Tufts UNIVERSITY

SCHOOL OF ARTS AND SCIENCES

Department of Physics & Astronomy

Summer 2013

Dear Friends of Tufts Physics & Astronomy,

It's been another eventful year for Tufts Physics and Astronomy. In this newsletter you'll learn about the role Tufts faculty, students and postdocs played in the (likely) discovery of the long-sought Higgs boson, probably the most exciting physics news of the year. But you'll also learn of many other accomplishments, awards and honors by our faculty, graduate students and undergraduates, as well as the arrival of a new staff member and the retirement of our long-time friend and colleague Leon Gunther. Just a sampling of what's been happening in our thriving physics-astronomy community.

Our Ever-Evolving Department

Addition

Paul Wagoner joined the department last summer as the new coordinator of student laboratories and lecture demonstrations. He is an engineer with experience in industry and worked for twenty years at TERC, a non-profit that develops math and science curricula and does research on teaching and learning, as a Senior Engineer. Paul is devoted to the improvement of education by increasing opportunities for learners to experience directly (and to control, where practical) the phenomena they are learning about. His current efforts focus on revisions to the labs in the introductory courses and on working with TAs to help them learn how to make the labs more engaging and rewarding for students.

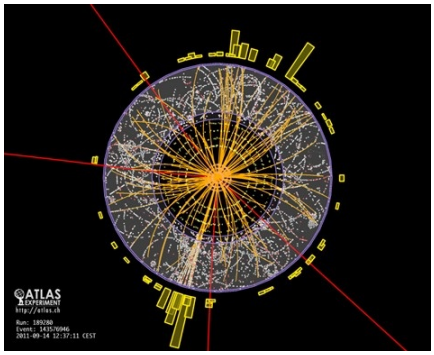
Retirement

After 48 years at Tufts, *Professor Leon Gunther* is retiring in May of 2013. Professor Gunther came to Tufts in 1965 as an Assistant Professor of theoretical Solid State Physics (later changed to "Condensed Matter Physics"). When asked about his "work", he immediately replies he didn't work, he "simply had the great fortune of loving all that he did at Tufts" - research, teaching, special programming (e.g. a Symposium on Energy) - and participating in music performances. Professor Gunther says he is indebted to the department for giving faculty the opportunity and support to experiment with and develop new courses - most significantly his Physics of Music and Color class, along with Gary Goldstein. He is indebted to all his colleagues and the Department of Physics and Astronomy staff for their camaraderie. Ultimately, Professor Gunther's fondest and warmest memories, which he will carry with him into the future, are the faces and personalities of the hundreds of students that he got to know well as their teacher, mentor and friend. We thank Professor Gunther for his years of service to the department and Tufts University!

News and Events

Higgs Boson

Tufts physicists were deeply involved in the most exciting physics news of 2012: last summer's announcement of the discovery of a new particle believed to be the long-sought Higgs boson. This is the



most important discovery in elementary particle physics since the electroweak bosons, W+,W- and Z_0 were found in 1983. Those particles were predicted by the Standard Model of particle physics, but it remained a mystery why they were not massless, like the photons and gluons that mediate the electromagnetic and strong interactions. A number of theorists developed an explanation based on spontaneous symmetry breaking that came to be known as the Higgs mechanism. However, there are many ways to realize the spontaneous breaking of the electroweak symmetry. In the simplest model, the Minimal Standard Model, there is only one Higgs neutral boson to be observed. The newly discovered particle, ~125 times more massive than the proton, could be that particle. It was found at the Large Hadron Collider at CERN in Switzerland by two enormous international collaborations working with independent particle detectors known as ATLAS and CMS. Eight researchers from the Tufts Physics Department are coauthors of the paper reporting the ATLAS signal: Profs. Hugo Beauchemin, Austin Napier and Krzysztof Sliwa; Drs. Evelin Meoni, Simona Rolli and Sarka Todorova; and graduate students Sam Hamilton and Jeff Wetter. The Tufts group helped design and build critical hardware and software for identifying one of the key Higgs decay modes, the four-muon channel. The Tufts ATLAS Group has also developed an advanced multi-dimensional analysis technique that will make it possible to determine whether events found in the 2011-2012 ATLAS data are due to the simplest version of the Higgs mechanism, or provide evidence for a more complicated form. This is the most important question regarding the newly discovered boson. The LHC is now being upgraded to nearly double its collision energy. When it restarts in 2015, it will be possible to go beyond merely identifying the Higgs and begin determining its properties. The Tufts group will remain involved in these studies, as well as other investigations, including the search for completely new particles and phenomena that could provide clues to exotic phenomena beyond the Standard Model, such as small black holes or extra dimensions.

Professor Ken Lang's latest book, *The Life and Death of Stars*, has just been published by Cambridge University Press. Geared toward the educated layperson who is curious about the universe, the book focuses on the formation of stars and their life cycles, among other astronomical subjects. Professor Lang's book will serve as the foundation for a course offered next year called *Written in the Stars*, in which he will explore not only astronomy, but religion, faith and the human condition.

Tufts Students and Faculty Present at the APS March Meeting

This spring 3 Tufts condensed matter physics faculty and 7 of their students and postdocs presented their research at the annual March meeting of the American Physical Society.

A Year of Distinction

Faculty and Staff

Assistant Professor Danilo Marchesini was one of 13 early-career faculty from all fields of science selected as a 2013 Cottrell Scholar. Recognized for their excellence in research and teaching, Cottrell Scholars do groundbreaking research and lead undergraduate teaching improvements.

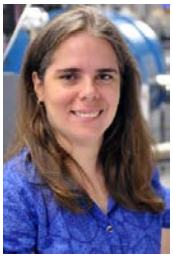
Professor Peggy Cebe was honored this spring with a special symposium titled "Providing Opportunities for Under-Represented Students in Polymer Science: Symposium in Honor of Professor Peggy Cebe". The symposium recognized her summer internship program for deaf and hard of hearing undergraduates.

Students

Wenwen Huang (G) was awarded the 2013 Graduate School of Arts and Sciences Outstanding Academic Performance (Doctoral Level) Award.

Noah A. Kurinsky ('14) was awarded a 2013-14 scholarship from the Barry M. Goldwater Scholarship and Excellence in Education Foundation. Designed to foster and encourage outstanding students to pursue careers in the fields of mathematics, the natural sciences, and engineering, the Goldwater Scholarship is the premier undergraduate award of its type in these fields.

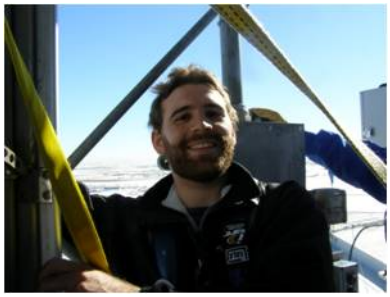
Christopher Kehayias ('13) was awarded the Benjamin G. Brown Scholarship. *Kevin C. Li* ('13) was awarded the Amos Emerson Dolbear Scholarship. *Joseph M. Rahamim* ('13) and *Robert S. Rockmore* ('14) were awarded the N. Hobbs Knight Scholarships in Physics. *Noah Kurinsky* ('14) was awarded the Class of 1947 Victor Prather Prize. *Samuel B. Hansen* ('14) received the Frederick Melvin Ellis Prize. Juniors *Joshua I. Levy* and *Yu Li* and sophomore *Matthew J. Ryan* were awarded 2013 Howard Sample Prize Scholarships in Physics. Additionally, *Alek S. Razdan* ('15) won the Elizabeth Verveer Tishler Prize in Music Performance.



Alumni

Mayly C. Sanchez, G'03, received a Presidential Early Career Award for Scientists and Engineers, the highest honor bestowed by the United States Government on science and engineering professionals in the early stages of their independent research careers, in July 2012. The Presidential early career awards embody the high priority placed on producing outstanding scientists and engineers to advance the Nation's goals, tackle grand challenges, and contribute to the American economy.

In the Spotlight



Andrew Hastings-Black, A08

Current occupation?

Researcher at Second Wind, Inc., a company that develops and utilizes technologies for measuring wind speeds in potential wind farm locations.

How do you use your physics background in your line of work?

First, experience with the mathematics that underpins all physical phenomena gives one a feel for the playing field. Studying optics and quantum mechanics made picking up acoustics really easy — they're all wave mechanics! Second, and more fundamental, is problem solving...

To read more, visit https://wikis.uit.tufts.edu/confluence/display/physics/Alum-HastingsBlack

Congratulations!

The department would like to congratulate our 2013 graduates.

Bachelor of Science Degrees

Christopher Kehayias, B.S., Engineering Physics

Kevin Li, B.S., Physics

Dylan O'Connell, B.S., Physics

Jonathan Poli, B.S., Chemical Physics

Joseph Rahamim, B.S., Physics

Michael Tran, B.S., Electrical Engineering/Physics

Doctoral Degrees

- **Rebecca Batorsky**, Medical Physics, Advisor: I. Rouzine
  Thesis: *Mathematical Modeling of the Within-host Dynamics and Evolution of the Human Immunodeficiency Virus*
- **Wenwen Huang**, Condensed Matter Physics, Advisor: Peggy Cebe
  Thesis: *Thermal Analysis, Structural Studies, and Morphology of Spider Silk-like Block Coploymers*
- **Spencer Smith**, Fluid Dynamics, Advisor: Bruce Boghosian
  Thesis: *Point Vortices: Finding Periodic Orbits and their Topological Classification*
- **Douglas Urban**, Cosmology, Advisor: Ken Olum
  Thesis: *Average Null Energy Condition*

We are proud of your work at Tufts and look forward to the great things in your future.

Sincerely,
Roger G. Tobin, Chair

Tufts Physics Tidbit

The only Tufts faculty member to win a Nobel Prize was been physics professor Alan Cormack. He was a theoretical particle physicist, but you will search for his name in vain on the list of Physics laureates; he shared the 1979 prize for Physiology or Medicine for his work on the mathematical theory that made possible X-ray computed tomography, better known as CT scans.

In CT scans, a three-dimensional image, say of the brain, is reconstructed mathematically from a set of flat X-ray images taken from different directions. You can do that if you have perfect images taken in all directions, but in practice, one has only a limited set of images, and to minimize the radiation dose you want as few as possible. Moreover, each image subject to noise and uncertainty. Cormack's analysis showed how to construct a reliable image in spite of these limitations, and was crucial to the practical development of what is now a standard diagnostic technique.

Alan Cormack was born in South Africa in 1924 and moved to the United States in 1956, joining the Tufts faculty in 1957. He was department chair from 1968 to 1976 and retired in 1980. Besides the Nobel Prize he was the recipient of numerous national and international awards and honors. He died in 1998.

We welcome your news, stories, and ideas for our future newsletters. To contact us or to be added to our mailing list, please email newsletter editor: Shannon.Landis@Tufts.edu. We would especially like to hear from recent graduates of the program (undergraduate or graduate) about what you're doing!

Link In With Us

In a continued effort to reach and share with friends, alumni, current and prospective students, donors and anyone else interested in Tufts Physics and Astronomy, the department created a Linked In account this past year. If you have not already done, so we welcome you to link with us at http://www.linkedin.com/pub/dept-of-phy-astro-tufts-university/52/348/621.

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