The Adolph C. and Mary Sprague

Miller Institute
for Basic Research in Science

Newsletter
Spring 2016

Molecular Machines with Mechanical Bonds

Miller Fellow Focus: Carson J. Bruns

In his celebrated 1959 lecture, *There's Plenty of Room at the Bottom*, Richard Feynman outlined a vision for what would later become the field of nanotechnology. Among his provocative questions was, "what are the possibilities of small but movable machines?" Half a century later, the world's tiniest machines are made (by chemists) out of individual molecules as small as a single nanometer in length, yet the question of how to best use them remains open.

Strictly defined, a machine is a tool that uses energy to perform an intended task. Interest in artificial molecular machines is motivated by the remarkable functions of biological molecular machines that carry out many essential functions in the cell. For example, ATP synthase is a protein whose rotary motor, driven by the energy of an electrochemical gradient, produces adenosine triphosphate (ATP). ATP then powers other molecular machines such as myosin, the motor protein responsible for muscle contraction, and kinesin, a motor protein that "walks" along filamentous highways in order to carry cellular cargo from site to site. It is anticipated that novel technological applications will emerge from synthetic molecules that could mimic the machine-like functions of these biomolecules. However, the physical laws that govern machines we encounter in our everyday lives are very different than those acting on machines at the molecular scale, where gravity and inertia are irrelevant. Therefore, the design and operation of molecular machines requires a fundamentally different mindset – one that appreciates and harnesses the incessant, unavoidable, and chaotic "wigglings and jigglings" of molecules, known as Brownian motion.

My research focuses on synthesizing artificial molecular machines and exploring their effective use, especially in the context of biochemistry. My tiny machines comprise a type of molecule known as a rotaxane, a name derived from the latin rota (wheel) and axis (axle), reflecting the ring-and-axle geometry (**Figure 1a**) of these molecular assemblies. The ring of a rotaxane is mechanically constrained to a one-dimensional pathway defined by the axle it encircles, since two bulky "stoppers" at each end of the axle prevent the ring from escaping. This permanent entanglement between two or more molecular components, such as that found in rotaxanes, is known as a mechanical bond, since there are no chemical bonds that otherwise hold them together. In a comprehensive book on *The Nature of the Mechanical Bond* that will be published in summer 2016, I review the body of literature comprising more than 5000

CONTINUED ON PAGE 6 >

Inside this edition:

Miller Fellow Focus	1, 6, 7
Call for Applications/Nominations	2-3
Miller Fellowship Awardees	4-5
2016 Miller Senior Fellow Award	7
Gifts to the Miller Institute	8
Next Steps, Birth Announcements	8

Call for Nominations

Miller Research Fellowship Nominations
Deadline: Saturday, September 10, 2016

Miller Research Professorship Applications
Deadline: Thursday, September 15, 2016

Visiting Miller Professorship Departmental Nominations
Deadline: Friday, September 16, 2016

For more information on all our programs online: miller.berkeley.edu & on PAGES 2 & 3.

"The Miller Institute was an outstanding opportunity to pursue my interdisciplinary training. My time as a Miller Fellow was marked by fantastic talks with the people who are passionate about their science – no matter what the discipline. This exposure was critical for me to determine my future career-path."

- Marla Feller

Miller Fellow 1994 - 1996,
Professor and Head: Neurobiology Division, Department of Molecular and Cell Biology and Helen Wills Neuroscience Institute, UC Berkeley.

Call for Miller Professor Applications

Online Application Deadline: Thursday, September 15, 2016

Miller Research Professorship AY 2017-2018

The Miller Professorship program is looking with a view to the future in announcing the call for applications for terms in 2017-2018. The goal is to accommodate a greater range of campus faculty to participate in the vibrant Miller community. The objective of the Miller Professorship program is to provide opportunities for faculty to pursue new research directions on the Berkeley campus. For some, this may best be enabled by taking time off from teaching. This continues to be an option. For others, the teaching obligations are critical to maintaining campus academic programs. There is thus a second option for Miller Professors, allowing the continuation of campus service and teaching. Funds will be distributed differently depending upon the choice selected. Details of the terms and the application procedure are posted on the Miller Institute website. The primary purpose of the Miller Professorship program and the evaluation criteria will continue to be research excellence. Applicants are encouraged to describe their interest in participating in the Miller Institute community.

Beginning May 2016 applications will be accepted from UC Berkeley faculty only for terms in the 2017-18 academic year. The purpose of the Professorship is to allow members of the faculty to pursue new research directions on the Berkeley campus. Appointees are encouraged to follow promising leads that may develop in the course of their research.

Applications are judged competitively and are due by Thursday, September 15, 2016. It is anticipated that between five to eight awards will be made.

Call for Visiting Miller Professor Nominations

Online Nomination Deadline: Friday, September 16, 2016

Visiting Miller Research Professorship AY 2017-2018

The Advisory Board of the Miller Institute for Basic Research in Science invites Berkeley faculty to submit online departmental nominations for Visiting Miller Research Professorships and the Gabor A. and Judith K. Somorjai Visiting Miller Professorship Award for terms in Fall 2017 or Spring 2018. The purpose of these Visiting Miller Professorships is to bring promising or eminent scientists to the Berkeley campus on a short-term basis for collaborative research interactions. It is required that awardees are in residence at Berkeley during their appointment term. Faculty members or research scientists from any place in the world are eligible to be considered for sponsorship. Non-US citizens must be eligible for J-1 Scholar visa status. Faculty members at other UC campuses are eligible to be nominated for this program. The Miller Institute, as the sponsor and administrative department, will extend an invitation after advising the department of its selection.

Any questions regarding this program may be directed to the Institute's office by phone at (510) 642-4088 or by emailing the Miller Institute.

:: **Nomination & Application details**: miller.berkeley.edu

:: **Questions?** Kathryn Day: 510-642-4088 | millerinstitute@berkeley.edu

Call for Nominations: Miller Research Fellowship

2017-2020 Term

Nomination Deadline: Saturday, September 10, 2016

The Miller Institute for Basic Research in Science invites department chairs, faculty advisors, professors and research scientists at institutions around the world to submit nominations for Miller Research Fellowships in the basic sciences. The Miller Institute seeks to discover and encourage individuals of outstanding talent, and to provide them with the opportunity to pursue their research on the Berkeley campus. Fellows are selected on the basis of their academic achievement and the promise of their scientific research. Miller Fellows also have a keen curiosity about all science and share an appreciation for an interdisciplinary experience. The Miller Institute is the administrative home department for each Miller Fellow who is hosted by an academic department on the Berkeley campus. All research is performed in the facilities provided by the UC Berkeley academic department. A list of current and former Miller Research Fellows can be found at: http://miller.berkeley.edu/fellowship/members/all-mf-by-name

Miller Research Fellowships are intended for exceptional young scientists of great promise who have recently been awarded, or who are about to be awarded, the doctoral degree. Normally, Miller Fellows are expected to begin their Fellowship shortly after being awarded their Ph.D. A short period as a post-doctoral fellow elsewhere does not exclude eligibility. However, applicants who have already completed five years or more of post-doctoral experience are not eligible for nomination. **A nominee cannot hold a paid or unpaid position on the Berkeley campus at the time of nomination or throughout the competition and award cycle**. Nominees who are non-US citizens must show eligibility for obtaining J-1 Scholar visa status for the duration of the Miller Fellowship. Non-US citizens will be required to prove English language proficiency prior to award. The Miller Institute does not support H1B visa status. The Fellowship term must commence between July 1 and September 1, 2017. Eligible nominees will be invited by email by the Institute to apply for the Fellowship after the nomination has been reviwed. Direct applications and self-nominations are not accepted.

*All nominations must be submitted using the Online Nomination System at: http://**miller.berkeley.edu**

Nominators will need the following required information to complete the online nomination process:

- Nominee's complete full and legal name (do not use nicknames)
- Nominee's current institution
- Nominee's complete, current, and active E-mail address that will be valid through March 2017, current mailing address with postal code and telephone number
- Nominee's Ph.D. Institution and (expected) Date of Ph.D. (month & year required)
- Letter of recommendation and judgment of nominee's promise by the nominator (saved in PDF format). Letter must be specific to the Miller Fellowship, have a current date, and be on institutional letterhead. The Executive Committee finds it helpful in the recommendation letter to have the candidate compared with others at a similar stage in their development.
- Nominator's current active E-mail address, title, and professional mailing address (include zip code/campus mail code)

The Institute provides a stipend of $65,000 with annual 2% increases and an annual research fund of $10,000, for total initial compensation of $75,000. There is provision for travel to Berkeley for Miller Fellows and their immediate families and a maximum allowance of $3,000 for moving personal belongings. Benefits, including medical, dental, vision and life insurance are provided with a modest contribution from the Miller Fellow. All University of California postdocs are represented by the UAW. Fellowships are awarded for three years, generally beginning August 1, 2017 and ending July 31, 2020. Approximately eight to ten Fellowships are awarded each year. Candidates will be notified of the results of the competition starting in mid-December, and a general announcement of the awards will be made in the spring.

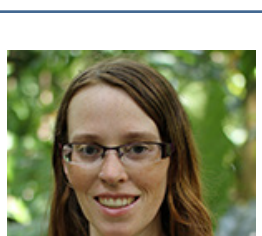
We are grateful for your thoughtful participation in this process and hope that you regard the time you may devote to this effort justified by the contribution you will be making to the careers of distinguished young scientists.

MILLER INSTITUTE FOR BASIC RESEARCH IN SCIENCE
2536 Channing Way, Berkeley, CA 94720-5190
ph: 510-642-4088 | fax 510-643-7393
miller.berkeley.edu

Miller Research Fellowship Awardees 2016-2019

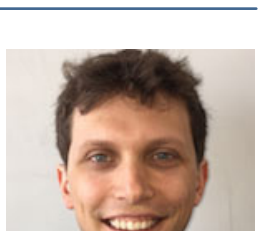
The Miller Institute is pleased to introduce the 2016-2019 Miller Research Fellows. Each year, the Miller Institute seeks to discover individuals of outstanding talent and to bring to Berkeley young scholars of great promise. Candidates are nominated for these awards and are selected on the basis of their academic achievement and the potential of their scientific research. The Fellows will be working with Berkeley faculty hosts for a three-year term beginning in the 2016 academic year. A full list of all past and present Miller Fellows is available on our website.

Rebecca Duncan
Ph.D. - University of Miami
Berkeley Dept. - Integrative Biology
Faculty Host: Noah Whiteman



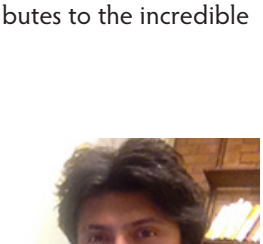
Herbivory, a diet consisting solely of plants, is a key driver of animal diversification despite the fact that it is also a major evolutionary hurdle, in part because most plants deter herbivores by producing toxic chemicals like nicotine, caffeine, morphine, and mustard oils. Many of these chemicals are easily metabolized by bacteria that may partner with animals to facilitate herbivory, but surprisingly little is known about the role bacteria play in degrading host plant toxins. Using the emerging model herbivorous fly Scaptomyza flava, I aim to address the hypothesis that bacteria in the gut and on host plants facilitate host plant detoxification. In doing so, my research will help address the long standing question of the extent to which bacteria facilitate the evolution of herbivory, illuminating a mechanism to one key life strategy that contributes to the incredible biodiversity on Earth.

Benjamin Good
Ph.D. - Harvard
Berkeley Dept. - Physics/Bioengineering
Faculty Host: Oskar Hallatschek, Physics
Adam Arkin, Bioengineering



I am interested in understanding how evolution works at a quantitative level, with enough precision to eventually predict the rates of different microevolutionary outcomes. To study this process, I combine theoretical tools from population genetics and statistical physics with empirical data from rapidly evolving viruses and bacteria. During my PhD, I focused on patterns of DNA sequence variability in some of the simplest models of microbial evolution, as well as computational methods for testing these models using experimentally evolved bacteria in the lab. As a Miller Fellow, I plan to extend these quantitative evolutionary models to communities of microbes in their natural habitat, by analyzing the DNA sequences of bacteria that inhabit the human gut.

Shirshendu Ganguly
Ph.D. - University of Washington
Berkeley Dept. - Statistics/Math
Faculty Host: Alan Hammond



My research focuses on probability theory and applications, in particular on understanding various phenomena in statistical physics, random matrices, probabilistic combinatorics and high dimensional geometry. A central theme in my research is the study of Interacting particles systems. Based on non rigorous heuristics, remarkable conjectures about particle behavior exist in the literature. Understanding these models and making progress towards formal verification of these conjectures forms the core of my research. This involves applications of ideas and tools from several other areas of mathematics. In another direction, I am looking into questions related to understanding the geometry of random graphs, forced by certain rare events, in the context of large deviations.

Christopher Lemon
Ph.D. - Harvard
Berkeley Dept. - Molecular & Cell Biology
Faculty Host: Michael A. Marletta

The efficacy of chemotherapeutics may be increased if an external stimulus, such as light, is used to activate drug release directly at a tumor. My research focuses on the development of dual functional probes that combine imaging and therapeutic agents in a single construct. In this way, an organ or tissue will first be imaged to locate the tumor and then localized light will be applied to release a drug selectively at the tumor, minimizing damage to healthy tissue.

Call for Nominations

Miller Research Fellowship 2017-2020

Online Nomination Deadline: Saturday, Sept. 10, 2016

Kelly Nguyen
Ph.D.-University of Cambridge, UK
Berkeley Dept. - Molecular & Cell Biology
Faculty Host: Eva Nogales

Chromosomes are capped with repetitive DNA sequences called telomeres which protect chromosomes from end-joining and from end-replication issues. Telomeres are shortened after each round of cell division due to incomplete genome replication. Once telomere length is critically shortened, cells undergo proliferative senescence or cell death. Telomerase is a ribonucleoprotein that synthesises the telomeric repeats at the chromosome ends and thus maintains telomere length. Telomerase activity is undetectable in somatic cells while germ cells, stem cells and cancer cells have active telomerase, making it an attractive therapeutic target against cancer and ageing. My research focuses on understanding the molecular mechanism of human telomerase using an integrated biochemical and structural approach.

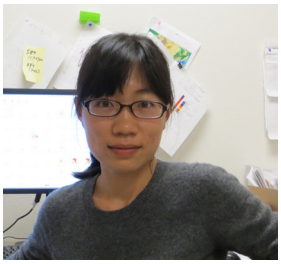
Alejandro Rico Guevara
Ph.D. - University of Connecticut
Berkeley Dept. - Integrative Biology
Faculty Host: Robert Dudley

As a functional anatomist, the goal pervasive to all my research is to describe the links among the structures (e.g. organismal morphology), underlying mechanisms (e.g. biomechanics), and the emergent phenomena (e.g. performance, ecological and evolutionary patterns) in live organisms. My Miller project focuses on the trade-offs among ventilation, drinking, and locomotion in a group of animals that pushes the limits in all of those biological functions: hummingbirds.

Sarah Slotznick
Ph.D. - Caltech
Berkeley Dept. - Earth & Planetary Science
Faculty Host: Nicholas Swanson-Hysell

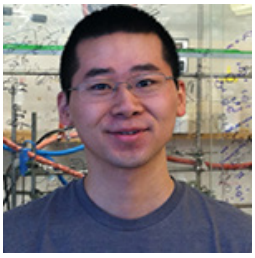
I study iron-bearing minerals in ancient rocks for insights into oceanic and atmospheric chemistry of the early Earth. I combine microscale textural analyses from light microscopy, electron microscopy, and x-ray spectroscopy with bulk magnetic measurements to unravel the primary mineralogy from secondary overprints. My research currently focuses on Proterozoic rocks in the 1.5 billion years after the rise of atmospheric oxygen during which eukaryotes and complex life evolved.

Lian Xue
Ph.D. - University of California Santa Cruz
Berkeley Dept. - Earth & Planetary Science
Faculty Host: Roland Burgmann



I study fault behavior through earthquake cycles by using hydrogeology and geodesy. I investigate fault zone hydrogeologic architectures using water level tidal response and ground deformation using GPS and InSAR.

Yang Yang
Ph.D. - MIT
Berkeley Dept. - Chemistry
Faculty Host: Jeff Long



Hydrocarbons are produced on an enormous scale from petroleum and natural gas processing. Unfortunately, to separate these hydrocarbon mixtures into value-added fuels and feedstock chemicals, a series of distillations with tremendous energy consumption is required. Through the development of novel porous materials as effective and selective hydrocarbon absorbents, my research seeks to deliver low-energy techniques for the separation of hydrocarbons.

In the News

Lisa Pruitt (Miller Professor 2000) was honored with the 57th Annual Distinguished Teaching Award for her inspiring and transformational teaching.

Michael Manga's (Miller Fellow 1994 - 1996, Miller Professor 2008 - 2009) new article on volcanology, hydrology, geodynamics, fluid mechanics and planetary science was published in the Tectonophysics Journal.

Erin O'Shea (Miller Fellow 1992 - 1994) has been named the new President of HHMI.

Chang Liu (Miller Fellow 2009 - 2012) & **Yogesh Surendranath** (Miller Fellow 2011 - 2013) are winners of 2016 Sloan Research Fellowships.

Saul Perlmutter (Miller Senior Fellow 2009) is to lead a 29-member scientific dark energy team from 15 institutions on NASA's new WFIRST mission.

Paul Alivisatos (Miller Professor 2001 - 2002) has been awarded the international Dan David Prize for his contributions in the field of nanoscience.

Roger Blandford (Visiting Miller Professor 2013) & Roy Kerr have been awarded the 2016 Crafoord Prize in Astronomy "for fundamental work concerning rotating black holes and their astrophysical consequences".

For updated news:
miller.berkeley.edu/news

publications on molecules with mechanical bonds, or *mechano-molecules*, of which rotaxanes are one archetype.

The mechanical bond is of interest in the design of artificial molecular machines because it imparts molecules with the ability to sustain relatively large-amplitude mechanical motions, such as the translation or rotation of a ring with respect to an axle. In appropriately designed rotaxanes, the time-averaged position of the ring with respect to the axle can be set, controlled, and reconfigured by modulating the local interactions (e.g., electrostatic, dipole–dipole, etc.) between the ring and various sections of the axle. Rotaxanes are often made to express bistability, such that the ring preferentially encircles one of two sites on the axle, in a manner that can be controlled (**Figure 1b**) by the application of an energy source, such as the influx of light, chemical reagents, or changes in electrochemical potential, pH, temperature, and so on. Recalling that the forces acting on molecular machines are dominated by Brownian motion, the translation of the ring between different sites in a rotaxane is driven by a process of random walk as the system attempts to lower its free energy during re-equilibration in response to a stimulus. Part of my doctoral thesis research involved the design, synthesis, and actuation of molecular "muscles" that expand and contract under the jurisdiction of the mechanical bond while being driven by electrochemical or thermal energy supplies. As a Miller Fellow hosted by Matt Francis in the College of Chemistry, my current research projects explore potential functions for rotaxane-based molecular machinery in biochemistry.

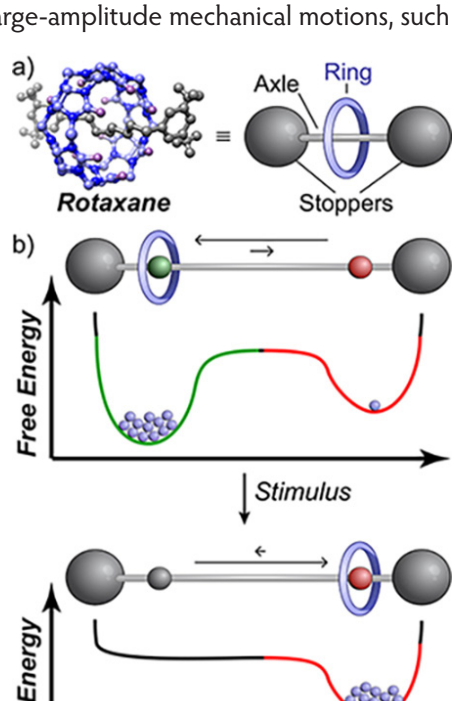


Figure 1: Features of the mechanical bond. **(a)** The mechanical bond of a rotaxane molecule arises from the "stoppers" that prevent a molecular ring from escaping the molecular axle it encircles. **(b)** A molecular switch in which a ring's position with respect to an axle is controlled by stimuli that modulate local interactions between a rotaxane's component parts, as described by the stimulus-induced changes to its free energy profile.

One possible role for rotaxanes in biochemistry is to use their controllable motions to regulate (**Figure 2a**) protein function. For example, if the ring component moves close to the active site of an enzyme to which its axle is attached, it might prevent substrate access and shut down catalytic turnover. Although this concept is seemingly simple and plausible, there are no reported examples of proteins modified with rotaxanes. Therefore, my first step towards the goal of rotaxane-mediated enzymatic regulation has been to develop the chemical transformations that allow us to install bistable rotaxanes on the surfaces of proteins. Having recently succeeded in this endeavor using well-established bioconjugation reactions, I hope to leverage the mechanical motion of these protein-mounted machines in the "mechano-allosteric" regulation of protein function. In the long term, molecular tools with the capacity to regulate enzymatic catalysis could be employed in industrial chemical processes, or to correct metabolic diseases related to malfunctioning enzymes, for example.

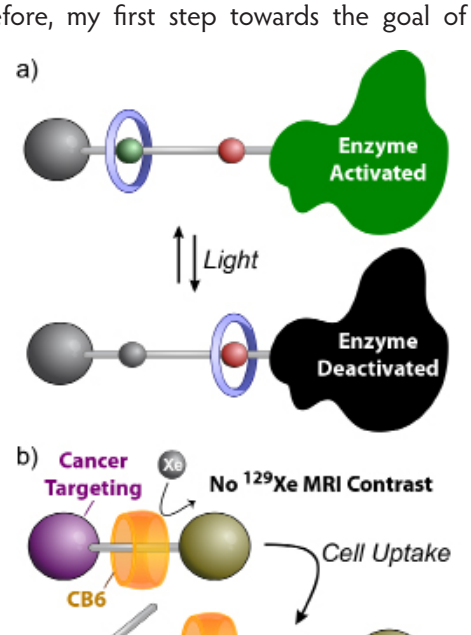


Figure 2: Potential applications of rotaxane molecular machines in biochemistry. **(a)** The light-controlled mechanical motion of a rotaxane's ring can regulate the activity of an enzyme by blocking the access of substrates to an active site. **(b)** A "theranostic" rotaxane molecular vehicle that simultaneously releases an MRI contrast agent and a cytotoxic drug when its mechanical bond is broken. These therapeutic and diagnostic agents may be released predominantly inside of cancer cells by virtue of a tumor-targeting stopper.

A second research project (**Figure 2b**) utilizes the mechanical bond in the design of novel "theranostic" (therapeutic + diagnostic) rotaxanes that combine targeted drug delivery and MRI contrast agents. A molecular ring, nicknamed CB6, serves as a contrast agent for an emerging magnetic resonance imaging (MRI) technology, ^{129}Xe MRI. Whereas conventional MRI technologies used in hospitals today detect the hydrogen atoms in water, ^{129}Xe MRI detects a non-toxic gas that distributes throughout the body's tissues. I synthesized a CB6 rotaxane, which cannot produce ^{129}Xe MRI contrast because a mechanical bond prevents CB6 from interacting with xenon gas. We can break the mechanical bond, however, and liberate the CB6 ring from the axle in order to "turn on" MRI contrast in response to a spe-

2016 Miller Senior Fellow Award

David Chandler

The Miller Institute is pleased to name David Chandler the 2016 Miller Senior Fellow. Chandler is Professor Emeritus and Professor of the Graduate School in the Department of Chemistry at UC Berkeley. His specialty is statistical mechanics, and he is the author of that discipline's best selling textbook, Introduction to Modern Statistical Mechanics (Oxford U Press, 1987). Over a 40-year period, he has used statistical mechanics to make fundamental contributions to the theory of disordered materials, especially liquids. His current research is devoted to understanding complex systems driven far from equilibrium, including glass transitions.

David Chandler, pictured here in 2011, received his S.B. degree in Chemistry from MIT in 1966, and his Ph.D. in Chemical Physics at Harvard in 1969. He began his academic career as an Assistant Professor in 1970 at the Urbana-Champaign campus of the University of Illinois, rising through the ranks to become a full Professor in 1977. Chandler spent two years as Professor of Chemistry at the University of Pennsylvania prior to joining the faculty at Berkeley where he became the Bruce Mahan Professor, a position he held until retiring from regular teaching duties in 2015.

Chandler's arrival at Berkeley in the 1980s marked the University's introduction to the modern subject of statistical mechanics. His courses over the last 30 years have trained hundreds of students in the subject, and dozens of his graduate and postdoctoral research protégées now populate many of the outstanding scientific institutions throughout the US and abroad. Two are currently members of the Berkeley faculty and senior research community, and two more will be joining the Berkeley faculty this coming summer. Chandler is a Member of the National Academy of Sciences and a Foreign Member of the Royal Society. His numerous awards include the Hildebrand Award for Research on Liquids, American Chemical Society (1989); a Miller Research Professor (1991 and 1999-2000); Theoretical Chemistry Award, American Chemical Society (1996); Irving Langmuir Prize in Chemical Physics, American Physical Society (2005); Liquid Matter Prize, European Physical Society (2011); and the Peter Debye Award in Physical Chemistry, American Chemical Society (2012).

Miller Senior Fellow Chandler joins Raymond Jeanloz, Professor of Earth & Planetary Science and Barbara Meyer, Professor of Molecular and Cell Biology, as part of our community of world-renown scientists. Taking its place alongside the Institute's other programs: the Miller Fellowships, the Miller Research Professorships and the Miller Visiting Professorships, the Miller Senior Fellow Program was established in 2008. Its purpose is to support excellence in basic science at UC Berkeley by providing distinguished faculty on campus with discretionary research funds in support of their research and by involving them in the activities and intellectual fellowship of the Miller Institute. The Miller Senior Fellow Program enhances the Institute's mission by fostering interactions between these distinguished senior scientists in different disciplines and our postdoctoral Fellows.

Miller Fellow Focus

> CONTINUED FROM PAGE 6

cific chemical or biological signal. We can now envision rotaxanes possessing one stopper that targets receptors overexpressed in cancer cells, and a second stopper comprising a cytotoxic drug, which is connected to the axle by a bond that breaks at low pH. We envision that this molecular "vehicle" will (i) be taken up primarily by tumor cells on account of its cancer-targeting stopper, at which time (ii) the cytotoxic drug will be released as a result of bond cleavage in the acidic environment of the tumor cell, resulting in (iii) the death of the cancer cell and (iv) the appearance of an MRI signal, which "reports" the site of drug delivery and cell death. In principle, such a rotaxane drug delivery vehicle would allow physicians to target, kill, and visualize cancer cells with a single compound.

The mechanical bond is a relatively new bond in chemistry, but I hope that my research will help to show that its ability to constrain the mechanical motions of molecular machines – even as a means of regulating the interactions of drugs and biomolecules – will render it an important tool in nanotechnology.

Carson Bruns grew up in the foothills of the Rocky Mountains in Loveland, Colorado. He received BA degrees in religion and chemistry from Luther College in 2008, and a PhD in organic chemistry from Northwestern University in 2013, under the joint supervision of J. Fraser Stoddart and Sam Stupp. His research interests span organic, inorganic, polymer, and biochemistry, as well as materials science and engineering. When away from the lab, Carson enjoys thinking about philosophy and art (especially music, digital art, and body art), as well as writing, running, camping, and hiking.

Contact: cbruns@berkeley.edu

University of California, Berkeley
Miller Institute for Basic Research in Science
2536 Channing Way, #5190
Berkeley, CA 94720-5190
510.642.4088
miller.berkeley.edu

Miller Institute News - Spring 2016
Please send address corrections to:
miller_adm@berkeley.edu

Peter Hintz, Cassandra Hunt and Jacqueline Cherfils don their Miller gear at Tahoe!

Next Steps

The Miller Institute congratulates the Miller Fellows on their next endeavors:

Greg Finnigan (Assistant Professor @ Kansas State University)

Birth Announcements

Heather Knutson (Miller Fellow 2009-2012) & and her husband Paul Nerenberg welcomed daughter Eliana Florence Nerenberg, born 11/2/15.

Meredith Hughes (Miller Fellow 2010-2013) & and her husband Geir Helleloid announced the birth of their son, Soren Trygve Hughes born 2/23/16.

Gifts to the Miller Institute

The Miller Institute gratefully acknowledges the following contributors to the Miller Institute programs in 2015. These generous donations help support both the Miller Research Fellowship program and the general programs of the Institute.

Miller Partner ($500 - $999)

Andrew Ogg

Miller Advocates (up to $249)

Philip Chang

Make a Gift

Donations can be made by going to:

Give to CAL for the Miller Institute

miller.berkeley.edu/gift

The Miller Institute is "dedicated to the encouragement of creative thought and the conduct of research and investigation in the field of pure science and investigation in the field of applied science in so far as such research and investigation are deemed by the Advisory Board to offer a promising approach to fundamental problems."

For More Information:

+ Staff: Kathryn Day, Donata Hubert, Erin Lyman & Emily Birman
*+ 510.642.4088 | **miller.berkeley.edu***