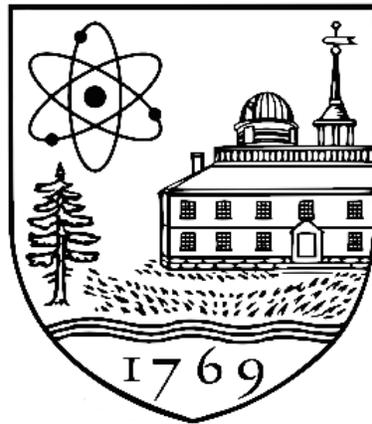
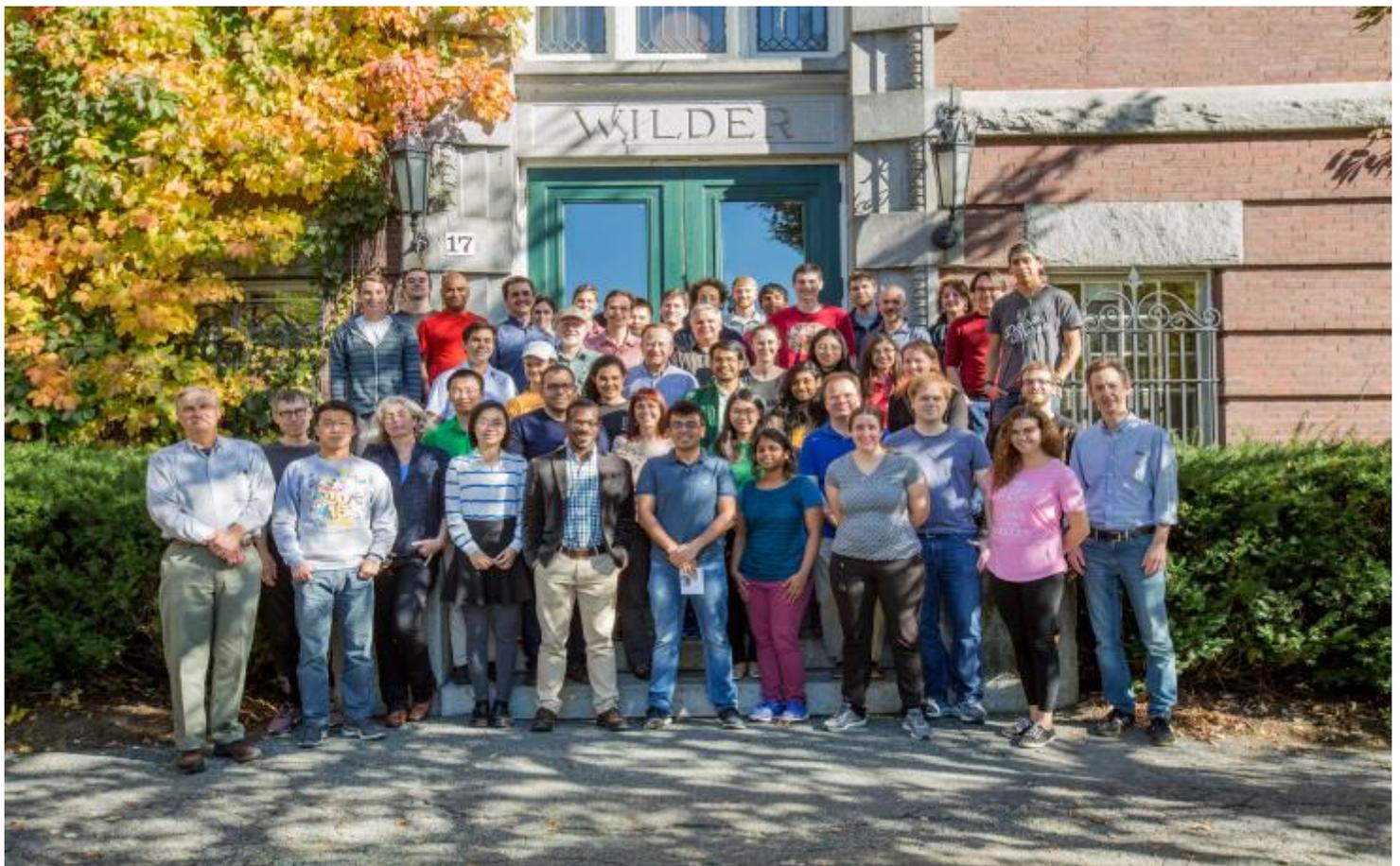


# News for the Friends of Dartmouth Physics & Astronomy



A New Interdisciplinary Institution • Recent Faculty  
Research • Physics Major Presents Valedictory Address





## A Message from John Thorstensen, Chair

Dear Friends,

As you can see from these pages, we've had another good year here in the Department of Physics and Astronomy.

If you've been keeping track, you'll notice that the Chairship has changed hands -- Jim LaBelle handed me the reins at the end of June. I had already served a 3-year term a decade ago, so the chairship is "deja vu all over again" for me -- as the handoff approached, Jim referred to me in his inimitable way as "The Once and Future Chair". Hopefully I'll be up to the job -- as the Department's longest-serving faculty member (I was hired in 1980), I at least bring institutional memory to the table. In any case, I am grateful to Jim for having handed me a happy and well-functioning department.

The intellectual life of the Department is vibrant, thanks to the vigorous research effort that you'll see detailed in these pages. While research and teaching are sometimes painted as being in conflict, we would surely not attract the superb students we see without the intellectual excitement that comes from working at the edge of the unknown. I have interviewed many prospective undergraduates over the years, and pretty much every single one has asked about research opportunities for students -- and I've always been able to reassure them on that point.

This summer we welcomed a new faculty member, James Whitfield; another, Devin Walker, is arriving at the start of the new year. Both are theoretical physicists. James, who comes to us from the Vienna Center for Quantum Science and Technology, works on quantum computers. Devin comes to us from SLAC and the University of Washington, and works on dark matter candidates and theoretical cosmology.

We're seeing retirements, too. Mary Hudson is winding down her teaching prior to retiring fully next year, and is spending this fall in Boulder at the National Center for Atmospheric Research. Mary has been at Dartmouth since 1983. She was -- and remains! -- a research powerhouse, building a thriving research group studying the earth's magnetosphere and space weather phenomena. We will miss her tremendous energy and commitment, as well as her infectious laugh. Astronomer Gary Wegner, who has been at Dartmouth since 1982, is teaching his last course this fall and retiring at the end of the year. Gary began his career in stellar astrophysics, studying white dwarfs and other oddities such as the peculiar A stars. In mid-career he expanded his horizons to extragalactic astronomy, most famously working with the so-called Seven Samurai -- an extraordinary all-star (or, more fittingly, all-galaxy) collaboration -- to uncover evidence for the Great Attractor, a huge overdensity of mass in the local universe. We will miss Gary's fellowship, dry humor, and immense erudition.

This fall Marcelo Gleiser inaugurated a new Institute for Cross-Disciplinary Engagement, or ICE, using a large grant from the Templeton Foundation. Over the next few years this will bring many distinguished philosophers and scientists to campus. It should be enlightening to all.

Although most of the items in this newsletter focus on research, we continue to give high priority to excellent teaching. Seemingly more often than not, our monthly faculty meetings feature thoughtful discussions of curricular innovations, and careful assessments of student progress. The number of majors has increased in recent years, in keeping with national trends, but the number of physics and astronomy majors remains small enough that there are plenty of opportunities for undergraduate research, often culminating in thesis work of very high quality. Jonathan Vandermause '16, working with Professor Sekhar Ramanathan, wrote a thesis that was nominated for an Apker award from the American Physical Society.

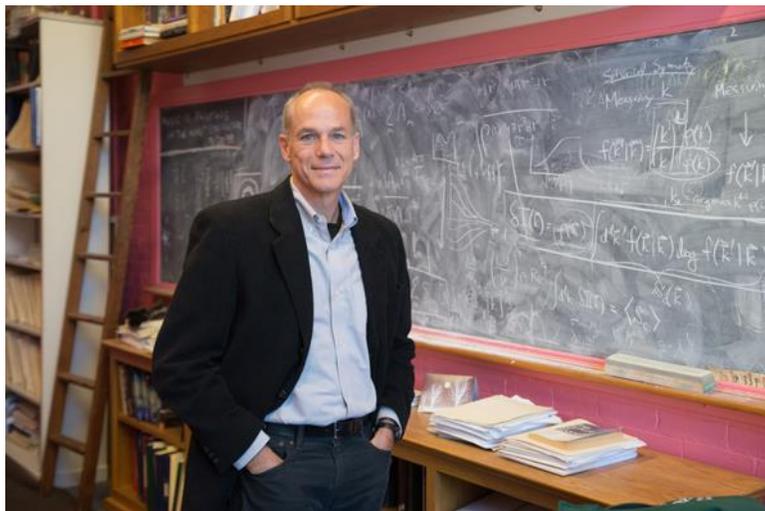
I've barely scratched the surface of the many things we've been up to. Read on!

John Thorstensen

## Marcelo Gleiser, Bridging the Sciences and the Humanities

Professor Marcelo Gleiser recently received a megagrant of \$3.5 million from the John Templeton Foundation to create a new institute here at Dartmouth. The Institute for Cross-Disciplinary Engagement, or ICE, will bring together eminent minds from both the sciences and the humanities to discuss fundamental questions on the nature of the universe and humanity's place within it. Upcoming programs include:

- a conference held here at Dartmouth, featuring talks from experts in the fields of neuroscience, physics, philosophy and religion.
- a series of public dialogues on fundamental problems in both the sciences and the humanities, the first of which will be between the neuroscientist Antonio Damasio and the philosopher David Chalmers.
- the development of two online courses one of which will be taught by Marcelo Gleiser himself and will discuss the search for meaning in both science and philosophy.



Professor Gleiser also published a book this past year, *A Tear at the Edge of Creation*, which examines the place of life in the universe and questions humanity's attempts to find order within the chaos that surrounds it.

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## The Physics Department Welcomes Devin Walker and James Whitfield



*Devin Walker*

Devin Walker will be joining the department as an assistant professor. He obtained his doctorate at Harvard University, before working at the SLAC National Accelerator Laboratory. Professor Walker is currently investigating the nature of dark matter and the methods we might use to detect it.

James Whitfield received his Phd in Chemical Physics from Harvard, where his thesis focused on the link between quantum computing and quantum chemistry. He most recently worked at the Vienna Center for Quantum Science and Technology as one of the inaugural VCQ (Vienna Center for Quantum Science and Technology) Fellows, studying the applications of quantum information.

Here at Dartmouth, James Whitfield will be researching the ability of both current and quantum computers to run physical simulations. Specifically will be investigating the role of quantum mechanics in computation in terms of quantum computers and classical models of quantum information.



*James Whitfield*

# The Dartmouth Physics Society

The physics society has been very active throughout the past year. The members of the society held weekly events designed to bring together students interested in physics, provide them with support and give them opportunities to further explore their interest. The society invites professors to speak on subjects such as preparing for graduate school and participating in research. One of the highlights was a talk from visiting Professor Jim Gates, who once served as a member of President Obama's council of advisors on science and technology and is currently doing research on supersymmetry and string theory.

The physics society also organized many fun activities! Some of the most memorable ones were: completing a challenge to drop an egg from the top of the Fairchild atrium - without breaking it.

- a guided tour of Alexander Rimberg's laboratory.
- a stop by Robert Caldwell's class on general relativity to let his students experience supercooled fluid by making liquid nitrogen ice cream.
- The yearly Liquid Nitrogen Ice Cream Social, which gives students and professors a chance to get together and share their interest in doing (and tasting) physics.



*Students make liquid nitrogen ice cream at the DPS Ice Cream Social. Photo provided by Saba Nejad ('18)*



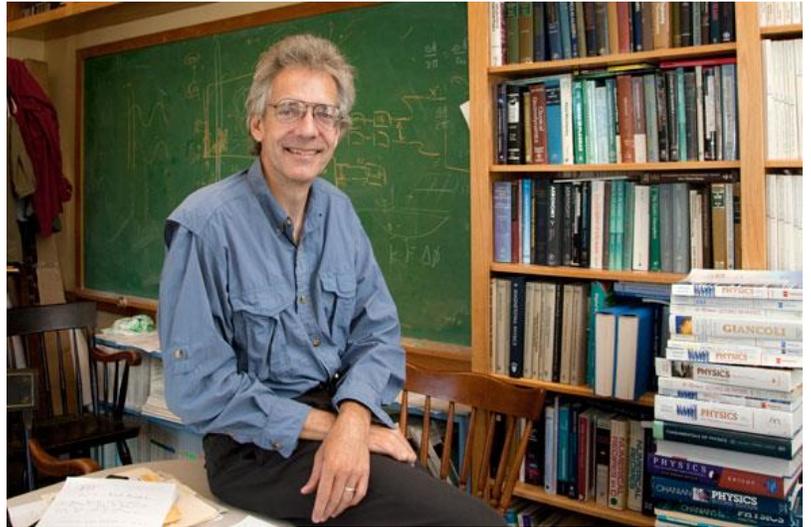
*Liquid nitrogen ice cream  
Photo provided by Saba Nejad ('18)*

## Jim LaBelle's Time as Chair

During his years as chair of the Physics Department, Jim LaBelle made some major infrastructure improvements, including the installation of a back up power supply in the basement laboratories, to prevent data loss and the interruption of experiments during power outages and of a helium recovery system to avoid excess helium loss during experiments. In addition, a new bathroom, including a shower, was added to Wilder and the two wings of the Shattuck Observatory were renovated. He also instated the professors James Whitfield and Devin Walker.

In July 2016 Jim LaBelle left Hanover on a six-month sabbatical that will take him to the South African National Space Agency near Cape Town, and Bahir Dar University in Ethiopia, the homes to Africa's two largest space physics groups.

While at Bahir Dar, he will hold seminars, and run an experiment to look at ionosphere using AR broadcast signals. The students of Bahir Dar University will also have the opportunity to gain hands-on experience by assisting Professor LaBelle with his experiments.



*Professor Jim LaBelle*

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## Dartmouth College Awarded for 125 Years of Weather Monitoring



*Presentation of the award in front of Shattuck Observatory.  
Photo by Robert Gill.*

This year the National Weather Service (NWS) granted the College an Honored Institution award for their uninterrupted weather monitoring over the course of 125 years. The NWS collects data from institutions all over the world, of which Dartmouth has one of longest running observation sites. These data provide the NSW with a comprehensive view of the changes in weather patterns around the globe.

Hendricus Lulofs, meteorologist-in-charge at the NWS forecast office in Gray-Portland, Maine presented the award in front of the Shattuck Observatory, which houses a 143 year old telescope and still runs public observing sessions.

# News from the Research Groups

## Astronomy News

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*Ryan Hickox*

This year Ryan Hickox received an NSF grant to continue his research on obscured supermassive black holes. The detection and study of these supermassive black holes, which are obscured by the fuel they accrete, will contribute to an understanding of how supermassive black holes and their host galaxies evolve. Hickox and his group will use the funding to study data from Dartmouth's partner observatories, such as the Southern African Large Telescope and the MDM Observatory in Arizona as well as data from NASA space observatories.

The NSF award will also be used to expand AstroConnect, a program which brings together research scientists and K-12 classrooms using video chats such as Skype and Google Hangouts.

*Robert Fesen*

Robert Fesen continues his research studying the remnants of supernovae. His current research focuses on the remnant of the first recorded supernova to take place outside the Milky Way, S Andromedae. S Andromedae was briefly visible as a bright light in the sky, a "new star" when it exploded in 1885, however, its traces were long believed undetectable. Using the Hubble Space Telescope, Professor Fesen was able to find the supernova's remnant by looking for its dark silhouette outlined against the Andromeda Galaxy's bright emissions. The remains of the supernova have proven to be surprisingly iron rich, providing new insights into the process of the star's explosion.



*Ryan Hickox. Photo by Eli Burakian ('00)*

## Cosmology News

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*Robert Caldwell*

Robert Caldwell is currently focused on gravity wells, that is potential field around large astrophysical objects, which he has found behave in a manner similar to coupled oscillators. This year Caldwell published a paper on the link between gravity wells and coupled oscillators, along with Nina Maksimova ('15) and graduate student Chris Devulder.

Professor Caldwell is now working on a project looking at how a network of future gravitational wave detectors could be optimized to detect different polarization states of gravitational waves. The detectors would be spread out around the globe, and perhaps some would even be space based, so as to increase the total sensitivity to these very faint waves

# Quantum and Condensed Matter

## *Miles Blencowe, Contributing Correspondent*

Miles Blencowe has been working with graduate student Hui Wang and former undergraduate student Oscar Friedman on understanding the quantum dynamical properties of classically nonlinear systems. In particular, Hui has been developing a theoretical model of the so-called Cooper pair laser that was first experimentally realized by Alex Rimberg's group. This laser exploits nonlinearity to generate a highly coherent source of microwaves; Hui's work will help us understand how unavoidable noise sources affect the quantum nature of these generated microwaves.

On the other hand, Oscar is developing a new way to visualize the formation and destruction of quantum states for nonlinear microwave and mechanical oscillator systems, called 'Wigner flows', named after the famous theoretical physicist Eugene Wigner (1902-1995). Oscar's work is a continuation of his senior thesis; currently he is spending a year out in Northern Michigan before applying to graduate school, dividing his time between physics research and x-country ski training.

## *Richard Denton, Contributing Correspondent*

Richard Denton has been working on several projects. Most of his time during the past year has been spent on analysis of data from the Magnetospheric MultiScale (MMS) mission, in collaboration with Professor Bengt Sonnerup from the Thayer School of Engineering.

The MMS mission is designed to determine the physics occurring on small electron scale sizes when oppositely directed magnetic fields reconnect. Denton investigated a magnetic reconnection event at the magnetopause, the boundary between the Earth's magnetic field and the magnetic field embedded in the solar wind. Denton was able to determine the orientation of the reconnection structure, and the motion of the MMS spacecraft through that structure. Because the relative velocity between the spacecraft and the structure is determined mainly by the motion of the plasma (charged particles) that flaps back and forth in response to changes in the solar wind, this is not a trivial task.

Denton has also been working with Dartmouth postdoc Caitano de Silva to simulate whistler waves (high-frequency oscillations of the plasma and magnetic field) generated in the inner magnetosphere off of the magnetic equator. The whistler waves are driven by the properties of the plasma, and this happens preferentially where the magnetic field is weak. Normally, the minimum in the Earth's magnetic field is

at the magnetic equator (nominally the geographic equator), but when the magnetic field is compressed by strong solar wind flow, a minimum in the magnetic field can occur at higher latitudes along the Earth's magnetic field lines (toward the poles).

## *Rahul Sarpeshkar, Contributing Correspondent*

This year, Rahul Sarpeshkar's research focused on the initiation of a new analog circuits and analog computational formulation of quantum mechanics. This approach offers a pictorial and rigorous circuit view of Hamiltonians, enabling principled design of quantum circuits, taking measurement, back action, noise, entanglement, and other effects into account. This method provides an intuition and transparency similar to that which pictorial Feynman diagrams provide in particle physics.

This approach may also inspire the design of whole new quantum circuits and quantum computational architectures drawn from classical analog circuits. Finally, the emulation of quantum architectures on classical analog super-computing chips may have a wide range of applications in several fields such as quantum chemistry or in hybrid quantum-and-classical systems.

## *Lorenza Viola, Contributing Correspondent*

This past year has been a busy and very exciting one in Viola's group. Research activities have continued on a variety of problems within quantum information science, on topics as diverse as quantum noise spectroscopy, quantum engineering, and topological quantum matter.

Graduate student Peter Johnson and Professor Viola, in collaboration with Francesco Ticozzi (Assistant Professor, University of Padua, Italy), have continued their work in quantum control theory, focused on stabilizing quantum entanglement in many-body systems. Most recently, they published their findings in the journal *Quantum Information and Computation*. After defending his PhD thesis this fall Peter will move to Cambridge, MA, to begin a postdoc in the Harvard Chemistry department with the Aspuru-Guzik group.

Salini Karuvade joined Professor Viola's group as a graduate student in Summer '15. Together with Peter Johnson and Professor Ticozzi, she has been investigating quasi-local dissipative dynamics of open quantum systems, as well as related questions of "parts versus whole" for pure quantum states, so-called quantum marginal problem.

Postdoc Leigh Norris began her second year in the group in January. In April, Norris, Viola and collaborator (former Viola's postdoc) Dr. Gerardo Paz-Silva, now at Griffiths University, published their work on quantum spectroscopy of non-Gaussian noise in *Physical Review Letters*. While Viola presented this work at the Annual Program Year Workshop on Quantum and Nano Control held in April in Minneapolis, Norris traveled to Juneau, Alaska in June to present on topics relating to quantum noise spectroscopy at the Last Frontiers of Quantum Information Science workshop

Emilio Cobanera is the newest postdoc in Professor Viola's group, having joined in September '15. Emilio and graduate student Abhijeet Alase, also in collaboration with Professor Gerardo Ortiz (Indiana University, Bloomington) have continued their exciting research on topological insulators and superconductors, and exact solvability. In August, they published a first paper summarizing their findings in *Physical Review Letters*. In August 2015, Abhijeet attended the conference on Recent progress in many-body theories, held in Buffalo, NY. Emilio and Abhijeet also presented their work in the annual March Meeting of the American Physical Society March, held in Baltimore, MD. Emilio has also been working on extending the theory of Hamiltonian dualities to quantum dynamical semigroups, with an eye on information preserving structures, and developing a systematic projector method for determining effective boundary theories of topological quantum matter.



*Lorenza Viola's group barbecue at the Dartmouth Sailing Club, featuring Emilio grilling. Image courtesy of Lorenza Viola.*

#### *Chandrasekhar Ramanathan*

This was a busy year for Chandrasekhar Ramanathan's group, as they continue their research on the link between quantum information processing and condensed matter physics. Last fall, Lihuang Zhu and Mallory Guy presented at the 2015 Joint Fall Meeting of the APS (American Physics Society) and AAPT New England Sections and Mallory published a paper in the *Journal of Magnetic Resonance*. A new helium recovery system was added to the lab, so that they could run experiments more efficiently.

In the spring, Jonathan Vandermause ('16) published a paper on the superadiabatic control of quantum operations in the journal *Physical Review A*. Jonathan Vandermause and Hassan Kiani ('16) both completed their senior honors theses, on quantum dynamics and the interactions of graphene respectively. In addition, Jonathan was one of the eight graduating valedictorians, and presented the valedictory address to the College at Commencement.

Also over the spring, the lab was joined by undergraduates Kent Ueno ('18), Krishan Canzius ('18) and Jesse Feldman-Stein ('18) who were awarded James Freedman Presidential Scholarships.

Last summer, Lihuang, Mallory and postdoc Kipp van Schooten presented posters at the Gordon Conference on Defects in Semiconductors. Also, Jonathan Vandermause was named a finalist for the prestigious 2016 APS LeRoy Apker award, which honors outstanding physics research from undergraduates around the country.

#### *Roberto Onofrio*

This year Roberto Onofrio published two papers in the journal *Physical Review A* on the cooling of atomic gases. His first paper explores models to optimize the cooling of degenerate Bose-Fermi mixtures His second paper describes an experimental technique to cool Fermi gases to the point of quantum degeneracy.

## Space-Plasma Physics

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### *Mary Hudson, Contributing Correspondent*

Mary Hudson retired from teaching at the end of spring term 2016 after 32 years in the department. She will be spending most of her time at the High Altitude Observatory (HAO) of the National Center for Atmospheric Research in Boulder, Colorado.

She has been joined this summer by postdoc students Maulik Patel and Murong Qin. Hudson lectured at the Center for Integrated Space Weather Modeling (CISM) summer school which Murong attended along with the NASA Heliophysics Summer School at the same venue. Maulik is studying radial transport and energization of radiation belt electrons by Ultra Low Frequency waves and presented results at the Geospace Environment Modeling workshop in Santa Fe, New Mexico in June, which Hudson also attended as did her Dartmouth postdoc Zhao Li.

Hudson served as co-chair of the National Academy of Sciences/National Research Council Committee on Solar and Space Physics, and besides organizing the work of that committee and bi-annual meetings in Washington DC, she attended the Space Studies Board Executive Committee Meeting at Woods Hole, MA in August, where she highlighted a major new initiative in Space Weather by the White House Office of Science and Technology Policy released in October.

She will give two papers at the Global Modeling of the Space Weather Chain workshop in Helsinki, Finland in October and will continue her research as co-investigator with two instrument teams on NASA's Van Allen Probes satellite mission launched in August 2012, now in its extended mission phase through 2018.

### *Robyn Millan*

This summer Robyn Millan attended a balloon campaign in Sweden, where her team launched balloons carrying payloads of scientific instruments with the purpose of observing relativistic electron loss from the earth's radiation belts, as a part of the BARREL (Balloon Array for Radiation belt Relativistic Electron Losses) project.

Her team also published two papers this past year, one describing their observations from a previous BARREL launch, and the other discussing the effect of geomagnetic storms on relativistic electrons within the outer radiation belt.



*BARREL balloon filling up. Photo courtesy of Robyn Millan*

### *Jim LaBelle, Contributing Correspondent*

2015 was a challenging year for the geoplasma physics group. After several years of preparation, Professor Jim LaBelle, graduate student Spencer Hatch, and engineers David McGaw and Dave Collins assembled in Andoya, Norway, for the launch of the Cusp Alfvén and Plasma Electrodynamics Rocket (CAPER). This rocket was to probe the polar cusp, which is the funnel-shaped region where the Earth's magnetic field lines converge near the poles. Because the magnetic field lines of the cusp connect directly to the solar wind, the cusp has unique physics compared to the much more studied nighttime aurora.

Professor LaBelle served as PI for CAPER, and the group had built the electric field antennas and receivers that flew on the rocket. Unfortunately, the third stage motor of the rocket did not ignite correctly, and CAPER was a complete failure, with no data returned. A proposal has since been submitted to re-build and re-fly the experiment in 2019.

Graduate student Spencer Hatch, who was working on CAPER for his thesis project, re-directed his efforts into analysis of satellite data from the cusp and has just had a paper accepted on this topic in *Journal of Geophysical Research*. Two more papers are in preparation. Spencer presented his work at both the American Geophysical Union and the European Geophysical Union annual meetings.

The group continues to maintain ground-based radio observatories at several sites in the Arctic and Antarctic. Several undergraduates have contributed to the analysis of the data from these stations, resulting in two papers with undergraduate co-authors, one by Professor LaBelle and Michelle Dundek ('18), and the other by Professor LaBelle and Yining Chen ('18).

Undergraduates Jeffrey Kim ('18) and Rongfei Lu ('18) contributed to a growing network of small receivers in the northeastern U.S. being used to monitor the ionosphere by measuring the Doppler shift imparted on commercial AM radio signals by ionospheric motions at the locations where the signals are reflected.

*Hans Mueller*

Hans Mueller continues his research on the simulation of the emission of solar winds with the help of Michael Cobb ('18) and Morgan Bronson ('18). He is also simulating the collision of the stellar winds ejected by the stars Alpha Centauri A and B, along with Alana Juric ('18). Upon collision, these winds create a disk of superhot plasma, which could influence the habitability of any exoplanets in the system of Alpha Centauri



*Hans Mueller with Alana Juric and Michael Cobbs at the Dartmouth Outing Club.*

*Kristina Lynch*

The Lynch Rocket Lab group participated in the successful RENU2 launch (PI Marc Lessard at UNH) last December (2015) from the Andoya Rocket Range in Andenes Norway.

For the ISINGLASS mission (Ionospheric Structuring: In Situ and Groundbased Low Altitude Studies) the team will launch two rockets this coming winter at the Poker Flat Rocket Range in Alaska. The sounding rockets will study the aurora, therefore they are launched into dark skies, in the winter. They will carry payloads of scientific instruments, including a magnetometer, a spectrometer and a thermal electron plasma sensor, in order to provide data on the plasma within the aurora. These data, coupled with data from a ground-based sensor array will give a more complete picture of the nature of the auroral ionosphere.

## Theses and Recent PhDs

### Senior Theses:

**Lucas Bezerra:** "Fast Wavefront Characterization of Optical Traps for Quantum Gases"  
Advisor: Kevin Wright

**Pawan Dhakal:** "High Precision Helium Spectroscopy and Quantum Gravity Effects"  
Advisor: Roberto Onofrio

**Oscar Friedman:** "Time Evolution of Wigner Flow Function"  
Advisor: Miles Blencowe

**Muhammad Kiani:** "Fabrication and Characterization of Graphene Devices"  
Advisor: Chandrasekhar Ramanathan

**Luis Martinez:** "Bubbles in My Scalar Field Soup: A Study on Oscillons in Cosmology"  
Advisor: Marcelo Gleiser

**Jonathan Vandermause:** "Characterization and Control of Nuclear Spin Systems"  
Advisor: Chandrasekhar Ramanathan

**Kathryn Waychoff:** "Zonal Wind Variability of the Jovian Planets"  
Advisor: Robyn Millan

### Recent PhDs:

#### 2016

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

**Erind Brahimi:** "A Driven Resonator Coupled With a Josephson Junction: An Exploration of the Quantum and Classical Dynamics"  
Advisor: Miles Blencowe

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

**Micah Dombrowski:** "Sounding-Rocket Studies of Langmuir-Wave Microphysics in the Auroral Ionosphere"  
Advisor: Kristina Lynch

**Miles Engel:** "Test Particle Simulations of Inner Belt Protons During Geomagnetic Storm"  
Advisor: Mary Hudson

**Lisa Fisher:** "Overcoming and Utilizing Plasma Sheaths for Low Energy Plasma Analysis"  
Advisor: Kristina Lynch

**Yuxiang Liu:** "The Numerical Solution of Frequency-Domain Acoustic and Electromagnetic Periodic Scattering Problems"  
Advisor: Alex Barnett

## Undergraduate and Graduate Student Awards

Graduate and undergraduate students from the Physics Department received the following awards this year:

### Undergraduate Awards:

**Jonathan Vandermause** ('16), 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. He also received the *Gazzaniga Family Science Award at Dartmouth College*, which is given to the graduating senior with the best accomplishments in scientific research and was named *Valedictory of the College*.



*Jonathan Vandermause gives the valedictorian address: "In those moments of full attention we become alive to the hidden possibilities all around us,"*  
Photo by Eli Burakian ('00)

**Pawan Dhakal** ('16) AND **Lucas Valenca Soares Bezerra** ('15) were 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.

**Kathryn Waychoff** ('16) 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.

**Connie Jiang** ('17) received the *Stamps Leadership Scholar Award* for the 2015-2016 academic year to research 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 their first couple years in college.

**Connie Jiang** ('17) AND **Nina Maksimova** ('15) received *National Science Foundation (NSF) Graduate Research Fellowships (GRF)* for 2016.

### Graduate Awards:

**Lihuang Zhu** 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.

**Ben Zhu** 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.

**Peter Johnson** 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.

**Kathryn Weil**, working with Robert Fesen, won the award for best poster presentation at the *Annual Graduate Student Poster Session* in April for her poster, *STIS Spectra of the Remnant of SN 1885 in M31*.

**Mallory Guy** was named a Gordon F. Hull Fellow for the 2016-2017 academic year.

