LBT OBSERVATORY NEWSLETTER

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From the Director
Joe Shields

As a leading astronomical research facility, LBTO is generating forefront results while taking steps to grow its impact in the future.

The year 2025 marks the 20th anniversary of the LBT's first light with a single primary mirror. In the ensuing two decades, the telescope has generated a wealth of observations that have been systematically archived through a partnership with the Italian Center for Astronomical Archives (IA2). As detailed elsewhere in this issue, steps have now been completed to make the large majority of these data available for public access. I invite readers to explore the archive to understand how this rich resource can be used to advance their research programs.

The Observatory is moving forward with planning for the next generation of instrumentation for the telescope. In response to the call for new instrument concepts issued last year, nine proposals were submitted by the May deadline, and the LBTO Science Advisory Committee is now leading a review process to provide guidance to the LBT Board allowing selection of projects to advance in planning. Completion of this process is expected in fall 2025.

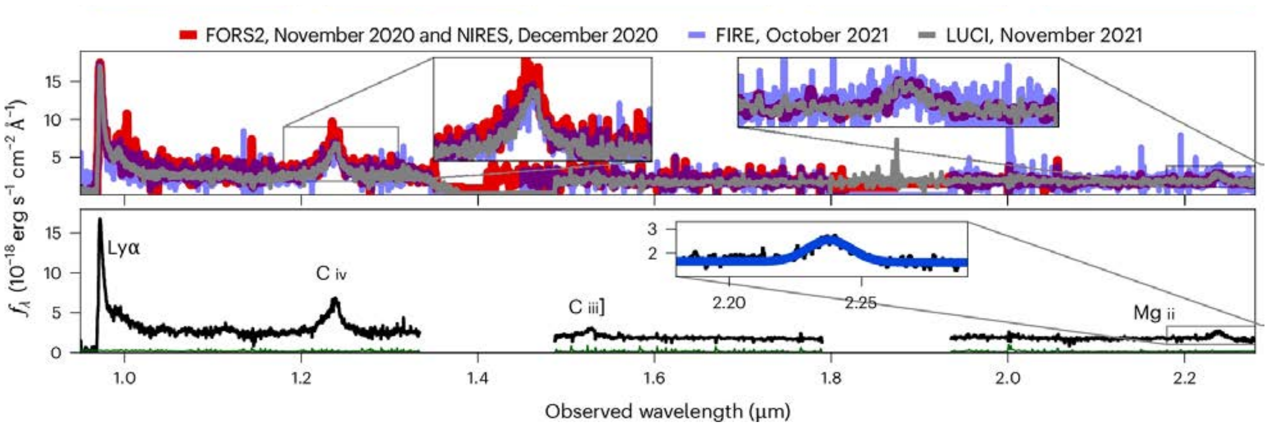
LBTO exists as part of a global ecosystem of observatories, with science advancing in many cases via studies that combine measurements from multiple facilities. The new Rubin Observatory with its Legacy Survey of Space and Time (LSST) provides an incredible resource for astronomical research, but realizing the LSST's full potential will require follow-up observations with other telescopes. The LBT is well positioned to contribute to this effort. Although located in the northern hemisphere, the LBT has access to half the LSST survey area, and has demonstrated capabilities relevant to many of the LSST science focus topics. We look forward to new discoveries resulting from this synergy, and are open to expanding the Observatory consortium with new members interested in leveraging this opportunity.

LBTO Science Highlights
A Blazar in the Epoch of Reionization

We now know there is a close connection between the formation of galaxies and the supermassive black holes that are ubiquitous in their centers. The processes underlying this connection remain uncertain, but feedback from an accreting black hole is likely an integral part.

A recent study by Bañados et al. using LUCI spectra provides new evidence that relativistic jets may be a primary driver of feedback in the early evolution of black holes and their associated galaxies. The authors report results for J0410-0139, which was identified as a high-redshift quasar candidate on the basis of DESI Legacy Imaging Survey photometry showing it to be a *g*- and *r*-band dropout, coupled with detection as a radio source in the 1.4 GHz NVSS and 3 GHz VLASS surveys.

Spectra from multiple telescopes including the LBT with LUCI confirmed that the source is a



Individual (top) and combined (bottom) spectra of J0410-0139 revealing prominent quasar emission lines.

quasar at redshift z = 7.0. The data also allow determination of the black hole mass, which is $6.9^{+0.5}_{-0.4} \times 10^8$ M$_\odot$, and the accretion rate described by an Eddington ratio of 1.22± 0.08.

Archival and follow-up radio observations of J0410-0139 reveal significant variability, and this behavior coupled with its radio-to-X-ray broad-band spectral properties strongly suggest that this source is a blazar, with beamed emission produced by a collimated relativistic outflow oriented close to our line of sight.

The discovery of a single beamed source pointed toward us strongly suggests that many similar objects reside at the same redshift, but elude detection since their beamed emission is pointed in other directions. Based on plausible estimates of the bulk Lorentz factor and resulting jet opening angle, the density of jet sources is comparable to or larger than the total population of quasars based on the rest-frame ultraviolet luminosity function at redshifts 6.9 < z < 7.7.

The implication is that a large fraction of the total quasar population in this realm hosts jets which in turn may be influential in driving evolution of their surrounding host galaxy. The alternative, that the ultraviolet luminosity function significantly underestimates the total population of quasars, would suggest that much of the early growth of black holes takes place via super-Eddington accretion in highly obscured environments that suppress the emergent ultraviolet emission. Either scenario has important implications for the early evolution of galaxies and their associated supermassive black holes.

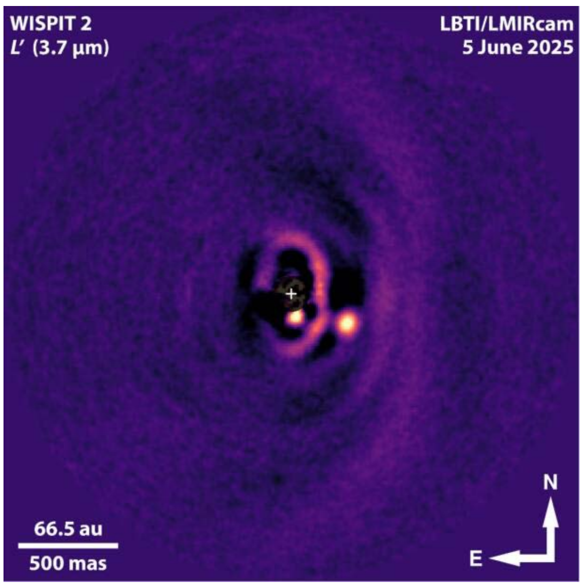
LBTO Science Highlights

An Accreting Protoplanet in a Circumstellar Disk

Disks of material surrounding newly formed stars form the raw material for planets that in turn interact dynamically with the circumstellar structure. A recent paper by Close et al. reports the rare discovery of a growing protoplanet apparently clearing a dust-free gap in its associated circumstellar disk.

The source, WISPIT 2, was identified as a target of interest based on observations of young solar-mass stars with the Very Large Telescope/SPHERE as part of the Wide Separation Planets in Time (WISPIT) survey (van Capelleveen et al. 2025). Those data, obtained in the *H* and *K*$_S$ bandpasses, revealed a ringed circumstellar disk. Close et al. used the MagAO-X extreme adaptive optics camera at the Magellan Clay Telescope to discover a new planet WISPIT 2b in the Hα emission line, located in one of the disk gaps. The Hα emission is of particular significance as a tracer of the poorly understood accretion processes in young gas-giant protoplanets.

The planet was also detected at H and K_S with follow-up SPHERE measurements which can be used to obtain a mass estimate for WISPIT 2b of 4.9 $M_{Jupiter}$, and radius estimated from models of 1.6 $R_{Jupiter}$. Assuming a magnetospheric accretion process, the accretion rate obtained from the Hα flux is ~2×10^{-12} $M_{\odot}$ yr^{-1}.



LBTI LMIRCam image of WISPIT 2 showing the accreting protoplanet between two rings in the southwest part of the circumstellar disk. An additional candidate protoplanet (undetected in Hα) is visible south of the central star and interior to the bright ring.

Follow-up observations of WISPIT 2b using the LBTI LMIRCam instrument provided a further very high signal-to-noise detection in the L' (3.70 µm) bandpass. An additional observation of the central star was obtained with the PEPSI spectrograph. As part of the young stellar group Theia 53, the central star WISPIT 2A is known to be younger than ~13.6 Myr, and the Hα emission and a strong lithium feature in the PEPSI spectrum combined with other arguments suggest an age of $5.1^{+2.4}_{-1.3}$ Myr. With this age the L' photometry coupled with evolutionary models suggest a mass of 5.3±1 $M_{Jupiter}$, consistent with the protoplanet mass based on the H and K_S measurements.

WISPIT 2b is only the fourth protoplanet detected in Hα, and its discovery opens the prospect of meaningful studies of such sources as a population. Intriguingly, the associated circumstellar disks for all four systems fall within a narrow inclination range of $37° \leq i \leq 52°$, which may point to a preferred orientation for selection based on the magnetospheric accretion geometry.

Archive Public Access and Enhanced Tools

As a result of policies recently adopted by the LBT Board, most of the data in the LBT Archive is now available for public access and use. Beginning with the 2024A semester, new data are released for public access one year after the date of acquisition. This Observatory-wide policy aligns with data access policy already in place for INAF observations.

Effective July 1, 2025, data acquired in 2023B and earlier semesters are similarly available for public access. For both new and archival data, a longer period of exclusive use will be retained if the PI provides a scientifically motivated reason that is endorsed by their Member time allocation committee. To date a relatively small number of such requests have been submitted.

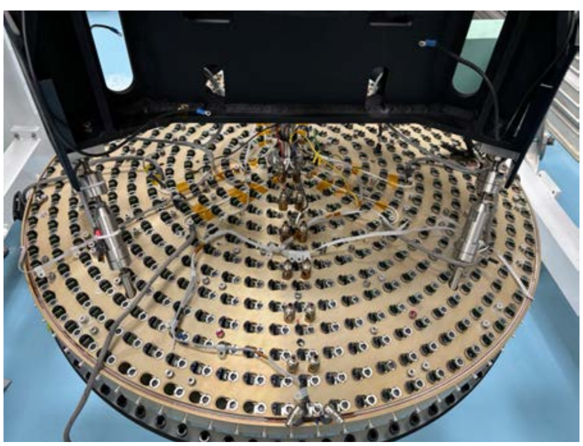
The archive contains data extending back to observations with the first instrument, LBC-Blue, in 2006. Observers are encouraged to consider how archival data can be used to advance their science goals.

To facilitate more efficient use of the archive, staff at LBTO and IA2 have worked on tools to more efficiently associate science observations with relevant calibration files.

After selecting data for downloading, users are now presented with the option of identifying and downloading relevant calibration files, accessed via a new "Get cals" button. The new functionality is available for LBC, LUCI, and MODS observations. Full details can be found on the Science Operations pages at the LBTO website.

Adaptive Optics Updates

Work is continuing on the Adaptive Secondary Mirror (ASM) that was recently transferred from Magellan Observatory to LBTO. The Magellan ASM, with technology of the same generation as the existing LBT ASMs, requires some renovation to be fully functional. The Magellan secondary was powered up upon arrival in Tucson for initial assessment with support from Steward Observatory, and subsequently disassembled by LBTO staff. University of Arizona Optical Sciences personnel have assisted with modifications of the unit's reference body in preparation for recoating.



Magellan secondary with disassembly in progress. Photo Credit: S. Ragland

Additional work is planned in coordination with industry partners A.D.S. International and Microgate srl. The Magellan ASM was used with an undersized thin shell, and renovations include addition of the outer ring of actuators to enable use with a full-size thin shell currently maintained in storage by LBTO.

Completion of the Magellan ASM renovation is anticipated in 2026, thereby providing a backup spare unit for the LBT, and means for ASM testing off the telescope without interruption of observations.

During the Summer Shutdown, maintenance work was carried out on both existing ASM units. A new Uninterruptible Power Supply (UPS) and Programmable Logic Control (PLC) system was installed that will reduce risks from unanticipated power interruptions. The system will additionally monitor glycol coolant flow and shut down the ASM automatically if disruption of the glycol supply is detected.

LBTO staff members Alessandro Cavallaro and Dan Rapoza working on the new ASM PLC box inside the telescope central structure. Photo Credit: A. Cavallaro

MODS Upgrade

During the 2025 Summer Shutdown, the CCD controllers and associated electronics were replaced in the MODS spectrographs. The changes addressed concerns with the aging first generation controllers originally produced at Ohio State, which are no longer supported and lack critical spare parts in the event of hardware failure. The upgrade utilizes Archon controllers produced by Semiconductor Technology Associates, Inc.

(STA). In addition, the DOS computers used with this system were replaced with modern Linux computers.

Installation in August was the culmination of a large amount of work over several years including fabrication of electronics boards and boxes, testing, and software changes, led by OSU personnel with contributions also by Steward Observatory and LBTO staff. Support for the upgrade was provided through LBTO Development funding and in-kind contributions from OSU.

The system is currently undergoing recommissioning activity with a return to routine operation expected later this fall. Users can look forward to a much faster readout time, and a disappearance of the bias level offset between odd and even columns in the data.

Solar Disk Integration Telescope Upgrade

AIP-Potsdam operates a small robotic telescope delivering light integrated across the solar disk that is fed into the PEPSI spectrograph, providing solar spectra acquired on a daily basis. The Solar Disk Integration (SDI) telescope is located on the balcony over the LBT's main entrance. The results are a unique data set relevant for studying solar spectral behavior in a way that is directly comparable to measurements for other stars (i.e., "sun-as-a-star" studies).

AIP-Potsdam personnel have recently collaborated with LBTO personnel and the iLocater team to add additional functionality to the SDI system. A separate feed (actually the original SDI telescope, removed in a 2022 upgrade) was installed on the robotic mount, which will deliver integrated solar light to the iLocater spectrograph.

A separate small telescope functioning as a Ring-Image Next Generation Scintillation Sensor (RINGSS) was also added to the SDI

A view inside the SDI dome showing the PEPSI SDI (far side) with the new RINGSS telescope (near side, left) and iLocater solar feed (near side, right) sharing a common robotic mount. Photo credit: I. Ilyin

mount. The RINGSS system will extend operation of the robotic mount to night-time use in order to measure the vertical distribution of atmospheric turbulence. Such measurements have potential value for comparison with predictions from the Advanced LBT Turbulence and Atmosphere (ALTA) project led by Arcetri Astrophysical Observatory, and will provide real-time information to inform decisions on use of Adaptive Optics.

Summer Shutdown 2025

A long list of repairs, upgrades, and preventive maintenance tasks were completed during the annual Summer Shutdown (SSD) this year. In addition to activity described in preceding news stories, highlights include:

- Primary Mirror washing. A major renovation of the M1 aluminization control system is in progress, with the result that no recoating occurred this year and instead both primary mirrors were washed. The washing procedure was successful and reflectivity increases of 2.5%-5% were measured.

- Primary Mirror Cell. Extensive work was carried out inside the M1 cells in order to reactivate failed thermocouples, replace actuator power wiring connectors, and assess hardpoint and actuator performance with future improvements identified.
- Mount Control System (MCS). A failure of the MCS coincident with the start of SSD prompted a deep dive into the status of this system, which provides essential controls for functions including motion of the telescope mount in azimuth and elevation, and operation of instrument rotators at the Gregorian and bent Gregorian focal stations. Several issues were identified with electronics boards, communication hardware, and rack cooling, with steps taken to remediate problems and obtain critical spare boards for future risk mitigation.
- LUCI maintenance. Both LUCIs were warmed and multiple minor mechanical and electronics problems were resolved. Helium supply lines were replaced for the SX side. The Observatory also received a shipment of spare LUCI electronics boards fabricated at the Max Planck Institute for Astronomy.
- Computer Room UPS. A new UPS was installed to replace the old unit providing backup power for the instrument computers on Level 2, which had reached end-of-life.

Newly installed Computer Room UPS unit. Photo credit: P. Hartley

- All-sky Camera replacement. A new all-sky camera was prepared for installation to replace the existing aging unit. In addition to enabling improved visual assessment of sky conditions from the monitor, automated software tools are planned to provide notification of changes in transparency and cloud conditions. The new unit is expected to be on-line in October.
- Cyclope Seeing Monitor. A new capability for monitoring seeing conditions is now in place through installation of a Cyclope monitor produced by Alcor System. The automated unit, mounted on a balcony at the Vatican Advanced Technology Telescope (VATT), provides continuous measurements of seeing via high-frame-rate imaging of Polaris. Financial support for the LBT Cyclope was provided by INAF-Arcetri Astrophysical Observatory.

Cyclope seeing monitor mounted at the VATT. Photo Credit: C. Veillet

MGIO Backup Generator

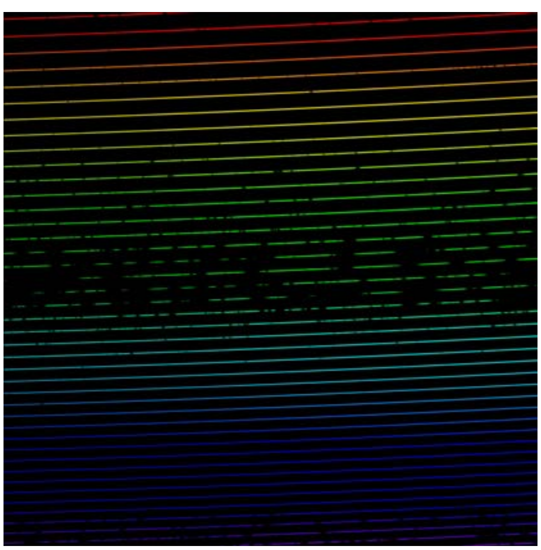
Mount Graham International Observatory has acquired and installed a new generator as a primary source of backup power for MGIO facilities including the LBT. The need for a new generator became evident over the past year while the Mt Graham facilities were on generator power as repairs were in progress on the power line serving the summit. The previous generator, a Cummins 800 kW unit in service for 25+ years, was increasingly unreliable during the repair period, and it became evident that the unit had reached end-of-life.

New backup generator arriving at the summit on June 3. Photo Credit: W. Boltinghouse

The new generator, a Caterpillar 1500 kW unit (de-rated to 1200 kW because of altitude) will provide enhanced reliability as well as increased power when utility power is unavailable.

iLocater Update

Work continues on the iLocater spectrograph, including cryogenic testing at the Ohio State University. The instrument obtained its first data for an astrophysical source on June 20, capturing a spectrum of the Sun observed through the laboratory window.



False color spectrum of the Sun recorded using the iLocater spectrograph.

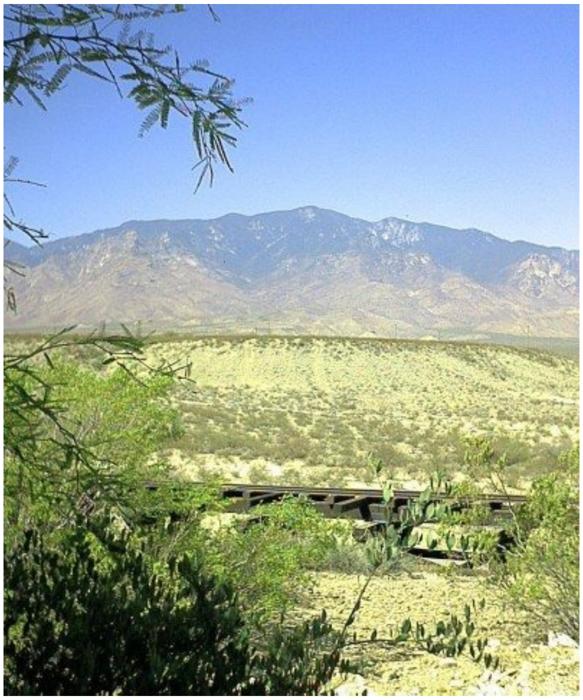
At Mt Graham, work is progressing on the instrument chamber on Level 3L, including finalization of the HVAC design with installation to follow shortly.

An iLocater Preship Review has been scheduled for October. Subject to LBT Board approval, the instrument is expected to arrive at Mt Graham later in 2025, with installation and commissioning activity to begin soon thereafter.

Working at High Altitude

When traveling to the telescope, it is important to remember that the LBT is located at a remote and high-altitude site (3200 m/10,500 ft). At this elevation, partial pressure of oxygen is decreased, and hemoglobin in the blood is less effective in taking oxygen through the lungs. The result is less oxygen in the blood, and the body must compensate by initiating a series of physiological responses including increased respiration, heart rate, and blood pressure, as well as increased water dumping (frequent urination). In driving from the Mt Graham International Observatory Base Camp at the foot of the mountain to the telescope, the climb is rapid and substantial – 2200 m/7200 ft – providing limited opportunity for travelers to adapt to the change in conditions.

Personnel visiting or working at the LBT thus need to be alert to possible adverse consequences linked to high altitude. It is important to recognize that any individual, including those in excellent health, can experience altitude-related symptoms. These can include fatigue, reduced focus, confusion, headaches, and shortness of breath. More serious consequences can include chest pain, palpitations, nausea, dizziness, changes in vision or speech, loss of coordination, weakness, or loss of consciousness. High altitude can also exacerbate pre-existing medical conditions, and visitors with known health conditions should consult with a physician before traveling to the Observatory.



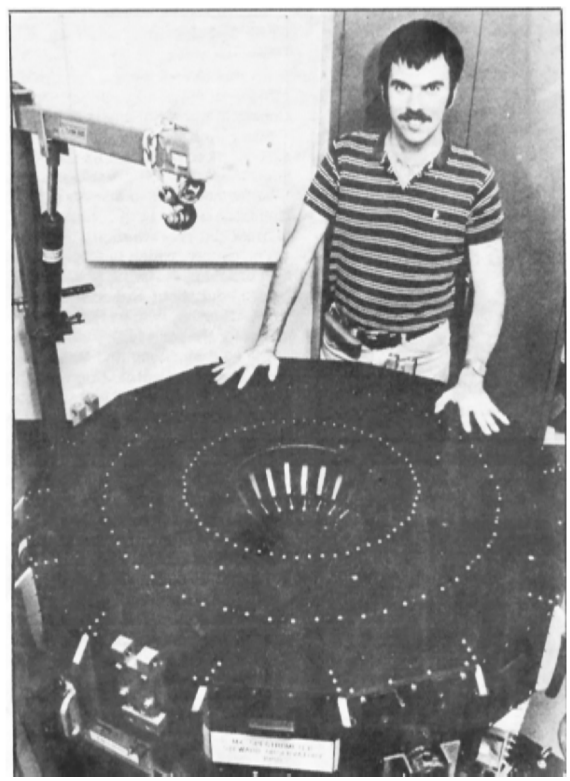
Mt Graham as seen from Discovery Park in Safford. Photo Credit: J. Ratje

You can reduce the risk of altitude-related illness by arriving rested and well-prepared with food and routine medications; taking time to acclimate upon arrival (~30 minutes); and drinking plenty of liquids to avoid dehydration.

If you or a colleague experience more than minor discomfort, please consult immediately with the LBT Shift Manager, who will work with you to address the situation. The Observatory partners with medical personnel who can be consulted 24/7 as needed. Bottled oxygen is available at several locations in the Observatory, but please note that these are not intended for casual or unsupervised use; if you feel you require oxygen, always notify an LBT staff member immediately to ensure the proper administration of oxygen and medical evaluation.

John Hill Retirement

LBTO marked a major transition with the retirement of Technical Director John Hill on April 25. John arrived at the University of Arizona as a graduate student in 1979 and quickly became involved in projects that would shape the future of astronomy. He completed a doctoral dissertation under the supervision of Roger Angel that presented a design for the first multi-fiber spectrograph with a mechanism for remote fiber positioning. After graduating in 1984, he held a postdoctoral position at Steward Observatory with NSF funding to build the spectrograph he designed, which produced the MX Spectrograph.



John Hill with the MX Spectrograph, 1986.

While a postdoc, John also began working on the project that resulted in the Large Binocular Telescope. He was appointed as the Columbus Project Technical Coordinator in 1990, transitioning to LBT Director in 1993. In that role he provided leadership during a critical phase of design and construction for the Observatory, serving until 2005, the same year first light was achieved. During the last two decades John has continued his contributions across a wide span of technical

John Hill receiving his retirement gift of an engraved borosilicate block.

and scientific areas, helping the Observatory to be more successful in innumerable ways. John has served as a role model for many of us, in his dedication to LBTO and its mission.

A retirement celebration of John's career was held in Tucson on April 24 in a location reflecting his culinary preferences. Going forward, John will remain associated with LBTO as Astronomer Emeritus, with the option to pursue projects according to his interest and preferred schedule.

Personnel Update: Feb – Sep 2025

Arrivals:

Murdock Hart	Telescope Scientist
Jon Rees	Service Observer

Departures:

Dan Cox	Software Engineer
David Gonzalez	Obs Support Associate
Kara Hatch	Program Coordinator
John Hill	Technical Director
Cindy Kontowicz	Sr Fin/Admin Coordinator
Sam Neff	Staff Technician