MILLER INSTITUTE NEWSLETTER

Fall 2011

Miller Fellow Focus: Nick Piro

CAPTURING AND TRANSFORMING SMALL MOLECULES

Chemists study molecules. From the physical chemist studying diatomic hydrogen to the biochemist examining a protein with 10's to 100's of thousands of atoms, the main goal of these chemists is the same: to understand how atoms interact and how to harness these interactions to better our understanding and utilization of the world.

Interestingly, some of the simplest molecules are the most elusive. Capturing such molecules and studying their reactivities has been of particular interest to Nicholas Piro, who is starting his third year as a Miller Fellow. In general, Nick builds molecules with a metal atom at the center that are designed to react with particular small molecule targets and aid in their transformation into larger, more useful, or more benign products.

The diatomic phosphorous molecule, P_2, is one such molecule that Nick has studied. P_2 is an unstable form of elemental phosphorus that has been detected in interstellar space, and also been implicated in the generation of early phosphorus-containing minerals, which provided the phosphorus sources for early life. In the laboratory, however, P_2 has only been observed either at very low temperature where it can be frozen in inert media, or at very high temperatures where it is in equilibrium with the principal form of the element, P_4. This is in stark contrast to phosphorus's lighter cousin, nitrogen, which exists as triply-bonded dinitrogen (N_2) and composes 78% of our atmosphere. While P_2 also possesses a triple bond, the two π bonds, which are responsible for making N_2 such a stable molecule, are significantly weaker in P_2. It is these π bonds that react to form all single bonds when P_2 dimerizes to form the P_4 tetrahedron. The fleeting nature of P_2 has thus left its reaction chemistry largely unexplored.

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CALL FOR NOMINATIONS

Miller Fellowship nominations
due Thursday, September 8, 2011

Miller Professorship applications
due Thursday, September 15, 2011

Visiting Miller Professorship Departmental nominations
due Monday, September 19, 2011

Please see page 5 for details on all our programs,
visit: http://millerinstitute.berkeley.edu

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Miller Fellow Focus (Continued)

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During his graduate work in Prof. Christopher Cummins's lab at MIT, Nick utilized niobium complexes and their reactions with P_4 under inert atmospheres to make molecules that could liberate diphosphorus. The P_2 was then trapped with organic and organometallic molecules to make P_2 -containing products. By varying reaction conditions and examining the chemistry by computational methods, evidence was provided that P_2 had been formed during the reaction. Further work on these systems illustrated that this system could be used to incorporate phosphorus into a variety of new compounds. Nick's research was focused therefore not only on capturing the elusive P_2 molecule, but also on finding mild routes to incorporate phosphorus into various organic compounds. These methods could be used in syntheses that would bypass the current industrial processes, which require harsh treatments of the toxic and pyrophoric elemental phosphorus, P_4. By often using the product of one phosphorus-capturing reaction as the starting material in the next, elaborate clusters of phosphorus containing small-molecules were built, including novel analogues of benzene.

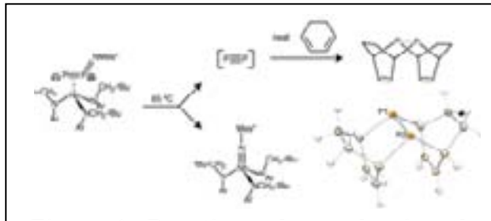


Figure 1. Reaction scheme showing the generation of P_2 and its trapping with an organic molecule, leaving the P_2 unit intact.

Another small molecule of interest to Nick is nitrous oxide, N_2O. While perhaps best known for its use as laughing gas, N_2O has been implicated as one of the main offenders in ozone depletion and is a major contributor to global warming. The N–O bond in N_2O is exceedingly weak, and removing the O-atom from N_2O would provide inert and harmless N_2 as a by-product, but reactions to remove the O-atom are in general very slow. While it is known that N_2O reacts with certain metal complexes, no structural snapshots of it bound to a metal have been captured.

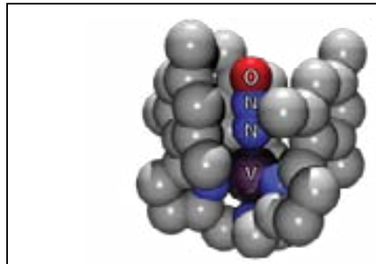
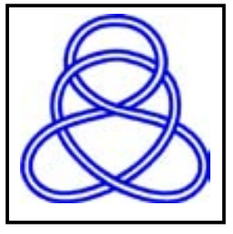


Figure 2. Structure of N_2O bound to a vanadium complex. Grey: carbon; blue: nitrogen; red: oxygen; purple: vanadium.

As a Miller Fellow in the laboratory of Miller Professor Christopher Chang, Nick was able to crystallize the first metal complex with N_2O. This work utilized a vanadium center surrounded by an organic ligand framework that tuned the metal site to allow binding of a N_2O molecule. The geometry of the complex resulted in pocket that allowed the cylindrical N_2O molecule to enter, while providing the correct electronic environment at the vanadium to allow binding without further reactions occurring. While this vanadium complex successfully bound N_2O, the ability to further transform the N_2O molecule was not afforded. As such, Nick has moved onto different combinations of metals and ligands in search of complexes that can not only bind but also react with N_2O in a controllable manner.

Another gas involved in global warming that piques Nick's interest is CO_2. Potential future endeavors for Nick include studying complexes that can convert CO_2 into fuels of other useful products. When not playing with molecules in lab, Nick enjoys cooking, hiking, and spending time with his wife Christine, dog Niobe, and two cats, Gibbs and Cobalamin.



Somorjai Visiting Miller Professorship Award

The Miller Institute for Basic Research in Science is pleased to announce the Gabor A. and Judith K. Somorjai Visiting Miller Professorship Award, established through a major gift to the Institute. The Somorjais' wishes are to support early career scientists for a one-month visiting term in the Miller Institute. Eligible recipients will be selected through the established Visiting Miller Professorship program competition and priority consideration will be granted to visiting scientists within the broad field of chemical sciences.

Gabor Somorjai is a Professor of Chemistry at the University of California, Berkeley and a Faculty Senior Scientist at the Lawrence Berkeley National Laboratory. He was born in Budapest in 1935 where he survived the tragedy of the Second World War. While attending University in the 1950s he met the young Judith Kaldor, his future wife, with whom he fled abroad after the Soviet suppression of the Hungarian Revolution. He received a PhD in Physical Chemistry at UC Berkeley in 1960 and then moved to New York to work at IBM in Yorktown Heights before returning to Berkeley to begin his academic career in 1964. He received tenure three years later and was appointed Full Professor in 1972. In 2001 he was named University Professor, the highest honor for faculty within the UC System. Professor Somorjai has trained more than 130 PhD students and 200 post-doctoral fellows. He has hosted Visiting Miller Professors Mostafa El-Sayed, Rutger Van Santen, Martin Quack, Ivar Olovsson, David King, John Pendry, Hans Siegmann, John Simons, and Harald Ibach and Miller Fellow Bruce Koel.

Professor Somorjai's research has focused on exploring and understanding catalytic selectivity of transition metal surfaces on the molecular level. His novel approach is to use model systems, presently monodispersed nanoparticles in the 1-10 nm range, to explore hydrocarbon conversion reactions. An important discovery from these studies is that the size and shape of metal nanoparticles control both reaction rates and selectivities. He developed surface-sensitive instruments that have permitted molecular level studies of the catalysts under reaction conditions at high pressures. Before the advent of these applications most catalysts were characterized only before and after the reactions. Somorjai has helped catalytic chemistry in its epoch-making transition from the macroscopic view to molecular-scale analysis.

Many institutions have recognized Somorjai throughout his distinguished career. His first association with the Miller Institute was as a Miller Research Professor in 1978. He became a Member of the National Academy of Sciences in 1979, was elected Fellow of the American Association for the Advancement of Science in 1982 and elected Member of the American Academy of Arts and Sciences in 1983. He has received Honorary Doctorates from many institutions including the Technical University of Budapest (1989), the Université Pierre et Marie Curie in Paris (1990), the Université Libre de Bruxelles (1992), the Università degli Studi di Ferrara, Italy (1998), the Royal Institute of Technology, Stockholm (2000), University of Manchester (2001), ETH Zurich (2003) and Northwestern University (2010). He has received several awards from the American Chemical Society, among them the Peter Debye Award in Physical Chemistry in 1989, the Adamson Award in Surface Chemistry in 1994, and the Priestley Award (the highest honor bestowed an American chemist) in 2008. He received the Van Hippel Award from the Materials Research Society in 1997 and the Langmuir Prize from the American Physical Society in 2007. Together with Gerhard Ertl, he won the prestigious Wolf Prize in Chemistry in 1998. He was awarded the National Medal of Science and the Pauling Medal, both in 2002. In 2009 he was awarded the Miller Senior Fellowship Award, and he recently received the BBVA Foundation Frontiers of Knowledge Award in Basic Sciences and the Eni Award "New Frontiers of Hydrocarbons Prize," which promotes the best research and the best scientists in the field of energy.

Nominations for the Somorjai Visiting Miller Professorship award will be accepted during the Fall 2011 competition cycle. Complete instructions are available on the Miller website: http://millerinstitute.berkeley.edu

In The News

Elizabeth Blackburn, one of the nation's most distinguished microbiologists, was in her office one fall day demonstrating what are known in her family as Ron's exercises. "Any exercise which involves this," she said, as she stood, leaned forward and pawed the air, "must be fun. It's a nice, approachable exercise. You stretch and use muscle groups and they feel sort of aerated. You feel really good at the end."

Elizabeth Blackburn is a member of the Miller Institute Advisory Board

Normally she would not be performing these moves - named after a brother-in-law who does them regularly - at work at UC San Francisco's Mission Bay campus, where she oversees her laboratory. But it seemed fitting as she was answering a question that was personal, but also directly tied to her research - how she stays fit.

Scientists have proved in the past decade that diet, exercise, stress reduction and other "lifestyle interventions" can reduce the risk of and reverse damage from coronary artery disease and stave off diabetes. This mind-body link is now fertile territory for prominent research scientists.

Blackburn is best known for her pioneering study of the nature of telomeres, the protective cap on the end of chromosomes, and co-discovery of the enzyme telomerase, which helps replenish them. But for the past few years, tantalized by evidence that physiology can be harnessed to make people healthier, she has teamed up with psychologists and doctors - including "lifestyle-driven diet" guru Dr. Dean Ornish - to investigate how such interventions might do more than make you feel better. They may also affect genetic expression.

At Telome Health Inc.'s Menlo Park office, the atmosphere is jovial. CEO Hunt sees two markets for telomere testing. First, for physicians with seriously ill patients, to determine whether a medical intervention would be worthwhile - in other words, to see if a patient is near death. The second market is for the curious private consumer, and the company plans to eventually sell the kit directly to individuals.

The ideal routine, Blackburn says, is to test every three months to see how rapidly telomeres are shortening and whether the rate is increasing or decreasing. Some experts are worried, however, that Telome Health Inc. is marketing telomere tests to the public too soon. "As a matter of overall public benefit, I'm not sure I see that they add societal value," says UC Berkeley bioethicist David Winickoff.

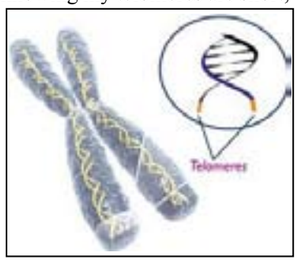
Bruce Ames and **Kathleen Collins** (Miller Professor Spring 2011, MCB), aging experts in the department of biochemistry and molecular biology at UC Berkeley, are cautiously optimistic. "My own suspicion is that telomeres shorten faster with bad nutrition. Americans are eating this god-awful diet," Ames says. "But giving out TeloAge? Seems a little premature. ... Whether or not telomeres actually lengthen has still not definitively been shown."

Enter the humble telomere. Once cast aside in textbooks and by genome coders as "junk DNA," these delicate noncoding strings that dangle off the DNA can show how we've lived - how hard we've been drinking, how much we've been eating, smoking and stressing out.

Telomeres shorten each time our cells duplicate, shedding tiny nucleotides off their tips until they become stubby and frayed, and we die. Several studies have shown or suggested that if we lose weight, take Omega-3s or meditate, the telomere shortening process can slow down. Some small observational studies suggest telomeres can even lengthen.

"But if people had waited to circulate aspirin," Collins counters, "a lot of people would be dead." Harley believes that any new information about health is always useful, though he is concerned that life insurance companies might take advantage of the telomere test results to increase premiums. That, he says, "would be a deep perversion of our technology."

In Telome headquarters, Harley offers astragalus root extract, meant to stimulate telomere growth, to any takers. He hasn't managed to lengthen his telomeres yet, but with running and weight loss, he says he has slowed their shrinking. "It's not easy knowing my telomeres are short," Harley leans back in his chair and sighs, "but it's good to know."



Longevity marker Telomeres are the necessary "cap" or end-sequences of DNA to finish cell division. Without them the specific information for each chromosome may get lost. As we age, our telomeres shorten by losing amino acids until the cell can no longer successfully divide.

This article appeared in the San Francisco Chronicle - pg E-1

Co-Author: Nellie Bowles
Email: nbowles[at]sfchronicle.com

Miller Research Competitions

All 2011 program competitions nominations and applications must be made online!
Information about the Miller Institute programs is available at http://millerinstitute.berkeley.edu
Direct questions to Kathryn Day at the Miller Institute office at 642-4088 or at millerinstitute@berkeley.edu

Miller Research Fellowship 2012-2015
Online Nomination Deadline:
Thursday, September 8, 2011.

The Miller Institute for Basic Research in Science invites department chairs, faculty advisors, professors and Ph.D. research scientists at institutions around the world to submit nominations for the Miller Research Fellowship 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. Fellowships are intended for exceptional young scientists newly awarded the doctoral degree and are selected on the basis of their academic achievement and the promise of their scientific research. Miller Fellowship terms must be completed within 5 years of receipt of the doctoral degree.

The Miller Institute is the home administrative 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 and host faculty. The Fellowship term must commence between July 1 and October 1, 2012. Early nominations are encouraged to allow the candidates more time to prepare and submit their online applications and request references by deadline. Nominations cannot be made by students or postdocs. Direct applications and self-nominations are not accepted.

The nomination must be completed online. Nominators will need the following information to complete the process:

- Nominee's complete full and legal name
- Nominee's complete and current **active** E-mail address
- Nominee's current Institution, mailing address including postal code and telephone number(s)
- Nominee's Ph.D. Institution and (expected) date of Ph.D. (month & year required-must be received by 9/30/12 to be eligible.
- The nominator's letter of recommendation and judgment of nominee's potential (This letter is included in the nominee's file as a letter of reference)
- Nominator's current active email address, title, and professional mailing address (include zip code/campus mail code)

Successful nominations will be confirmed by email within 24 business hours. Eligible nominees will be invited to submit an online application which will be due October 7, 2011. An announcement of awards will be made in the spring.

Nomination & Application details for all Miller Institute programs can be found at http://millerinstitute.berkeley.edu

Miller Research Professorship 2012-2013
Online Application Deadline:
Thursday, September 15, 2011.

The purpose of the Miller Professorship is to release members of the faculty from teaching and administrative duties and allow them to pursue research 100% time. Miller Professorships are open only to faculty of the University of California, but are not restricted to Berkeley faculty. The Miller behest requires, however, that research be conducted on the Berkeley campus. Extended absences from the campus should not be planned for the term of appointment. Other UC campus faculty must seek sponsorship of a Berkeley campus academic department before making an application and must solicit an endorsement letter from the Berkeley campus Department Chair as well as their home campus Department Chair. The term of appointment is for either the full academic year, beginning July 1, 2012, or one semester of Academic Year 2012-2013. Professorial salary and benefits for a regular 9/12 academic year or semester will be paid by the Miller Institute. Note: Miller Professors do not accrue time towards sabbatical leave. Applications are judged competitively and awards will be announced in December.

Visiting Miller Research Professorship 2012-2013
Online Nomination Deadline:
Monday, September 19, 2011.

The Miller Institute for Basic Research in Science invites Berkeley faculty to submit online nominations for Visiting Miller Research Professorships and the new Gabor A. and Judith K. Somorjai Visiting Miller Professorship Award. The purpose of the Visiting Miller Professorship is to bring promising or eminent scientists to the Berkeley campus on a short-term basis for collaborative research interactions. The purpose of the Somorjai Award is to support the collaborative research of an early-career visiting scientist within the broad field of chemical sciences for a one-month term. It is required that awardees be in residence at Berkeley during their entire Miller Institute appointment term and that the visit must run in consecutive weeks. It is the academic department host faculty member's responsibility to ensure their presence on campus. Travel during the appointment is not allowed and will result in adjusted stipend and living expense payments.

Terms of VMP appointments range from a minimum of thirty days to a maximum of one semester (120 days). Somorjai Award appointments are limited to 30 days. Appointments must take place during the regular academic year 2012-2013 (Fall 2012 or Spring 2013). It is not appropriate to request a starting date between semesters or during the summer, and the visit must run in consecutive weeks. Non-US citizens must be eligible for J-1 Scholar visa status. Visitors cannot be supported on H1B or B visa status. Nominations are judged competitively and awards will be announced in December.

Awards and Honors

June 10, 2011: **Gabor Somorjai** (Miller Professor 1977 - 1978, Miller Senior Fellow 2009 - 2014) has been awarded the Eni Award as well as the BBVA Foundation Frontiers of Knowledge Award in Basic Sciences.

June 6, 2011: **Heino Falcke** (Visiting Miller Professor Fall 2006) has been awarded the Spinoza Prize from the Netherlands Organisation for Scientific Research (NWO).

May 12, 2011: **Ray Jayawardhana** (Miller Fellow 2000 - 2002) and **Anne Pringle** (Miller Fellow 2001 - 2004) have been awarded Radcliffe Institute Fellowships.

April 19: 2011: The following Miller Members have been elected to the American Academy of Arts and Sciences:
-- **Anna Behrensmeyer** (Miller Fellow 1973 - 1975)
-- **Glenn Fredrickson** (Visiting Miller Professor Fall 1993)
-- **Martin Head-Gordon** (Miller Professor 2001 - 2002)
-- **Michael Jordan** (Miller Professor Fall 2008)

April 7, 2011: **Bjorn Poonen** (Miller Professor Fall 2005) was awarded a Guggenheim Fellowship.

March, 15, 2011: **Jillian Banfield** (Miller Professor 2006-2007) had been awarded a 2011 L'Oréal-UNESCO For Women in Science Award.

February 27, 2011: **David Milstein** (Visiting Miller Professor Spring 2006) has been awarded a Meitner Humboldt Research Award.

February 24, 2011: **Sandra Faber** (Visiting Miller Professor Spring 2005) has been named as one of the 2011 "Women of Influence" in the Silicon Valley/San Jose Business Journal. --UCSC Press Release

February 22, 2011: **Connie Chang-Hasnain** (Miller Professor 2003 - 2004) has been awarded the 2011 David Sarnoff Award from the Institute for Electrical and Electronics Engineers (IEEE).

Publications

The following Miller Institute members have recently published works resulting from research during their Miller Institute terms. For more information about these publications and others, please visit the Miller Institute's website at: http://millerinstitute.berkeley.edu/publications.htm.

Prashant Jain	**Jeffrey R. Long**	**Raman Sanyal**
Miller Fellow 2008 - 2011	Miller Professor Spring 2011	Miller Fellow 2008 - 2011

Birth Announcements

Congratulations to Natalia Tchetchrina and **Dmitry Dolgopyat** (Miller Fellow 1997-1999) on the birth of their daughter Maria born May 5, 2011.

Congratulations to Lauren Sacks and **Tom Hunt** (Miller Fellow 2007 - 2008) on the birth of their daughter Beatrice Darcy Hunt born May 9, 2011.

Obituary

November 4, 2010: **Michael Tinkham** (Miller Professor 1960 - 1961, Visiting Miller Professor Spring 1987), an important contributor to the field of superconductivity passed away. He was 82 years old.

Interdisciplinary Symposium

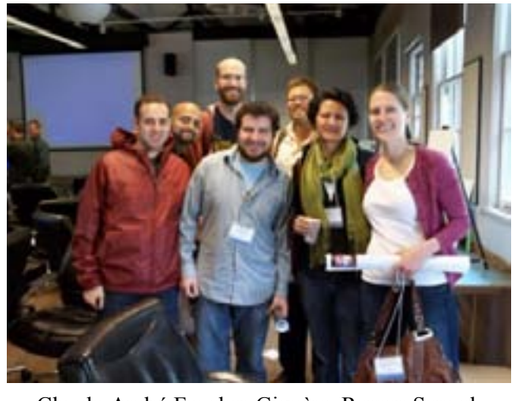
The Miller Institute hosted its 15th annual Interdisciplinary Symposium at the Marconi Conference Center during the weekend of June 3-5, 2011. A complete list of speakers and more photos can found at: http://millerinstitute.berkeley.edu/page.php?nav=53.

Heather Knutson, Franziska Bleichert, Meredith Hughes, August Johansson, Raman Sanyal, & Mark Laidre

Dan Nicolau, Maryam Modjaz, & Pascal Audet

Dan Rabosky & Jason Stajich

Melissa Wilson Sayres, Naomi Halas, & Eva Schmid



Claude-André Faucher-Giguère, Raman Sanyal, Marcus Roper, Phil Hopkins, Alexander Engström, Maryam Modjaz, & Heather Knutson

Claude-André Faucher-Giguère, John Huelsenbeck, Horst Rademacher, Charles Choi, Phil Hopkins, & Charles Day

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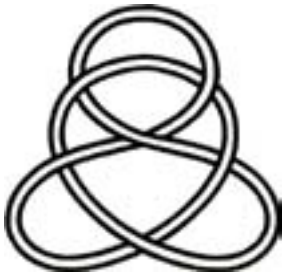

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2536 Channing Way, #5190
Berkeley, CA 94720-5190
Phone (510) 642-4088
Fax (510) 643-7393
http://millerinstitute.berkeley.edu

Please send address corrections to:
miller_adm@berkeley.edu

Next Steps

The Miller Institute congratulates the following Miller Fellows on their next endeavors.

Philip Hopkins
UC Berkeley Postdoc
Department of Astronomy

Eva Schmid
UC Berkeley Postdoc
Department of Bioengineering

Prashant Jain
Assistant Professor
Department of Chemistry
University of Illinois - Urbana Champaign

Marcus Roper
Assistant Professor
Department of Mathematics
University of California, Los Angeles

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."