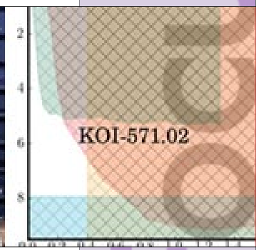
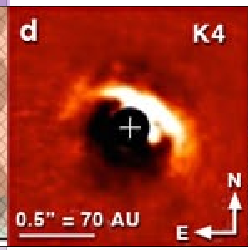
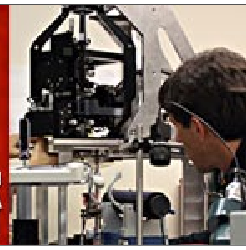
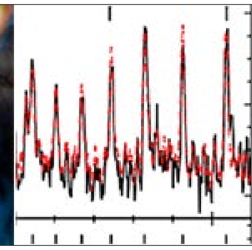
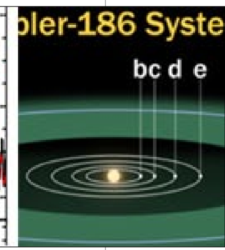
GeminiFocus

Publication of the Gemini Observatory | April 2014





ON THE COVER:

Gemini's assistant scientist, André-Nicolas Chené, delights the kindergarten class at Hilo Union School as he shares the student's drawings of Jupiter with the class.

Gemini*Focus* April 2014

*Gemini*Focus *is a quarterly publication of Gemini Observatory*

670 N. A'ohoku Place, Hilo, Hawai'i 96720 USA
Phone: (808) 974-2500   Fax: (808) 974-2589

Online viewing address: www.gemini.edu/geminifocus

Managing Editor: Peter Michaud

Science Editor: Nancy A. Levenson

Associate Editor: Stephen James O'Meara

Designer: Eve Furchgott / Blue Heron Multimedia

Markus Kissler-Patig

Director's Message

2014: What Lies Ahead

Gemini is starting in this new year with great expectations. There is much to look forward to in 2014. We are introducing several key changes to our operations, perfecting several new instruments at Gemini South, and hosting a couple of visiting instruments again at Gemini North. 2014 also marks the second year of our three-year transition to a 20 percent reduced budget, and many modifications and cost-reduction measures continue to take place internally. Our goal is for these adjustments to only be noticed positively, if at all, by our users.

The Operations Side

The community response to our new Large and Long Programs has surpassed expectations. We've received 31 proposals, which add up to a much larger over-subscription factor than for regular programs! These programs will provide us with a great opportunity to test the new priority visiting observing mode intended to mitigate weather loss during classical runs and encourage more users to come and visit our telescopes. Learn more about this observing mode at: *http://www.gemini.edu/node/11101?q=node/12096*.

In response to a request from the Users' Committee, we'll offer a further incentive for classical observing with our new "bring-one, get-one (almost) free" plan: We will subsidize, with $2,000, each observing visit of a student accompanying a more experienced classical observer. Apply for this opportunity now, since the offer is, at least initially, for a limited time only.

In other operations news, our fast-turnaround proposal scheme is currently being scrutinized by an external review committee. This program, which is intended to greatly decrease the time from having an idea, to acquiring the supporting data, will combine frequent proposal submission opportunities, rapid review, and fast preparation and execution of observations. We aim to launch the scheme at the end of this year and have it complement both the regular and the large and long proposal programs.

Also destined to help our user community is a change to the network of National Gemini Offices (NGOs). This change will more efficiently distribute work among the NGOs to optimally exploit their respective areas of expertise. In particular, Gemini will now directly support the Phase-II proposal process for U.S. Principal Investigators. In return, the U.S. NGO at the National Optical Astronomy Observatory will focus on improving post-observing support. A step in that direction was recently introduced with the user backed Gemini Data Reduction User Forum http://drforum.gemini.edu/ which already hosts many user-shared resources, and continues to grow.

The Instrumentation Front (and Beyond)

2014 promises to present a quantum jump for Gemini South's instrumentation. Last year, the Observatory introduced two significant instruments: the Gemini Multi-conjugate adaptive optics System (GeMS, with its near-infrared adaptive optics imager), and the near-infrared instrument FLAMINGOS-2. Both instruments are now slowly reaching maturity (although quite some work remains to make them as stable as we desire). The Gemini Multi-Object Spectrograph at Gemini South (GMOS-S) will also finally receive its long-awaited, new, Hamamatsu CCDs by the middle of the year (as this is written the CCD's are in transit from Gemini North to Gemini South).

Also exciting, commissioning of the Gemini Planet Imager (GPI) should conclude by May, and we expect it will then start to flourish as a unique, world-class resource for Gemini's user community. If you attended the January 2014 meeting of the American Astronomical Society in Washington, D.C., you likely saw some of GPI's spectacular early results that we released (and displayed) at the meeting. Furthermore, Gemini has selected 16 short programs for early GPI science, for a total of 32 observing hours, before regular operations commence in 2014B. GPI promises to further enhance the already strong exoplanet research ongoing at Gemini.

With all this activity at Gemini South one might think that Gemini North was forgotten — but it wasn't. In addition to our expectation of two visiting instruments again this year, we've started upgrades to the Altair adaptive optics system and anticipate first light from GRACES — our demonstrator link to the Canada-France-Hawaii Telescope's high-resolution spectrograph ESPaDOnS (Echelle SpectroPolarimetric Device for the Observation of Stars), see details on page 12.

Finally, supporting our statement of purpose — "Exploring the Universe, Sharing its Wonders" — Gemini continues to support its outstanding outreach programs. Both Gemini North and South have already hosted major events in March. In the north, we are proud to announce that our flagship community outreach program, Journey through the Universe ("Journey") has just celebrated its 10th anniversary in a huge way. The Big Island event had a record number of classroom visits, and thousands of public participants enjoyed a wide-range of educational events. It was a spectacular success. Our annual AstroDay Chile program also continues to grow and lead the way in astronomy outreach in the south. This year's event attracted over 2,000 local participants, making it a phenomenal success as well. Both Journey and AstroDay formed many new community partnerships this year and engaged a diverse number of local educational institutions. Congratulations go out to all involved, and don't miss our sampling of images from these events starting on page of 25 of this issue.

In view of all these upcoming enhancements and events, 2014 will, without doubt, continue to be a terrific year for Gemini!

Elisa Quintana, Steve Howell, Tom Barclay, and Jason F. Rowe

Gemini Helps Confirm First Earth-sized Planet in the Habitable Zone of a Star

Gemini North observations using the visiting Digital Speckle Survey Instrument (DSSI) contribute to a monumental discovery — the first Earth-sized planet orbiting a star in a region that could support life.

The possibility that stars other than our Sun could have habitable worlds has long captured the imagination of humanity. Now, Gemini Observatory, along with observations with the W.M. Keck Observatory has helped to take that possibility one step closer to reality.

NASA's Kepler space telescope — a mission designed to search for planets in other solar systems — has discovered the first known Earth-sized planet orbiting a star in the "habitable zone" — a region where liquid water could exist on the planet's surface and possibly support life. Named Kepler-186f, this new world is one of five — all less than 50% larger than Earth — detected by Kepler that orbit this host star that is cooler and smaller than our Sun. Only Kepler-186f, though, lies in the star's habitable zone.

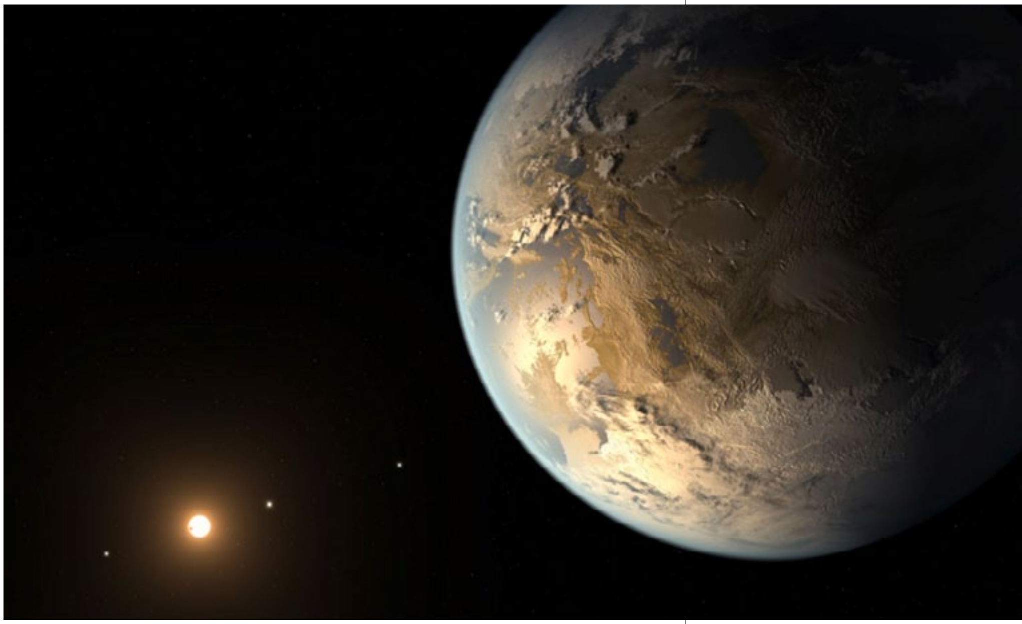
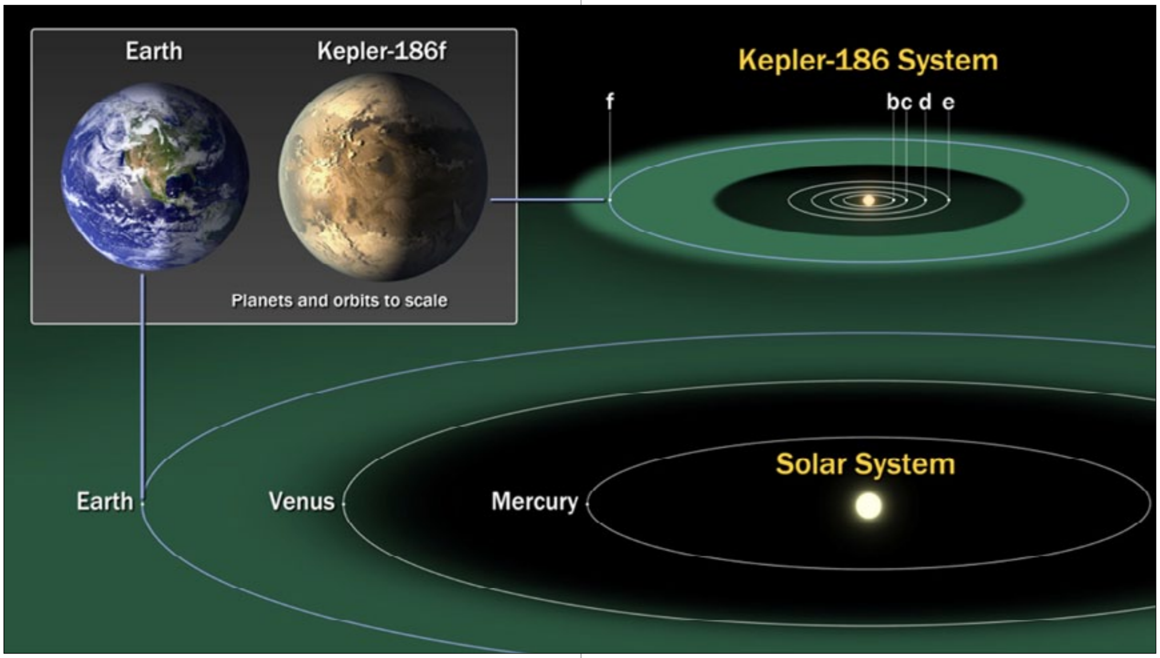


Figure 1.
This artist's concept depicts Kepler-186f, the first validated Earth-size planet orbiting a distant star in the habitable zone — a range of distances from a star where liquid water might pool on the surface of an orbiting planet. Kepler-186f resides in the Kepler-186 system about 500 light-years from Earth in the constellation Cygnus. The discovery of Kepler-186f confirms that Earth-size planets exist in the habitable zone of other stars and signals a significant step closer to finding a world similar to Earth.
Credit: NASA/Ames/JPL-Caltech/T. Pyle

Figure 2.
Kepler-186f is within ten percent the size of Earth, but its mass and composition are not known. Kepler-186f orbits its star once every 130-days and receives one-third the heat energy that Earth does from the Sun, placing it on the outer edge of the habitable zone (shaded region in green). The system is also home to four inner planets, all measuring less than 1.5 times the size of Earth, and orbiting a cooler and less massive star than our Sun. Because Kepler-186 is cooler and dimmer, the habitable zone is located closer in. All five planets in this system have orbital distances to their star less than Mercury's distance from the Sun. Credit: NASA/Ames/JPL-Caltech/T. Pyle



Follow-up observations with the 8-meter Gemini North and 10-meter Keck II telescopes provided high-quality observations that backed up the spacecraft's discovery, making Kepler-186f the first Earth-sized exoplanet with the potential to support life.

In Transit

The Kepler spacecraft discovered Kepler-186f by observing transits (where a planet passes in front of its host star) on several occasions. During a transit, the total amount of light we see from the star is diminished due to the

Kepler-186f: A Planet with Oceans?

The host star, Kepler-186, is an M-type star, an M dwarf, or a red dwarf. It lies in the direction of the constellation Cygnus, about 500 light-years away. The star is relatively dim with a luminosity of just about 5 percent that emitted by our Sun.

The habitable zone (HZ) around this lower-luminosity star is located much closer in compared to the habitable zone of a star like our Sun. The intensity and spectrum of the star's radiation determines the boundaries of the HZ. Kepler-186f receives about a third of the insolation (intensity of stellar radiation) as that received by Earth from the Sun and, with an orbital period of 130 days, it resides in the HZ throughout its orbit.

Since Kepler can only measure a planet's size, we don't know the mass of Kepler-186f and therefore we cannot say anything about its composition. Theoretical models have shown that planets as small as Kepler-186f are highly unlikely to be dominated by a gas envelope like Neptune, and more likely is composed of some combination of rock, iron and perhaps water or ice, material that also composes the Earth (and that we refer to as "rocky"). However, if Kepler-186f is rocky like the Earth, and has an Earth-like atmosphere, then any H_2O at its surface is likely to be in liquid form and compatible with life as we know it.

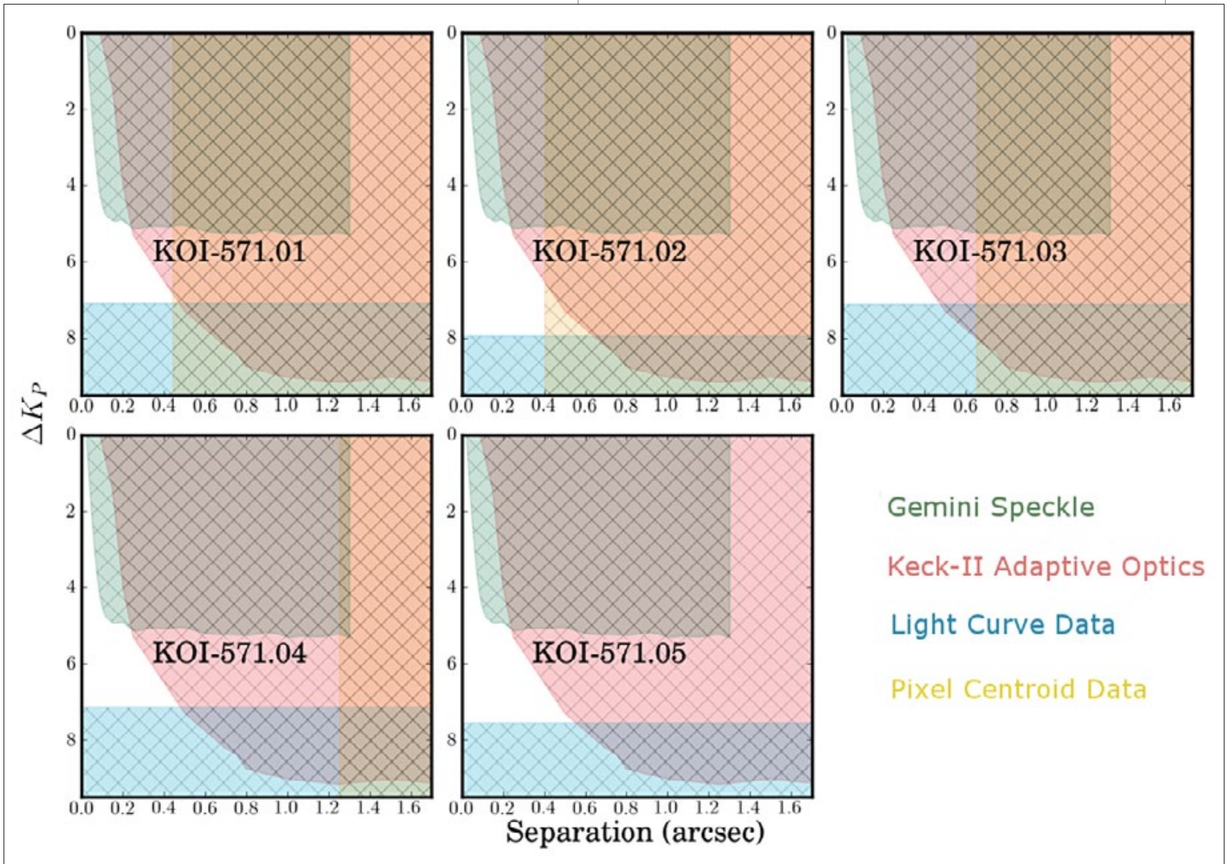


Figure 3.
Exclusion zones for each of the planet candidates in the Kepler-186 system. Prior to validation, the star was known as KOI (Kepler Object of Interest) 571, and Kepler-186f (KOI-571.05) is shown in the lower middle panel. The shaded regions indicate the parameter space that can be ruled out for having an astrophysical source (like a binary star system) that is inducing light variations that could mimic a planet signal. The region shaded in green is excluded by Gemini speckle imaging, the pink is from the Keck-II adaptive optics observations, the blue is based on modeling the transit light curve, and the yellow is based on pixel centroids data (measures of the movement of the pixels which can indicate if the primary source is a binary star system, not shown in the Kepler-186f panel). Observational constraints rule out in all parts of the save for the white region, which then goes through additional statistical analysis. The additional shaded region provided by Gemini — looking for sources very close to the star — was crucial in our validation of Kepler-186f.
Credit: Thomas Barclay

planet's blocking of some light from the star. Kepler measurements of the brightness decrease, and the frequency of transit, as well as knowledge of the star's size, are used to determine the size of the planet and the planet's distance from its star.

The Kepler mission has contributed more than 950 exoplanet discoveries to the current count of about 1700, in addition to the 38000 potential planets that await confirmation. Several key milestones have been reached by Kepler towards the goal of finding potentially habitable planets. A small number of Earth-sized planets, such as Kepler-20e, have been found, however they all orbit close to their star, making them extremely hot and therefore inhospitable to life. About a dozen planets have been found to orbit in their star's habitable zone, however they are all larger than Earth and most have a thick atmosphere of gas like Jupiter. Kepler-186f is the first "Goldilocks planet," it has the right size, and orbits at the right distance, to allow the existence of water, thought to be a key ingredient for supporting life.

Gemini's Role

One way to verify claims of exoplanet detection is to look for a signature "wobble" in the host star, as gravity from orbiting planets tug on it. However, Earth-sized planets, like Kepler-186f, are too small to create a detectable wobble with existing technology. Confirmation had to come in a new way.

To prove that the signals in the star's light are due to planets and not other nearby astrophysical sources, high-contrast images were obtained from both Gemini North and Keck II telescopes. Some common sources of apparent variability, which can trigger a false planetary detection, include a binary star system in the background or foreground that introduces small variations in the total measured light. Alternatively, if we are truly looking at a binary star system, but a third star is so

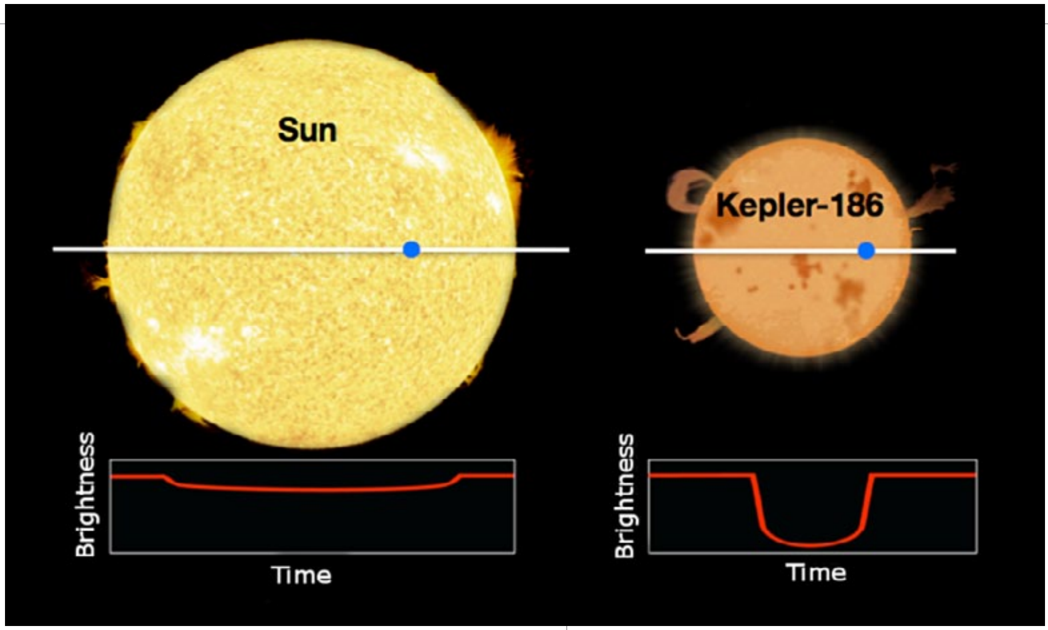


Figure 4.
An Earth-sized planet crossing in front of a Sun-like star (left) and an M dwarf like Kepler-186 (right). The amount of starlight blocked by an Earth-sized planet in the habitable zone is proportionately greater for an M dwarf than a Sun-like star, creating a larger dip in the transit light curve (bottom) and therefore making them easier to detect.
Credit: Wendy Stenzel

close that it dilutes the signal, or if the binary stars barely eclipse each other, then these are other scenarios that could cause a small dip in the light curve and be misinterpreted as a planetary eclipse.

Kepler-186 was observed using the Differential Speckle Survey Instrument (DSSI) on Gemini North and using the NIRC2 camera on the Keck-II telescope. Gemini and Keck each imaged Kepler-186 to different degrees of

M Dwarfs: Prime Targets in the Search for Habitable Worlds

M dwarfs (stars with 0.1-0.5 times the mass of the Sun) are excellent targets in the search for habitable worlds. Planets in the habitable zones of M stars are easier to detect than planets in the habitable zones of Sun-like stars due to their shorter orbital periods and frequency of transits detected. The proportion of starlight that they block is also greater (see Figure 4) so the transit depths are deeper. M-dwarfs are also very abundant, comprising about three quarters of all main sequence stars in our galaxy. They also evolve very slowly in luminosity, thus their habitable zones remain stable for billions of years. Furthermore, planets around M dwarf hosts may (ultimately) be imaged more easily due to higher contrast between the planet and the star.

M Dwarfs have long been thought to be unsuitable hosts for habitable planets due to the proximity of planets in the habitable zone and their vulnerability to the stellar environment. M stars are known to be highly active early in their life, often producing giant and frequent flares which could scorch planets nearby. They also gravitationally interact with the planets, causing tides that heat the planet and cause their rotations to be 'tidally locked,' which means one side always faces the star and the other side faces the cold open space, much like our moon is tidally locked with the Earth. Fortunately, Kepler-186f orbits a star that is on the larger end of the M dwarf mass range and is at a large enough distance where it could very well have escaped all of these complications to habitability. Regardless, there have been many recent studies that have shown ways around each of these challenges, and there isn't any one factor that precludes M dwarf planets from being habitable.

proximity (to address how close to Kepler-186 another source could be resolved) and magnitude (to determine the faintest a nearby source could be detected). The exceptional data from DSSI allowed us to be sensitive to stars just 4 AU from Kepler-186 (about the distance between Jupiter and the Sun in our own solar system). The Keck data helped us rule out sources at fainter magnitudes. No nearby sources were seen which we built into our false positive model to conclude that the probability that Kepler-186f orbits the M-dwarf star is 99.98%.

Kepler-186f, at a distance of about 500 light years from Earth, is too far away for any near-future ground or space-based observations that could indicate the presence of an atmosphere or oceans. This confirmation does, however, show that Earth-sized planets in the habitable zone of stars other than our Sun do exist. Given the fact that M dwarfs comprise more than 70% of all main-sequence stars in our galaxy, and that the majority of nearby stars — which are better suited for follow-up observations — are M dwarfs, planets like Kepler-186f may be common, and Gemini will no doubt play a large role in confirming them.

Elisa Quintana is a scientist at the SETI Institute and a NPP Senior Fellow on the Kepler Team at NASA's Ames Research Center. She can be reached at: elisa.quintana@nasa.gov

Steve B. Howell is the Project Scientist for the NASA Kepler Mission, at NASA Ames Research Center, near San Francisco, CA. He can be reached at: steve.b.howell@nasa.gov

Tom Barclay is an SO Support Scientist on the Kepler Team at NASA's Ames Research Center. He can be at: barclay.astro@gmail.com

Jason F. Rowe is scientist for Kepler at the NASA Ames Research Center who helped analyze the Gemini data for this work. He can be reached at: jason.f.rowe@nasa.gov

Nancy A. Levenson

Science Highlights

Gemini data help to understand the first B[e] supergiant stars in M31, support modeling of a young star's disk, and identify low-mass stars in young groups of stars.

Discovery of the First B[e] Supergiants in M31

Michaela Kraus (Akademie ved Ceske republiky, Czech Republic) and collaborators from Argentina and Brazil have used the Gemini Near-Infrared Spectrograph (GNIRS) on Gemini North to identify the first B[e] supergiants in the nearby galaxy M31. These stars represent a short-lived phase of evolution of massive stars, after their time on the main sequence.

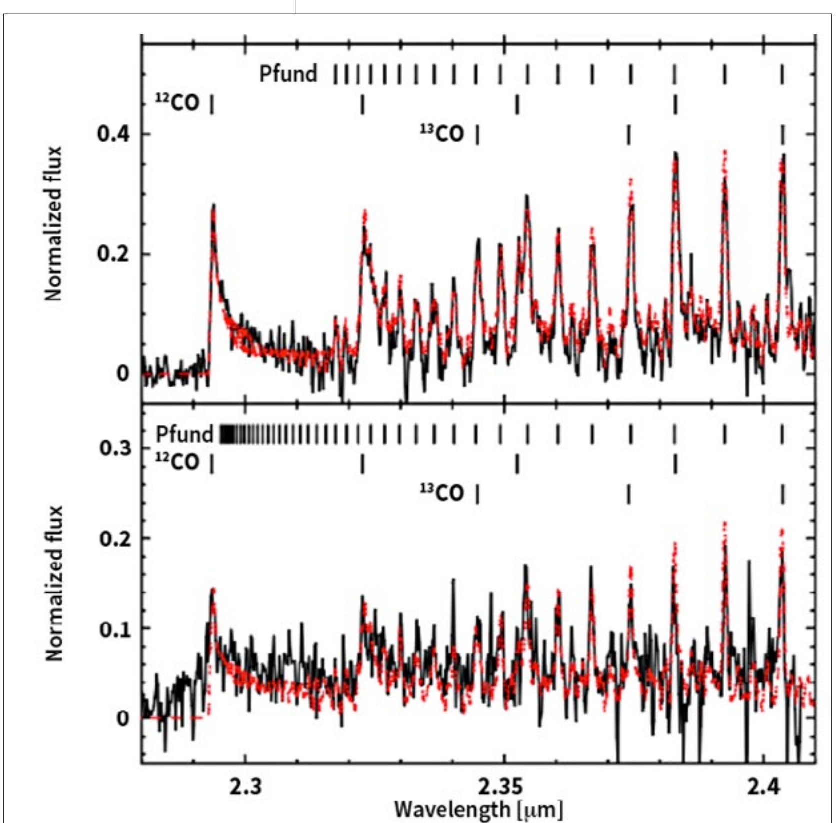


Figure 1. *GNIRS continuum-subtracted spectra of two newly identified B[e] supergiants in M31 (black), exhibiting the hydrogen Pfund series and both ^{12}CO and ^{13}CO. The red lines represent model fits to the observations.*

These stars are broadly relevant first in the context of stellar evolution and seconc as sources of metal enhancements in galaxies. B[e] supergiants deposit enriched material in the interstellar medium through mass loss (during post-main-sequence phases) and ultimately as supernovae. The mass loss can result in disks and rings, and the progenitor of supernova 1987A in the Large Magellanic Cloud may, in fact, be a B[e] supergiant. Besides increasing the known population of these rare objects, M31 offers an interesting host environment, having higher metallicity (about twice solar) compared with previous examples.

One challenge in identifying B[e] supergiants is to distinguish them from luminous blue variable (LBV) stars — another short-lived phase in the post-main sequence evolution of massive stars. This study's original targets were selected from stars previously identified as "LBV candidates." These newly discovered examples lie in a typical

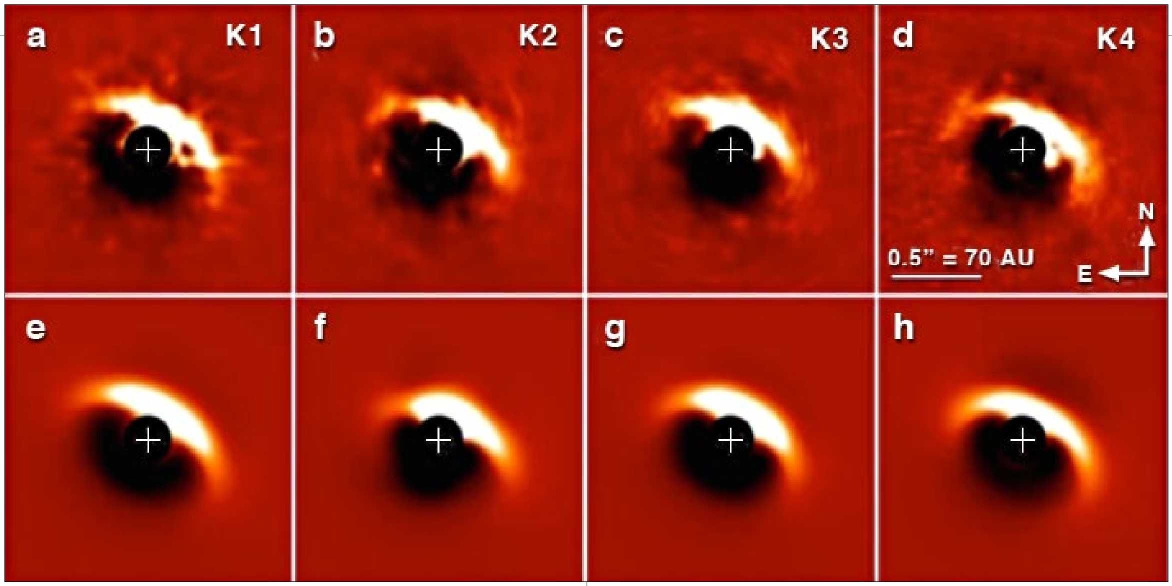


Figure 2. *NIRI/Altair observations of LkCa 15 in the K_s band at four epochs (labeled K1 through K4), reduced using angular differential imaging techniques (top row, a–d). Corresponding model observations of the disk emission appear in the bottom row (e–h).*

region of the near-infrared color-color diagram, one distinct from the location of luminous blue variables.

More important, B[e] supergiants have two identifying characteristics in the infrared: hydrogen Pfund series emission lines and carbon monoxide (CO) bands (Figure 1). Both ^{12}CO and ^{13}CO are detected, and their relative strength indicates the isotope ratio of $^{12}C/^{13}C$ at the stellar surface (7 ± 2). The relative enrichment of ^{13}C here is greater than that observed in lower-metallicity environments of the Milky Way and Magellanic Clouds.

This paper can be found in *The Astrophysical Journal Letters*, **780:**10, 2014

Detailed Observations and Modeling of a Young Star's Disk

Planets form in the dusty disks left over from star formation. Planet development can shape these disks, especially by carving holes in the dense medium. LkCa 15, a nearby young star somewhat similar to the Sun, has one of these residual disks. It is an excellent target for detailed studies, because previous evidence shows a Solar-System-sized gap (~50 astronomical units) around the star. Now, in a new work, Christian Thalmann (ETH Zurich and University of Amsterdam) and collaborators use four epochs of observations to provide a detailed model of this star's disk.

One important new result is that they distinguish the disk's geometry, identifying bright emission as the near side (where light is forward scattered toward the viewer) as opposed to direct illumination of the far side. The team finds evidence for disk asymmetry, namely, an offset between the star and disk center, which could be due to an unseen planet. In addition, the disk's inner wall has a rounded or irregular shape, rather than being flat. This characteristic, too, could be related to the presence of a companion.

The disk is directly evident in observations obtained with the Near-Infrared Imager (NIRI) and the Altair adaptive optics facility on Gemini North; the researchers used data reduction techniques to enhance the contrast of the faint disk near the bright central star. While such angular differential imaging increases contrast, the resulting images cannot be used for quantitative analysis. Therefore, the researchers model a variety of disk configurations, then simulate the resulting observations, including scattered light from the central host star (Figure 2). The best-fitting models yield the bright emission results noted above, indicate an inclination of 50 degrees, and confirm the inner gap's size.

This *Astronomy and Astrophysics* paper is available in electronic form at: ***arXiv:*** *1402.1766*.

Identifying Low-mass Stars in Young Groups

Obtaining a complete census of low-mass stars is an important step in determining the intrinsic distribution of stellar masses (the initial mass function), and these low-mass examples also offer some of the best opportunities to image planets, because the host stars are not overwhelmingly bright. In recent work, Lison Malo (Université de Montréal) and collaborators concentrate on the case of young nearby groups of stars, providing additional evidence to identify 130 more low-mass stars as members of these young moving groups.

The original target sample included 920 low-mass stars that exhibited some evidence for youth. Bayesian statistical techniques provided distance estimates and reduced the sample of interest. The new work concentrates on the most likely candidates and adds high spectral resolution observations, obtained primarily using Phoenix on Gemini South. These data enable measurement of the radial velocity, which provides kinematic evidence for group membership, and projected rotational velocity, which indicates age.

The age is an important characteristic to confirm group membership. One further result from this work is to identify X-ray luminosity as an additional useful age discriminant for the M dwarfs of interest (Figure 3), which is shown to be even more effective than the ratio of X-ray to bolometric luminosity that has previously been been applied. The X-ray luminosity technique also offers the advantage of extending to a broader (older) age range than some other common methods, such as measurements of lithium line strength.

Absolute confirmation of the individual stars as members of these nearby (distance less than 100 parsecs) and young (age less than 100 million years) moving groups still requires measurement of parallax, although the work so far provides a high likelihood that they would be confirmed. The results will be published in *The Astrophysical Journal*, and a preprint is now available at ***arXiv:****1402.6053*.

Nancy A. Levenson is Deputy Director and Head of Science at Gemini Observatory and can be reached at: nlevenson@gemini.edu

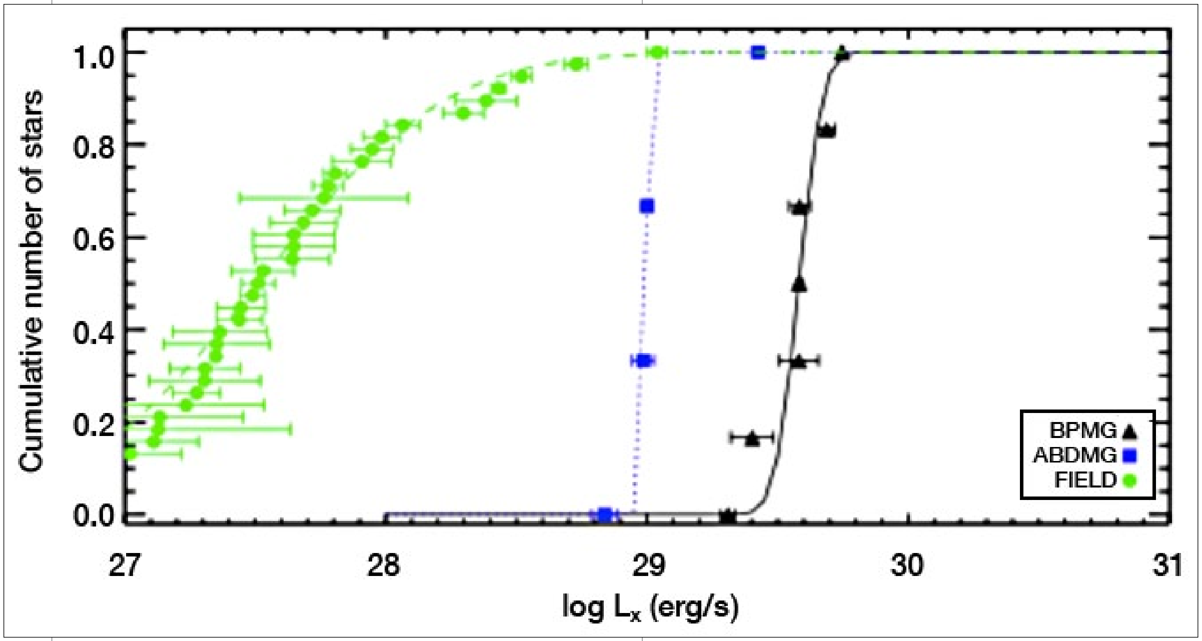


Figure 3. *Cumulative distribution of the X-ray luminosity demonstrates the utility of this measurement as an age indicator, showing field stars (green circles), confirmed members of the Beta Pictoris moving group (black triangles), and confirmed members of the AB Doradus moving group (blue squares).*

Stephen Goodsell, André-Nicolas Chené, and Scot Kleinman

Instrument Development Update

Gemini's optical spectroscopic program is rapidly advancing with both the Gemini High-resolution Optical Spectrograph (GHOS) and Gemini Remote Access to CFHT ESPaDOnS (GRACES) making significant strides. The Gemini Planet Imager is now poised for scientific operations, and ongoing work is extending the capabilities of our Gemini Multi-Object Spectrographs. The following highlights summarize recent progress in these important future capabilities.

The Gemini High-resolution Optical Spectrograph

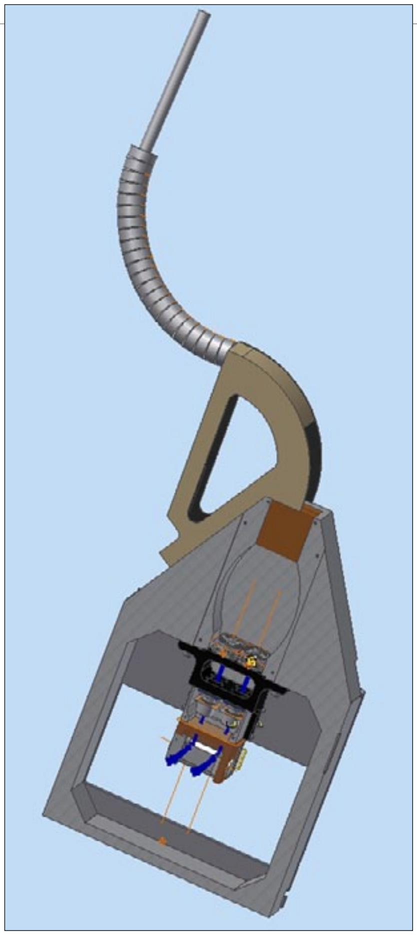
The Gemini High-resolution Optical Spectrograph (GHOS) post-conceptual-design contracts are now approved by the Gemini Board, the Association of Universities for Research in Astronomy (AURA) and the National Science Foundation (NSF), thus starting the Preliminary Design Stage for this long-awaited project. This allows us to proceed quickly into a team kick-off meeting with representatives from Gemini, the Anglo-Australian Observatory, National Research Council of Canada-Herzberg, and Australian National University. The remainder of the project should take about four years to complete.

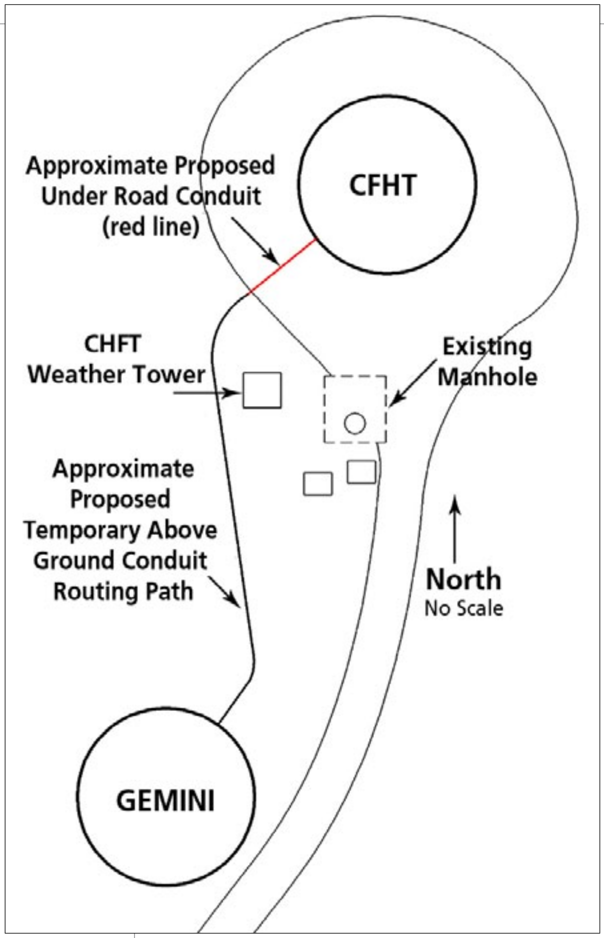
GRACES: A Gemini and CFHT Partnership in Spectroscopy Leaps Forward

Gemini Observatory, the Canada-France-Hawaii Telescope (CFHT), and the National Research Council (NRC) Herzberg in Canada have formed an innovative partnership on a project that is progressing rapidly. Called GRACES (Gemini Remote Access to CFHT ESPaDOnS Spectrograph), this exciting initiative hopes to prove our ability to provide a powerful new tool for high-resolution optical spectroscopy at Gemini.

Figure 1 (left). *View of the cassette to inject light into the optical fibers. This special cassette will be inserted inside GMOS.*

Figure 2 (right). *Approximate routing of the fibers between the telescope on Mauna Kea.*





The project combines Gemini North's large collecting area with the high resolving power and efficiency of ESPaDOnS (Echelle SpectroPolarimetric Device for the Observation of Stars) at CFHT. Using a long fiber running from Gemini to our neighbor on Mauna Kea, CFHT, the system is poised to deliver high-resolution spectroscopy (predicted maximum resolution of R~55.000) across the optical region for predicted transmission).

GRACES consists of three primary components: 1) an injection module (replacing the GMOS integral field unit) for sending the light from the Gemini telescope into the GRACES fibers (Figure 1), 2) two 280-meter-long fibers (the longest ever made for astronomy) that run through a conduit between Gemini and CFHT (Figure 2), and 3) a receiver unit that is responsible for injecting the light from the fibers into the ESPaDOnS spectrograph at CFHT (Figure 3).

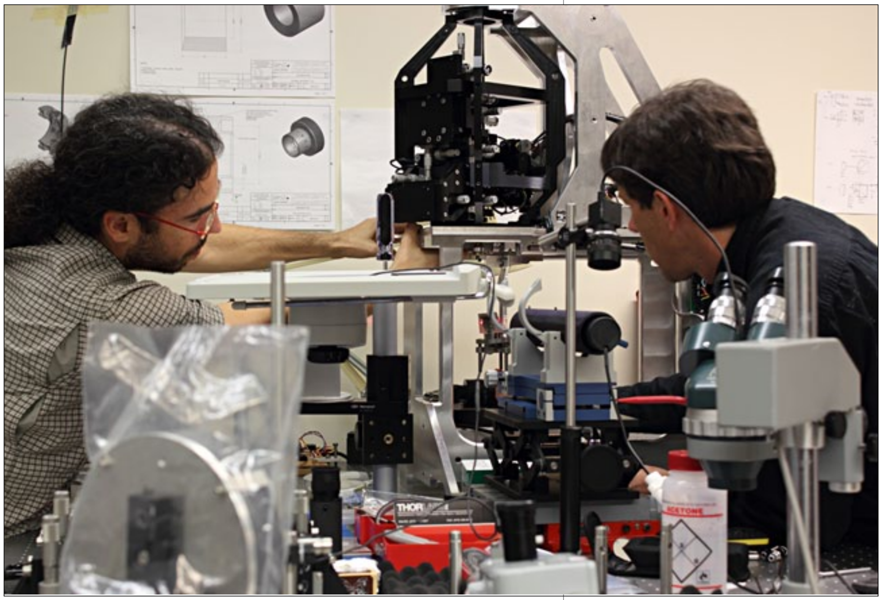


Figure 3. *A.N. Chené (Gemini) and G. Barrick (CFHT) testing the alignment procedure of the slicer bench during the acceptance tests in Canada.*

As of early April 2014, all the primary GRACES components have successfully passed acceptance tests in the NRC Herzberg labs and will be shipped to Hawai'i for installation later in April. Most significant, the two 280-meter-long fibers each have a higher transmission than expected. Moreover, each fiber introduces a focal ratio degradation (FRD) of order 10 percent, amazingly below the requirement of 20 percent.

The project is still in its initial phase, which was envisioned simply as a proof of concept: is it possible to transmit light from one telescope to a spectrograph at another, 280m away? If the integrated and tested GRACES works as well as acceptance tests indicate it will, we will then work with the Gemini and CFHT communities to find ways of entering the next phase: to make this instrument a fully functioning capability at Gemini in the near future. With GRACES high-resolution optical spectroscopy at Gemini North, research into the study of stellar populations, metal-poor stars, binaries, asteroseismology, and more are potentially on the horizon for its users.

Back on the Sky — With GPI!

At the January 2014 American Astronomical Society (AAS) meeting in Washington, D.C., we released several breathtaking first-light images from the Gemini Planet Imager (GPI). While the world marveled at the images, a team of dedicated GPI scientists and engineers (led by Leslie Saddlemyer from Canada's National Research Council; NRC), kept very busy making improvements to the instrument. They meticulously executed a carefully devised remediation plan to resolve some known problems identified prior to delivery. They also strived to improve the baseline performance of the instrument. With the successful completion of this work, on-sky verification and commissioning has recommenced, and the GPI team now anticipates an early science run in April with GPI offered for general community use in 2014B.

Following last November's first-light and December's first verification and commissioning runs, Gemini staff removed GPI from the Instrument Support Structure and transported it to the Gemini South instrumentation lab. There it received several upgrades to address remediation needs such as malfunctioning mechanisms. To facilitate this work (and lead other post-delivery activities), Saddlemyer relocated to Gemini South for a 6-month period, starting in October 2013.

The major opto-mechanical work packages involved in this most recent work included the instrument's Integral Field Spectrograph (IFS). Specifically, the IFS work led by James Larkin (University California Los Angeles), included the following: 1) fixing both the IFS pupil and prism slide mechanisms, to ensure robust performance; 2) installing a baffle, to eliminate a ghost image seen while calibrating the IFS; 3) installing a synchronized controller to the dual Closed Cycle Refrigerators (CCR), to reduce the vibration transmitted to the IFS; and 4) modifying the controller software, to reduce the IFS frame readout time from 7 to 3 seconds.

Other work packages included: 1) an upgrade to the control hardware for the micro-electro-mechanical deformable mirror (to improve its protection); 2) a replacement to the internal communications network (to improve robustness); and 3) a number of software improvements to several subsystems, including changes to improve adaptive optics performance.

On the lab's telescope flexure rig, in late February, we tested how GPI's performance changes under various gravitational vectors, prior to mounting the instrument back on the telescope's upward looking port. One significant measured change was the reduc-

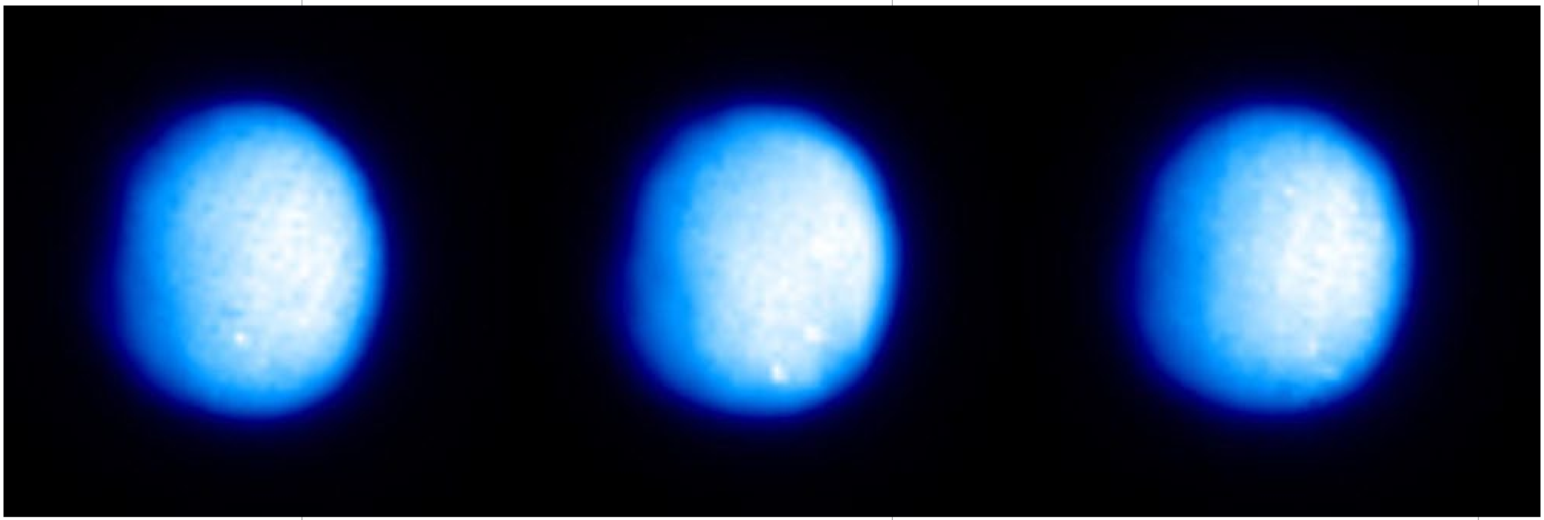


Figure 4.
Observations of 2 Pallas with GPI recorded with the J, H, and K1 gratings on March 22 during VC2 at high airmass (>1.5). The asteroid with an angular diameter of 0.7" is well-resolved and displays a potato shape typical for a 500-km asteroid. The surface remains mostly featureless but detailed analysis may confirm small difference in composition between the north and southern hemisphere of the asteroid. No moons with a diameter larger than 0.5 km and at less than 1.2" were seen. Pallas was observed with the same geometry, ~7.8h later with the SOFIA telescope and its mid-IR spectrograph called FORCAST. The combination of these two set of observations could reveal the composition of this asteroid.

tion in the 60 hertz vibration that the CCRs were propagating to the rest of the instrument. Synchronizing the controllers reduced the intensity of the vibration and completely eliminated the beating effect caused as the controllers drifted in and out of phase.

Following lab characterization, GPI was given the green light to recommence on-sky verification and commissioning, beginning March 20, 2014. Gemini prepared "Verification and Commissioning" contracts with Stanford University, Lawrence Livermore National Laboratories, "Search for Extraterrestrial Intelligence" Institute, University California Berkeley, University California Los Angeles, the National Research Council of Canada, and the Space Telescope Science Institute to help support the verification and commissioning stage.

The first on-sky run was in December, 2013 and the second occurred in March (see Figure 4, Pallas). The third and final runs are scheduled for May and September 2014. The overall plan includes a set of on-telescope and on-sky tests needed to fully characterize, optimize, and commission the instrument. Tests range from evaluating image motion to plate scale validation and stability. In total, 29 tests are detailed in this Verification and Commissioning plan, which Dave Palmer (Lawrence Livermore) is contracted to manage and execute on behalf of Gemini.

The well-attended press conference mentioned at the start of this article, resulted in over 70 articles in the international media. Shortly afterwards Gemini released a set of GPI public data (*http://www.gemini.edu/sciops/instruments/gpi/public-data*) from the 2013 runs. Further public release data will be available following future Verification and Commissioning runs.

In February, Gemini announced a GPI early call for science proposals. A number of proposals were received before the month's end. Sixteen of these proposals were selected and awarded time (see *http://www.gemini.edu/sciops/instruments/gpi/early-science/accepted-programs-and-status*). A variety of exciting programs will use three different instrument observing modes: direct, coronagraphic, and polarimetric observing. Observations will have begun on April 20th. The proprietary period for Early Science data is two months.

GPI has been offered for general use in 2014B. At the same time, the GPI Exoplanet Survey (GPIES) will commence. GPIES is an 890-hour exoplanet survey campaign to observe ~600 stars spanning a range of spectral types from A-M. The team will use published young association catalogs and a proprietary list that adds several hundred newly discovered young (<100 million years (Myr) old,

<245 light-years (ly) distant) and adolescent (<300 Myr, <115 ly) stars. The latter, older but closer than the known young associations, allow our survey to probe within the 5 astronomical units ice line, where it is cold enough for hydrogen compounds such as water, ammonia, and methane to condense into solid ice grains. Simulations predict this survey will discover approximately 50 exoplanets, increasing the number of exoplanet images by an order of magnitude, enough for statistical investigations. [More information can be found at *http://planetimager.org/*]

There is still much work to be completed both at Gemini South and among the groups working on the Verification and Commissioning tasks. This work is due to ramp down towards the end of 2014 and GPI will become an operational instrument. Given the early science programs, the GPIES, and the general 2014B observations, it shouldn't be too long before GPI discovers its first exoplanet!

For the latest information stay connected to the *Gemini Facebook page*.

GMOS: The new, extended red-sensitivity, Hamamatsu CCDs for the Gemini Multi-Object Spectrograph (GMOS) have now been delivered from Gemini North — where the system was developed in conjunction with a team at the Herzberg Institute of Astrophysics — to Gemini South, where they will soon be installed. In the coming months, *Gemini*Focus will provide further information about this significant project.

SPIE: Several Gemini instrumentation staff are scheduled to participate in the upcoming SPIE Astronomical Instrumentation meeting in Montreal this summer. We look forward to talking with the conference attendees about our vision for instrumentation at Gemini and welcome the opportunity to hear your thoughts and wants as well.

Stephen Goodsell is the Instrument Program Manager at Gemini and located at located at Oxford University, UK. He can be reached at: sgoodsell@gemini.edu

André-Nicolas Chene is the GRACES instrument scientist at Gemini. He can be reached at: achene@gemini.edu

Scot Kleinman is head of the Instrumentation Program at Gemini. He can be reached at: kleinman@gemini.edu

Andy Adamson

Operations Corner

Shutter Work Completed at Gemini North

In late December 2013, Gemini North joined the significant group of telescopes that have suffered major failures in their dome systems. A top shutter drive unit had a critical failure with one of its spherical bearings. These drive boxes are designed to last 50 years under normal operating conditions, so clearly it was a faulty mechanism and had to be replaced.

Because this failure rendered the dome unusable, repairing the unit became a high-priority project — one that needed to be completed before science operations could recommence at Gemini North. Removing this system proved extremely challenging. The Gemini North engineering team (Figure 1) worked with external consultants to develop an entirely new set of procedures to pin the shutters in place and extract the broken drive box (which weighs more than two tons and is not amenable to *in-situ* repair). Bad weather hampered an already difficult situation — winds well over 100 miles per hour were encountered in January, and there was significant snowfall during the period. The team finally extracted the unit from the dome at the end of January. Work then progressed very quickly as the unit was inspected, potential causes of the failure identified, repairs made, and the drive box rebuilt and reinstalled. By February 15th, Gemini North was once again ready for observations.

Read a complete summary at: http://www.gemini.edu/node/12160

Large and Long Proposal Mode Piques Interest

Interest from our user community in the new Large and Long Programs (hereafter "Large Programs" or LPs) mode is excellent. These Principal Investigator-defined and -driven programs generally either require significantly more time than a partner typically approves for

Figure 1.
The dome repair team, just before lifting the repaired gearbox back into position.

a single program or extend over two to six semesters, or both.

We are happy to report that our users have submitted over 40 letters of intent by the February 3rd deadline. The proposal teams include over 500 astronomers from all Gemini partner countries and beyond. Principal Investigators from all four participating countries (United States, Canada, Australia, and Argentina) intend to lead programs.

The proposals are scheduled for review by a specific Large Program Time Allocation Committee at the end of April. This committee will also make science-based recommendations to the Gemini Director. Approved programs will be merged into the semester plan at the International TAC meeting. We look forward to this first exercise that will be a regular annual opportunity.

In the longer term, Gemini will post an annual announcement of opportunity for these programs in December, with letters of intent due in early February, and final proposals closing at the end of March each year. The TAC meetings will generally precede the NTAC meetings. Program approvals will be announced along with the usual semester schedule.

For more information on the program and how it will work, see:

http://www.gemini.edu/sciops/observing-gemini/observing-modes/large-and-long-programs

New Data Reduction User Forum

With the encouragement of the Users' Committee and STAC, a forum for users engaged in reduction of Gemini data is now live and very active. It's located at: http://drforum.gemini.edu/.

The forum is intended to be an on-line discussion site "for Gemini users, by Gemini users," where people can drop useful scripts, discuss issues relating to data reduction as applied to Gemini data sets, and more. The usefulness of a forum like this depends on the number of people getting involved and staying involved. To help promote that goal, the Gemini Director put up some discretionary observing time (as a prize) to go to the

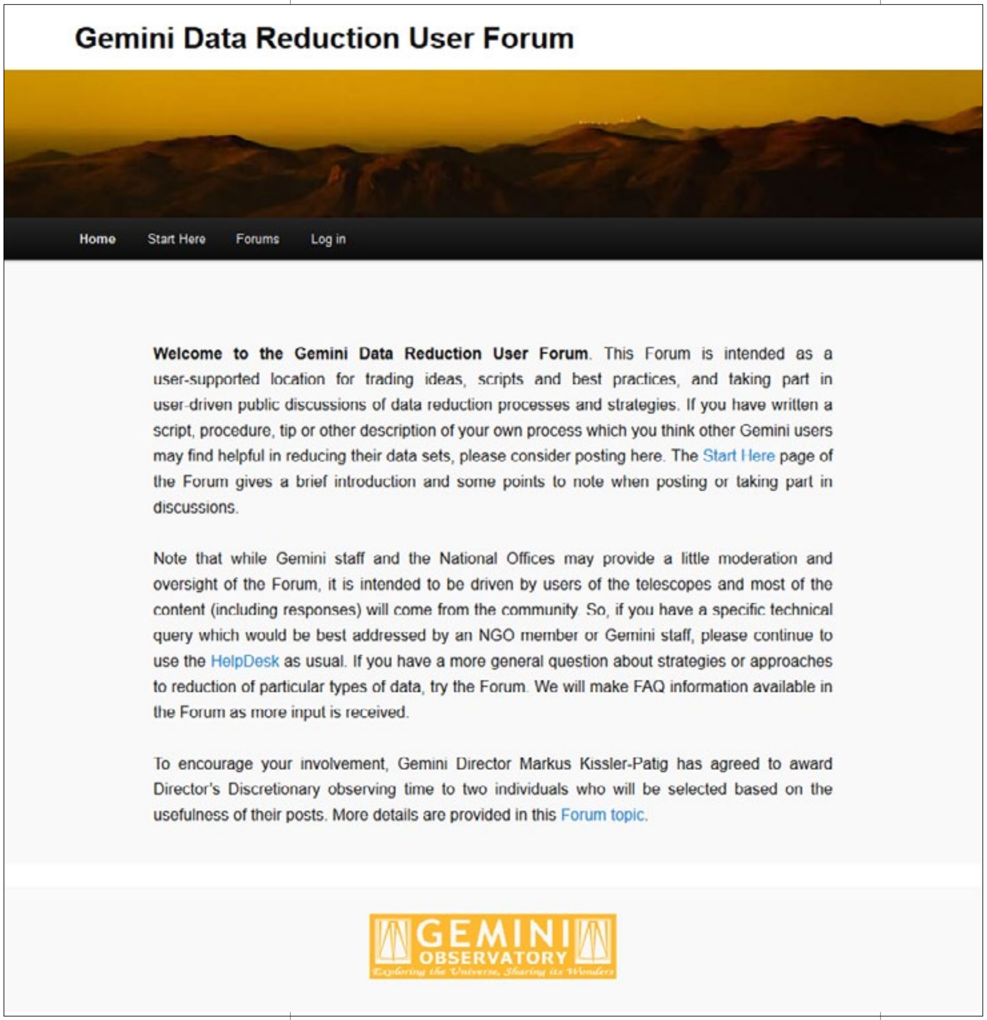


Figure 2.
A screen-capture showing the Data Reduction Forum homepage.

best two contributions received in the first few months!

The forum has a simple interface (Figure 2), using tags to keep track of topics by type, and is intended to provide a user-supported, and more open, complement to the Helpdesk — which will remain operated as always, by the National Gemini Offices and Gemini staff.

The forum is young, but already there have been quite a few postings by users, and some useful scripts (*e.g.* for Integral Field Unit data analysis, Gemini Near-Infrared Spectrograph, cross-dispersed spectroscopy, general imaging reduction, *etc.*) by both users and Gemini staff alike. If you're a graduate student involved in Gemini data, or a seasoned veteran with your own package to contribute, take a look at this forum and don't be shy with your contributions!

At the time of writing, the form hosts about 20 individual topic threads with a few dozen postings and replies or followups. It also has half a dozen scripts and packages, links to reduction cookbooks (some by Gemini staff, some by users), and some general threads directed at answering specific queries.

The Users' Committee for Gemini will be looking at all the postings and selecting the winners of the Discretionary Time competition.

GeMS Laser News

As users of the Gemini Multi-conjugate adaptive optics System (GeMS) are probably aware, the March run of the instrument had to be cancelled on short notice. The reason: a major loss of power from the laser, which nominally projects 50 Watts of sodium yellow light into the sodium layer of Earth's atmosphere and produces the five guide stars for GeMS. A laser specialist engineer from Lockheed Martin came to the Cerro Pachón site and worked with our staff to restore the laser power. At the time of writing, the laser is running at 30W, just going into the April GeMS run; this is not as good as hoped for and further work is being planned.

Operations Working Group Meets in Hilo

In February, the Operations Working Group held its 26th meeting in Hilo, just before issuing the 2014B call for proposals. From this meeting emerged a number of resolutions and actions, including an agreement that, for users requiring good seeing, we relax the full-width at half-maximum values corresponding to Image Quality 20 (IQ20), to better reflect the actual frequency of occurrence. This will have the effect of reducing the number of IQ20 programs that have aborted sequences and is intended to increase the completion rate of such programs.

With an increased focus on visiting instruments (particularly at Gemini North, while several new instruments come online in the south; Figure 3) the Working Group discussed how to best ensure that we increase awareness and promote opportunities within partner communities to solicit visitor instruments for Gemini. To this end, the National Gemini Offices will be looking for such opportunities within their partner countries.

Base-Facility Operations

By the end of 2015, Gemini plans to have both telescopes operated from their base facilities in La Serena and Hilo. To safely do this, a key element is being able to remotely open the domes and have them automatically close should weather deteriorate — and to do so autonomously in the event that the network connection from the base to the summit is down. A pilot project to do exactly this is in progress at Gemini South, with commissioning planned by the end of April 2014 — ready, in other words, for the southern winter, where it will help greatly to be able to confidently open the dome before the night crew arrives at the telescope.

The results of this pilot project will eventually inform what is done in the full Base Facility Operations project, which is now being managed by Gustavo Arriagada (currently on the first of a number of extended stays in Hilo).

Andy Adamson is Gemini's Associate Director of Operations and can be contacted at: aadamson@gemini.edu

Figure 3.
The Gemini North visiting instrument DSSI (Differential Speckle Survey Instrument) being mounted on the Instrument Support Structure of the Gemini North telescope during an observing run in 2103.

Lynette Cook

Creating the Cosmos

Figure 1.
This supermassive black hole has nearly 10 billion times the mass of the Sun. It is located in NGC 4889, the brightest member of the Coma galaxy cluster. Credit: Gemini Observatory/AURA; artwork by Lynette Cook. http://www.gemini.edu/node/11703

The following article originally appeared in The Astronomical Society of the Pacific's *column "Astro Beat" and is reproduced here with permission of ASP and the author.*

My parents loved the outdoors, and I give them credit for my own wonder of the natural world. Favorite memories include hunting for giant puffballs and spring flowers in the Southern Illinois woods. On camping trips my mother would point out the constellations, which seemed especially close and bright on a summer vacation to Canyonlands National Park in Utah. I felt as though I could reach out, grab the stars, and pull the sparkling gems down to Earth.

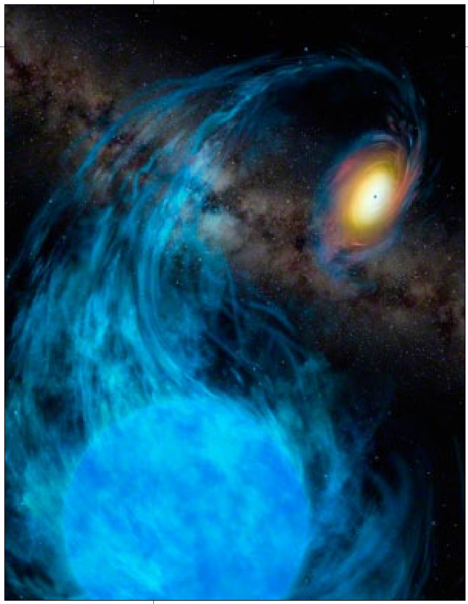
Given my aptitude and appreciation for art, it seemed fitting to become a scientific illustrator. A staff position of Artist/Photographer for the Morrison Planetarium, which I held from 1984-2000, was instrumental in connecting my art skills with astronomy. Through freelance work and subsequent self-employment, I have been privileged to work with research astronomers, science editors, and art directors, portraying the marvels of the universe visually: extrasolar planets, distant galaxies, black holes, possible life in the universe, and much more have been some of the wonderful places this work has allowed me to "visit."

Much of my artwork is commissioned for press releases about cutting edge astronomical research. How exciting it is to know the news before it makes news, and to play a role in getting the word "out there!" This process is a mystery to many, and I often am asked the question, "How do you know what to paint?" To shed light on this process, I turn to my work with the Gemini Observatory, for which I've created numerous illustrations used in press releases identifying new discoveries.

From Discussion to Form

My most recent Gemini art was for the November 26, 2013 announcement titled "Fast, Furious, Refined: Smaller Black Holes Can Eat Plenty." [http://www.gemini.edu/node/12100] It describes the environment around M101 ULX-1, and features a stellar-mass black hole with accretion disk and a Wolf-Rayet star that feeds the voracious appetite of the black hole.

As with many new ventures, artwork begins with brainstorming. Often the starting point is a conference call with Peter Michaud, the Public Information Outreach Manager at the Gemini Observatory, along with the Principal Investigators on the discovery team. In the case of M101 ULX-1 we resorted to e-mail communications since Stephen Justham and Ji-Feng Liu, the science contacts weighing in on the art, are with the Chinese Academy of Sciences in Beijing, China, and time zone differences were at play.



Figures 2 and 3.
Rough mockups explore options for composition and color.
© Lynette Cook, all rights reserved.

Peter and Stephen began the conversation by describing the M101 ULX-1 environment, specifying which objects needed to be shown in the art. We talked about the color, which often has little or no meaning in astronomical renderings, and size of the star, accretion disk, and gas stream. Also important was the overall “look” of the disk: whether it should appear thick and dense or thinner and less structured.

With key points in mind, I created several color mockups for the committee (*i.e.* everyone weighing in on the art) to review and discuss. Years ago I would have developed these “roughs” with graphite pencil on tracing paper or colored pencil on black mat board; today they are done digitally: low in resolution and unfinished in terms of detail, yet many steps closer to finished art than the simple mockups of yesteryear. The purpose is to show different compositions, orientations, and sizes of the main objects.

The committee then weighs in with comments and suggestions for changes. In this case, a key decision was to put the black hole and disk in the foreground and the star in back. We discussed in greater depth how much material the black hole should be pulling away from the star, the likely trajectory, and appropriate colors. I then modified the roughs and invited another round of comments. This process repeated until we had one image that satisfied all the primary criteria.

With approval of the first step, I moved on to the high-resolution file, fine tuning the details so the image would pass inspection when examined closely. This step takes the most time, as I zoom in and out and scroll around to tweak the “little stuff.” Regardless of how I create the various smaller components in an image, which can vary, I use Photoshop to composite all the main elements. This results in a file with many layers that becomes very large in size.

When I am satisfied, the process repeats: the committee weighs in again, more adjustments are made, and eventually all parties declare the image a “go.” At that time I send Peter a final high-resolution file and my part is done.

Figure 4.
Several revisions into the process, the locations of the star and disk are switched and the structure and color of the disk are fleshed out further.
© Lynette Cook, all rights reserved.

Elsewhere, work continues behind the scenes. Peter pairs the illustration with the press release text, writes a caption, and iterates with the astronomers on any remaining details. When finished, the release goes out to the media with an embargo

Figure 5.
The finished M101 ULX-1 artwork, showing a horizontal format. The black hole was reduced in size and the inner disk was brightened. Further adjustments were made to the density of the stream's gas, the material blowing away from the star, and the coloration of the disk.
Credit: Gemini Observatory/AURA; artwork by Lynette Cook

date, which means they have a "heads up" and may prepare their news stories but may not make it public until the embargo time and date arrive. Gemini's web site is prepared and ready to go live at the exact moment the embargo lifts.

When the magic moment arrives the article and accompanying images can appear anywhere: on the web, in magazines, on the evening news, and in the next morning's newspaper. The extent of the release's reach is dependent upon how exciting the news is deemed to be and how much other breaking news gets top billing. A politician's indiscretions or movie star's arrest might bump the science off the front page, or off the evening news entirely.

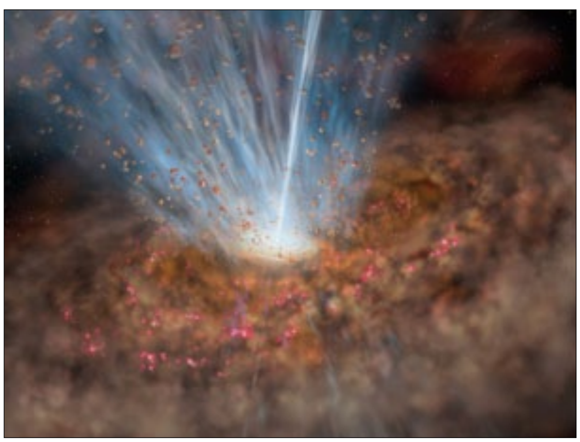


Figure 6.
The supermassive black hole at the center of Mrk 231 has a broad outflow, shown here as the fan-shaped wedge at the top of the accretion disk. A similar outflow is probably present under the disk as well and is hinted at in this illustration. A more localized, narrower jet is included as well.
Credit: Gemini Observatory/AURA; artwork by Lynette Cook. http://www.gemini.edu/node/11614

It's All in the Timing

Though I sometimes regret that the illustration world (both scientific and commercial) is largely computer-generated today, there is no question that digital art allows for faster turnaround, quicker changes, and more revisions than traditional media. And when it comes to illustrations for press releases, timing is everything. I have created art in as little as 48 hours or, when the pace was more relaxed, taken three weeks or more. The norm is about a week and a half. Figures 6 and 7 show two complex pieces that would have been nearly impossible to produce with traditional methods within the time frame available, while also allowing for communications among committee members and several changes at both rough and high-resolution stages.

It is a romantic notion to suppose that such projects are lined up in my studio at all times and that I whip them out in quick succession. In fact, they tend to come "out of the blue." One week I might be spending a little time on Earth, so to speak, painting the Golden Gate Bridge for a San Francisco Bay Area art exhibit, and then an e-mail with an exclamation mark pops into my in-box with an extra loud "Ping!" Next thing I know, I am Velcroing myself to the computer to create an exoplanet or gamma-ray burst, the embargo date looming large ahead of me.

Although each illustration is unique, some stand out as extra special. A case in point is the November 15, 2007, release about hot dust surrounding a 100-million-year-old star in the Pleiades star cluster. The star is very much like our Sun, though it is 45

Figure 7.
This rendering of W 33A showing the accretion disk (yellow/orange), torus (dark ring around disk) and bipolar outflow jets (blue) within the dense clouds of its stellar nursery.
Credit: Gemini Observatory/AURA; artwork by Lynette Cook. http://www.gemini.edu/node/11394

times younger and is orbited by hundreds of thousands of times more dust, suggesting catastrophic collisions in an evolving young planetary system. While working on this art I felt I was aboard a time machine, transporting myself into the past to witness two planets crashing into each other, spewing chucks of rock.

Topping that, an "Outer Limits" mystery: the case of the TYC 8241 2652 system. Several years ago it had all the characteristics of solar system formation. Today, however, the warm dust thought to originate from collisions of rocky planets is nearly all gone. What happened to it? For this news article I developed two images that show the "before" and "after" views. These were provided via the Observatory's website as stills and also as an animation. [*http://www.gemini.edu/node/11836*]

Figure 8.
Two Earth-sized bodies collide near HD 23514. Credit: Gemini Observatory/AURA; artwork by Lynette Cook. http://www.gemini.edu/node/259

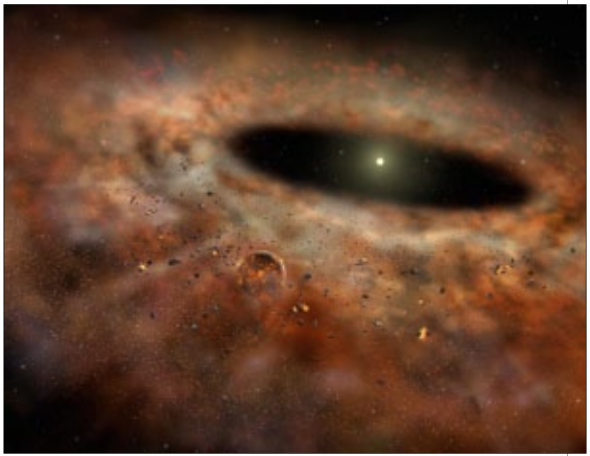


Figure 9.
The dusty TYC 8241 2652 system as it might have appeared several years ago when it was emitting large amounts of excess infrared radiation. Credit: Gemini Observatory/AURA artwork by Lynette Cook.

Communication is Key

It is said that "too many cooks spoil the broth." This usually means that the more people in the mix when it comes to input and decision-making, the more complicated the process becomes (also the more diluted and tasteless the results). To my delight, however, those with whom I've worked on press release artwork have been stellar (no pun intended). Able to narrow in on the most important elements of the science and what needs to be shown — and also able to communicate the finer details of size, color, texture, object relationships, and more — I've felt that these collaborations have gone exceedingly well, without the huge bumps in the road and frustrating impasses that can occur when individuals gather to move toward a common goal.

While good communication is necessary with Peter and the astronomers, as far as the rest of the world is concerned, this process moves in secrecy. One mustn't spill the beans about a release before its time. When someone outside our group asks what I am working on, I bite my tongue and reply with an answer that ranges from "Oh, nothing much" to "Just a 'star thing.'"

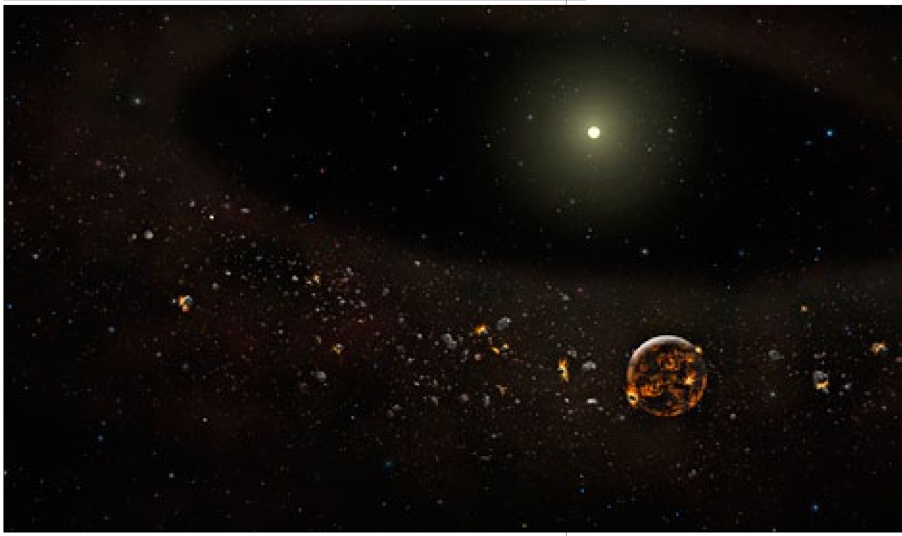


Figure 10.
Most of the surrounding dust has disappeared — based on observations by the Gemini Observatory and other ground- and space-based observatories. Credit: Gemini Observatory/AURA; artwork by Lynette Cook.

Recipe for Success

One process that can help reach the goal of creating successful art is to treasure hunt for existing photos and other imagery that might have a bearing on the new art. A prime example is using Voyager photos of Jupiter as a resource to depict exoplanets of several Jupiter masses. This said, no photo

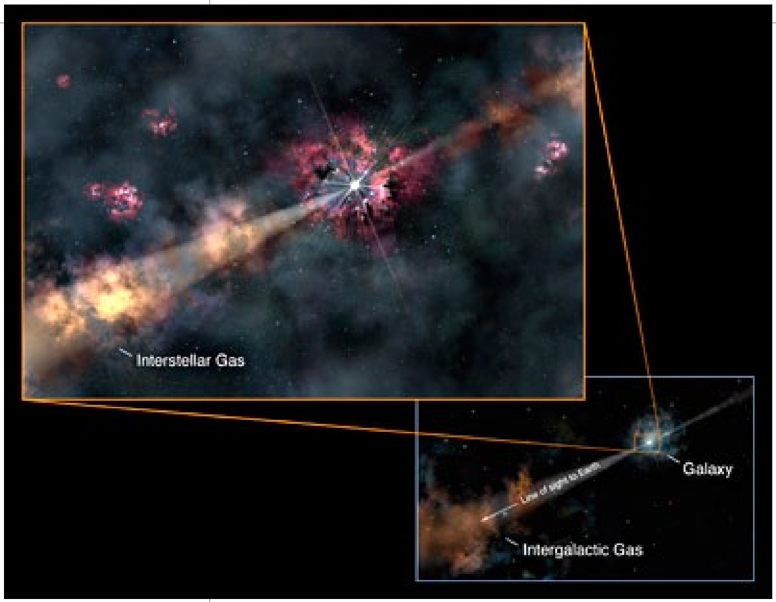
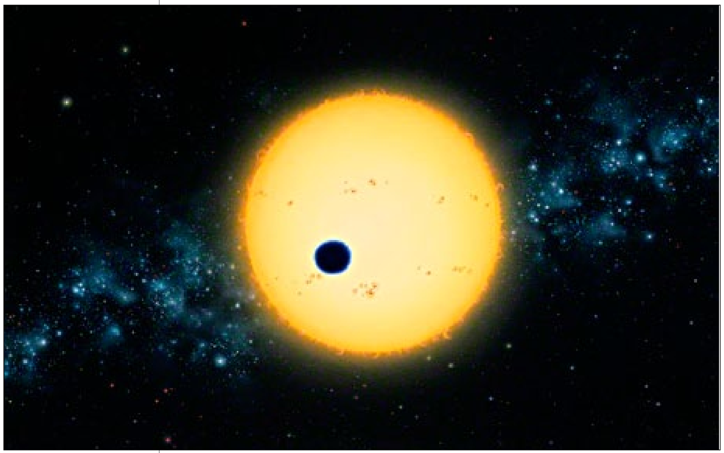


Figure 11.
Visualizing objects and distances of great proportions was necessary for this artwork. It shows light from a gamma-ray burst passing through interstellar gas in its host galaxy (close-up view, left), and also through intergalactic gas positioned between the distant galaxy and Earth (wide view, right). Photographs of nebulae and star-forming regions were useful as references. Credit: Gemini Observatory/AURA; artwork by Lynette Cook. http://www.gemini.edu/node/12046

or existing art will be ideal, and this is exactly the point: I am illustrating something that has neither been seen nor illustrated before. And such fun it is to be a cosmic creator of this sort!

In my darkest hours, when my computer behaves badly or I have a question that only another artist can help with (say, how to get correct lighting on a planet's rings), there is a way to get input even when zipping my lip. The International Association of Astronomical Artists, of which I am a Fellow, is a group of talented and experienced individuals who love to paint space, both digitally and traditionally. With members in several countries, usually someone is at the computer even in the wee hours of the night and can be queried for help. (For more information, see www.iaaa.org.)



I have not yet mentioned the groundbreaking "magic formula" that I use to create my astronomical art. Why? Because there isn't one. Nor have I provided a lengthy "nuts and bolts" discourse about the media, computers, software, and RAM that I use because, in the end, it doesn't matter. There are multiple paths to the same goal, including paint on paper, an old version of Photoshop, and a high end 3D software package. Creating a successful image takes basic (yet extensive) knowledge of composition, lighting, and color, plus masterful use of the tools chosen, regardless of whether these tools are digital or traditional.

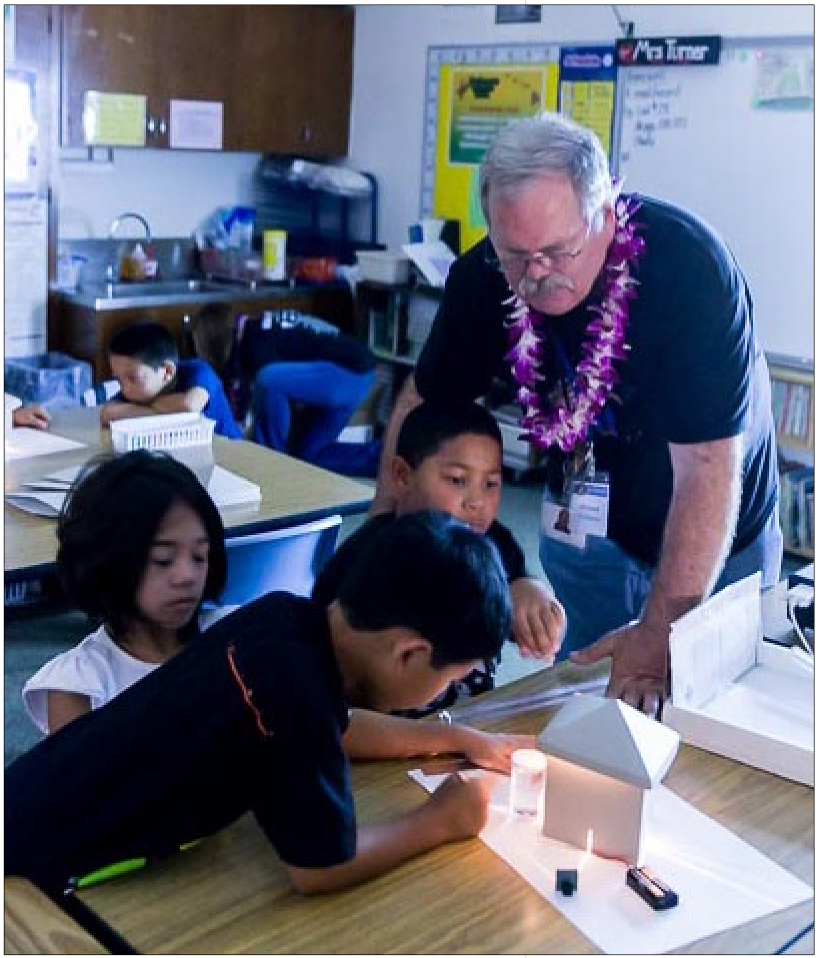
As I conclude, my mind flashes on a key point drilled into me as a science illustration student: that this career path is about artist/scientist collaborations in which each person on the team lends his/her expertise to create a new visual that informs and educates. This summarizes what the Gemini Observatory and I do together: we translate the scientific data into realistic visuals that enable others to experience the wonder of the universe for themselves. What could be more magical than this?

Lynette Cook has illustrated the cosmos since the 1980s. An award-winning illustrator and painter, Lynette's art has appeared worldwide in books, periodicals, documentaries, and online articles. She also is a consultant for the NOVAS program (NASA Opportunities in Visualization, Art, and Science), which provides art/science workshops to teens in the San Francisco Bay Area. To see more of Lynette's artwork, go to: www.lynettecook.com

Figure 12.
The Transit of HD 209458, used in association with Geoff Marcy's press release in 1999, was created with acrylic, colored pencil, and gouache on illustration board. It generated an e-mail from a distant viewer asking what amazing image processing software I had used to get such a clear photo. Credit: © Lynette Cook, all rights reserved.

Gemini's Journey Through the Universe Reaches a Giant Milestone

Gemini's senior optics technician, Jeff Donahue, demonstrates the use of optics with a 3rd grade class at Waiakea Intermediate in Hilo.



Ten years ago Gemini North embarked on an ambitious local outreach program that grew from a successful U.S. national science education initiative called "Journey Through the Universe." Since then, "Journey's" presence on the Big Island of Hawai'i has blossomed into an annual event that has far exceeded anyone's wildest expectations. Over the past decade, Gemini has brought Journey to more than 50,000 students in over 3,000 classrooms. This year's event, celebrated from March 7-14, added thousands more to that tally with a record number of classroom visits.

Each year through Journey, dozens of local science, technology, engineering, and mathematics (STEM) professionals from Gemini and beyond immerse themselves in local Hawai'i classrooms in Gemini North's Big Island community. Together they share the excitement of astronomical exploration with students, teachers, and the public. To sample the excitement of this year's event, please enjoy the pictorial that follows and learn more (including the final report of the 2014 program) at: www.gemini.edu/journey

University of Hawaii's Astronomy and Physics professor Marianne Takamiya helps students make a spectroscope during her classroom activities as part of Journey Through the Universe.

Below: Michael Hoenig, data analysis specialist at Gemini, has participated in multiple Journey programs. Here he is using interactive techniques to show middle school students how infrared light makes seemingly hidden objects become visible.

Gemini's head of instrumentation Scot Kleinman is blindfolded and instructed how to move by students at Hilo Union Elementary School in a highly engaging demonstration of remote sensing and control.

Above: Janice Harvey, Journey Through the Universe team leader, receives a special recognition plaque and commendation letter from Hawai'i Governor Neil Abercrombie. Both awards congratulate Harvey for her tremendous achievement in fostering the Hawai'i Journey program and encouraging students to envision their own futures in science and technology.

Above : Ambassador Perry Armor captures a 4th grader's delight as he wears a space suit provided by Rob Kelso, former NASA Space Shuttle Flight Director.

Left : Gemini interns, Aaron Bannister (foreground, left) and Bozi Yordanov (background, left), inspire students to "reach for the stars" at this year's Journey Through the Universe Family Science Day held at 'Imiloa Astronomy Education Center in Hilo.

Hawai'i State Department of Education Superintendent Kathryn Matayoshi shares a very special thanks and praise to the Journey community for inspiring our youth and providing STEM education to over 7,000 students during Journey's 10th anniversary week.

Sharing the Wonder at AstroDay Chile!

In March, Gemini South's premier local outreach event, AstroDay Chile, also delivered the wonders of our universe to local students, educators, and the public. The 2014 program was held for the first time at La Serena's Plaza de Armas and the University of La Serena's Outreach Center. Over 20 organizations participated, ranging from local observatories to formal education institutions from several Chilean cities in and around the Coquimbo region. As this photo gallery shows, the event offered lots to explore for the nearly 3000 participants who, along with Gemini's enthusiastic staff (and others), made this the most successful AstroDay Chile ever!

Top: Tuerca Loca, a physics teacher from Santiago, Chile, entertains students from San Joaquin school by impersonating Albert Einstein and performing experiments in light diffraction and physics.

Center: Last March, local dignitaries and Gemini partners attended the ribbon cutting ceremony for the 8th-annual AstroDay Chile, held for the first time in the University of La Serena's Plaza de Armas and Outreach Center in downtown, La Serena.

Bottom: Throughout AstroDay Chile, long lines formed to look through telescopes at either the Sun and its spots during the day, or craters on the Moon at night. Stargazing continued until the event closed at midnight.

Students from Colegio José Manuel Balmaceda in la Serena cheer over their "thermal protection system" creation during a workshop led by David Yenerall, astronomer and ambassador for NASA's Van Allen Probes mission.

Gemini South's Pedro Gigoux interacts with some of the nearly 3000 visitors that attended AstroDay Chile. The event featured staffed kiosks, informative talks, portable planetarium shows, and a great photographic gallery of the Astronomy of Chile's native people.

From 5 p.m. to midnight, the city of La Serena opened its Plaza de Armas and the University of La Serena's Outreach Center to the community, offering innovative astronomy experiences. Here, girl scouts enjoy their visit to the kiosks before a popular talk titled "The Simpsons and Astronomy."

This cloudy, but beautiful, sunset from a snow-covered Mauna Kea was captured by Gemini Science Operations Specialist Michael Hoenig in early April. Despite the clouds, some observations were eked out by Gemini staff during the night!

AURA

The Gemini Observatory is operated by the Association of Universities for Research in Astronomy, Inc., under a cooperative agreement with the National Science Foundation on behalf of the Gemini Partnership.

United States | NRC·CNRC Canada | Australian Government Australian Research Council Australia | Argentina | Ministry of Science, Technology and Innovation BRASIL Brazil | Chile

Gemini Observatory
670 N. A'ohoku Place
Hilo, HI 96720 USA