



# The California Tech

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TECH@CALTECH.EDU

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## Beaming with the Light of Millions of Suns

WHITNEY CLAVIN

Caltech Strategic Communications

*This article is adapted from a story that was originally published online at [caltech.edu](#).*

A Caltech-led astronomy team is homing in on the nature of extreme objects known as ULXs.

In the 1980s, researchers began discovering extremely bright sources of X-rays in the outer portions of galaxies, away from the supermassive black holes that dominate their centers. At first, the researchers thought these cosmic objects—called ultraluminous X-ray sources, or ULXs—were hefty black holes with more than 10 times the mass of the sun. But observations beginning in 2014 from NASA's NuSTAR (Nuclear Spectroscopic Telescope Array) and other space telescopes are showing that some ULXs, which glow with X-ray light equal in energy to millions of suns, are actually neutron stars—the burnt-out cores of massive stars that exploded. Three such ULXs have been identified as neutron stars so far.

Now, a Caltech-led team using data from NASA's Chandra X-ray Observatory has identified a fourth ULX as being a neutron star—and found new clues about how these objects can shine so brightly.

Neutron stars are extremely dense objects—a teaspoonful of neutron star would weigh about a billion tons, or as much as a mountain. Their gravity pulls surrounding material from companion stars onto them; when this material is tugged on, it heats up and glows with X-rays. But as the neutron stars “feed” on the matter, there comes a time when the resulting X-ray light pushes the matter away. Astronomers call this point—the point at which the objects cannot accumulate matter any faster and cannot give off any more X-rays—the Eddington limit.

“In the same way that we can only eat so much food at a time,

there are limits to how fast neutron stars can accrete matter,” says Murray Brightman, a postdoctoral scholar at Caltech and lead author of a new report on the findings in *Nature Astronomy*. “But ULXs

an unusual dip in the ULX’s light spectrum. After ruling out all other possibilities, they figured out that the dip was from a phenomenon called cyclotron resonance scattering, which occurs when

star’s spectrum of light, and the presence of these patterns, called cyclotron lines, can provide information about the strength of the star’s magnetic field—but only if the cause of the lines, whether it

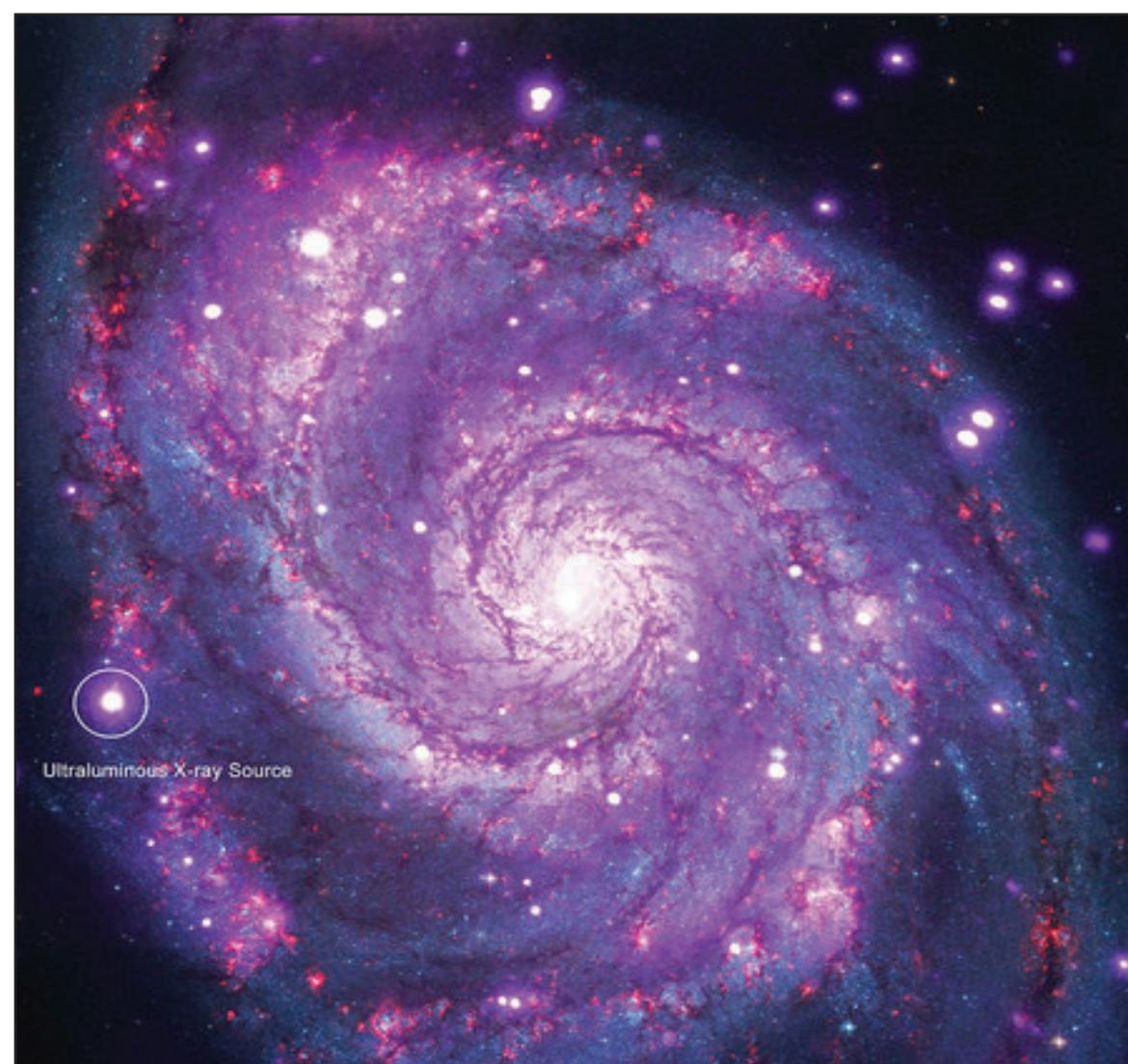
says Brightman. Such strong magnetic fields could reduce the pressure from a ULX’s X-rays—the pressure that normally pushes away matter—allowing the neutron star to consume more matter than is typical and shine with the extremely bright X-rays.

If the cyclotron line is from circling electrons, in contrast, then the magnetic field strength around the neutron star would not be exceptionally strong, and thus the field would probably not be the reason these stars break the Eddington limit.

To further address the mystery of how neutron stars are breaking this limit, the researchers are planning to acquire more X-ray data on the ULX in M51 and look for more cyclotron lines in other ULXs.

“The discovery that these very bright objects, long thought to be black holes with masses up to 1,000 times that of the sun, are powered by much less massive neutron stars, was a huge scientific surprise,” says Fiona Harrison, Caltech’s Benjamin M. Rosen Professor of Physics; the Kent and Joyce Kresa Leadership Chair of the Division of Physics, Mathematics and Astronomy; and the principal investigator of the NuSTAR mission. “Now we might actually be getting firm physical clues as to how these small objects can be so mighty.”

The *Nature Astronomy* study, titled “Magnetic field strength of a neutron-star-powered ultraluminous X-ray source,” was funded by NASA and the Ernest Rutherford Fellowships. Other authors include F. Fürst of the European Space Astronomy Centre; M.J. Middleton of University of Southampton, United Kingdom; D.J. Walton and A.C. Fabian of University of Cambridge, United Kingdom; D. Stern of NASA’s Jet Propulsion Laboratory; M. Heida of Caltech; D. Barret of France’s Centre national de la recherche scientifique and University of Toulouse; and M. Bachetti of Italy’s Istituto Nazionale di Astrofisica.



*Image of the Whirlpool galaxy, or M51. X-ray light seen by NASA’s Chandra X-ray Observatory is shown in purple, and optical light from NASA’s Hubble Space Telescope is red, green and blue. The ultraluminous X-ray source, or ULX, in the new Caltech-led study is indicated.*

Photo Courtesy of NASA/CXC/Caltech/M.Brightman et al.; Optical: NASA/STScI

are somehow breaking this limit to give off such incredibly bright X-rays, and we don’t know why.”

In the new study, the researchers looked at a ULX in the Whirlpool galaxy, also known as M51, which lies about 28 million light-years away. They analyzed archival X-ray data taken by Chandra and discovered

charged particles—either positively charged protons or negatively charged electrons—circle around in a magnetic field. Black holes don’t have magnetic fields, but neutron stars do, so the finding revealed that this particular ULX in M51 had to be a neutron star.

Cyclotron resonance scattering creates telltale signatures in a

be protons or electrons, is known. With regards to this ULX, the researchers don’t have a detailed-enough spectrum to say for certain.

“If the cyclotron line is from protons, then we would know that these magnetic fields around the neutron star are extremely strong and may in fact be helping to breaking the Eddington limit,”

## Cells Communicate in a Dynamic Code

LORI DAJOSE

Caltech Strategic Communications

*This article is adapted from a story that was originally published online at [caltech.edu](#).*

A critically important intercellular communication system is found to encode and transmit more messages than previously thought.

Multicellular organisms like ourselves depend on a constant flow of information between cells, coordinating their

activities in order to proliferate and differentiate. Deciphering the language of intercellular communication has long been a central challenge in biology. Now, Caltech scientists have discovered that cells have evolved a way to transmit more messages through a single pathway, or communication channel, than previously thought, by encoding the messages rhythmically over time.

The work, conducted in the laboratory of Michael Elowitz, professor of biology and bioengineering, Howard Hughes Medical Institute Investigator,

and executive officer for Biological Engineering, is described in a paper in the February 8 issue of *Cell*.

In particular, the scientists studied a key communication system called “Notch,” which is used in nearly every tissue in animals. Malfunctions in the Notch pathway contribute to a variety of cancers and developmental diseases, making it a desirable target to study for drug development.

Cells carry out their conversations using specialized communication molecules called ligands, which interact

with corresponding molecular antennae called receptors. When a cell uses the Notch pathway to communicate instructions to its neighbors—telling them to divide, for example, or to differentiate into a different kind of cell—the cell sending the message will produce certain Notch ligands on its surface. These ligands then bind to Notch receptors embedded in the surface of nearby cells, triggering the receptors to release gene-modifying molecules called transcription factors into the interior of their cell. The transcription factors travel to the cell’s nucleus, where the

cell’s DNA is stored, and activate specific genes. The Notch system thus allows cells to receive signals from their neighbors and alter their gene expression accordingly.

Ligands prompt the activation of transcription factors by modifying the structure of the receptors into which they dock. All ligands modify their receptors in a similar way and activate the same transcription factors in a receiving cell, and for that reason, scientists generally assumed that the receiving cell should not be

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FEBRUARY 27, 2018

THE CALIFORNIA TECH

## Caltech Y Column

### CALTECH Y

The Caltech Y Column serves to inform students of upcoming events and volunteer opportunities. The list is compiled by Katherine Guo from information given by the Caltech Y and its student leaders.

Founded by students in 1916, the Y was organized to provide extracurricular activities planned and implemented by students as an opportunity to learn leadership skills and discover themselves. The mission of today's Y remains the same—to provide opportunities that will prepare students to become engaged, responsible citizens of the world. The Y seeks to broaden students' worldviews, raise social, ethical, and cultural awareness through teamwork, community engagement, activism, and leadership. More information about the Caltech Y and its programs can be found at <https://caltechy.org>. The office is located at 505 S. Wilson Avenue.

### Upcoming Events

#### Costa Rica Alternative Spring Break Trip

Saturday, March 17th through Sunday, March 25th (9 days) | Cost: \$950

Applications Due: by Noon on November, 22nd

The Caltech Y is excited to seek applicants for our 2017 Alternative Spring Break trip to Costa Rica. Join other Caltech students for a conservation focused spring break trip this year. On the Costa Rica trip we will be working with a host organization OSA Conservation [www.osaconservation.org](http://www.osaconservation.org) – which is dedicated to protecting the globally significant biodiversity of Costa Rica's Osa Peninsula. Don't miss out on this fantastic opportunity to explore another part of our planet and make a tangible difference in the world.

Trips fees include transportation, lodging, and most food. The Costa Rica Alternative Spring Break trip is coordinated by the Caltech Y and has been made possible thanks to generous funding from the Frank and Elsie Stefanko Fund, the George Housner Fund, Caltech Student Affairs, and the Caltech Y. Spaces are limited.

Visit [http://caltechy.org/programs\\_services/areas/asb/](http://caltechy.org/programs_services/areas/asb/) for applications and more information.

The Caltech Y Social Activism Speaker Series presents:

#### Solving Climate Change: From Policy to Personal

Thursday | November 30th | 4:00 to 6:00 PM | Location: TBD

The Caltech Y Social Activism Speaker Series is hosting a panel with members of the Citizens' Climate Lobby, a non-partisan volunteer organization dedicated to national policy to address climate change.

Climate change is one of the most pressing issues facing humanity. While the impacts of emissions up to now will be felt potentially for decades, significant policy changes are required in the immediate future to address greenhouse gas emissions and reverse the warming

trend in the long term. Passing legislation to deal with this pressing issue however, remains a problem. CCL campaigns for the passage of a Carbon Fee and Dividend bill designed to tax carbon emissions and return carbon dioxide to its pre-1990s levels. This discussion will feature a panel of CCL members from a variety of backgrounds each of whom will bring their perspective to this issue. Each panel member will talk about their views and then take questions from the audience.

Presentations are intended to introduce one perspective in order to stimulate thought and to provide a forum for respectful dialogue and examination. The views expressed by speakers are solely those of the speakers. Presentations do not necessarily reflect the opinion of the California Institute of Technology or the Caltech Y and should not be taken as an endorsement of the ideas, speakers or groups.

#### Decompression 2.0

Friday | December 1st | 3:00 to 5:00 PM | Center for Student Services

We made the move... Decompression is now an end of the week stress reliever with activities, snacks and entertainment. Don't go into finals week stressed out. Join us at the end of class week for a little break before studying. A variety of drinks and snacks, entertainment and activities will be provided.

#### Caltech Y Explore LA Series The Broad Museum

Sunday | December 3rd | 2:30 PM | Cost: \$5 | Transportation Included

Sign-up starting Thursday, 11/16 at the Caltech Y

Join us on a visit to The Broad with the Caltech Y! The Broad is a contemporary art museum founded by philanthropists Eli and Edythe Broad. Designed by Diller Scofidio + Renfro in collaboration with Gensler, the museum is home to 2,000 works of art from the Broad collection, which is among the most prominent holdings of postwar and contemporary art worldwide, and presents an active program of rotating temporary exhibitions and innovative audience engagement. The 120,000-square-foot building features two floors of gallery space and is the headquarters of The Broad Art Foundation's worldwide lending library, which has actively loaned collection works to museums around the world since 1984. With in-depth representations of influential contemporary artists like Jean-Michel Basquiat, Barbara Kruger, Cy Twombly, Ed Ruscha, Kara Walker, Christopher Wool, Jeff Koons, Joseph Beuys, Jasper Johns, Cindy Sherman, Robert Rauschenberg, and more, plus an ever-growing representation of younger artists, The Broad enriches, provokes, inspires, and fosters appreciation of art of our time. This offer is for students only; however, students purchasing tickets are permitted to purchase tickets for up to one guest each – and that guest can be a non-student. Explore LA is coordinated by the Caltech Y. The Caltech Y is located in the Tyson House 505 South Wilson (Bldg. 128).

The Caltech Y Social Activism Speaker Series is hosting a panel with members of the Citizens' Climate Lobby, a non-partisan volunteer organization dedicated to national policy to address climate change.

Climate change is one of the most pressing issues facing humanity. While the impacts of emissions up to now will be felt potentially for decades, significant policy changes are required in the immediate future to address greenhouse gas emissions and reverse the warming

## Caltechlive!

FRIDAY, MARCH 9, 2018 • 8 PM

## MIWA MATREYEK

*Myth & Infrastructure / This World Made Itself*



"Her combination of projected animation and contemporary shadow play have a magical quality in which the convergence of the common everyday world with the fantastical create an immersive dreamlike effect."

—Fabrik

\$30 (general admission) / \$10 Youth

### Free Parking

Caltech's Beckman Auditorium

[www.events.caltech.edu](http://www.events.caltech.edu) • 626.395.4652

Cosponsor:



\* Participants will need to meet at the Caltech Y at 2:30 pm to pick up tickets and coordinate rides. We have a timed entry of 3:30 pm. We will be staying for two hours, then ubering back to the Caltech Y. Although tickets are free, we are offering transportation for \$5.

### Pasadena LEARNS

Every Friday | 3:00 - 5:00 PM | Pasadena

Come volunteer at Washington Middle and Elementary STEAM School! We are partnered with the Pasadena LEARNS program and work with their Science Olympiad team or do regular tutoring along with occasional hands-on science experiments. Transportation is provided.

For more information and to RSVP, contact [azhai@caltech.edu](mailto:azhai@caltech.edu). Eligible for Federal Work Study.

### Hathaway Sycamores

Every Monday | 5:45 - 8:00 PM | Highland Park

Volunteer at Hathaway Sycamores, a group that supports local underprivileged but motivated high school students. There are a variety of ages and subjects being tutored. The service trip includes about 40 minutes of travel time and 1.5 hours of tutoring. Transportation is included.

For more info and to RSVP email Elisabeth at [egallmei@caltech.edu](mailto:egallmei@caltech.edu). Eligible for Federal Work Study.

### Mentors for L.I.F.E

Volunteer times: 2:45 - 5:00 PM at various locations in Pasadena

Stressed out by school? Step outside the Caltech bubble and mentor tweens who've yet to even consider college. Things you could do: Build a baking soda and vinegar volcano, read a book aloud, play sports or board games, teach the alphabet of another language, do a craft. Having a mentor makes an at-risk student 55% more likely to attend college, 78% more likely to volunteer regularly, and 130% more likely to hold a leadership position. Interested? If you have 180 seconds, you can watch this video and be inspired. If you have an hour a week, you can mentor someone and be their inspiration. If you feel unqualified, don't worry. Ultimately, mentoring is about being a consistent, dependable friend—not a surrogate parent or psychiatrist.

To get started, contact [noelle@caltech.edu](mailto:noelle@caltech.edu).

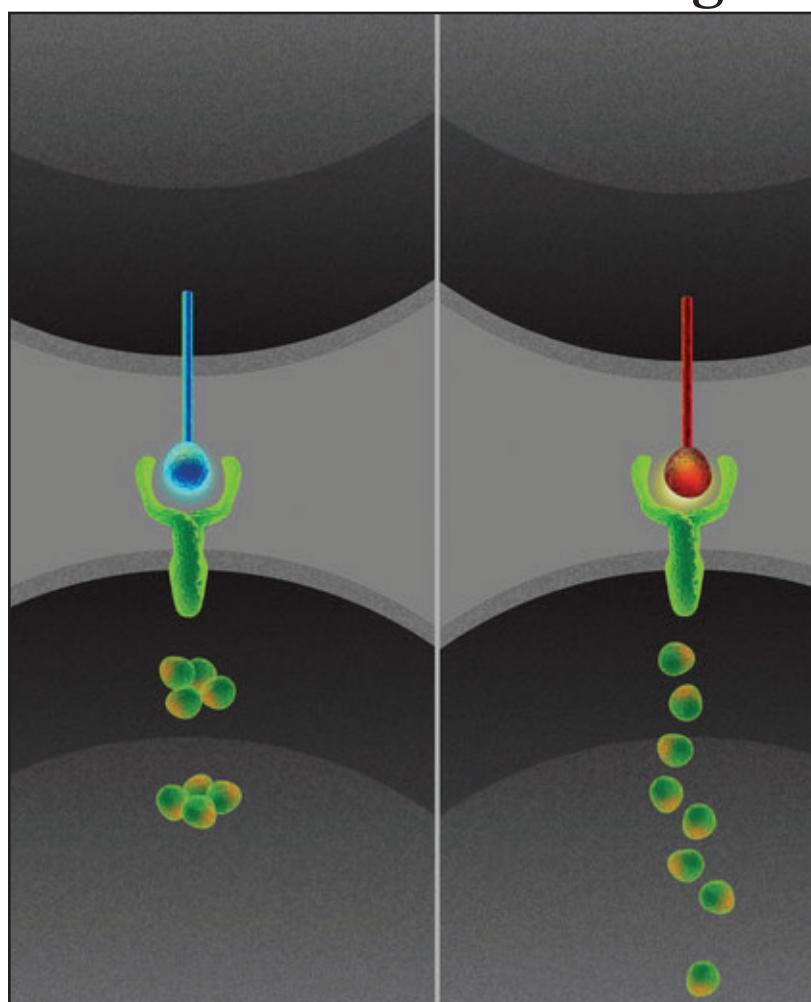
## A Critically Important Intercellular Communication System is Found to Encode and Transmit More Messages Than Previously Thought

*Continued from page 1*

able to reliably determine which ligand had activated it, and hence which message it had received.

"At first glance, the only explanation for how cells distinguish between two ligands, if at all, seems to be that they must somehow accurately detect differences in how strongly the two ligands activate the receptor. However, all evidence so far suggests that, unlike mobile phones or radios, cells have much more trouble precisely analyzing incoming signals," says lead author and former Elowitz lab graduate student Nagarajan (Sandy) Nandagopal (PhD '18). "They are usually excellent at distinguishing between the presence or absence of signal, but not very much more. In this sense, cellular messaging is closer to sending smoke signals than texting. So, the question is, as a cell, how do you differentiate between two ligands, both of which look like similar puffs of smoke in the distance?"

Nandagopal and his collaborators wondered whether the answer lay in the temporal pattern of Notch activation by different ligands—in other words, how the "smoke" is emitted over time. To test this, the team developed a new video-based system through which they could



*Artist's concept of a cell expressing the Delta1 ligand (left) and a cell expressing the Delta4 ligand (right). While these two ligands activate cellular receptors in the same way, they do so in different patterns over time. In this way, a receiving cell can decode instructions.*

Photo Courtesy of Caltech

record signaling in real time in each individual cell. By tagging the receptors and ligands with fluorescent protein markers, the team could watch how the molecules interacted as signaling was occurring.

The team studied two chemically similar Notch ligands, dubbed Delta1 and Delta4. They discovered that despite the ligands' similarity the two activated the same receptor with strikingly different temporal patterns. Delta1 ligands activated clusters of receptors simultaneously, sending a sudden burst of transcription factors down to the nucleus all at once, like a smoke signal consisting of a few giant puffs. On the other hand, Delta4 ligands activated individual receptors in a sustained manner, sending a constant trickle of single transcription factors to the nucleus, like a steady stream of smoke.

These two patterns are the key to encoding different instructions to the cell, the researchers say. In fact, this mechanism enabled the two ligands to communicate dramatically different messages. By analyzing chick embryos, the authors discovered that Delta1 activated

abdominal muscle production, whereas Delta4 strongly inhibited this process in the same cells.

"Cells speak only a handful of different molecular languages but they have to work together to carry out an incredible diversity of tasks," says Elowitz. "We've generally assumed these languages are extremely simple, and cells can basically only grunt at each other. By watching cells in the process of communicating, we can see that these languages are more sophisticated and have a larger vocabulary than we ever thought. And this is probably just the tip of an iceberg for intercellular communication."

The paper is titled "Dynamic Ligand Discrimination in the Notch Signaling Pathway." In addition to Nandagopal and Elowitz, other Caltech co-authors are Leah Santat, who is also a Howard Hughes Medical Institute Investigator, and Marianne Bronner, the Albert Billings Ruddock Professor of Biology. Additional co-authors are Lauren LeBon of Calico Life Sciences and David Sprinzak of Tel Aviv University. Funding was provided by the Defense Advanced Research Projects Agency, the National Institutes of Health, the National Science Foundation, and the Howard Hughes Medical Institute.

## 2018 CALTECH UNDERGRADUATE WRITING PRIZES

Each year the division of Humanities and Social Sciences awards a number of prizes for undergraduate writing. Consider submitting your work to be recognized and rewarded for your work as a writer.

Submit your writing this year for these prizes:

### MARY A. EARL MCKINNEY PRIZE IN LITERATURE

Awarded to the best original poetry and fiction. Submit up to three poems. Fiction should not exceed 12,000 words – one submission. Prize amount: \$500.00/each category

### GORDON MCCLURE MEMORIAL COMMUNICATIONS PRIZE

Awarded to the best academic writing in three categories: English, History and Philosophy. No length limit. Please include prompts for all essays composed in courses. Essays written for courses may be revised before submission.

Prize amount: \$500.00/each category

### HALLETT SMITH PRIZE

Awarded to an outstanding essay related to the work of Shakespeare.  
Prize amount: \$500.00

Copies of last year's prizewinning writing are stored in CaltechTHESIS, and they can be viewed by following links from this writing center webpage: <http://writing.caltech.edu/community/prizes>

### Submission Guidelines:

## Deadline: April 6th, 2018

Only currently enrolled full-time students may submit. Entries should be double-spaced PDFs. Winners will be announced in June, and winners' names will be in the commencement program. Winning writing will be archived using CODA through the Caltech Library. Email entries to Cecilia Lu at [cecilia@caltech.edu](mailto:cecilia@caltech.edu), noting the prize to which you are applying in the email subject and filename.

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JANUARY 17

POSITIVE PSYCHOLOGY

JANUARY 31

GRIEF AND LOSS

JANUARY 24

EMOTION REGULATION STRATEGIES

FEBRUARY 21

SEXUAL HEALTH  
\*LAURITSEN (bldg 48) rm 269

FEBRUARY 14

HEALTHY RELATIONSHIPS

MARCH 7

ALCOHOL & DRUGS

FEBRUARY 28

PROCRASTINATION

APRIL 16

HEALTHY ADVISOR RELATIONSHIPS

APRIL 11

COPING WITH ADHD

APRIL 25

HEALTHY SLEEP

MAY 9

STRESS MANAGEMENT

MAY 16

MINDFULNESS

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a play by qui nguyen  
directed by randee trabitz

"A deceptively breezy and rather ingenious comedy."

—THE NEW YORK TIMES

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Fridays, Saturdays 7:30 pm

Sundays 2:30 pm

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### Open-Mindedness

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### Face The Fear

Learn how to hang in there with difficult situations and emotions without having to avoid them.

**Friday, February 16th and 23rd**

Just show up! Fridays 4:00 - 5:00, 326 Sherman Fairchild Library

## Kawashima wins Ducey Award

**GOCALTECH.COM**  
Actual Sports Content Editor

LAGUNA NIGUEL, Calif. (Feb. 23, 2018) – Senior wing David Kawashima will depart the Caltech men's basketball program with the prestigious SCIAC Ducey Award, as voted on by the conference's coaches. The Ducey is an all-encompassing award reserved for senior players of high-character on and off the court and players who use their free time to give back to the community. Kawashima is the first Caltech player to win the award since K.C. Emezie '16.

"I really appreciate of all the support from the Caltech community throughout my career here, as I simply could not have thrived without my teammates, coaches, or the best fans in the SCIAC," Kawashima said. "I

would like to thank everyone who supported me and our team these past four years."

Kawashima finished the 2017-18 season averaging 8.7 points per game, 4.3 rebounds to go with a .540 field goal percentage to lead the team, good for the fifth best all-time. Similarly, the senior's .466 field goal percentage ranks sixth in program history. Kawashima captained the Beavers in his senior season and is a four-year member of the team. He is a reigning NABC Honors Court honoree and 2-time SCIAC all-academic team member who holds a 3.7 cumulative GPA as a computer science major. He interned at Fox Networks and JPL his freshman and sophomore summers, and has a software-engineering job lined up at Tinder upon graduation. He currently serves as a volunteer teacher for 4th and 5th grade students at Jefferson Elementary School in Pasadena.



"Ayyyyyy...I won an award...cool!"

-gocaltech.com

## Peng named to Second Team



"What? Huh? I did a thing...a basketball thing?"

Photo Courtesy of Noelle Davis

**GOCALTECH.COM**  
Actual Sports Content Editor

LAGUNA NIGUEL, Calif. (Feb. 22, 2018) – For a second year in a row, sophomore guard Grace Peng of the Caltech women's basketball team earned SCIAC recognition, this time for Second Team All-SCIAC. The sophomore received the SCIAC Newcomer of the Year honor in 2017.

Peng finished seventh in the conference in scoring, seventh in steals, eighth in field goals per game and ninth in assists, in addition to ranking second in minutes per game. Additionally, the point guard is currently on pace to be the Beavers' most accurate three-point

shooter in school history (32.2 percent) and is already Caltech's 10th all-time leading scorer. Perhaps her best game came on Jan. 3 when the Beavers picked up their first SCIAC win under first-year Head Coach Bridgette Reyes at Pomona-Pitzer Colleges. Peng scored 21 points, knocked down two three-pointers and handed out a pair of assists.

With Peng manning the point guard position, the Beavers picked up three SCIAC wins for the first time ever, two of which came against the University of La Verne which marked the first time the Beavers have swept the Leopards. The three wins brought Caltech to an eighth-place conference finish.

## Men's team scores favorably at SCIAC's Day 2

**GOCALTECH.COM**  
Actual Sports Content Editor

COMMERCE, Calif. (Feb. 22, 2018) – A handful of new records and personal improvements allowed the Caltech men's swimming & diving team to score enough points to hold steady in the middle of the standings on the second day of the 2018 SCIAC Championships. The Beavers are currently sitting in the middle of the field in fifth place.

Freshman Adam Kogan began the evening with a new personal best in the 500 Free, lowering his prelim record from the morning by six-tenths of a second. The freshman touched the wall in 4:37.02, crushed his previous top time by nearly 20 seconds and broke the Caltech record previously held by junior Dylan Lu. The freshman got it done with steady splits throughout the race, with his second-fastest 50 split coming on the final lap. The subsequent event, the 200 IM, saw two Beavers participate in the 'B' final and earn their team some meaningful points. Freshman Alex Janosi improved on his previous top 200 IM time by nearly seven seconds and won the race in 1:53.11 to



A fish out of water.

-gocaltech.com

score 10 points for the Beavers. Junior Henry Steiner joined the freshman in the 'B' final and posted the fastest fly split of the group (24.11). Junior Jonathan Willett capped off the men's team's solo events for the day with an appearance in the 50 Free 'A' final after lowering his own 50 Free record to 20.90 in the morning.

Caltech also got some action in the 200 Free Relay later in the day when one more record fell for the Beavers. Sophomore Thomas Gallup teamed with Janosi, Lu and freshman JD Walker to defeat teams from Chapman University and the University of La Verne in the 'A' final, breaking the program record in the process (1:25.30). Gallup's 21.82 leadoff split translated into his fastest 50 Free time in two years at Caltech and helped set the tone for the rest of the team turning in a solid showing. The 'B' team, consisting of Kogan, senior Avikar Periwal and freshmen Michael Yao and Andy Rothstein finished ahead of Whittier College in their section of the final.

# ANNOUNCEMENTS

THE CALIFORNIA TECH

## ANNOUNCEMENT:

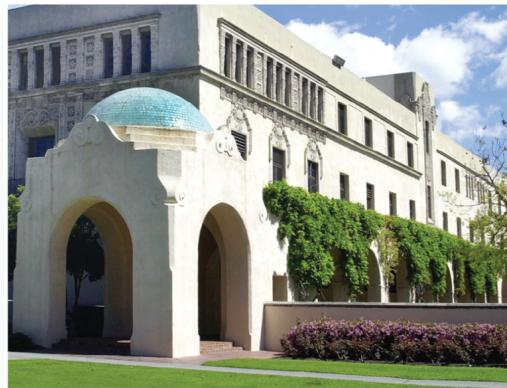
VICE PROVOST, CHIEF DIVERSITY OFFICER, AND PROFESSOR OF ENGLISH CINDY WEINSTEIN HOLDS REGULAR OFFICE HOURS AS AN OPPORTUNITY FOR UNDERGRADUATE STUDENTS, GRADUATE STUDENTS, AND POSTDOCS TO MEET FOR DISCUSSIONS PERTAINING TO THE COUNCIL ON UNDERGRADUATE EDUCATION; CALTECH ACCREDITATION; THE STAFF AND FACULTY CONSULTATION CENTER; STUDENT-FACULTY PROGRAMS; THE CENTER FOR TEACHING, LEARNING, AND OUTREACH; THE CALTECH DIVERSITY CENTER; AND THE CALTECH LIBRARIES.

THERE ARE FOUR 15-MINUTE APPOINTMENTS AVAILABLE PER OFFICE HOUR. SIGN UP AT THE OFFICE OF THE VICE PROVOST IN PARSONS-GATES ROOM 104, BY PHONE AT 626-395-6339, OR BY EMAIL TO [DLEWIS@CALTECH.EDU](mailto:DLEWIS@CALTECH.EDU). WE LOOK FORWARD TO HEARING FROM YOU!

STUDENT OFFICE HOURS FOR WINTER TERM 2018:

2/27/18 TUESDAY 10:00-11:00 A.M.  
 3/8/18 THURSDAY 11:00 A.M.-12:00 P.M.  
 3/12/18 MONDAY 10:00-11:00 A.M.  
 3/19/18 MONDAY 10:00 A.M.-11:00 A.M.

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When you want unsurpassed stability, integrity and value for your money, Caltech Employees Federal Credit Union offers an honest alternative. There are no gimmicks. No annual fees. No harsh penalties.

Just some of the lowest lending rates and highest savings rates in the nation...and a state-of-the-art eBranch for easy, convenient online and/or mobile access to your account. We're the overwhelming choice for financial services among the entire Caltech family. If you haven't yet joined, call or visit us online or in person today. You belong here.



<sup>62</sup>**S**marter <sup>16</sup>**S**olutions. <sup>59</sup>**P**roven <sup>75</sup>**R**esults.

**Campus Office** 515 S.Wilson Ave. (physical address) • **Campus ATMs** Winnett Center & Keith Spalding Building  
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Must qualify for CEFCU membership to join. Minimum \$5 deposit and one-time \$5 membership fee due upon opening any CEFCU account. Federally insured by NCUA.

## ASCIT Minutes

Meetings are every week in SAC 13

## ASCIT Board of Directors Meeting

Minutes for February 23, 2017. Taken by Dana He.

Officers Present: Sakthi Vetrivel, Kavya Sreedhar, Rachael Morton, Dana He

Guests:

Call to Order: 4:38 pm

## President's Report (Sakthi):

- ACRL had first meeting to discuss how to best represent everyone at Caltech. Website with minutes posted. Next meeting on Monday.

## Officer's Reports:

## V.P. of Academic Affairs (Kavya):

- Met with GSC academic chair for research seminars. Coming up next Tuesday and Wednesday.
- Course compliments are on the ARC website.

## V.P. of Non-Academic Affairs (Rachael):

- Sammy was elected as Ricketts president, so new IHC is complete.
- Waiting on ACRL for timeline. Next two meetings will focus on Bechtel. Would like to figure some stuff about rotation before Prefrosh Weekend. IHC is welcome to bring up topics or ideas to ACRL. Rotation will be evaluated each year. Discussion on how to restructure student government to have representation from Bechtel.

## Director of Operations (Sara):

- Not in attendance.

## Treasurer (Sarah):

- Would like to increase budget for ditch day and interhouses.

## Social Director (Alice):

- ASCIT movie night for Black Panther is tonight.
- Be A Kid Again Day is on Sunday.
- Ruddock OPI on March 10.

## Secretary (Dana):

- Nothing to report.

If anyone has any questions or concerns about a section of the minutes please email the appropriate officer. We are happy to answer any questions.

Meeting Adjourned: 4:59 pm

## ARC Minutes 2.25.2018

Present: Kavya Sreedhar, Arushi Gupta, Alison Tang, Michael Yao, Andrew Zhou, Matthew Zeitlin, Alice Jin

Minutes submitted by: Alison Tang and Shreya Ramachandran

## 1. Programming

- Student Faculty Lunches (SFLs): 18/27 students RSVPed so far; should consider how many times a student has gone to an SFL in the past to equitably distribute spots. Able to grant everyone who signed up a spot this time!
- Course Compliments: biweekly schedule; response rate slowing down; 3 out of 5 people confirmed for lunch from last week
- UG+Grad Student Research Seminars: will try to launch next term; need low activation energy for grad student presentations
- Research List: email goes out to Provost Office tomorrow to update the list
- Millikan Student Sessions: can do 2 CS2 sessions this term on Saturday nights; ask students in CS1 and other large classes (> 150 students)

## 2. Projects

- TQFR Improvement: shift this to course concerns

## 3. Miscellaneous

- Olive Walk Display Case: list of programs with photos, student guide to TQFRs, ARC tip of the week, biweekly course compliments
- Deans Meeting: went well; heard about core from freshmen perspectives

The ARC website at [arc.caltech.edu](http://arc.caltech.edu) has more information about what the ARC does if you are interested. We meet every Sunday at 11am in SAC13 and our meetings are open to everyone! If you have any questions, please feel free to email [ksreedha@caltech.edu](mailto:ksreedha@caltech.edu).



## ARC Tip of the Week

If you weren't able to register for a limited seating course, email the professor to get added to the waitlist and attend the first class.

SIGN-UPS/NOMINATIONS FOR THE ELECTIONS OCCURRING THIS TERM (CRC COCHAIR, IHC CHAIR, BOC CHAIR, BOC SECRETARIES, AND TECH EDITORS) WILL GO UP THIS MONDAY (26 FEBRUARY) AND DOWN THIS FRIDAY (3 MARCH). THEY ARE LOCATED ON THE OLIVE WALK ENTRANCE TO FLEMING.

ELECTIONS WILL BE ON MONDAY THE 12TH OF MARCH.

## Crossword

## Across

- Professional cook
- Curved shape
- Felines
- Cleave
- Battery terminals
- Elaborate song for solo voice
- Esurient
- Harass
- Submerged ridge near the surface
- Beneath
- Bill of fare
- Challenge
- Music genre
- Not in favor of
- Form of pasta in slender tubes
- Echo sounder
- Make a mistake
- Aroused to impatience or anger
- Stories
- Try to discover
- Part of a stable
- Former Italian currency
- Smile contemptuously
- Move furtively
- Bakery item
- Month
- Ingressing
- Musical instrument
- Oculus
- Taxis

## 61. Ululate

64. Escargot

68. Cruel and inhuman person

69. Be of use to

71. Currency unit

72. University or college administrator

73. Pier or landing place

74. Smile

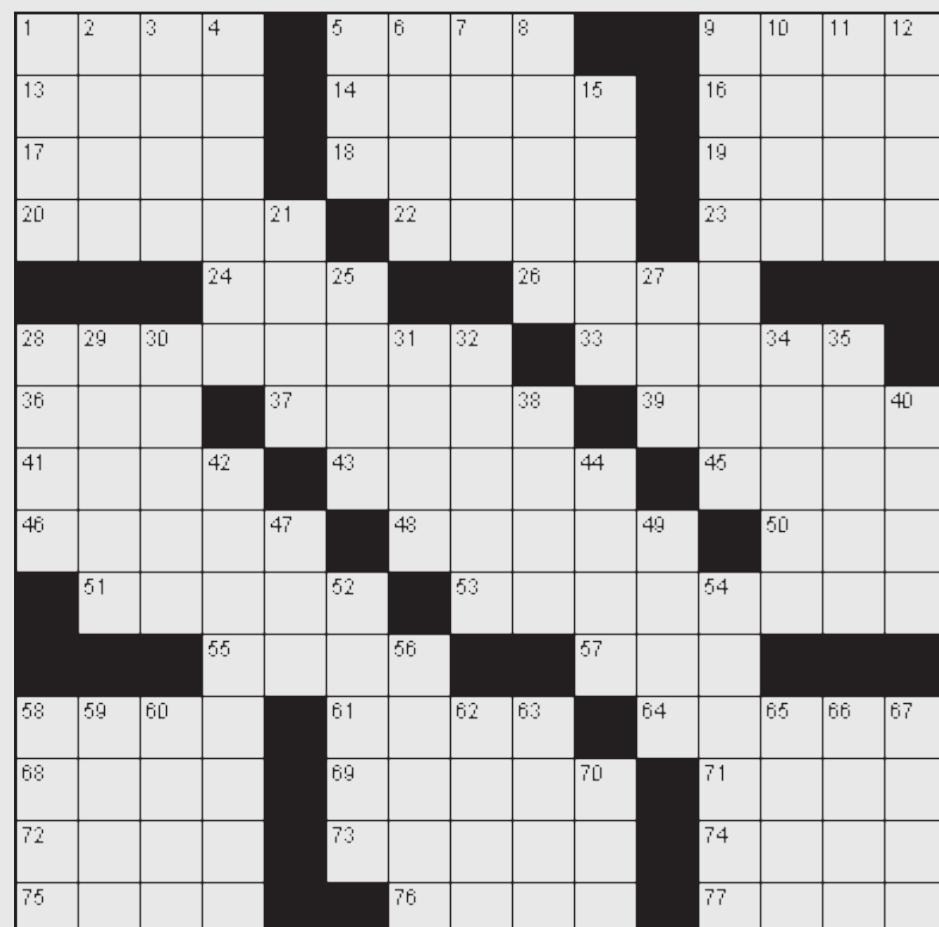
75. Boundary

76. Transmitted

77. Alleviate

## Down

- Direct an aircraft into a crosswind
- Teeming multitude
- Malevolent
- Type of hat
- Pertinent
- Wander
- Hint
- Hair dye
- Bishop
- Region
- Grade or level
- Strongbox
- Stupefies
- Armed conflicts
- Cooking vessels
- A small amount of rum
- State of confusion and disorder
- Sports stadium
- Crawl



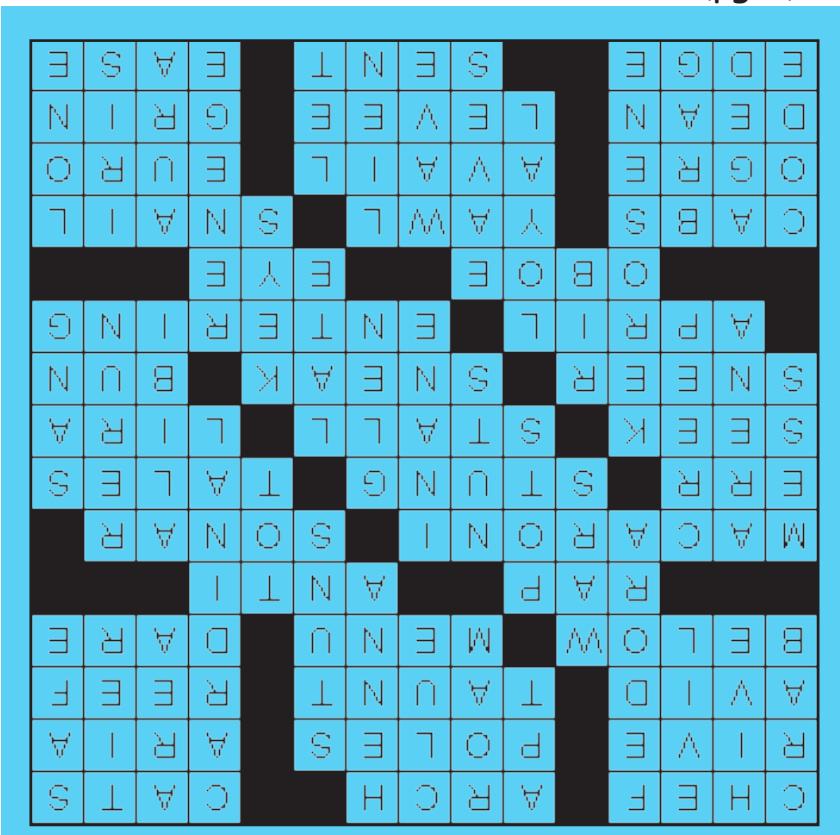
# HUMOR

## REVENGE OF THE NERDS

BY MATT TORUSSANER



## Answers to current crossword (pg 7)



-<http://puzzlechoice.com>

*The California Tech*

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