DOE Princeton Plasma Physics Laboratory

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PPPL NEWS

The Princeton Plasma Physics Laboratory is a United States Department of Energy Facility

Director Gives State-of-the-Lab Address

Charts Future, Summarizes Past Year's Accomplishments

Once again turning to a nautical theme for his 11th State-of-the-Lab address, PPPL Director Rob Goldston used 1930s cartoons to make a point: Popeye had the right attitude — all you need is spinach — and we have a lot of it at PPPL.

Goldston, delivering the December 13 talk to a standing-room-only crowd in the MBG Auditorium, summarized the past fiscal year, discussing the Lab's experiments and collaborations, on-site improvements, Business Operations, and safety record and initiatives. He concluded with personal remarks.

"NCSX [National Compact Stellarator Experiment] is making good progress, with 14 of 18 coils completed to exacting accuracy requirements," Goldston said, adding that coil-to coil assembly starts in January. "NCSX had lots of DOE reviews, all of them successful. For example, the programmatic and scientific review committee emphasized the U.S. should have a significant stellarator presence as part of its magnetic fusion energy research program, and that NCSX would have a profound effect on international stellarator research."

Goldston said the National Spherical Torus Experiment (NSTX) had a remarkable range of excellent results this year, and PPPL has new design and construction activities under way for ITER, and is making major contributions to the ITER Design Review. ITER is an international fusion experiment being planned for construction in France. He also discussed successes in Theory and smaller experiments.

The Director talked about improvements at the Lab, such as "spiffing up" the landscape, adding new gym equipment, and making PPPL "greener than ever" by reducing water usage, non-experimental energy use, and fleet fuel consumption.

He praised Business Operations for "doing a great job," noting its Achievement of Excellence in Procurement Award from the National Purchasing Institute.

On safety, he said, "We are undertaking numerous initiatives to improve safety at the Lab" and noted the Lab-wide November 20 Safety Forum. He emphasized that because the Lab wants outstanding safety performance, it has to be more thoughtful about safety than other institutions. On a lighter note, the Director showed how the Lab was "having fun" and praised the "naval architects" at PPPL for building a pirate ship for the PPPL Pirate Picnic in September (page 7). He also presented this year's Employee Recognition Awards and Kaul Prizes.

At the conclusion, Goldston discussed his personal plans. After more than 10 years at the helm of PPPL, Goldston announced that he will step down as Director to focus his efforts on fusion energy policy, on ITER, and on the next major initiatives for U.S. fusion.

"I have been involved in many of fusion's big policy challenges," Goldston said. "I have now decided, however, that after these 10 exciting years, it will be better for the Laboratory — and will let me continue to put my own efforts strongly into moving fusion forward — if we find a new candidate for Director in our proposal for the next five-year contract period." Goldston will remain as Director until his successor is in place, and plans to remain at PPPL after that. The DOE is holding a national competition for a new management and operations contract for the Lab, which has been managed by the University since 1951. This competition is planned to be completed by September 30, 2008, when Princeton's current contract ends.

DOE Undersecretary for Science Raymond L. Orbach said of Goldston, "Our country, and the entire field, owe him a debt of gratitude for his scientific leadership and insight." Ray Fonck, DOE's associate director of the Office of Fusion Energy Sciences, commended Goldston for his leadership. "I have seen up close Rob's unflagging enthusiasm for fusion science and his devotion to moving it forward," Fonck said. "He has also guided the establishment of new levels of collaborations in PPPL experiments, which provides us a template for future international and national cooperative ventures."

Goldston concluded by saying, "It has been a pleasure and an honor to lead this Lab." Everyone left their seats to give the Director a standing ovation. A news release is at: http://www.princeton.edu. ●

Reflections of a Fusion Leader

By Patti Wieser

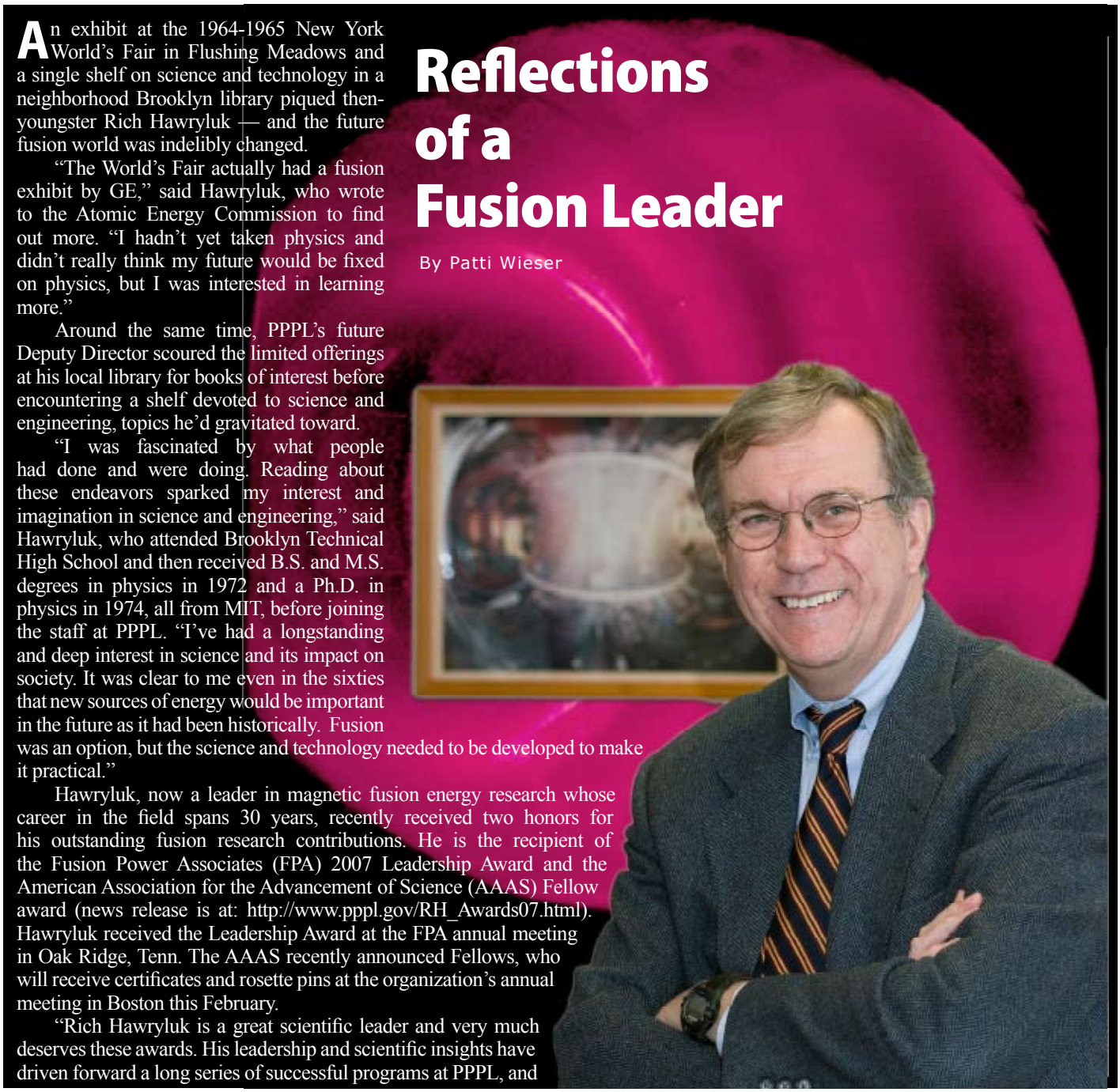


Photo composite by Elle Starkman

An exhibit at the 1964-1965 New York World's Fair in Flushing Meadows and a single shelf on science and technology in a neighborhood Brooklyn library piqued then-youngster Rich Hawryluk — and the future fusion world was indelibly changed.

"The World's Fair actually had a fusion exhibit by GE," said Hawryluk, who wrote to the Atomic Energy Commission to find out more. "I hadn't yet taken physics and didn't really think my future would be fixed on physics, but I was interested in learning more."

Around the same time, PPPL's future Deputy Director scoured the limited offerings at his local library for books of interest before encountering a shelf devoted to science and engineering, topics he'd gravitated toward.

"I was fascinated by what people had done and were doing. Reading about these endeavors sparked my interest and imagination in science and engineering," said Hawryluk, who attended Brooklyn Technical High School and then received B.S. and M.S. degrees in physics in 1972 and a Ph.D. in physics in 1974, all from MIT, before joining the staff at PPPL. "I've had a longstanding and deep interest in science and its impact on society. It was clear to me even in the sixties that new sources of energy would be important in the future as it had been historically. Fusion was an option, but the science and technology needed to be developed to make it practical."

Hawryluk, now a leader in magnetic fusion energy research whose career in the field spans 30 years, recently received two honors for his outstanding fusion research contributions. He is the recipient of the Fusion Power Associates (FPA) 2007 Leadership Award and the American Association for the Advancement of Science (AAAS) Fellow award (news release is at: http://www.pppl.gov/RH_Awards07.html). Hawryluk received the Leadership Award at the FPA annual meeting in Oak Ridge, Tenn. The AAAS recently announced Fellows, who will receive certificates and rosette pins at the organization's annual meeting in Boston this February.

"Rich Hawryluk is a great scientific leader and very much deserves these awards. His leadership and scientific insights have driven forward a long series of successful programs at PPPL, and now he is also driving forward key scientific analyses for ITER," said PPPL Director Rob Goldston. ITER is an international fusion project being planned for construction in France.

Hawryluk was noted in the FPA award for his scientific leadership in past and present fusion projects at PPPL — including as Head of the Tokamak Fusion Test Reactor (TFTR) project when it produced record breaking results — and for his "recent involvement with the ITER Working Groups that are providing much needed input for final design decisions for ITER."

"One of the things I've enjoyed most about PPPL is the range of opportunities I've had here, from being a physics operator of the Princeton Large Torus physics to leading the TFTR experiments, to simulations and managing operations at the Lab," Hawryluk said. His proudest accomplishment? "The deuterium-tritium experiments on TFTR were challenging, exciting, and extraordinarily rewarding."

Outside work, Hawryluk enjoys spending time with his family, including wife, Mary Katherine — whom he describes as "a tremendous source of support" — and sons David and Kevin. He is an avid reader, preferring biographies, *The First American – The Life and Times of Benjamin Franklin* and *Alexander Hamilton*, and non-fiction, *The World is Flat: A Brief History of the Twenty-first Century, Guns, Germs and Steel: The Fates of Human Societies*, and *Conquering Gotham – A Gilded Age Epic: The Construction of Penn Station and Its Tunnel*, which are recent reads. Mystery and spy novels sneak into his reading repertoire on long plane trips.

He lauded the PPPL staff for its accomplishments, dedication, enthusiasm, strong motivation to address the scientific challenges of fusion research, and continual support in this effort. "I have an extraordinary respect and appreciation for the people here at the Lab." ●

Technology Transfer Success of PPPL's Miniature Integrated Nuclear Detection System Awarded

In recognition of PPPL's successful transfer of the Miniature Integrated Nuclear Detection System (MINDS), the Federal Laboratory Consortium Northeast Region recently presented the Laboratory with the Excellence in Technology Transfer Award. An anti-terrorism technology, MINDS was developed for detection of the radiation emitted from a nuclear threat, such as a dirty bomb or from dangerous nuclear material. This technology employs a conventional off-the-shelf hardware approach to detecting the nuclear radiation spectrum coupled with an innovative detection scheme.

"I am very pleased that technology we have developed here at the Princeton Plasma Physics Laboratory can be applied to enhance the security of our nation," said PPPL Director Rob Goldston.

Using a sodium iodide scintillating crystal to detect X-ray and gamma radiation, the emitted signal is then coupled to a multi-channel analyzer (MCA) with appropriate amplification. The output of the MCA is analyzed by the propriety software developed by PPPL for the identification of specific sources of radiation that may be associated with the threat of nuclear terrorism. The analysis is generally done in a laptop or other conventional computing environment.

In 2005, Princeton University signed a licensing agreement with InSitech, a not-for-profit organization that brings government-developed technology to market. "Since we started on the path of developing MINDS for homeland security purposes, the system has been successfully deployed at a major commuter rail station in the northeast, at the Port of Oakland in California, at a U.S. military base, and with an international security company. Currently, plans are underway to employ MINDS algorithms in hand-held detectors that are being developed by SAIC [Science Applications International Corporation]. I find it particularly satisfying that our Laboratory is able to support the country in the current war on terrorism, in parallel with pursuing our primary mission of developing viable fusion energy," said MINDS team head Charles Gentile. ●

From left, MINDS team members Charles Gentile, Kenny Silber, Dana Mastrovito, and Bill Davis test the system. Other members of the team not pictured are Andy Carpe, Steve Langish, and Lewis Meixler.

PPPL Collaborates with MIT on X-Ray Crystal Spectrometer

The PPPL-MIT spectrometer collaboration team includes, from left, MIT's Alex Ince-Cushman, PPPL's Ken Hill and Manfred Bitter, MIT's John Rice, and Christian Broennimann of the Paul Scherrer Institute in Switzerland.

A PPPL-MIT collaboration on the Alcator C-Mod machine has resulted in the demonstration of a greatly improved X-ray crystal spectrometer. Alcator C-Mod is a fusion experiment at the MIT Plasma Science and Fusion Center in Massachusetts.

Experiments conducted by a PPPL-MIT team earlier this year mark the beginning of a new era in the ability of such devices to determine radial profiles of the ion temperature and the rotational velocity of high temperature plasmas without the need for diagnostic beams. Their success will benefit substantially ITER and other advanced fusion energy systems. ITER is an international fusion project being planned for construction in France. The U.S. is one of seven ITER partners. ●

Stix Prize Winner Granstedt Attends ITER Summer School in France

Prize Joins the Past, Present, and Future of Plasma Physics

By Patti Wieser

Princeton University graduate student Erik Granstedt was among 78 international students attending the first ITER Summer School, thanks to a fund created in memory of plasma physics giant Tom Stix.

Granstedt, winner of the 2007 Thomas H. Stix '54 Plasma Physics Prize, used the award to participate in the week-long summer school, "Turbulent Transport in Fusion Plasmas." The school was held in Aix-en-Provence, France: about an hour from Cadarache, the future site of ITER.

ITER (Latin for "the way") is a large international fusion experiment aimed at demonstrating the scientific and technological feasibility of fusion energy. Seven partners, including the U.S., are participating in the project, with operations expected to begin in 2016.

"We listened to lecturers from all over the world whose talks focused on science issues related to ITER," Granstedt said, adding that PPPL's Roscoe White and T.S. Hahm were among 21 presenters.

He said the students got a chance to talk to the school's speakers during coffee breaks and at a dinner reception. One day they took a side trip to Tore Supra, the French tokamak at Cadarache. They also visited lavender fields and found out about the distillation process for lavender oil.

Although the talks were in English, novice European visitor Granstedt benefited from striking up friendships with fellow students. "On the first day I arrived, I met a student from Russia who helped me get my bearings because he spoke some French," he said.

Once the school concluded, Granstedt took a side trip to the plasma physics lab at Ecole Polytechnique and ended his trip sightseeing with his wife in Paris. PPPL's Nat Fisch had gotten in touch with a friend at Ecole Polytechnique about hosting Granstedt's visit to the plasma physics experiments.

Erik Granstedt at the Eiffel Tower.

A second-year graduate student, Granstedt spent his first year at PPPL conducting research on Hall thrusters with Fisch and Yevgeny Raitses. "Cross-field turbulent transport is common to both," he said of his summer school education and his year's work on the thruster. The prize winner, who grew up in Honduras and Ecuador before his family settled in San Diego, came to Princeton after receiving bachelor's and master's degrees in applied physics from Caltech in 2004 and 2005. "I deferred for a year to go to Japan with my wife for Christian work," he said.

When he found out about the Stix Prize, he submitted a two-page proposal outlining how he would use the prize money and describing why it would be beneficial for him to participate in the ITER summer school program.

Granstedt had heard about Stix when he began studying physics. "Stix was one of a generation of great leaders in plasma physics, and I knew of his waves book [The Theory of Plasma Waves]," he said. "I see him as one of the founding fathers of plasma physics."

Stix was the founder and longtime director of graduate studies for the University's Program in Plasma Physics and a leader in the development of plasma physics. He died in 2001. A fund, co-organized by PPPL's Greg Hammett, was created in his memory to establish a prize for first and second-year graduate students studying plasma-related topics. The prize would enable international travel for conferences or research. PPPL's Hong Qin and Randy Wilson made up the selection committee in 2007.

This year's prize brings together a plasma physics great from the past, a student of the present, and a plasma physics project of the future: Stix, Granstedt, and ITER.

Of receiving the prize, Granstedt offered, "I feel really honored." He said it was fitting that the prize be used to support an international trip for a plasma physics student because he understood that Stix appreciated science's role in promoting international dialogue and understanding. By using it to attend international conferences, students establish connections with others around the world involved in similar research. Granstedt's experience at the ITER summer school enabled him to connect with others in the field — from student peers to researchers.

He said he believed the ITER summer school was meant to foster the interest of future fusion scientists and educate them about key ITER issues.

So might he end up being a researcher at ITER when it begins operating around 2016? "Perhaps." ●

PPPL Summer Program Empowers Next Generation of Plasma Scientists

By Chad Boutin

The future of nuclear fusion and its promise of limitless, clean energy arrived at PPPL last summer in the form of 28 budding scientists, many of them still in their teens.

This contingent of top-notch university and high school students from across the country gathered for a summer of intensive lab work in plasma physics, the field that could someday provide a way to create power the way the Sun does—by pressing two uncommon forms of hydrogen together until they combine to form helium atoms, releasing a burst of energy in the process.

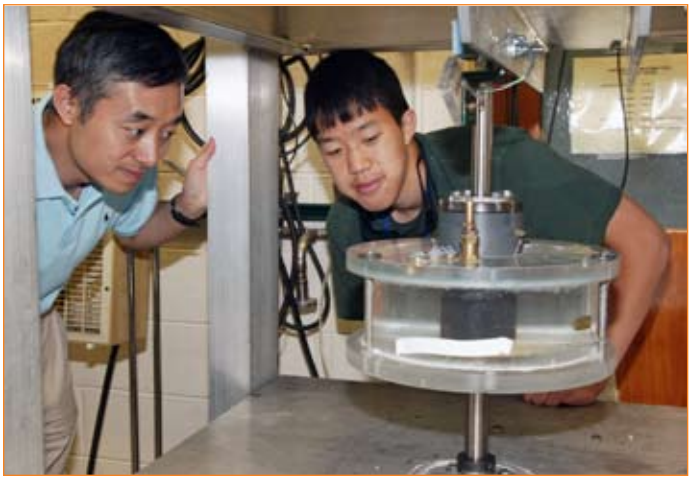
Because a practical fusion reactor may still be decades away, the current generation of fusion experts is already preparing to pass their nuclear torch on to the next, and the Lab's research internship program aims to provide a smooth hand-off.

"As a Lab, just as at the University, we want to train the next generation of scientists," said Andrew Zwicker, Head of PPPL's Science Education Program. "The point is to give them a real lab experience, with nothing canned, from the initial research to presenting the results at a national conference. We want to give them the most hands-on training we possibly can."

Providing this experience requires the joint commitment of a score of Lab scientists, who mentor the students; Princeton University, which provides room and board; and the U.S. Department of Energy, which funds the internship program. This marks the 16th year that student groups have come to the Lab for summer training, which Zwicker said is crucial to the future of the field.

"We track our students for up to eight years after they finish the program, and it turns out it makes a big difference in their career choices," he said. "We find that if we don't expose bright students to plasma physics when they are getting started, we lose them to other fields."

The university students spent their first week at PPPL in an intensive introduction to the physics of plasmas. Plasmas are hot, ionized gases used as the fuel in the production of fusion energy. The next nine weeks were spent in labs, working with scientists on research projects.



PPPL physicist Hantao Ji with a summer student at the lab.

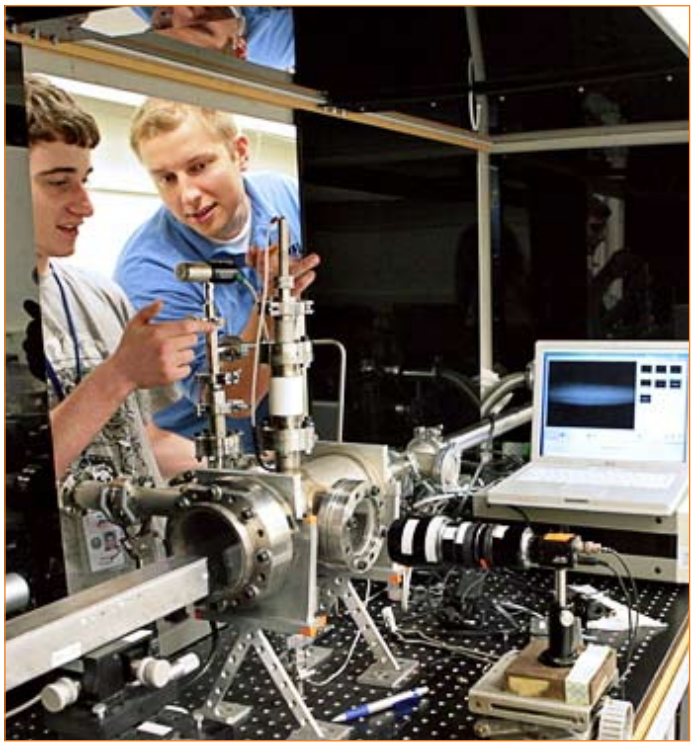


Photo by Denise Applewhite

Ruslan Fridman (left), a senior at Livingston High School, works on a dusty plasma chamber with his research partner, Mike Hvasta, a senior at the College of New Jersey.

Mike Hvasta, a physics major at The College of New Jersey, said he was excited to spend his summer in Princeton with a dusty plasma chamber. Dusty plasmas form the tail of comets. "Learning about dusty plasmas helps us understand things like the rings of Saturn," said Hvasta, whose mentor was Zwicker.

Hvasta, who intends to go on for an advanced degree in physics, said he grew more comfortable with his career choice as he spent time with the Lab's state-of-the-art equipment. "It's rewarding knowing what we're doing will contribute to the scientific body of knowledge, and tinkering with these machines helps me to really learn about them."

Two weeks after the university students arrived, an additional 10 high schoolers joined them in the Lab.

Zwicker said the research process is rigorous, but the numbers show it gives students the background they need to continue in the field. "Of the students who finish the summer program, about two-thirds go on to get an advanced degree in physics, math or engineering, and a fifth of those specialize in plasma physics," Zwicker said.

Joshua Kallman, who finished the summer program in 2005, is now in his second year of graduate school in plasma physics at Princeton. "I wasn't sure at that point what subfield of physics I wanted to study, and my time here inspired me to choose plasma physics as my career path," said Kallman. "I like the connection to fusion, to creating power. But it's also because I liked the work. I had a really great mentor, and the experience has led me to a great Lab here at the Forrestal Campus too." ●

PPPL's Anderson Has Spent Lifetime *Being Prepared*

You could say PPPL's Glenn Anderson was born with sea legs. By the time he was 11 they were well developed. "I grew up with the Sea Scouts. We cruised boats instead of pitching tents like the Boy Scouts," said Anderson, who came on board in 2006 as an electrical safety representative for the ES&H group.

His fascination with the sea and boating continued as an adult. This summer, the Point Pleasant resident retired from the U.S. Coast Guard with 20 years of service, including fours years on active duty and 16 on reserve. He was activated for 9-11 and Operation Restore Iraqi Freedom in 2003.

"I joined the Coast Guard when I graduated from high school and traveled all over aboard the Icebreaker Glacier — Antarctica, the Arctic, Fiji, Tahiti, American Samoa, New Zealand, Australia, and South America," said Anderson.

While enlisted he attended electricians school at Governors Island. Anderson is a N.J. licensed electrical contractor and N.J. electrical sub-code official. At the Lab he comments on electrical safety issues concerning peer labs, and is involved in PPPL design reviews and final electrical inspections.

After active duty, Anderson married Lisa Adams. "Basically on the weekends we are on the water," he said. The family has a Boston Whaler, kayaks, paddleboats, and sailboats, and both daughters, Kristen and Allyson, have their boating licenses. The latest acquisition for the Anderson fleet is a 24-foot Sea Ray. "It was idle for about three years, but the engine is in great shape," he said.

The sea and all things nautical have always entranced Anderson. "There was a scout unit three blocks from my house when I was growing up and a buddy of mine had joined. I went down to the unit when I was 11 and never left until the unit folded," he recalled, noting that nearly every weekend was spent there as a teen. "I was never home when I was a kid. I was always working on the engines and maintaining the boat."

Glenn Anderson and his wife, Lisa, and daughters Kristen and Allyson, attend Anderson's Coast Guard retirement ceremony.

The unit, with adult leadership, restored a 1954, 63-foot Aviation Rescue boat used by the Corps of Engineers' as an officers' party boat. The boat was completely restored to original specifications. "As teen scouts, we cruised the boat to Canada and North Carolina, and also used it to practice Army ROTC maneuvers with local colleges. It had been used as an Air Force rescue boat to rescue downed pilots," he said. After his military stint, he sailed as a civilian electrician with the U.S. Navy's Military Sealift Command and did a couple of tours of duty in the Mediterranean, and the North and South Atlantic. Shortly after Desert Storm he re-enlisted with the Coast Guard Reserve and was a qualified small boat engineer. He said being a reservist required spending two weeks each summer and one weekend a month on the boats.

Glen was honored for his years of Coast Guard service in July during a flag ceremony at the U.S. Coast Guard Station in Point Pleasant. Retiring from the Coast Guard, however, will not mean less time on the sea. "I'm more comfortable on boats. I can navigate better on water than on land," Anderson said. ●

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Information Services Head: Anthony R. DeMeo
Photographer: Elle Starkman
Editor/Writer: Patti Wieser
Layout and Graphics: Greg Czechowicz

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Pirates of PPPL Picnic

The Lab's "pirates" gathered on the front lawn at lunchtime on September 10 for the ship-side Pirates of PPPL Picnic. The USS Plasma crew and friends enjoyed food and buccaneer games, and had boatloads of fun. ARRRRR!

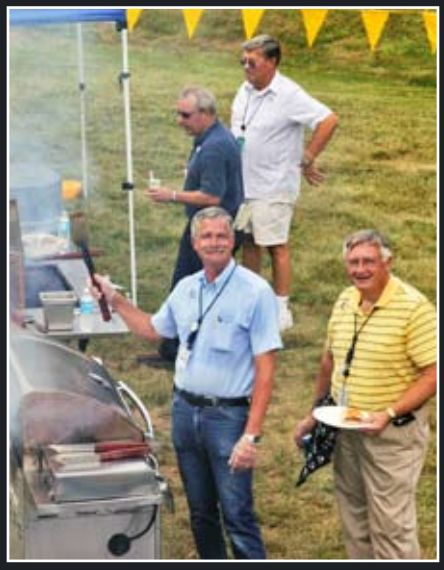

Photo by Elle Starkman

Stellarator Coils Shape Up

PPPL technician Doug Voorhees (above) is installing chill plates on a modular coil at PPPL's National Compact Stellarator Experiment (NCSX) Coil Winding Facility. The machine is being built at PPPL in partnership with Oak Ridge National Laboratory, with operations expected to begin in 2011. The stellarator's 18 modular field coils are among the most complex, innovative electromagnets ever designed. Six each of three coil types are being fabricated. More information about the project is on the web at: http://www.pppl.gov/nationalcompactstellarator.cfm ●