

At PPPL THIS WEEK

MONDAY, OCT. 21

Benefits Open Enrollment for 2014 Begins

TUESDAY, OCT. 22

Special PPPL Colloquium
3 p.m. ♦ MBG Auditorium

Creating, Diagnosing and Controlling High-energy Density Matter with Lasers

Yuan Ping, Lawrence Livermore National Laboratory

WEDNESDAY, OCT. 23

PPPL Colloquium
4:15 p.m. ♦ MBG Auditorium

Space Weather

Jacob Bortnik, University of California - Los Angeles

SATURDAY, OCT. 26

Boy Scout Merit Badge Fair
8 a.m. to 4 p.m.

UPCOMING EVENTS

Oct. 28 - Nov. 1
Max Planck Princeton Research Center for Plasma Physics Meeting

Oct. 28 - 29 at PPPL
Oct. 30 - Nov. 1 at Princeton Univ.

October 30
PPPL Colloquium
4:15 p.m. ♦ MBG Auditorium
Why the Big Bang was not the Beginning
Paul Steinhardt, Princeton University

November 3
Daylight Saving Time ends

November 4
United Way Campaign begins

INSIDE...



Boy Scout Fair
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Fire Safety
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Cafe@PPPL Menu ...
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Director's Corner

Agreement ends weeks of uncertainty



By **STEWART PRAGER** — Director, Princeton Plasma Physics Laboratory

Dear PPPL'ers:

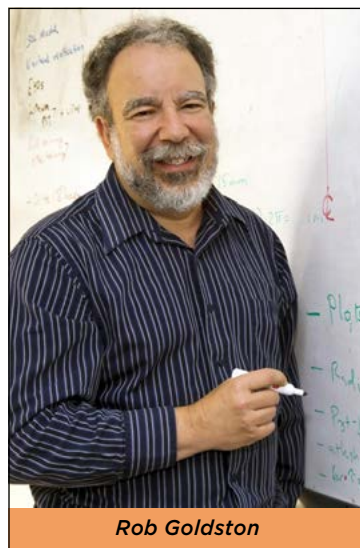
As you all know, last Wednesday evening Congress reached an agreement that both ended the lapse in funding (the "government shutdown") and raised the debt ceiling. This was very good news and brought to closure a very stressful period. We at PPPL were relatively fortunate during this time of great uncertainty – we were able to remain open and to advance our mission, while cutting back on expenditures. It is most unfortunate, and we are saddened, that our colleagues at many federal agencies and other laboratories suffered closure and furloughs. The budget agreement extends to January 15 and the debt ceiling agreement to February 7. Let us hope that, before those new deadlines, Congress reaches agreements and we do not have to relive another deadline crisis.

Through these past few weeks, all of you at PPPL have remained calm, focused, and dedicated to your important work. For that, I am very grateful.

Sincerely,

Rob Goldston: "Progress in fusion has been amazing!"

Courtesy of ITER Newline



Rob Goldston

Former PPPL director, physicist and Princeton University professor of Astrophysical Sciences Rob Goldston was interviewed in the Sept. 30 issue of the [ITER Newline](#) about his view of how magnetic fusion has progressed in the 40 years since he first came to Princeton in 1972 as a graduate student in the Program in Plasma Physics. This article is reprinted with the permission of ITER Newline:

In every field of human creation, the 1970s were an exceptionally exciting decade. Everything seemed to be open for exploration: the arts, the sciences, politics, the economy. Inventiveness and inspiration were the rule that drove artists and physicists alike.

Fusion research was no exception. The field had been completely transformed 10 years earlier by the introduction of a new architecture in fusion machines — the tokamak.

As they aimed to change the world, fusion research and plasma physics attracted brilliant and creative minds. Rob Goldston, who came to Princeton University in 1972 as a graduate student in the Program in Plasma Physics was one of them.

He reflects here on the 40 years gone by, from his first experiments with the Adiabatic Toroidal Compressor to his present involvement with ITER.

Altitude seems to have played an important part in the early history of fusion. Lyman Spitzer had the intuition of the "magnetic bottle" while skiing on a mountain slope in Aspen, Colorado and—if we are to believe fusion lore — you had your own epiphany on a mountaintop in Vermont some 43 years ago that changed the course of your career. Can you tell us about this moment?

R.G. When I entered Harvard University I wasn't sure if I wanted to study psychology or physics, so for my first year and a half I took the courses I needed for both majors. I was pretty dissatisfied with my psychology courses —it didn't

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PPPL will welcome 250 Scouts to STEM event Oct. 26

By Jeanne Jackson DeVoe

A cadre of Boy Scouts, former Boy Scouts, and volunteers who are Scouts at heart from PPPL will be helping out with the Laboratory's first "Science and Technology Merit Badge Fair," which will bring about 250 Boy Scouts to the Laboratory to learn about science and technology on Saturday, Oct. 26.

The future of the event was in question because of the lapse in U.S. government funding but organizer Robert Sheneman, head of the Environmental Services Division, confirmed it would, in fact, be taking place after the U.S. government reopened last week. "We definitely want to tell people that we're on," said Sheneman, a former Boy Scout and Eagle Scout who led each of his four sons' Cub Scout and Boy Scout troops.

"We're excited to be able to open up the Laboratory to the scouting community and to bring our expertise to young people who are interested in science and technology," Sheneman added.

Some 25 PPPLers have volunteered as "technical experts" and more than a dozen have stepped forward to help out with the check-in and to serve as escorts but more volunteers are needed for a few hours in the morning and early afternoon. (Contact Sheneman at rsHENEMA@pppl.gov to volunteer).

There will be two meetings for volunteers on Tuesday, Oct. 22 at 10 a.m. and on Thursday, Oct. 24 at 1 p.m. in the Director's Conference Room, Room B331.

The PPPL "experts" will offer hands-on activities with the help of Merit Badge counselors in a wide range of 17 different subjects including robotics, engineering, electronics, sustainability and, of course, nuclear science.

"PPPL provides a unique venue for us to make science accessible, understandable and fun," said



Steve Bernini, the staff advisor to the STEM program at the Boy Scouts Council of Central Jersey in Dayton, N.J.

Boy Scouts typically earn Merit Badges in a variety of subjects in order to progress through the Boy Scout ranks from Star to Life Scout to Eagle Scout. While some badges, like First Aid and Family Life, are required, there are numerous choices for optional badges. The PPPL STEM event will give Boy Scouts a rare opportunity to earn Merit Badges in specialized STEM fields that they don't often get because many require the Scouts to work with engineers or scientists.

True to the Boy Scout motto, "Be prepared," the Scouts must fulfill various requirements, such as reading a book on the subject and completing various activities, before they come to PPPL for the final activities.

The Scouts will begin checking in at PPPL at about 8:30 a.m. and will meet together in the auditorium, before meeting their PPPL "experts" and going to the morning session from 9:30 a.m. to 11:30 a.m. or 12:15 p.m. After breaking for lunch, they'll have an afternoon session from about 12:45 or 1:15 p.m. to approximately 3:30 or 4 p.m. (The activities are staggered and some are a full day). "I'm looking forward to a fun day," Sheneman said.

Meanwhile, Sheneman has already met with representatives of local Girl Scout troops to discuss the possibility of PPPL hosting an event for local Girl Scouts. They do not have the same badge system as the Boy Scouts but were enthusiastic about the idea of organizing a STEM event, possibly as early as next spring. "I really conveyed to them that the Laboratory is very much interested in that," said Sheneman. ☐

PPPL Fire Safety Demonstrations

PPPL's Emergency Services Unit gave fire safety demonstrations on Monday, Oct. 14, after being rained out on Friday. The demonstrations were part of the annual Fire Prevention Week. ☐



Officer Sean Galie, right, is all smiles as Sonja Patterson tries on a fire hat.



PPPL's Deputy Director for Operations Adam Cohen, right, tries out his fire extinguishing skills with the help of ESU Officer John Mazukewicz during fire safety demonstrations outside the LSB building.

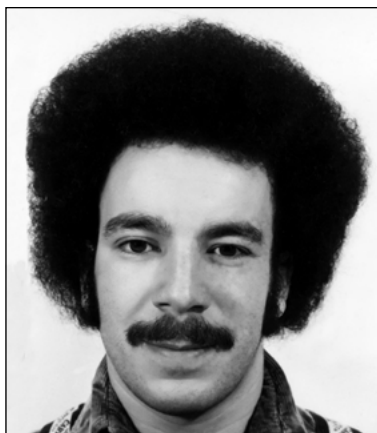


PPPL Officer Jon Bain gave fire extinguisher training to about 30 residents at the Plainsboro Township Fire Department Open House on Sunday, Oct. 6 at Station 49 in Plainsboro.

(Photos by Jon Bain)

Goldston

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In her 1990 book on fusion history ("Fusion, the search for endless energy"), author Robin Herman described young Rob Goldston as having a "black Cossack mustache and bushy black hair that grew out and up so that the circumference of his head increased as weeks went by."

started climbing. I spent the night in a cabin two-thirds of the way to the peak and the next morning headed up alone to the bald, stony top. After some distance I hung my jacket on a tree, figuring I would pick it up on the way back—my compass and map, however, were in the jacket pocket. I got to the top and after a moment looking around realized that I had lost track of my direction. I had visions of newspapers coming off a printing press, like in a 1930s movie, with headlines about a young man found dead on top of Mt. Mansfield.

This, unlike the view, engaged my emotions and my mind. I reasoned that if I walked down from the peak in a slowly expanding spiral I would have to cross the trail and find my jacket, map and compass. This is exactly what I did and exactly what happened. What a joyous consequence of using logic and geometry!

I spent the rest of the day enjoying fun things like jumping between boulders and "feeling" gravity. I came to the conclusion that what was fun about being human was playing with energy. For example, Mozart eats an omelette in the morning and composes a symphony in the afternoon. As I looked down on the valley below and saw smoke coming up from the houses, it occurred to me that the key is to access energy without making a mess in the process. And so I thought about fusion, and thought that maybe I could contribute. I returned to the university and ultimately graduated magna cum laude in physics—I don't think many students switch from psychology to physics in their junior year! I worked at the MIT fusion lab during my summers, and then went to graduate school at Princeton.

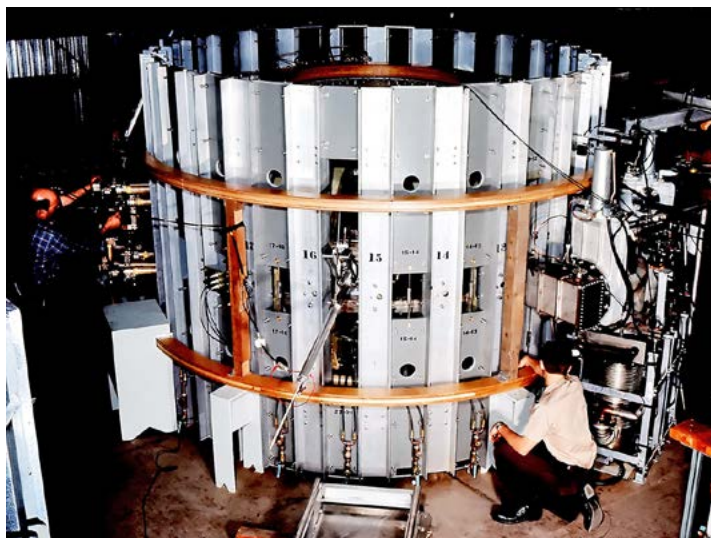
Entering the world of fusion research in the mid-1970s must have been exciting — one scientific and technical breakthrough followed another. Did you feel that the Holy Grail was close at hand?

I understood from the beginning that fusion energy was not going to happen overnight. I was then, and I continue to be, happy standing on the shoulders of giants and seeing a bit further towards our goal. And I knew then, as I do now, that we will be able to make industrial levels of fusion energy. I am confident that ITER will prove this. All along, however, I have recognized that there will be big challenges to making fusion economical.

What attracted you more, the game-changing nature of fusion as an unlimited energy source, or the intellectual challenge of understanding the wonderful and fascinating tricks of plasma?

seem to me that my professors had much in the way of real knowledge to impart. On the other hand, my physics teachers clearly knew what they were talking about and physics problems had definite solutions. With enough thought I could even find those solutions. I found myself enjoying the big red books filled with mysteries and the fun of unravelling them.

On the way home from Montreal with a friend, I had him drop me off at the base of Mt. Mansfield in Vermont. I chained my bicycle to a tree and



Scientists used the Adiabatic Toroidal Compressor to investigate a technique for increasing the temperature and density of tokamak plasmas during the 1970s.

I liked them both. The two biggest highlights of my early career were one of each type.

In 1978, I got to report at the IAEA Fusion Energy Conference on the breakthrough towards fusion energy that we made with neutral beam heating on the Princeton Large Torus (PLT), achieving ion temperatures in the range of 5 keV for the first time ever.

The British team was especially skeptical about these results, given the problems that were uncovered with their early ZETA experiments when the measured neutrons proved not to be thermonuclear. The team organized a special session to dig into the PLT results with a tremendously long list of questions. I represented the Princeton group to an audience of the most distinguished plasma physicists in the world, and worked through the answers one by one. People went away satisfied, and I went away thrilled. That was on the fusion energy side.

As for the thrill of the intellectual challenge, our group discovered a new instability on the Princeton Divertor Experiment (PDX) that barred the way to higher plasma pressure. We called it the "fishbone" instability, based on the signals we saw on the magnetic pickup coils. By doing numerical calculations one night soon after the discovery, I figured out that the instability was traveling around the torus in synchrony with the trajectories of so-called trapped beam ions, and therefore was very likely directly driven by them. At that moment, at my desk in the middle of the night, I was the only person in the world who understood this important piece of physics. There is really very little in life that compares with such a thrill.

When did you realize — or did you know right from the start — that the road to fusion energy would be much longer, complex and costly than expected?

As I say, I knew all along that fusion was going to require a huge scale-up from our experiments. My friends in graduate school had a good laugh at my expense when I came to dinner one evening with oscilloscope pictures showing signals from 31 fusion neutrons.

Three years after I got my Ph.D, in 1980, the U.S. Congress passed the Magnetic Fusion Engineering Act authorizing a budget for magnetic fusion energy development that was pretty hefty. Twenty-three years later I led a subcommittee for the Fusion Energy Sciences Advisory Committee that examined the future development costs for fusion energy. After we had submitted our report I looked back at the 1980 Congressional authorization and — if you added in what had been spent between 1980 and 2003 — our cost projection was about the same. But fusion had been funded at about one-third of the rate specified in the Congressional authorization. By then I had learned about the difference between "au-

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Goldston

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thorization" and "appropriation." The latter is what really counts. I had been director of the Princeton Plasma Physics Laboratory for six years by that time.

From the Adiabatic Toroidal Compressor (ATC, Princeton) in graduate school, to PLT, to the TFTR physics program that you headed soon after the machine began operations, and on to ITER, you have been involved with four generations of fusion devices. How would you describe the progress that was accomplished during the past four decades?

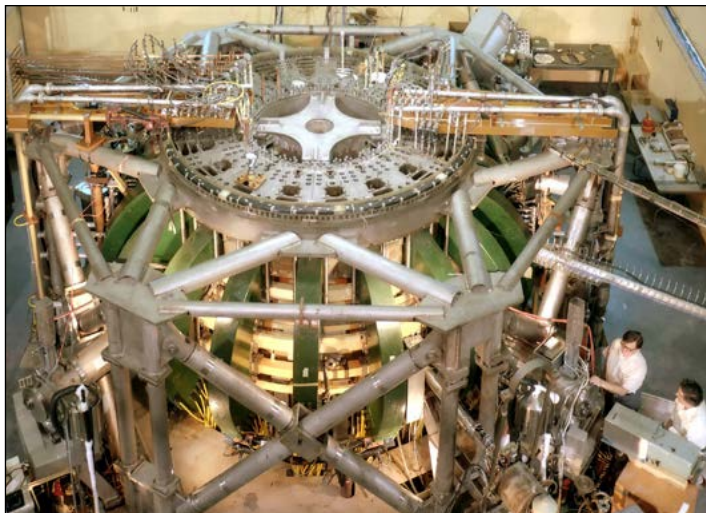
Amazing. We made about one-tenth of a watt of fusion energy for about one hundredth of a second on ATC, and we will make hundreds of megawatts of fusion power in ITER for 15 minutes and longer. That is 13 orders of magnitude — 10 million million. Quite a scale-up! We have also learned more than a little high-temperature plasma physics along the way.

In 2006 you wrote an article entitled "Is Fusion Research Worth It?" In short, what would be your answer today?

Yes. If fusion can be significantly better than other energy sources, however you think about better (cheaper, safer, cleaner, less risk of proliferation) then even if you have a moderate chance of success, the net present value of the research is much greater than its cost.

How do you see the scientist's relationship to large societal issues? Do you think a scientist has a special responsibility?

I do think scientists have a special responsibility to examine the societal issues associated with their work, and, more generally, in areas where they have particular knowledge. We don't have any special moral authority to judge good vs. bad, but we do have the capability of seeing the potential outcomes of scientific and technological R&D in ways that others cannot. We have the responsibility to make these potential outcomes clear to the public.



The Princeton Large Torus (PLT) experiment used neutral beam heating to achieve a then-record plasma temperature of 60 million degrees Celsius in 1978.

This theme, in fact, motivates my undergraduate course at Princeton, "The Science and Technology of Nuclear Power: Fission and Fusion." The course is for science and engineering majors, not for political scientists. We stretch their scientific capabilities by digging into the fascinating underlying physics of both energy systems. As I developed this course, I found it pretty amazing how much you can understand about fission and fusion energy with just undergraduate physics. By the end, the students understand in some detail what happened at Fukushima and how dangerous it is to have no plans for "beyond-design-basis" accidents. They know for themselves how to calculate the number of weeks it would take Iran to produce the material for a bomb if it broke out from IAEA safeguards, and they know what the scientific and technological issues are for fusion—including ITER's role. So, hopefully, they are both better scientists and better citizens.

What message would you send to the ITER staff?

Keep at it! We need ITER to succeed, and we need your energy, your insight and your enthusiasm for it to happen. ☺



The Tokamak Fusion Test Reactor (TFTR) set then-world records by producing 9.2 million watts of fusion power in 1994 and reaching a plasma temperature of 510 million degrees Celsius in 1995 before being decommissioned later in the decade.

SPECIAL • SPECIAL • SPECIAL • SPECIAL • SPECIAL

COLLOQUIUM



Creating, Diagnosing and Controlling High-energy Density Matter with Lasers

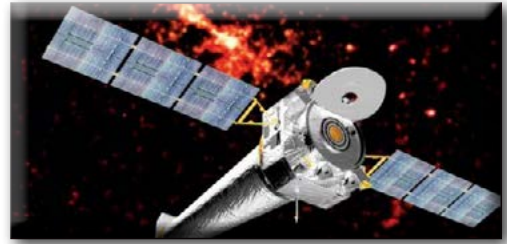
YUAN PING

Lawrence Livermore National Laboratory

Tuesday, Oct. 22

3 p.m. (Coffee/Tea at 2:45 p.m.) • MBG Auditorium

COLLOQUIUM



Space Weather

JACOB BORTNIK

University of California - Los Angeles

Wednesday, Oct. 23

4:15 p.m. (Coffee/Tea at 4 p.m.) • MBG Auditorium

OPEN ENROLLMENT BEGINS TODAY, OCT. 21

Open enrollment for health benefits will be from Oct. 21 through Nov. 15. You should have received the 2014 Annual Benefits Open Enrollment packet at home by now. You can also view the packet online at www.princeton.edu/hr/oe starting today.

The PPPL Health Fair will be held on Nov. 6 from 10 a.m. to 2 p.m. and representatives from various health care providers will be on hand to answer your questions.

Representatives of two free programs, My Health Coach and My Medical Expert, will give a presentation in the MBG auditorium at 11 a.m.

FLU SHOTS STILL AVAILABLE



Flu vaccine appointments are still available at PPPL. Please contact the OMO at extension 3200 or email omo@pppl.gov for an appointment. The vaccine is available to regular employees, grad students and DOE.

Coming soon...



\$2 BELOW PPPL Value Menu



Flatbread Breakfast Sandwiches



Breakfast Combos



Menu

BREAKFAST 7 a.m. • 10 a.m.
CONTINENTAL BREAKFAST 10 a.m. • 11:30 a.m.
LUNCH 11:30 a.m. • 1:30 p.m.
SNACK SERVICE until 2:30 p.m.

— **MARK GAZO, Chef Manager**

COMMAND PERFORMANCE
CHEF'S FEATURE

MON. 21
OCT.



CHICKEN CHOW MEIN WITH RICE

Sausage, Egg and Cheese Croissant

Vegetarian Lentil

Grilled Roast Beef & Provolone with Horseradish Cream

Turkey Cobb Wrap with Bacon, Avocado, Tomato & Bleu Cheese

Philly Cheesesteak Panini

½ Sandwich, Small Soup or Salad, Chips, 12 oz. Soda

TUE. 22
OCT.



MEAT & CHEESE LASAGNA

Ham Steak with Two Eggs Any Style

Chicken Vegetable with Rice

Buffalo Chicken Wrap

Turkey, Ham, Swiss Russian Dressing & Coleslaw on Rye

Seafood Salad Melt With American Cheese on Rye

2 Slices Pizza, Bag of Chips, 12 oz. Soda

WED. 23
OCT.



BEEF & BEAN BURRITO

Potato Pancakes and Applesauce

Cream of Spinach

BBQ Beef on a Kaiser Roll with Onion Rings

Curried Chicken Salad with Greek Yogurt

Tomato, Fresh Mozzarella and Basil Ciabatta

Cheeseburger, French Fries, 12 oz. Soda

THU. 24
OCT.



CHEESE RAVIOLI

Florentine Omelet with Spinach and Feta Cheese

French Onion

BBQ Blue Turkey Burger

Classic Italian Sub

Roast Veggie Wrap with Feta Cheese and Hummus

2 Hot Dogs, French Fries, 12 oz. Soda

FRI. 25
OCT.



BLACKENED SALMON

Craisin Pancakes with Turkey Sausage

Black Bean with Ham

Grilled Middle Eastern Turkey Burger with Yogurt

Turkey, Cheddar and Bacon on Rye

Chicken Cutlet Sub

Meatball Sandwich, Potato Chips, 12 oz. Soda

MENU SUBJECT TO CHANGE WITHOUT NOTICE

VEGETARIAN OPTION

CLICK HERE FOR A PRINTABLE WEEKLY MENU

WEEKLY

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