROB is on the critical path to DKIST operations. On the instrument side, the Visible Tunable Filter instrument is experiencing delays that may blur the end of the construction phase.

The UC was pleased to see impressive results from factory acceptance testing of the deformable mirror for the wavefront correction (WFC) system and encouraged by a proposal from a UK consortium (led by Queen's University Belfast) to contribute a high-speed 4Kx4K visible-light camera.

DKIST Science Working Group

The UC had previously requested an update from the DKIST Science Working Group (SWG), and we were pleased to hear an informative presentation by Dr. Mark Rast on the last SWG meeting, 23-26 October 2014. The next meeting is planned for October 2015. The SWG comprises 20 members and 9 Co-Investigators and instrument Principal Investigators. The membership is highly stable because the

members are uniformly enthusiastic and eager to serve. The third day of the meeting was devoted entirely to the Critical Science Plan (CSP), which includes three major research areas, each with subsidiary research topics. Rast emphasized that the CSP is intended to stimulate self-organization of the user community; it is not run by NSO, although NSO scientists are not excluded from membership. In response to a question by Dr. Braun, Rast made it clear that a science user case developed through the CSP is envisioned as an effective but not exclusive route to a user proposal.

DKIST Data Center

The UC was pleased to hear the first comprehensive report on the status of the DKIST Data Center (DC) by Drs. Reardon (Project Scientist) and Berukoff (Project Manager). With a core team in place, considerable progress has been made in the critical task of defining the scope and requirements of the DC with the active engagement of the DKIST SWG and the DC Working Group (chaired by Dr. Neil Hurlburt). A “Proto DC” exercise is planned to validate the proposed architecture in preparation for a Preliminary Design Review in the fall of 2015. The UC requests that it receive periodic updates on how the DC will provide data to the user community and encourages DC personnel to seek out best practices from space-based as well as ground-based projects.

The UC was gratified that SWG and NSO agree with a previous UC recommendation that the first priority of the DC in its early operations should be to provide calibrated data sets to the user community, with derived data products developed as budget and schedule permit. The UC acknowledges that the DC development schedule has been pushed out to some extent and that it will be challenging (given budget constraints) to be fully ready for initial DKIST operations.

NSO Integrated Synoptic Program (NISP)

Dr. Hill reported on the status of NISP. The UC follows NSO’s plans for NISP with great interest in view of our previous findings on the criticality of a robust synoptic program to a balanced NSO portfolio that serves a broad user community, complements DKIST, and contributes to a national space weather program. While we recognize that the reduction of NSF base support to \$2.0M in FY16, as mandated by the NSF/AST Portfolio Review, poses a continuing challenge, we applaud NSO’s vigorous efforts to forge partnerships that will broaden the financial support of NISP. These efforts have so far led to \$1.0M of support from the NOAA Space Weather Prediction Center in FY16 and beyond and \$0.3M in FY15 and FY16 from NASA for infrastructure and Virtual Solar Observatory (VSO) operations. NSO is hopeful that \$2.5M will be available in FY16 for the refurbishment of GONG (as included in the President’s budget request) and that USAF will support NISP after they end support of operations at NSO/Sunspot. In the longer term, NSO is developing collaborations with several groups in Europe in pursuit of the Solar Physics Research Integrated Network Group (SPRING), envisioned as the successor to SOLIS and GONG.

After a two-year hiatus, GONG preventive maintenance has resumed. Dr. Hill described a number of ideas for GONG refurbishment and solicited input from the UC.

SOLIS is currently located in Tucson after being out of operation July 5 – October 23, 2014. The VSM is recovering from the aftermath of a camera cooling failure and faces a key decision: should the cameras be replaced with a new system to replace the aging and inadequately spared current system? The FDP is almost back to routine operation after suffering water damage. Dr. Pillet asked the UC to prioritize SOLIS data products for the near future.

NSO received 6 responses to a request for expressions of interest in hosting a permanent site for SOLIS. NSO has developed selection criteria and plans to distribute an information package in June

2015 with responses due in September 2015. NSO is working toward site selection in December 2015 and completed installation by the end of FY16. The UC stresses the importance of a speedy and successful SOLIS relocation and provision of these valuable data to the community.

Dr. Hill described plans for the NISP Data Center transition to Boulder. While acknowledging that the DKIST and NISP Data Centers must concentrate on near-term objectives, the UC encourages NSO to “build in,” to the maximum extent possible, an architecture that will facilitate the eventual unification of the two programs for the benefit of all users.

Transitional Facilities

Dr. Penn reported on the status of the McMP. Absent new funding or new charges from Kitt Peak, the McMP will cease operations at the end of June 2016. Although four organizations have expressed interest in operating the McMP in the future, a potential consortium needs an administrative body and the intention to make a several-year commitment in order to write a viable proposal.

The UC has stated in previous findings that the regions of the infrared spectrum to which only the McMP provides access are scientifically important and an important component of the transition to DKIST. We note in that regard two significant papers by Penn et al. to be submitted to *Astrophysical Journal Letters*, “Spectral and Imaging Observations of a White-light Flare in the Mid-Infrared” and “Spectropolarimetry of Atomic and Molecular Lines near 4135 nm.” The first paper reports the first broad-band observations of the spectral energy distribution of a solar white-light flare in two wave bands at 5 μm and 8 μm . Observations in infrared and submillimeter bands are important for understanding the flow of energy in solar flares. Moreover, the results were obtained with a Quantum Well Infrared Photodetector (QWIP) camera not previously used for solar observations. The second paper used the NSO Array Camera to identify a photospheric line of Fe I at 4137 nm which has 2.5 times the magnetic sensitivity of the well-known 1565 nm Fe I line and shows great promise for probing quiet-Sun magnetic fields. These two papers demonstrate that the McMP is fulfilling two key aspects of its transitional role: the exploration of new infrared diagnostics and the application of state-of-the-art technology. It is also worth noting that most of the 11 co-authors of these papers represent external institutions, reflecting robust user interest in solar infrared science. Finally, we note that a group of investigators from Northrup-Grumman, CU, and JPL took advantage of the unique capabilities of the McMP to test a starshade for future application to exoplanet studies.

The UC recognizes that NSF support of the McMP will end in FY16 or FY17. We judge that the scientific merit and technological relevance of the recent results described above merit a year of operation beyond June 2016 and to that end request that NSO and NSF strive to forestall new site charges and seriously consider directing potential savings in Tucson operations to McMP operations for that period.

Dr. Uitenbroek reported on the status of the DST. The DST continues to attract strong user interest. During the past year, science proposals filled 81% of available observing days; one fourth of the proposals were service mode. Among regular proposals, 60% were from US institutions. The main goals of the DST program are to continue to make observing time available to the user community at least through 2017, to transition key personnel to DKIST while preserving their knowledge and making it occasionally available for DST support, and to maintain the facilities at a level that keeps the DST viable for a potential operating consortium.

To achieve those goals within the resources available, the DST will be open only on weekdays, will include scheduled downtime, will be scheduled on a six-month rather than three-month cadence, will offer a limited number of fixed instrument combinations, and will block-schedule proposals that require on-site science support. Unfortunately, labor-intensive service mode operation will no longer be

possible, but the rich trove of calibrated observations from the three completed service mode cycles will be an important resource to help bridge the potential two-year gap from the end of NSO operations at the DST to the beginning of DKIST operations.

Pillet and McAteer reported on possibilities for the divestiture of Sac Peak facilities. The main current prospect is a consortium led by New Mexico State University (NMSU); members may include Apache Point Observatory, Queen’s University Belfast, California State University at Northridge, and the University of Hawaii at Manoa. A workshop was held in Sunspot on May 27, 2015 to develop a vision and plan for the future operations of the Sunspot facilities. NSO and NMSU will meet in July 2017 for further discussions.

NSO should not expend significant resources in seeking formal arrangements with other observatories to provide NSO user access to observing time. Although coordination with other observatories is extremely important—particularly with an eye toward long-term, strategic partnerships—specific gap-filling efforts could easily become a distraction and lessen the ability of NSO’s transitional facilities to provide value to the user community. With respect to the DST, the Committee sees no value in “mothballing” the facility.

Community Engagement and Education and Public Outreach (EPO)

Dr. Pillet reported that, although EPO has not ramped up as quickly as hoped—in part because of the late start of the Cooperative Agreement—substantial progress in education and community engagement has been made, NSO’s proposal to reinstate a Research Experience for Undergraduates (REU) program was accepted. NSO’s participation in the Akamai Workforce Initiative has been renewed for FY15-FY17. NSO and CU held a workshop in June 2015 to plan future activities of the Hale COLLABorative Graduate Education (COLLAGE) Program, which currently comprises five universities and two national laboratories. NSO aims to strengthen its Student Research Assistantship program and increase the number of thesis students and postdoctoral fellows working at NSO. NSO is pursuing several opportunities to increase diversity through the programs described above and others in collaboration with CU.

NSO is actively engaging the professional community through its hosting of the 2016 SPD meeting and the 2016 ALMA/IRIS/DKIST meeting. NSO scientists will visit several universities in the fall of 2015 to promote awareness of DKIST and the many avenues for observing and collaboration. NSO is also leading a collaboration to engage students and citizen scientists in an exciting initiative to acquire white-light coronal images at 60 sites during the 2017 total solar eclipse, after which the observing equipment will be donated to the citizen volunteers to use in a variety of follow-up science projects.

Findings

- Because the unique scientific investigations and infrared technology development being carried out at the McMP merit operation for a year beyond June 2016, NSO and NSF should strive to forestall new site charges on Kitt Peak and seriously consider directing potential savings in Tucson operations to McMP operations for that period.
- The UC concurs with NSO’s ramp-down plan for the DST and realizes that difficult decisions may be necessary to avoid impacting the DKIST schedule if a major DST system fails. However, the UC concurs with the 2014 recommendation of the Cooperative Agreement Review Panel that NSF should give high priority to limiting to no more than two years a gap in new high-resolution observations available to the NSO user community before the start of DKIST operations. Maintaining some level of availability of the DST in 2018 is the best option

for ensuring this.

- Although the scientific purview of joint NSO-CU faculty positions should not be unduly narrow, there should be a clear emphasis on science with core relevance to DKIST capabilities.
- NSO should seriously consider replacing the aging and inadequately spared VSM camera system with a system that will make VSM data reliably available to users, provide effective support of DKIST, and constitute a viable model for inclusion in a future SPRING network.
- With the DKIST Data Center staffed and progressing toward Final Design Review, the DC should find avenues to socialize the anticipated user interface with the user community. Correspondingly, the UC should participate by identifying and communicating to the DC the types of information that would be most helpful.

Respectfully submitted,

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