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BERKELEY ASTRONOMERS SELECTED TO TAKE NEW SPACE TELESCOPE FOR A SPIN

By Robert Sanders, Media relations
November 21, 2017

Berkeley astronomers, Imke de Pater and Daniel Weisz, have been chosen to lead two of the first 13 groups that will test the capabilities of NASA’s advanced new successor to the Hubble Space Telescope, the James Webb Space Telescope.

From November 2019 until April 2020, these teams will scan objects near and far, ranging from planets in our solar system to planets around nearby stars, and from star systems in the Milky Way galaxy to galaxies at the edge of the universe.

“The diversity of science represented by these 13 teams is amazing,” said Weisz, “we are definitely excited about this opportunity.”

The teams are hoping for new discoveries, but they’ve also been selected because of promises to provide baseline information for future observers and computer software tools that those astronomers will need to make sense of their observations on the telescope.

“With the telescope’s five-year lifetime, we need to use it very efficiently to maximize the return,” Weisz said. “The early release science program is supposed to produce science-enabling results within five months of the observations, which in the James Webb Space Telescope, courtesy of NASA.

astonomy world is basically yesterday.”

Letting astronomers rather than staff take the telescope for a test drive is a new concept for NASA, said de Pater. She and her team will focus on Jupiter, its moons Io and Ganymede and its faint rings, to see if they can capture fine detail against the bright background of Jupiter, which is actually too bright for the telescope to look at without filters.

“We will see if we can image the rings and get rid of the scattered light from Jupiter, which pushes the telescope’s limits and really tests the capabilities of JWST,” she said.

Weisz, who studies star systems, from globular clusters with millions of stars to galaxies in the local Universe, will take the long view. He is particularly interested in systems near enough that individual stars can be picked out and counted, which can tell astronomers about the history of the galaxy and ultimately the history of the universe.

The James Webb telescope will be ideal for this, because its mirrors will be two and a half times the size of the mirror in the Hubble space telescope, effectively cutting the time it takes to collect data on a cluster or galaxy by a factor of 10. This allows detailed studies of the very faintest stars, some of which first started to glow when the universe was a baby more than 10 billion years ago.

“For studies of very faint stars in the Milky Way – our own galaxy – the JWST is going to be phenomenal,” he said. “The telescope will do roughly in its five- to 10-year mission what Hubble has done in its 25-year mission for local galaxies.”

During the 20 hours of telescope time allocated to his team, they will take images in both optical and infrared for a globular cluster in the Milky Way, a very faint, dark-matter-dominated dwarf galaxy that orbits the Milky Way and a close neighbor and traveling companion of the Milky Way, a galaxy at a distance of about 3 million light years.

By counting and determining the age of each star within these galaxies, for example, he hopes to shed light on what happened early in the universe when stars first began to shine across the cosmos, the so-called epoch of reionization.

De Pater admits that two years is a long time to wait, but hopes to use the 28.9 allocated hours of observing time to measure the wind speeds in Jupiter’s Great Red Spot.
observe gases in the atmospheres of Io and Ganymede and see ripple left by comets in the rings around the planet.

"The idea is that for any solar system object, you have to assemble to understand the planet or moon from multiple observations when everything is moving and rotating and changing. How do you do that?" said Kasen. "We have to develop the software so that astronomers can put their little postage stamps together to get the whole picture."

UC Berkeley research astronomer Michael Wong is one of the co-investigators on de Pater’s team.

**PUZZLING NEW SUPERNOVA MAY BE FROM STAR PRODUCING ANTIMATTER**

By Robert Sanders, Media relations
August 2, 2017

An exploding star that continued to shine for nearly two years — unlike most supernovae — and became by far the brightest supernova ever seen, was created when a massive star exhausted its core, a team of astronomers led by UC Berkeley astrophysicist Daniel Kasen, said. Kasen and his colleagues have proposed a new scenario for what a kilonova should look like.

"As the debris cloud expands into the surrounding doughnut and spherical core, the red glow of this material will be especially apparent," said Kasen. "This will cause the entire sky to become red, much brighter than we’ve ever seen before."

"Variations in the colors of this material over time will tell us whether the kilonova is red or blue, which will help us determine the type of object it formed from," Kasen said.

Kasen said that the kilonova, which was first observed by the Laser Interferometer Gravitational-Wave Observatory (LIGO) in October 2017, is the result of a star that was originally about 20 times as massive as our sun. The star was a neutron star, which is a highly packed density of matter. According to Kasen, the star’s core must have been composed of antimatter.

"A kilonova is a situation in which you have a neutron star coming together with another neutron star and when they collide, they produce antimatter which remineralizes and produces a kilonova," said Kasen.

"The idea is that for any solar system object, you have to assemble the parts to understand the planet or moon from multiple observations when everything is moving and rotating and changing. How do you do that?" said Kasen. "We have to develop the software so that astronomers can put their little postage stamps together to get the whole picture."

"The first detection of gravitational waves in 2015 from a neutron merger would look like this," Kasen said.

"Now that we’ve discovered this interesting cloud complex in Neptu, N ned has a running start on a nice paper for his Ph.D. thesis."

**ASTROSMERS STRIKE COSMIC GOLD**

By Robert Sanders, Media relations
October 26, 2017

The first detection of gravitational waves by the Laser Interferometer Gravitational-Wave Observatory (LIGO) detectors in the United States and is the first time that light associated with a source of gravitational waves has been detected. "We have been working for years to predict what the light from a neutron merger would look like, and we have worked on the project for many years," said Kasen. "Our team of astronomers has been working on this project for many years and we have been very excited to have our results confirmed by the detection of gravitational waves."

"We were very excited to see that light from this merger would be detected by LIGO, but we were not completely surprised," said Kasen. "We have been working on this project for many years and we have been very excited to have our results confirmed by the detection of gravitational waves."

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Three days after the merger and explosion, the bright blue glow from heavy elements in the outer polar regions is beginning to fade, giving way to the red glow from the heavier elements in the surrounding doughnut and spherical core. The red glow persisted for more than 2 weeks.

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**Distant Galaxy Sends Out High-Energy Radio Bursts**

Robert Sanders, Media Relations
August 30, 2017

Breakthrough Listen, an initiative to find signals of alien life in the universe, has detected 15 brief but powerful radio pulses emanating from a mysterious and repeating source — FRB 121102 — far across the universe.

Fast radio bursts are brief, bright pulses of radio emission from distant locations, and FRB 121102 is the only one known to repeat more than 150 high-energy bursts have been coming from the object, which was identified last year as a dwarf galaxy about 3 billion light years from Earth. Possible sources for the repeating bursts range from outbursts from rotating neutron stars with powerful magnetic fields — so-called magamors — to more speculative ideas: They are directed energy pulses, powerful laser beams used by extraterrestrial civilizations to power spacecraft, akin to Breakthrough Starshot’s plan to use powerful laser pulses...

Continued on page 4
pulses to propel nano-spacecraft to our solar system’s nearest star, Proxima Centauri. “Bursts from this source have never been seen at this high frequency,” said Andrew Siemion, director of the Berkeley SETI Research Center and of the Breakthrough Listen program. First detected with the Parkes Telescope in Australia, fast radio bursts have now been seen by several radio telescopes around the world. FRB 121102 was discovered on Nov. 2, 2012, (hence its name) and in 2015 it was the first fast radio burst seen to repeat, ruling out theories of bursts’ origins that involved the catastrophic destruction of the progenitor, at least in this instance. Regardless of FRB 121102’s ultimate source, when the recently detected pulses left their host galaxy, our solar system was less than a billion years old, noted Steve Croft, a Breakthrough Listen astronomer at UC Berkeley. Life on Earth consisted only of single-celled organisms; it would be another billion years before even the simplest multi-cellular life began to evolve.

From the Chair’s Desk
Campbell Hall, the Department of Astronomy's beaux arts-style building on campus, has been beautifully restored to its original 1914 architectural character. The certified building, has been our happy home now for the past three years. Here we have enjoyed summer night observation parties via our much celebrated monthly Astro Nights; searched for extraterrestrial life from the doors offices of Breakthrough SETI; and continue to teach record numbers of astrophysics majors in our full classroom. This year, we welcome Courtney Dressing to our faculty ranks. Courtney is an observational astrophysicist specializing in the detection and characterization of extrasolar planets. Most exoplanet observers specialize in either planet detection through transits (analyzing the tell-tale dimming of starlight as a planet passes in front of its host star) or detection through radial velocities (analyzing the Doppler shifts of stellar absorption lines as a planet forces its host to revolve around their common center of mass). Courtney is an expert in both methods. By measuring planet radii through transits and stellar velocities through radial velocities, she characterizes these otherworldly worlds to zeroth order, starting humanity on the journey to understanding extrasolar planet compositions, formation histories, and potentialities for harboring life. We are exceptionally fortunate that Courtney has joined our Department, as she is reinventing our graduate and undergraduate teaching and research programs in planetary science, and is attracting postdoctoral talent.

We continue to see an extremely high level of communication and coordination between administrators, staff, faculty, postdocs, students, and the public, in finalizing our decadal self-review. We have worked relentlessly on revamping curriculum to reflect current needs and industry trends, bringing in internationally-renowned speakers for our weekly Colloquium, CIPS, TAC, and Department Lunch seminars, and addressing issues arising from faculty hiring needs to the use policy of the undergraduate research lab. Our appointed Astronomy Climate Advisors work tirelessly to raise awareness of issues related to gender equality and inclusion through one-on-one interventions, a Department-wide survey, and Town Hall discussions.

The level of dedication, enthusiasm, and scholarship by our students and faculty is so strong that it is difficult to list all of our departmental events. In particular, I encourage you to attend one of our monthly Astro Nights, a popular occasion for our immediate academic community to gather and also a laudable endeavor of outreach to the public. Envisioned, initiated, and run by our talented and enterprising group of graduate students (special thanks to Carina Cheng and Lea Hirsch), it features free public lectures from faculty, postdocs, and graduate students, followed by an opportunity to star gaze with the Trefers telescope with enthusiastic and knowledgeable student guides.

As you can see from various news developments in this issue, this has been a fruitful and exciting year for research for our group. I continue to be proud to serve as Chair of Astronomy, and look forward to what unfolding as we enter the new year.

Eugene Chiang
ASTRO NIGHTS

Astro Night is a free stargazing and lecture event open to the public. The monthly event is usually held on the first Thursday of each month (during select months, as weather permits), starting with lecture and Q&A session, followed by guided star tours using our fleet of telescopes, including our 17-inch roof-top telescope.

Welcome to our newest Graduate Students

The Astronomy community is excited to welcome our new graduate students to the department! Our 2017 first year cohort brings diverse backgrounds and broad research interests—we welcome them as they begin their graduate studies!

Jordan Fleming (Duke University): Jordan’s research experience has been in structural acoustics, as he studied mechanical engineering prior to changing to physics. He is interested in cosmology, large-scale structure, dark matter, and galaxies.

Steven Giacalone (University of Chicago): Steven has worked on research involving transit timing variations in Kepler data, modeling planetary migration, and dust transport and magnetic fields in protoplanetary disks. He is interested in continuing to work in exoplanets and dynamics but finds most areas interesting.

Phyllis Kempso (Oxford University): Philipp has worked on condensed matter theory as well as galactic outflows into dark matter halos. He is interested in continuing research in physics and cosmology using both analytic and computational models.

Casey Lam (MIT): Casey’s prior research includes math theory, pulsars kicked out of the galactic disk, and primordial black holes. She is interested in continuing to research observational cosmology and black holes, but appreciates a data-driven approach to theoretical work.

Sandor Nathaniel (Pomona College): Nathaniel is interested in galaxy formation and evolution, and in stellar structure and evolution. He has previously worked on modeling metallicity gradients in spatially resolved galaxies, observations of near-Earth asteroids, and searching for gamma ray excess from dark matter annihilation.

Sarafoena (University of Texas-Austin): Sarafoena is interested in theoretical and computational astrophysics on supernovae. Sarafoena’s research experience has been on stripped-envelope supernova progenitor models using the MESA code.

Spring 2018 Commencement

On May 16, 2017 the Departments of Astronomy and Physics held their joint commencement ceremony in Zellerbach Hall. The Department of Astronomy congratulates our 47 undergraduate students receiving their B.S. degrees in physics or astronomy, who have completed their masters, and 7 Ph.D. recipients for the 2016-2017 academic year. Dr. Lars Bildsten, Director of the Kavli Institute for Theoretical Physics and Gluck Professor of Theoretical Physics at the University of California, Santa Barbara, gave the commencement talk. Prior to the commencement ceremony, the department awarded several prizes to graduating students during an intimate celebration in Campbell Hall. We are proud of our students and are reminded of their amazing accomplishments as they take their knowledge out into the world. Congratulations to the Class of 2017!

2017 GRADUATE AWARDS

Mary Elizabeth Uhl Prize – for outstanding scholarly achievement by a graduate student finishing their dissertation in Astronomy or scholarly achievement by a graduate student finishing their dissertation in Physics in fall 2017. A scholar of experimental astrophysics, infrared and submillimeter astronomy, Genzel’s research contributed greatly to the understanding of the physical processes and the evolution of active galaxies; as well as to the development of novel instrumentation, including sensitive infrared spectrometers and imagers.

Katherine Rebecca de Kleer

IN MEMORIUM: HAROLD WEAVER

Harold Francis Weaver, a pioneer of radio astronomy who discovered the first microwave laser, or maser, in space, passed away peacefully in his Kensington, California, home on April 30 at the age of 99.

Weaver was a professor emeritus of astronomy, the founder of UC Berkeley’s Radio Astronomy Laboratory and its director from 1951 until 1972 and a former chair of the Department of Astronomy. He joined the UCB astronomy faculty in 1951.

Weaver founded the Radio Astronomy Laboratory in 1958. The lab dedicated its first telescopes in June 1964, in Hat Creek Valley in Northern California. Using the dish, Weaver and his colleagues discovered the first astrophysical maser—a microwave amplification by stimulated emission of radiation, the radio equivalent of a laser—which had only been observed on Earth in the laboratory. He continued to work on his research, going on to obtain his bachelor’s degree in 1940 and his Ph.D. in 1942 in astronomy from UC Berkeley.

As an undergraduate taking a course in practical astronomy, he met his future wife, Cecile Trumpler, daughter of UC Berkeley astronomer Robert Trumpler. They married in 1939, before the elder Trumpler supervised Weaver’s Ph.D. dissertation on peculiar stars, star clusters and stellar statistics.

Over Weaver’s career, he published more than 70 professional papers. He retired in 1988, but remained very much involved in the department until nearly the end of his life.

“Harold was truly a giant in our Department of Astronomy,” said colleague Alex Filippenko. “I will always remember his warm smile, his generosity and how he kept going with his research and other activities well into old age.”

He is survived by his wife, Cecile, three children—Margot of Tucson, Arizona, Paul of Kensington and Kirk of Houston, Texas—all grandchildren and 11 great grandchildren.

Weaver’s family has donated his home in Kensington to the university to be used after their deaths to fund the Trumpler-Weaver Endowed Professorship of Astronomy at UC Berkeley.

Evening with the Stars

The department hosted its annual Evening with the Stars event on March 25th, featuring an engaging talk by Professor James Graham, Department Chair Eugenie Chiang, and graduate student Jason Wang and Eve Lee.

The evening began with conversation and hors d’oeuvres as guests mingled with Astronomy department faculty members. Following the reception, Dr. Graham, Dr. Chiang, and Mr. Wang and Ms. Lee, described their efforts to detect, characterize, and understand the origins of extrasolar planets using specialized infrared instrumentation, large telescopes and adaptive optics. Their lively talk included demonstrations of the technologies underlying the direct imaging of planets.

After the lecture, guests enjoyed an extended opportunity to discuss the talk with the speakers and were treated to a tour of the Campbell Hall rooftop telescope and guided star gazing by graduate students Carina Cheng and Lea Hirsch.

RETIRES – REINHARD GENZEL

Professor Reinhard Genzel retired this fall, after over two decades on campus at UC Berkeley. He was appointed to Astronomy in a joint appointment with his home department of Physics in fall 2011. A scholar of experimental astrophysics, infrared and submillimeter astronomy, Genzel’s research contributed greatly to the understanding of the physical processes and the evolution of active galaxies; as well as to the development of novel instrumentation, including sensitive infrared spectrometers and imagers across the entire 1-1000 micrometer band. He and his laboratory were the first to track the motion of stars near the center of the Milky Way and show that they were orbiting a very massive object, most likely a black hole.

He left campus in 1996 to become Director of the Max Planck Institute for Extraterrestrial Physics, where he had been appointed an honorary Professor in 1989 at the Ludwig-Maximilian University. He returned to Berkeley in 1999. Genzel is the recipient of many awards for his work, including Otto Hahn Medal of the Max-Planck Society Miller Fellowship, Shaw Prize of The Shaw Prize Foundation, Einstein Medal of the Albert–Einstein Gesellschaft AEG, Newton Lacy Pierce Prize of the American Astronomical Society. Harvey Prize in the field of Science & Technology from the Israel Institute of Technology. The Shaw Prize of The Shaw Prize Foundation, the Dannie and Lee Shapleigh Medallion from the Royal Astronomical Society. He continues to serve campus in his post-retirement appointment as professor of the graduate school.
Support Berkeley Astronomy

On behalf of the faculty, students, and staff we extend our greatest thanks to our friends and donors for helping to preserve and enhance the scholarship, teaching, and research excellence of the Berkeley Astronomy Department.

Berkeley Astronomy is home to world-renowned scientists and researchers and is universally regarded as one of the top astronomy departments in the world. Our award-winning faculty and outstanding students are engaged in some of the most fascinating research today—from studying the relationship between planets and moons in our solar system, to discovering new planets, galaxies, and black holes, to creating a road map for exploring the structure of the Universe.

As a friend of the department, you already know the important role private funding has in supporting our endeavors toward excellence. Over the past decade, state funding has continued to decline and the Astronomy Department has increasingly relied on the generosity of our alumni and friends to maintain our mission of award-winning teaching and research. Without the support of our extended family, we would be unable to maintain our standard of providing the best resources for our faculty, researchers and students.

We invite you to make a gift to any of the following funds, each a critical component in the investment of our future. Visit http://give.berkeley.edu/#astronomy to make an online gift, or use the enclosed envelope.

**Student Observatory Fund** assists with the purchase and maintenance of the latest instrumentation and teaching observatories managed by the Astronomy Department. The fund also provides support for the department’s upper-division undergraduate laboratory course - the capstone experience for all astronomy majors.

**Friends of Astronomy Fund** supports all facets of the department’s program budget, from research travel for students, to recruitment of top faculty, to the day-to-day material needs of the classrooms and teaching labs.

**Graduate Student Support Fund** directly benefits our students. Funding for fellowships is a top priority in the department, as a full year fellowship can cost more than $35,000 and will only continue to increase. Offering student support is one of our best tools for attracting the brightest and most promising students.

**Thank you for your generosity!**

Did you know—many employers match gifts to UC Berkeley? To discuss matching or other opportunities to support Astronomy at Berkeley, contact Maria Hjelm, Director of Development and College Relations, mhjelm@berkeley.edu.

**GO BEARS!**