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Currents

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- Planets, Exoplanets, and Planet Formation with Gemini Large and Long Programs (LLPs)
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KPNO in the News

In this Issue

5000 Eyes Open as Kitt Peak Telescope Prepares to Map Space and Time
The Dark Energy Spectroscopic Instrument (DESI), now installed on the 4-meter Mayall telescope, has opened its array of thousands of fiber-optic "eyes" to the cosmos and successfully captured the light from distant galaxies. The milestone marks the beginning of commissioning for DESI, which is poised to begin creating the most detailed map of the Universe ever undertaken.

Read more in the NSF OIR Lab's Press Release.

Opportunity, Partnerships, and Unity

Last month's grand unification — of NOAO with Gemini Observatory and LSST operations — consolidated all of NSF's nighttime optical-infrared astronomy facilities under one roof, creating the next incarnation of the US national observatory. The new organization, NSF's National Optical-Infrared Astronomy Research Laboratory (temporarily nicknamed NSF's OIR Lab), operates five facilities — Cerro Tololo Inter-American Observatory (CTIO), the Community Science and Data Center (CSDC), Kitt Peak National Observatory (KPNO), Gemini Observatory, and the Large Synoptic Survey Telescope (LSST), the first three of which were formerly under NOAO.

Currents sat down with Pat McCarthy, the Lab's recently appointed Director, to learn his perspective on the Lab's mission and the opportunities and challenges ahead. Previously the Vice President of the Giant Magellan Telescope project and Astronomer at the Carnegie Institution for Science, Pat began his 5-year term on 1 October 2019.


Patrick McCarthy, Director, National Optical-Infrared Astronomy Research Laboratory

How do you see the role of the Lab in the US astronomical landscape?

NSF's OIR Lab is about creating opportunities, both by using the assets we have in new and different ways and by creating a solid platform on which new initiatives can form and grow. The Lab is intended to be a true national center where people from all around the US and our partner communities can come to further their research goals. It is a place where people come to collaborate, where teams coalesce, and where new ideas — as well as projects and teams of all sizes — can find the resources they need to take root and grow. As a focal point for community coordination and collaboration, the Lab makes it easier for the US community to speak with one voice to our funding agencies.

The Lab is also about strategic planning in partnership with our community. We must be ready to support the ground-based OIR initiatives that come out of the 2020 Decadal Survey. But also, as we navigate the coming decade, we need to keep one eye on the far horizon, the 2030's and beyond. We must sustain the exploration of known scientific horizons as well as the discovery of future horizons.

Sounds exciting. Can you give us an example of a science opportunity that is enabled by the integration of the five facilities?

A good example is time-domain and survey astronomy. These research approaches will be major science drivers in the coming decade — think LSST and other time-domain surveys, multi-messenger astronomy, and large spectroscopic surveys like

the Dark Energy Spectroscopic Instrument (DESI). To capitalize on the likely deluge of discoveries, we will need CSDC's tools to identify and schedule sources for follow up observations, as well as a fleet of telescopes — at CTIO, Gemini Observatory, KPNO, and elsewhere — to carry out follow up observations. With a larger number of telescopes in the mix, we can allocate apertures to specialized roles and carry out observations over a range of time zones. Telescopes at one site can backstop another in the case of bad weather or provide a longer time sampling for variable objects.

What excites you most about the new organization?

In my work at GMT I learned a great deal about the power of large teams working within professional organizations. Teams supported by strong institutions and solid governance structures can accomplish things that simply cannot be done by small groups — the expert professor and her graduate students, for example. We build big teams to do things that we cannot do any other way. This is a driving force behind the formation of NSF's OIR Lab — with its scale, structure, and governance, we can undertake projects and programs that were previously impossible.

At the same time, astronomy is more diverse than ever before, with discoveries being made and frontiers expanded in many areas, by projects and teams spanning a range of sizes that are funded in different ways. We need to help sustain and grow these diverse efforts. A key lesson I learned in moving from small teams to large organizations is that good leaders empower people, they take chances on people, and they let young people shine. I'm looking forward to what we will accomplish together, in partnership with all parts of our community.

NEID Installation and Commissioning Update

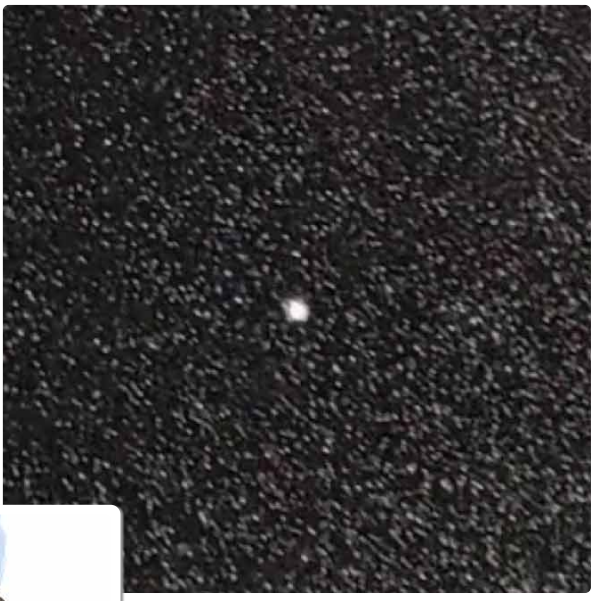
Dan Li (NSF 's OIR Lab)

Commissioning of the NN-EXPLORE Exoplanet Investigations with Doppler spectroscopy (NEID) instrument has begun at WIYN Observatory, as marked by the delivery of the NEID port adapter. The port adapter, which has been developed by NSF's OIR Lab in close collaboration with the University of Wisconsin-Madison and the NEID team, provides crucial basic functions such as target acquisition, fast tip-tilt for guiding, and correction of atmospheric dispersion for the NEID spectrograph.

Port adapter after installation

The FedEx truck that carried the port adapter arrived at Kitt Peak on 17 October 2019, accompanied by the UW team. After assembly (a number of key optical and electronic components had been stored in separate cases during shipping) and a post-shipping health check, the adapter was installed on WIYN's folded Cassegrain

port on 21 October. After another week of intense work (e.g., cabling, optical alignment, electronic and mechanical functionality tests, software integration into the WIYN network and computer system), the port adapter acquired its first light on 29 October with closed-loop (50 Hz) guiding using the fast tip-tilt mirror and the port adapter's internal camera. Over the following nights, we had successfully closed loops on targets down to 14th magnitude (V-band). The guiding dispersion is better than 70 milliarcseconds over 5-minute intervals for bright sources (V < 12 magnitude).



the port adapter camera

The NEID spectrograph, built at The Pennsylvania State University, arrived at Kitt Peak on 28 October. The 2-ton vacuum chamber and many of NEID's supporting and calibration instruments were safely transferred into two connecting cleanrooms inside the WIYN building after being unloaded outside the dome. With help from the OIR Lab personnel, the PSU team spent the following two weeks installing equipment in the cleanrooms, routing cables, opening the vacuum chamber to inspect all the optics and fibers, and waking up the CCD detector, among other activities. The pumping and cooling of the cryostat is now underway. First light with the spectrograph is anticipated later this month, and shared risk science is expected to begin in December 2019.

NEID spectrograph in the WIYN cleanroom

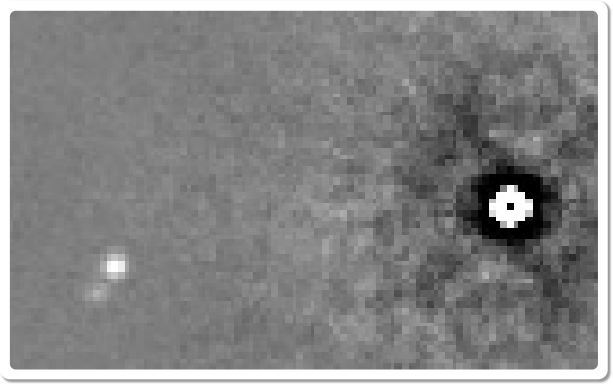
SOAR Follow-up of TESS Exoplanet Candidates: most exoplanets don't "like" binaries, but some do!

Andrei Tokovinin (NSF's OIR Lab)

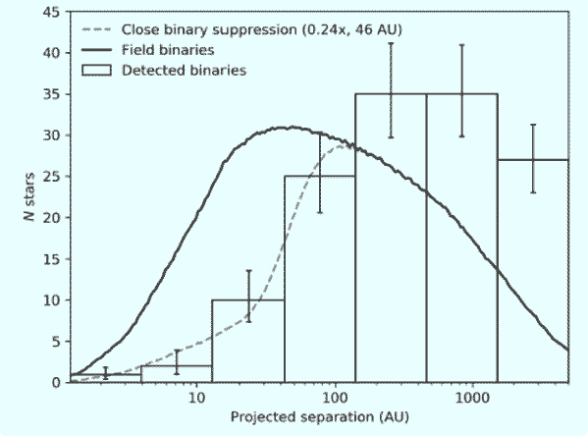
The Transit Exoplanetary Survey Satellite (TESS), launched by NASA on 18 April 2018, scans the whole sky, looking for planets around bright stars by detecting the small light loss caused when a planet transits its host star. Thousands of transiting exoplanets have been discovered from space and from the ground. The strength of TESS, however, is in its uniform survey of bright stars, which are most interesting for the detailed study of exoplanets.

Binary stars present a problem for transits because (i) the light of the companion dilutes the depth of the observed transits, which leads to an underestimate of the planet's radius, and (ii) if the faint companion is an eclipsing binary, it can mimic exoplanet transits around the main star, producing a false-positive detection. Screening all exoplanet host candidates for binary companions with high-angular-resolution imaging is therefore an essential complement to TESS observations.

As TESS began its survey by scanning the southern sky, the High-Resolution speckle camera at the 4.1-meter SOAR telescope was the natural choice for screening hundreds of TESS objects of interest (TOIs) for close companions. The team led by Carl Ziegler (University of Toronto), which includes NSF OIR Lab astronomers A. Tokovinin and C. Briceño, began the observations in September 2018, soon after the very first TOIs were announced. These observations are highly automated, covering up to 300 objects per night. The data were processed within a week and posted promptly on the TESS follow-up web site. Several papers on TESS exoplanets have used these observations. It turns out that about 20% of the 542 TOIs observed to date at SOAR have companions within 3 arcseconds, only a fraction of which were previously known. The first Figure shows the pair of faint stars, separated by 0.17", accompanying TOI 612 at a distance of 2", as revealed by SOAR.



The results of the TESS follow-up campaign at SOAR, which have been accepted for publication in the Astronomical Journal (Ziegler et al. 2019), are available online. Apart from their purely technical utility (correction of transit depth and false positives), the large and uniformly observed sample of TESS exo-hosts revealed interesting statistical trends (see the Figure below from Ziegler et al. 2019). The frequency of binary companions with separations below ~50 au is reduced by a factor of 4 compared to similar stars that do not host transiting planets (a similar trend was found earlier by A. Kraus et al. for Kepler exoplanet hosts). Apparently, the existence of a close binary companion suppresses (albeit not completely) the formation of planets.



Even more intriguingly, the SOAR survey revealed the excess of wide binaries among TESS exo-hosts. However, the surplus of wide companions is found almost exclusively for stars hosting "hot Jupiters" (massive planets on tight orbits, like the one orbiting 51 Pegasi). This finding points to the relationship between binary systems and the properties of their planets. It is currently believed that hot Jupiters formed at large distances from their stars (like Jupiter in our Solar System) and later migrated inward to their present-day tight orbits. Wide binary companions could

have played a critical role in promoting the migration of hot Jupiters, e.g., by destabilizing other planets that could have thrown the hot Jupiters into close orbits.

Special Sessions at the January AAS Meeting

AEON: Progress in Networking Observatories and Tools for Follow-up in the ZTF/LSST Era

Sunday, 5 January 2020, 5:30–6:30pm, Room 306AB

The Astrophysical Events Observatories Network (AEON), a collaborative partnership, is developing a network of telescopes to execute astronomical observations effectively and efficiently in the ZTF/LSST era. The founding partners are the Gemini, Las Cumbres, and SOAR Observatories and NSF's OIR Lab. AEON is being developed to enable observations across multiple facilities and support highly responsive, flexible scheduling and programs that require coordination.

Observation requests for the SOAR 4.1-meter can now be programmatically submitted and queue-scheduled through the Las Cumbres Observatory (LCO) network infrastructure, thanks to recent upgrades at both facilities, which enable a range of science. LCO has developed an open-source package to enable astronomers to easily build and customize Target and Observation Manager systems (TOMs) to manage and facilitate their science programs. The package provides a range of interfaces to essential observing facilities, brokers and data archives, including AEON, as well as observation planning and data visualization tools. Gemini has begun the Time Domain Astronomy (TDA) project to develop the infrastructure needed to incorporate Gemini's telescopes into the AEON. NSF's OIR Lab plans to integrate the Blanco telescope into AEON as well.

In this splinter session, the AEON partners will provide updates on the implementation of AEON to date and plans for the future.

The Zwicky Transient Facility Community Survey Update for Year 3

Monday, 6 January 2020, 5:30 pm–6:30 pm, Room 303 A

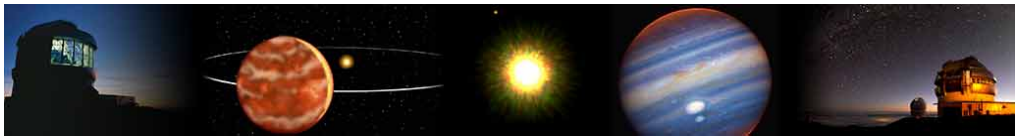
The Zwicky Transient Facility (ZTF) team will present an update on the performance and products of the ZTF Community Survey as the end of its second year approaches. The session will include schedule and content for data releases 2 and 3. Plans for the third year of the community survey will be open for discussion, including the recently initiated program to track the TESS fields with daily monitoring. The ZTF Community Science Advisory Committee urges participation in this timely opportunity for feedback and input on the community survey element of the ZTF program. This session is expected to be of interest to anyone who is using or may use data from the ZTF survey.

DR2 is expected to contain up to 18-month time series for more than 2 billion sources. Data releases are supported by IPAC. Feedback on user experience with and advice concerning database content and access will be welcome.

ZTF variability alerts are published daily and are available directly or via several brokers. Presentations will include lessons learned on alert quantity and quality. Community experience with alert use, especially follow up, will be appreciated.

As the survey enters its third year, the program for the community element of the survey, which represents 40% of all survey time, will be reviewed. We welcome input from participants concerning the products of the community survey to date.

As of this writing, the ZTF team is pursuing the possibility of continuing the public survey beyond year 3. Advice and comment from the community on potential observing strategies is invited and welcome.



Planets, Exoplanets, and Planet Formation with Gemini Large and Long Programs (LLPs)

Tuesday, 7 January 2020, 9:30–11:30am, Room 303B
Letizia Stanghellini, Alison Peck, and Ken Hinkle (NSF's OIR Lab)

All scientists, especially current and potential Gemini users, are invited to participate in this splinter meeting, which will showcase science results from Gemini Large and Long Programs (LLP). The program will focus on mature LLPs in the field of exoplanets and planet formation. The following talks will present science results along with data analysis strategies:

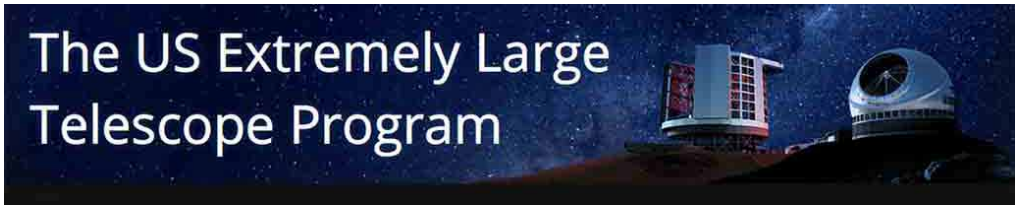
- Characterizing Dusty Debris in Exoplanetary Systems (Christine Chen)
- Observational Characterization of Active Main-Belt Comets and Main-Belt Comet Nuclei (Henry Hsieh)
- Validating K2's Habitable and Rocky Planets with AO Imaging (Elisabeth Matthews)
- Follow-up of Newly Discovered Near-Earth Objects from the NEOWISE Survey (Joseph Masiero)
- Scattered Light Imaging of YSOs: Probing the Fundamental Stages of Planet Formation (Evan Rich)

Challenges to Astronomy from Satellites

Wednesday, 8 January 2020, 10am–11:30am, Room 317B
Connie Walker (NSF's OIR Lab), Jeff Hall (Lowell Observatory), Lori Allen (NSF's OIR Lab)

This exciting session will feature a presentation by Patricia Cooper (SpaceX) who will describe the "Emergence of Low-Earth Orbiting Satellite Constellations and Their Impact on Astronomy". Chris Impey (Steward Observatory) will speak on the industrialization of space. Patrick Seitzer (U. Michigan) will talk about modeling the possible impacts of mega-constellations of satellites on optical astronomy facilities and possible solutions. Harvey Liszt (NRAO) will discuss "Radio Astronomy in a New

Era of Radio-communication". Come participate in the discussions and provide feedback on the next steps.



US ELT Program Open House

Sunday, 5 January 2020, 7:30 pm–9:00 pm, Room 306AB

The Giant Magellan Telescope (GMT) and the Thirty Meter Telescope (TMT) are two of the next generation extremely large telescopes (ELTs) with significant US participation. The projects are expected to reach first light within the next decade and are working together to develop a plan for broad access to the completed facilities by the US community in coordination with NSF's National Optical-Infrared Astronomical Research Laboratory (NSF's OIR Lab).

At this Open House, members of the US ELT Program team will present brief status updates. Open discussion will follow, and all members of the community are encouraged to participate. There will also be an opportunity for attendees to meet socially with key organizational, technical and scientific leadership of TMT, GMT, and NSF's OIR Lab. Complimentary snacks and refreshments will be provided thanks to generous support from the Gordon and Betty Moore Foundation.

The US Extremely Large Telescope Program

Tuesday, 7 January, 10:00 am–11:30 am, Room 306AB

After more than 20 years of science operations with 8-10m class telescopes, some of today's forefront astronomical problems demand new facilities with still larger apertures. The forthcoming generation of extremely large telescopes (ELTs) will offer tremendous gains in angular resolution and sensitivity, opening new frontiers in nearly all areas of astrophysics, from our Solar System to cosmology.

The US Extremely Large Telescope Program (US-ELTP) is a partnership between the National Science Foundation's National Optical-Infrared Astronomy Research Laboratory (NSF's OIR Lab) and the organizations building the Thirty Meter Telescope (TMT) and the Giant Magellan Telescope (GMT). Its aim is to ensure that all US scientists may conduct forefront scientific research using these new observatories. The US-ELTP seeks to enable 25% or greater shares of open access observing time on both the GMT and the TMT for US astronomers regardless of their institutional affiliations. This bi-hemispheric ELT system will support US scientific leadership in the global ELT era by enabling US astronomers to observe objects anywhere on the sky, and to use a broader suite of instruments than a single observatory could provide.

This session will describe the objectives of the US ELT Program, and provide up-to-date information about the TMT and GMT projects. There will be presentations on the primary scientific motivations for the US-ELTP, including Key Science Program (KSP) concepts developed by community-based teams. KSPs will address questions of fundamental scientific importance that require tens to hundreds of GMT and TMT nights, and will follow open collaboration models that encourage broad, diverse

participation by scientists throughout the US research community. The session will include opportunities for audience discussion.

Contact Us

We welcome your input on this issue of *Currents*. Please contact us at currents@noao.edu. We look forward to hearing from you!

Currents is a spark plug for communication between us and our community. It provides updates—and solicits community input—on observing opportunities and programs and policies on a more rapid timescale than is possible with our *Newsletter*.

The NSF's National Optical-Infrared Astronomy Research Laboratory is the US center for ground-based optical-infrared astronomy and is operated by the Association of Universities for Research in Astronomy (AURA), Inc. under cooperative agreement with the National Science Foundation.