News for the Friends of Dartmouth Physics & Astronomy

Rocket Launches • Astronomy goes to South Africa
News from Students and Faculty • Doyle Plasma Lab
Greetings and welcome to the 2015 edition of Wilder Notes!

Highlights of the year included the third EE Just symposium organized by Professor Stephon Alexander, held October 31-November 1, 2014, and featuring scholars from both Dartmouth and beyond speaking on a wide range of topics. We also held a workshop on quasars and active galactic nuclei hosted by Professor Ryan Hickox in June and look forward to a conference on Relativistic Quantum Information to be hosted by Professor Miles Blencowe this summer.

The department offered its first off-campus program in over twenty years when Professors Chaboyer and Thorstensen headed to South Africa with TAs Mackenzie Jones and Eric Alper and fifteen undergraduates. The group spent most of the time at the University of Cape Town, except for one week observing at the SALT observatory in Sutherland, 350 km inland and at 1600 m elevation. The group actively explored the region while enjoying an intensive learning experience. The program was considered a great success. It will be repeated in 2017 and is expected to be over-subscribed with interested students once again.

The department welcomed 15 new physics majors out of this year’s sophomore class. We say goodbye to 10 undergraduates who earned bachelors degrees in June, and 10 graduate students who finished Masters or PhD degrees since publication of last year’s Wilder Notes. Our two medical physics students were stellar: Rongxiao Zhang, whose thesis contributed to an astonishing total of 18 papers, on nine of which he was first author, will be joining the Medical Physics Residency program at Harvard Medical School, and Dan Reeves, who contributed to a dozen papers while at Dartmouth, will be taking a postdoctoral position at the University of Washington. Chien-Ting Chen, whose thesis on black holes contributed to nine papers, one of which already has 46 citations, is taking a postdoctoral position at Penn State University.

In space physics/astronomy, we are happy to that Zhao Li is continuing at Dartmouth as a postdoctoral scholar in the space physics theory group, and Julie Skinner is a postdoctoral scholar in astronomy at Boston University.

Two recent graduates are taking their skills to industry and finance: Matt Broughton is applying his skills doing “big data” with a company in his native Minnesota, and Jannis Bielefeld, whose thesis on cosmology was the department’s nomination for the Croasdale Award, will be a “quant” in the world of finance.

The department welcomed two new staff members during 2014-5. Terry Kovacs joined us as a information systems consultant and has rapidly worked his way into making significant contributions to most of the research groups. Sara Riordan joined us part-time to assist with publicity and outreach. She brings a wealth of experience in these areas having worked previously in the Office of Science and Technology Outreach.

Finally, one bit of sad news to report: Professor Emeritus Bill Doyle died in August at the age of 88. Many alumni remember his enthusiastic lectures, and faculty and staff remember his lively presence in the department for over fifty years.

Wilder Notes is now being issued in the summer, when the weather is great with long days here in Hanover. Alumni are always welcome in Wilder Hall, so please plan a visit!
When Natalie Drosdoff ('17) first stepped out into the night sky in Sutherland, South Africa it took a few minutes to adjust to the intense darkness surrounding her. Then she could not believe her eyes as she took in the stunning Large and Small Magellenic Clouds and the Milky Way Galaxy arching directly overhead as it is never seen in the northern hemisphere. “It was just so cool!”

The spectacular viewing conditions at the southern tip of Africa as well as Dartmouth’s membership in the Southern African Large Telescope (SALT) Consortium provided a unique opportunity for a group of undergraduates, faculty, and teaching assistants to travel to South Africa for the department’s first Foreign Studies Program (FSP) during the 2015 winter term. The University of Cape Town Astronomy Department and the South African Astronomical Observatory in Sutherland, home of SALT and one of the darkest observatories on the planet, served as hosts for the group.

There is no better place to teach astronomy according to Brian Chaboyer who has been visiting South Africa for over a decade. The southern sky is a rich resource with objects such as the Magellanic Clouds and the Omega Centauri galaxy visible to the naked eye.

Upon arrival, the undergraduates were immersed in a nine-day summer school program with the National Astronomical and Space Physics Program. While based in Cape Town students had access to the UCT telescope and took courses in preparation for a week observing in Sutherland. Arriving in South Africa with little or no astronomy background, the students were soon using research telescopes, analyzing data and working on independent projects. By the end of the term they had written a report which will be used by John Thorstensen as well as South African collaborators in future publications.

Of course there were opportunities for cultural experiences as well, including visiting high schools in local townships to talk with students about science and to encourage them to continue their education. Non-academic highlights included hiking, going on safari, enjoying local dishes such as antelope, and shark diving!

The Physics and Astronomy Department is already planning for the next FSP in Cape Town which is scheduled for the winter 2017 term.
A Big Year for Rocket Launches

Late fall 2015 and winter 2016 will be a busy season for the Dartmouth rocket groups with three separate campaigns ready to launch starting in November. Each mission seeks to learn more about the aurora and the interaction of solar winds with the Earth’s atmosphere. Preparing for a launch is a painstaking and complicated process requiring at least 2-3 years of preparation so it is unusual to have so many launches occurring within such a short period of time. Collaborators on the missions include the University of New Hampshire, Cornell, the University of Alaska, Embry-Riddle, the University of Iowa, and Goddard Space Center.

CAPER

Jim LaBelle is PI on the CAPER project which will launch from Andenes, Norway during a window between late November and early December with the goal of studying activity in the Earth’s cusps, areas where plasma has direct access to Earth’s upper atmosphere. The magnetosphere at the dayside high-latitude polar cusp has some significant differences from the nightside and has not yet been studied extensively. By taking more advanced measurements on the cusps than ever before, LaBelle’s group hopes to answer questions about the special characteristics of these areas of the magnetosphere.

ISINGLASS

Kristina Lynch, graduate student Rob Clayton and postdoc Max Roberts will be launching the ISINGLASS rocket from Poker Flat, Alaska in February of 2016. This will be a nightside launch during the winter months allowing for study of the aurora. The group will measure scale lengths of plasma, density, and temperature in the aurora. Prior to this launch there have been very few multi-point in situ measurements of the aurora. This mission will provide a much more complete picture of the aurora than ever before.

RENU 2

Kristina Lynch is collaborating with Marc Lessard, of UNH, PI on the scheduled launch of RENU 2 from Andenes, Norway during the November/December time period. Graduate student Meghan Harrington has been working on the project and will attend the launch. The campaign will seek to obtain a 3D view of the velocity distribution in the ionsphere to better understand the flow of the ionsphere and aid in predicting space weather.
BARREL Project Prepares for Balloon Campaign in August

Robyn Millan’s group is busily preparing for another balloon campaign that will be conducted in August from Kiruna, Sweden. The balloons, launched as part of the BARREL (Balloon Array for Radiation belt Relativistic Electron Losses) project, will study the loss of electrons from Earth's Van Allen Radiation belts. The Van Allen Belts are a region of near-Earth space filled with energetic electrons (~200 keV to 10 MeV). The belts wax and wane on timescales as short as a few hours due to a complicated interplay between acceleration and loss processes. The electrons are scattered into Earth's atmosphere where they produce x-rays that can be detected from a high-altitude balloon platform. Comparison of BARREL data with data from NASA's twin Van Allen Probes are allowing the BARREL team to understand the physical processes that scatter electrons out of the belts.

Graduate student Brett Anderson's photograph of a BARREL launch was featured as the September image in the 2015 NASA Science Calendar! Photo credit: Brett Anderson

Dartmouth Hosts the New England Regional Quasar and AGN Meeting

On June 4, 2015, the Department of Physics and Astronomy hosted the New England Regional Quasar and AGN Meeting, which was the 25th annual NERQUAM and the first held at Dartmouth. The meeting was organized by the research group of Ryan Hickox and featured 50 participants from all over the Northeast, including a number of very interesting talks and posters on the growth of black holes and the evolution of galaxies. The invited review talk was by Prof. Eilat Glikman of Middlebury College, who discussed "Obscuration and Reddening in AGN and Quasars: Teasing out Signposts of Co-evolution". More information on the meeting is at: http://www.dartmouth.edu/~hickox/NERQUAM/.
Sharing Research Through Public Outreach

Many members of the Physics and Astronomy Department have participated in public outreach over the last year. Here are a few highlights!

Grad student **Erek Alper** organizes the public observing events in the Shattuck Observatory each Friday night during the term, weather permitting.

**Hans Mueller** was a guest at Hartford Middle School last March where he gave presentations about robotic and human space exploration to 6-8th graders.

**Ryan Hickox** has organized **AstroConnect**, a project connecting middle and high school classrooms in the Upper Valley with guest astronomers from around the country via Skype. First piloted in spring 2014, the program focused on x-ray astronomy and black holes this spring with five astronomers “visiting” the classrooms.

Grad student **Brett Anderson** visited The Pingry School in Basking Ridge, NJ last November to discuss his space physics research, including experiences from his numerous trips to Antarctica to launch scientific research balloons. He was particularly struck by the enthusiasm for science that the 8th graders showed—they were too interested in the science behind space weather to be bothered with photos and videos of penguins!

Grad student **Phillip Fernandes** served as a judge for the annual Lyme Elementary School 6th and 7th grade annual science fair in May.

Grad students **Mackenzie Jones** and **Erek Alper** brought some wonder to a group of Cub Scouts at a 2014 summer camp in Canaan, NH, using solar telescopes to view the Sun and guiding them in building models of the solar system.

**Undergraduates attending the FSP** in South Africa during winter term visited high school students in local townships to talk about astronomy and encourage students to continue their education.

Postdoc **Kevin Hainline**, grad students **Katie Price, McKinley Brumback**, and **Christine Black**, helped run the annual **Montshire Earth and Space Day**, where they had spectra to show the museum guests, as well as multiple arts and craft activities. Kevin volunteers every Sunday morning at the Montshire running activities and talking with guests about the exhibits. He has convinced other Dartmouth postdocs to join him as weekly explainers as well!

**Alex Rimberg** paid a visit to Lebanon High School in January to talk with the “Nerd Herd”, a group of students who are interested in science and technology. Alex shared highlights of his research and answered questions on topics such as wave particle duality and quantum particle behavior.

Three New Hampshire teachers attended a NSF funded teacher professional development workshop on astronomy at the University of Wyoming during the summer of 2014 thanks to Ryan Hickox’ NSF grant. Four more teachers from NH will be attending a two-week workshop in Wyoming this summer.

Postdoc **Alexa Halford** gave a talk, “Paintings in the Sky: The Northern Lights”, for the Astronomy Lecture Series at the Keene Library. She also gave a seminar via Google Hangouts titled "Space Balloons and Killer Electrons" which was geared toward undergraduates and the general public.

Postdoc **Kevin Hainline** and grad student **Erek Alper** participated in a School Science Café at the Woodstock, VT Middle School, sharing their excitement for astronomy and thoughts on career paths in science with 8th grade students.

**Kevin Hainline’s enthusiasm for astronomy is evident as he speaks to a group of 8th grade students.**
USA Science And Engineering Festival, Washington DC, April 2014

The Physics and Astronomy Department was well represented at the three day USA Science and Engineering Festival in Washington DC in late April 2014, sending two groups of faculty, postdocs and graduate students from the department to provide hands-on activities in their exhibits. Robyn Millan, postdoc Alexa Halford, and grad student Brett Anderson wowed visitors young and old with their exhibit, Space Balloons: Exploring the Extremes of Space Weather. Brian Chaboyer and grad students Christine Black, Erik Alper, Erin O’Malley, and Mackenzie Jones demonstrated how astronomers use light to understand the Universe with their colorful and engaging exhibit Light Hunters: Probing the Dark. The Festival drew an estimated 275,000 visitors.

Dartmouth Physics Society

The Dartmouth Physics Society, a very active group for undergraduates interested in physics and astronomy has continued to organize events to provide opportunities to seek advice, support, and friendship among those who share their enthusiasm for the subject. Highlights of the year include...

The Undergraduate Physics and Astronomy Research Session for interested students, highlighting research opportunities for undergraduates within the department.

Post-colloquia Q&A Sessions have been a big hit, offering students and speakers a chance to interact informally. Most often these discussion center around the speakers professional biography including their decision to pursue a career in physics, how to chose a research area, how to deal with “bad days”, and what they might like to do next!

A book signing and Q&A with David Griffiths, author of legendary undergraduate physics texts.

Faculty research presentations including a recent standing room only event with Marcelo Gleiser which was attended by students from across campus.

A Liquid Nitrogen Ice Cream Social for the entire department, a nice way to spend time with students, faculty and staff in the department during the reading period.
One very exciting development this year was the first offering of the Astronomy Foreign Study Program in South Africa, during the Winter 2015 term. Brian Chaboyer led a group of 13 Dartmouth undergraduates to Cape Town, where they studied theoretical and observational astronomy and attended lectures with African astronomy students participating in the South African National Astrophysics and Space Science Programme. John Thorstensen took over from Brian in early February. Shortly afterward he and the students traveled to the South African Astronomical Observatory, near the town of Sutherland in the desolate high Karoo, to experience the spectacular southern sky from an amazingly dark site and to obtain observations for their student projects using the 1-meter and 1.7-meter telescopes. Dartmouth graduate TAs Mackenzie Jones and Erek Alper provided invaluable help throughout the term, and South African students Mokhine Motsoaledi and Hannes Breytenbach helped run the observations. Using high-speed photometers, the students obtained light curves of cataclysmic variable stars. Aside from determining several orbital periods, they found a curious system with a magnetized accreting white dwarf that has a double eclipse. The observing part of the trip was made possible in part by the generosity of Jay Weed ('80) and Claudia Sweeney Weed ('81).

Dartmouth was well represented at the recent Science with SALT meeting. Approximately 100 astronomers from the SALT consortium gathered in Stellenbosch, South Africa to discuss science results from the largest single optical telescope in the southern hemisphere. Grad student Erin O’Malley gave a talk on abundance determinations in very metal-poor stars using high-resolution spectroscopy. Kevin Hainline’s talk highlighted his research on spectroscopic observations of obscured active galactic nuclei, done in collaboration with his post-doctoral mentor Ryan Hickox. Brian Chaboyer reported on SALT high resolution spectroscopic observations of the eclipsing binary UV Piscium, which are being used to test the Dartmouth stellar evolution models. The meeting was opened by the South African minister of Science and Technology, who stressed the importance of astronomy, and particularly SALT in furthering South Africa’s economic development.

Astronomers were active closer to home, too. Ryan Hickox’ grad student Chien-Ting Chen finished his PhD and is heading off for a postdoc with Niel Brandt at Penn State. Ryan continued on the science team for the revolutionary hard-Xray imaging satellite NuStar, for which Fiona Harrison ('85) is the project scientist. And a year from next fall, Ryan and his family will take up residence near a Dartmouth dorm, as part of the new system of Residential Houses, a key part of the Moving Dartmouth Forward initiative; Ryan will be in the very first cadre of House Professors.

Rob Fesen continues imaginative and varied work on supernovae. He and his undergraduate student Jack Neustadt, an FSP participant, discovered a supernova remnant that appears ten times bigger than the full moon in the sky! Despite its enormous angular size, it had escaped notice because it does not lie on the plane of the Milky Way, where nearly all such objects are found.

John Thorstensen has continued a vigorous observing program at MDM in Arizona; in 2015 December, first-year student Ana Colon ('18) accompanied him to MDM, again through the generosity of the Weeds. Gary Wegner traveled to Korea to attend the 8th KIAS Workshop, "Cosmology and Structure Formation," November 3-7, 2014 at the Korea Institute for Advanced Studies in Seoul where he was invited to present a review entitled "Double Galaxy Clusters."
Cosmology News  

Robert Caldwell, Contributing Correspondent

The members of the Cosmology Group had an eventful year. In addition to the usual activities – scientific publications, technical seminars, conference and workshop travel – we report on a few highlights. Stephon Alexander hosted the EE Just Symposium at Dartmouth in October 2014. He gave the keynote address at the STEM Caribbean Conference held in the Cayman Islands in March 2015. Alexander and students Sam Cormack and Dhrubo Jyoti each published their first cosmology papers, examining novel aspects of inflation.

Robert Caldwell served on the panel of judges for the newly-established Buchalter Cosmology Prize; the first winner was announced at the January 2015 meeting of the American Astronomical Society. Matthew Digman ('15) and Nina Maksimova ('15) traveled to MIT in August 2014 to participate in an undergraduate cosmology workshop, organized by David Kaiser ('92). Both students completed senior theses in the Spring 2015 with Caldwell, each having to do with broken gravitational symmetries. Jannis Bielefeld defended his PhD in May, summarizing work on a broad range of topics, also with Caldwell.

Marcelo Gleiser was awarded the “Brazilians in Diaspora” Prize from the Brazilian government for his work in research and education. His book “The Island of Knowledge” has been published in four languages to positive reviews. Gleiser and students Damian Sowinski and Nan Jiang are pursuing a new direction on information entropy in physics. You can also follow Gleiser on the blog, “13.7: Cosmos and Culture” hosted by National Public Radio. As we go to press, we learn that he has received a mega-grant from the John Templeton Foundation to develop a new institute at Dartmouth that brings together the sciences and humanities.

Students enjoy Robert Caldwell’s “Physics 19: Relativistic and Quantum Physics” class outside on a sunny spring day.

Quantum and Condensed Matter

Kevin Wright, Contributing Correspondent

Miles Blencowe’s student Erind Brahimi successfully defended his thesis, “Quantum versus classical dynamics of strongly nonlinear superconducting circuit systems.” Miles also had a very special opportunity to speak at the all girls school in London, England, where his daughter Cecilia is currently attending. The audience was on the whole rather shy, but appeared to appreciate the demonstrations suggested by Dartmouth colleague Tim Smith, in particular the diffraction of laser light by hair!

Kudos to Lorenza Viola for her recent election as Fellow of the American Physical Society in recognition of her many contributions to the field of quantum information science. Her group is growing with the addition of postdocs Leigh Norris and Emilio Cobanera, and undergraduate Connie Jiang ('17) who will be working toward a senior thesis on the subject of non-equilibrium dynamics of quantum spin chains. A recent paper by Viola and graduate student Peter Johnson was selected as a “publisher’s pick” article in the Journal of Physics A.

On the experimental side, Chandrasekhar Ramathan’s lab received a boost from a 3-year NSF grant to study Dynamic Nuclear Polarization (DNP)-enhanced Nuclear Magnetic Resonance (NMR) surface characterization. Will Athol ('15) completed a senior thesis and graduated as a salutatorian. Last year’s Wilder Notes missed out on two senior theses, by Laurel Anderson ('14) and Sarah Pasternak ('14). Laurel received the Francis W. Sears Memorial prize, and won first place in the Christopher G. Reed Science Competition at the 2014 Wetterhahn Symposium. She spent the past year at Churchill College in Cambridge, UK as a James B. Reynolds scholar. Sarah was awarded the Haseltine Physics Prize and is now finishing a master’s degree at Thayer.
Quantum and Condensed Matter continued

Summer travel for Alex Rimberg includes a stop at the Asia Pacific Center for Theoretical Physics to talk about efforts to couple a cavity embedded Cooper pair transistor to a nanoresonator. Rimberg recently received an NSF grant supporting this work, which came with additional funding to allow the group to purchase a liquid helium reclamation system. Graduate student Billy Braasch is working with Joel Stettenheim to produce the first generation of cavity embedded Cooper pair transistors coupled to a nanomechanical resonator. Spencer Diamond (‘15) defended his senior thesis, and is now working as a teaching fellow in physics at Phillips Andover Academy. In the undergraduate arena, WISP intern Kaleigh Mentzer (‘18) worked on characterizing etch rates of a new ion mill, joining Khizar Hussein (‘16) and Nizar Ezroura (‘18) working on microwave circuitry.

The research group of Kevin Wright hit a notable milestone in October 2014 when the renovations of their laboratory in the basement of Wilder were completed. Since then, new graduate student Yanping Cai has been hard at work installing the magneto-optical traps needed to cool lithium atoms to microkelvin temperatures. Last fall, former student Sam Wheeler was hired by the signal and image processing group at BAE systems in Nashua NH. Undergraduate Kelsey Justis (‘16) has completed a project to install hardware and software for computer control of the experiments. Sarah Khatry (‘17) was awarded the Barbara Crute Memorial fellowship for her undergraduate research project on high-finesse optical cavity traps for lithium atoms. Sarah plans to return to this project for a senior thesis after terms abroad in Dublin and Nepal.

Postdoc Max Roberts works on “The Elephant” vacuum chamber in the 112 Lab in preparation for the ISINGLASS mission.

Space-Plasma Physics . . . . . . . . . . . .

Barrett Rogers, Contributing Correspondent

Mary Hudson spent last summer at the High Altitude Observatory of the National Center for Atmospheric Research in Boulder, Colorado. She was accompanied by PhD students Maulik Patel and Lena Goryunova who attended the Center for Integrated Space weather Modeling (CISM) Summer School at HAO at which Hudson lectured. Mary Hudson is currently on sabbatical at NCAR. Zhao Li defended her thesis and is now continuing as a postdoc with Hudson. Her most important news is that she and husband Ben Zhu, who works with Barrett Rogers, welcomed their son Bennett Zhenyuan Zhu last September.

In the Rogers group, Dustin Fisher recently gave an invited talk at the Sherwood International Fusion Conference held at New York. Fellow PhD students Ben Zhu and Manaure Francisquez also gave presentations at the conference. David Montgomery remains active, recently publishing a paper on magnetohydrodynamically generated velocities in confined plasma.

This coming winter brings a lot of excitement to the experimental groups in the department as they prepare for rocket and balloon missions (see articles pg 3-4).

Members of Robyn Millan’s group are analyzing data from the BARREL campaigns. Postdoc Alexa Halford and others worked with University of Minnesota researcher Aaron Breneman to compare BARREL data with Van Allen Probe plasma wave measurements with results accepted to the journal Nature. Grad student Zan Li and postdoc Leslie Woodgers published results from two previous campaigns. Grad students Brett Anderson and Sapna Shekhar have each analyzed data from a variety of different spacecraft to study the same kinds of events detected by BARREL. Kathryn Waycho (‘16) recently completed a Presidential Scholars internship and spent her spring term working at Goddard Space Flight center. She will be back at Dartmouth late this summer to help with the Sweden balloon campaign. Visiting student Drew Chaboyer was an intern last summer and spent his time developing an improved model of the BARREL detector response. The BARREL team is also proud to report that Brett’s photograph of a BARREL launch was featured in the NASA calendar this year!

In addition to the rocket experiment, Jim LaBelle’s group remained as always occupied with remote ground-level observing sites in Alaska, Manitoba, Greenland, and Antarctica. Engineer David McGaw made several trips to maintain instruments there. Grad student Micah Domrowski remotely directed installation of instruments at the South Pole. Matt Broughton successfully defended his PhD thesis in September. In March the group hosted Australian colleague Professor Iver Cairns, from University of Sydney, who is a world expert on plasma waves and
radio emission. Professor Cairns will also be spending August 2015, at Dartmouth.

This year is also marked by the passing of Bill Doyle, a beloved member of the Dartmouth physics department and the plasma community. Lab 112, home to Kristina Lynch’s plasma experiment, the ELEPHANT, will be dedicated in loving memory of his friendship and mentorship as the William T. Doyle Plasma Physics Lab.

The William T. Doyle Plasma Physics Lab Dedicated

Professor Bill Doyle’s memory was honored this June with the dedication of the William T. Doyle Plasma Physics Lab in room 112 Wilder. Kristina Lynch announced the dedication during the Alumni Reception on June 19. Kristina notes that Bill was in the building every day from 1955 until long after his retirement. He took on the task of helping Kristin Frederick-Frost build the Plasma Physics lab from 2002-2006 and was instrumental in making the lab work. “Bill was the experimental wizard of the building, the one to go to if you needed to know how anything worked.”

The dedication was attended by Bill’s wife, Barbara, his son, Peter Doyle, Professor of Mathematics, Peter’s wife Martha Cochran (’77), and their daughter Helen, a graduate student in the Earth Sciences Department. Others who shared fond memories of Bill included John Thorstensen, Ralph Gibson, Richard Kramer and Jim Slinkman. Kristina also read a heart-felt remembrance from Kristin Frederick-Frost. A plaque dedicating the lab to Bill’s memory will be placed over the door, a very fitting memorial to his dedication to the department.

Barbara Doyle, Peter Doyle, and Kristina Lynch listen as members of the department share stories about Bill.
**Theses and Recent PhDs**

**Senior Theses:**

**Will Athol:** "Design and Validation of a Zero-Field and Low-Field EDMR System"
Advisor: Chandrasekhar Ramanathan

**Matthew Digman:** "Gravitational Anomaly in Anisotropic Spacetimes"
Advisor: Robert Caldwell

**Nina Maksimova:** "Testing Alternatives to the Standard Cosmological Model Using the Cosmic Microwave Background"
Advisor: Robert Caldwell

**Recent PhDs:**

**2015**

**Chien-Ting Chen:** "The Growth of Supermassive Black Holes and Connections to Star Formation in Galaxies"
Advisor: Ryan Hickox, (postdoc at Pennsylvania State University)

**Jannis Bielefeld:** "The Impact of Weakly Coupled Fields on the Accelerated Expansion and its Observables"
Advisor: Robert Caldwell

**Rongxiaio Zhang:** "Cherenkov Imaging and Biochemical Sensing in Vivo During Radiation Therapy"
Advisor: Brian Pogue, (postdoc at Harvard)

**Daniel Reeves:** "Nonequilibrium Dynamics of Magnetic Nanoparticles in Biomedical Applications"
Advisor: John Weaver, (postdoc at Fred Hutchinson Cancer Center, Seattle, WA)

**2014**

**Zhao Li:** "Modeling Geomagnetic Storms on Prompt and Diffusive Time Scales"
Advisor: Mary Hudson, (postdoc at Dartmouth College)

**Julie Skinner:** "Cataclysmic Variables and White Dwarf-M Dwarf Binaries From the Superblink Proper Motion Survey"
Advisor: John Thorstensen, (postdoc at Boston University)

**Matthew Broughton:** "Ground and Space Observations of Medium Frequency Auroral Radio Emissions"
Advisor: James LaBelle, (senior researcher, Minneapolis-St Paul, Minnesota)

**Latchezar Benatov:** "The Quantum-to-Classical Transition in Strongly Interacting Nanoscale Systems"
Advisor: Miles Blencowe

**Jarod Parrent:** "Spectroscopic Analyses of Type Ia Supernovae"
Advisor: Robert Fesen, (postdoc at Harvard-Smithsonian, Center for Astrophysics)

**Thiago Brito:** "Precipitation and Energization of Relativistic Radiation Belt Electrons Induced by ULF Oscillations in the Magnetosphere"
Advisor: Mary Hudson, (postdoc at Laboratory for Atmospheric and Space Physics, University of Colorado)
The Annual Physics and Astronomy Senior and Graduate Reception was held on Saturday, June 13, 2015. The following students received annual awards at the event:

**William Athol** ('15), received *The Haseltine Chemistry-Physics Prize*: Offered to that student who, in the opinion of a committee consisting of the President, the Dean of the College, and the ranking professors in each of the subjects mentioned, shall show the most promise in Chemistry or Physics.

**Matthew Digman** ('15) was awarded *The Physics and Astronomy Chair’s Prize*: First awarded to Lynn Proctor in 1999, the Chair’s Prize is given at the discretion of the Chair of Physics and Astronomy to an outstanding senior who shows great promise for graduate school and/or the teaching of physics or astronomy, particularly offering encouragement to women and minorities in physics.

**Nina Maksimova** ('15) was awarded *The Physics and Astronomy Faculty Prize in Memory of Francis W. Sears*: Awarded to a graduating senior for significant contributions to the department, for unusual achievement as an undergraduate and for the promise of continued commitment to the study of physics. Nina also received the *Gazzaniga Family Science Award at Dartmouth College*: The award recognizes that graduating senior who has best demonstrated accomplishment in scientific research, as presented in a senior thesis, scientific paper, or other tangible representation.

**Erek Alper** received *The Physics and Astronomy Chair’s Teaching Award*: The Chair’s Teaching Award is given at the discretion of the Chair of Physics and Astronomy to a graduate student and on occasion an undergraduate student to recognize excellent laboratory instruction.

**Mackenzie Jones** was awarded *The Selamawit Tsehaye Teaching Award*: This award, established in memory of Selamawit Tsehaye, a graduate student in physics who lost her life in 1991, is given annually by the Physics and Astronomy faculty to the teaching assistant best exemplifying her dedication to the teaching of Physics.

**Chien-Ting Chen** AND **Rongxiao Zhang** received *The Physics and Astronomy Graduate Research Award*: This prize is awarded by the Physics and Astronomy faculty to a finishing or advanced Ph.D. student for outstanding research accomplishments as a graduate student and the commitment to continued work in physics, astronomy, or related sciences.

**Connie Jiang** ('17) has just received the *Stamps Leadership Scholar Award* for the 2015-2016 academic year to work with Lorenza Viola on exploring the correlation spread in quantum spin chains. The award was established to allow the most promising students an opportunity to design an experiential learning program to build on or respond to what they’ve learned through multiple experiences in their first and second years at Dartmouth.

**Mallory Guy**, working with Chandrasekhar Ramanathan, won the award for best poster presentation at the *Annual Graduate Student Poster Session* in April for her poster, *Using Frequency Modulation to Improve Dynamic Nuclear Polarization at 3.34 T.*
Eiichi Fukushima (MS ’59) reports “got my terminal masters degree in 1959, working with Bob Christy, and then went to U of Washington and got a Ph.D. in physics. I worked at Los Alamos for 18 years and at Lovelace Medical Foundation, an independent non-profit lab, for 12 years before co-founding a public non-profit lab New Mexico Resonance. After 8 years, we split off ABQMR, a for-profit research lab, where I have been for 9 years. I am also an adjunct professor at U of New Mexico.” He is currently Scientist and President of ABQMR.

George Valley (’66) writes that he uses his physics background daily as Senior Scientist at the Aerospace Corporation in El Segundo, CA where he does research in signal processing. After Dartmouth he went on to complete a PhD in physics with Eugene Parker at U Chicago.

Steve Harvey, (PhD ’71) relays the following story. “My biggest challenges – which I came to really appreciate afterward – came from Bill Doyle, who challenged me every day…. A typical Doyle challenge came at my first thesis committee meeting, where I presented data. Upon examining one graph, he asked, ‘So, what does it mean?’ I stumbled and fumbled and mumbled. He repeated, ‘What does it MEAN??’ When I again failed to give a meaningful interpretation, he said, ‘Steve, you could put a rat turd in the sample chamber, and you’d get an identical curve. It wouldn’t mean anything!’ He was right – although I later did figure out what my data meant, and to his satisfaction. I got my PhD in 1971, working under Bill Doyle, who was serving his term as department chair at that time. Inspired by Eric Jakobsson, a student a couple of years ahead of me, I chose to work on a biophysical problem, even though there were no biophysicists in the department. My thesis committee included Doyle; Pieter Hoekstra, a scientist at CRREL, in whose lab I did most of my experiments; David Dennison, a biophysicist who was (I believe) chair of the Biology Department; Forrest Boley (then editor of the American Journal of Physics); and John Walsh. I sold John my MGB when I left Dartmouth. It later caught fire, because of a jury-rigged wiring job I’d done. I was also influenced by John Kidder, Bob Christy, Ag Pytte and John Merrill in class, in numerous scientific conversations, and at the variety of social functions we enjoyed.” After 30 plus years at the University of Alabama – Birmingham, Steve was recruited to Georgia Tech in 2003, and is now Professor Emeritus, School of Biology, Georgia Tech, but remains fully active in computational structural biology research.

Paul Dolan, (PhD ’84) writes “my students do both superconductivity & thin films in some of the upper level labs, both of which I learned from Bruce Pipes. I also took ‘senior lab’ from him, and modeled my ‘advanced lab’ after that course.” Paul was recently made Fellow of the American Physical Society, via the Forum on Education. He is tenured Professor of Physics at Northeastern Illinois University.

Andrew Sornborger (’85) visited in June 2015 and gave the computational physics seminar on structure and propagation of information in neural circuits. Andrew is currently in the Department of Mathematics at UC-Davis.

Abby (Goodhue) Vieregg (’04) is currently Assistant Professor of Physics at the University of Chicago. She visited Dartmouth in 2014 to give the department colloquium. Robert Caldwell ran into Abby in May 2015 at a CMB workshop in Chicago. Abby was on the ice in Antarctica from November 2014-January 2015 as Co-I on the ANITA experiment searching for ultra-high energy neutrinos. She was then at the South Pole working on the Keck Array and BICEP3 CMB telescopes. Abby is now in Greenland installing a prototype receiver to detect high-energy neutrinos at Summit Station.

Abby (Goodhue) Vieregg (’04) and colleagues at their camp in Greenland where they searched for high energy neutrinos.

Jason Spellmire (’10) worked on the family farm in Ohio for a year before joining the US Army. On his astronomy degree: “The analytical ability fostered by my coursework is constantly useful. But the greatest benefit has been the ability to look up at the night sky while in the middle of some third-world country and find some comfort in its familiarity and some diversion in thinking about the physics of what I’m seeing. Once, I walked outside a tent, was momentarily confused to find it darker than it should have been, and looked up to see a partial solar eclipse that I had no previous knowledge of, which I excitedly explained to my fellow soldiers.”

Alumni Notes: Reporting from the field…
In Memorium

Carl Breuning (1937-2015)

Carl Bruening, former Electronics Engineer for the Physics and Astronomy Department passed away on March 27, 2015 in Westmoreland, NH at the age of 77. Carl was born and raised in Newport, NH and served in the U.S. Navy on the USS Boston during the Cuban Missile Crisis. Carl and his wife of 48 years, Cheryl A. (Morrison), raised their family and made a home in Newport.

Carl worked at Joy Manufacturing, at Sanders Associates in Nashua as an Engineering Tech for 19 years, then as the 2-Way TV chief engineer at Dartmouth, serving as the electronics engineer for the Physics & Astronomy Lab for 20 years before retiring. Carl was a member of the American Legion, and a Jaycee and "Exhausted Rooster". He was an amateur astronomer and member of Stellafane, the Springfield Telescope Makers, and was past vice-president.

Carl is survived by his wife, Cheryl, of Newport, a daughter and a son, their spouses, and 3 grandchildren.

(Adapted from the Newton-Bartlett Funeral Home website)

Bill Doyle (1925-2014)

Bill Doyle, Professor Emeritus, passed away August 3, 2014 in Hanover NH at the age of 88. Bill dedicated his career to teaching and mentoring countless Dartmouth undergraduate and graduate students. Even in his retirement he could regularly be found in Wilder, talking with students and colleagues, and working on his research.

Bill enjoyed tinkering with radios from a young age, dropped out of high school at 16 and at 17 enlisted in the Navy, entered radio school, and served in the Mediterranean during WWII as a radio operator. After the war Bill was granted a GED and entered Colby College where he met his wife Barbara. He went on to earn his B.S. at Brown and his Ph.D. in Physics at Yale. Bill graduated in 1955 and took a job at Dartmouth, where he spent his entire career, teaching physics and studying the amazing way light is able to pass through solids.

Bill particularly loved physics; German; poetry; the writings of Henry David Thoreau; his camp in the Maine woods; and his family and friends. Bill is survived by his wife Barbara; two sons and their wives; five beloved granddaughters; and a passel of nieces and nephews, both real and nominal.

(Adapted from the Valley News)

Robert A. Naumann (1929-2014)

Robert Bruno Alexander Naumann, Adjunct Professor of Chemistry, Physics and Astronomy, passed away in Hanover on Dec. 10, 2014 at the age of 85. Born in Dresden, Germany, Bob attended schools far and wide, eventually entering Princeton University’s graduate program in Physical Chemistry, a field, engrossing him since early boyhood.

In 1953 with a Ph.D. in Chemistry, a fresh US naturalization certificate and a new ham-radio license (W2FNY) Bob chose not to leave Princeton. Instead he remained for a 39-year career as the university’s only joint Professor of Chemistry and Physics. While there he taught hundreds of undergrad and graduate students, plus Albert Einstein! On an April 1, 1955 home-visit he and N.Y.U. Prof. Henry Stroke answered atomic-clock questions, long puzzling Einstein. This was to be their elder’s last lesson, for he died three weeks later.

Bob travelled widely with his family during summer breaks and sabbaticals pursuing his research at Los Alamos National Lab as well as several universities in Europe. In 1992 Bob retired with his wife Marina to Norwich, VT. Across the Connecticut River at Dartmouth College Bob found stimulating scholars who graciously honored him as their Adjunct Professor of Chemistry, Physics & Astronomy.

Bob is survived by his wife of 53 years, Marina, a daughter, a son, and their spouses, and four grandchildren.

(Adapted from the Ricker Funeral Home website)
Built in 1854, the Shattuck Observatory is the oldest scientific building on the Dartmouth campus and is home to a 143-year-old refractor telescope. Professor of Natural Philosophy Ira Young, appointed in 1833, soon began requesting modern equipment to support his teaching. Young was appointed Professor of Astronomy in 1838 and in 1846 requested funds for a state-of-the-art telescope. With growing student interest in the sciences, Young was able to convince the Trustees that a proper building was needed to house the telescope in 1852. Thanks to a gift from George Shattuck, class of 1803, and a grant from the Board of Trustees, the observatory became a reality.

Regular public observing sessions hosted by members of the department still occasionally use the original 9.5 refractor telescope.