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People Profile: Rob Goldston

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Profiles Encouraged — Dr. Rob Goldston

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Dr. Rob Goldston

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Education: Ph. D. in Astrophysics, Princeton
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Number of employees: 474 full time (which includes
91 physicists and 85 engineers,
plus support staff).

Important Publications— Books:

Eliezer & Eliezer, *The Fourth State of Matter*, 2nd edition, (paper), 2001, Institute of Physics Publishing; Goldston & Rutherford, *Introduction to Plasma Physics*, (both cloth & paper), 1995, Institute of Physics Publishing. **Journals:** *Nuclear Fusion*, International Atomic Energy Agency; *Physics of Plasmas*, American Institute of Physics; *Plasma Physics and Controlled Fusion*, Institute of Physics Publishing; *Plasma Sources Science and Technology*, Institute of Physics Publishing.

Important Developments: 50th anniversary of the Princeton Plasma Physics Labs (PPPL).

JL: I've heard the scientific term, *plasma*, described as the *fourth state of matter*. When we think about our Sun, we are really witnessing plasmas occurring in thermonuclear reactions. At PPPL your researchers are producing controlled plasma forces here on earth! I believe our readers will find that mind boggling. Could you comment on that?

Dr. Goldston: It still amazes me that we can create plasmas in the laboratory at temperatures approaching a billion degrees Fahrenheit - actually quite a bit hotter than the center of the sun. These plasmas are contained by magnetic fields, while the bulk of the sun is contained by gravity. Plasmas are ionized gases - gases so hot that collisions have ripped the electrons away from the atomic nuclei. As a result a plasma is a dizzying whirl of plus and minus charges, so it is electrically very responsive, and can be channeled by magnetic fields, as we do in the laboratory, and as happens on the surface of sun in coronal arches.

JL: I think that our readers will be amazed at the extent of international collaboration that goes on in plasma physics research at PPPL, and isn't the ITER (International Thermonuclear Reactor) collaboration very large also?

Dr. Goldston: Since 1958 scientific research focused on generating energy from fusion has been highly international. During the Cold War, fusion research was one of the rare areas where the US and the Soviet Union collaborated. Many visitors from abroad came to PPPL to participate in our experiments, and we sent scientists and engineers overseas as well. Fusion is an international enterprise, which will hopefully benefit the whole world. The US participated in the design of the ITER experiment, and with a little luck we may participate in its construction, along with Europe, Japan, Russia and maybe Canada. There are also strong fusion research programs in South Korea, India and China, and smaller programs

in many other countries.

JL: As a non-scientist myself, I look at what you and your researchers are doing, and I think to myself that Plasma Physics Research could solve world problems like global warming and perhaps provide us with new technologies for exploring our solar system and beyond.

Dr. Goldston: Indeed, fusion energy research is aimed at providing a new energy source, which would be clean and safe, and not emit carbon dioxide. This is a major reason why many of us are doing this research. The debate about global warming tends to be polarized between those who do not believe it is an issue, and those who feel we must restructure our economy immediately. In fact, carbon dioxide build-up is a 100 year issue, and we have time to develop attractive energy sources like fusion - so long as we begin to deploy them sometime in the middle of this century. As far as space travel goes, it is hard to imagine any power source other than fusion which could be used for interstellar travel. Plasma "jets" (not necessarily powered by fusion) are an attractive means for interplanetary travel.

JL: The 50th Anniversary of the PPPL Lab is coming up, and I believe you will be celebrating this wonderful event in mid-September. It must be a homecoming of a sort for many scientists who got their start at PPPL and will be returning for the anniversary.

Dr. Goldston: The 50th anniversary party was delayed by the events of 9/11. These events, I think, further underscore the importance of energy sources like fusion whose fuel is easily available to all nations, for thousands of years. We are tentatively rescheduling the symposium for this June. Indeed, many leaders of the US and world fusion community have spent some of their career at PPPL, so this would be a homecoming of a sort for them.

JL: When you were growing up, did you know that you wanted to be a physicist? How did you first get interested in plasma physics and did you have a mentor in the Physics Department, here at Princeton?


Dr. Goldston: I was interested in physics from my childhood. I used to read popular books on science in summer camp when I was supposed to be at sports events - the counselors called my mother to ask what was going on. I think she reassured them that this was OK. I got interested in plasma physics and fusion the summer between my sophomore and junior years in college, when I was climbing Mt. Mansfield, near Stowe, Vt. I was enjoying the feeling of running around the mountain -

using energy - and had the thought that what was special about being human was that we consumed energy and made beauty. Mozart eats a pastry and drinks some coffee in the morning and writes a symphony in the afternoon. Looking down at Stowe village, I saw smoke coming up from chimneys, and had the thought that the trick was to access energy without making waste. I had read *Scientific American* articles about fusion and plasma physics, and decided that I wanted to see if I could get into that field. It turned out that my Dad knew the parents of an engineer at MIT working at their fusion lab - and helped me get a summer job the next year. I had a great time working there, and decided to pursue a career in this field. After graduating from Harvard with a BS in Physics, I went to Princeton in 1972 for graduate study in plasma physics. My closest mentors at Princeton were Harold Eubank, who was an instrument builder of the highest caliber, and Harold Furth, who understood how to build enthusiasm in a scientific team so that they produced excellence under fire.

JL: It must have been a wonderful thrill for everyone here when your PPPL colleague, Dr. Russell Hulse, won the Nobel Prize in 1993—an incredible day at PPPL?

Dr. Goldston: It certainly was wonderful when Russell Hulse won the Nobel Prize. Many of us had wondered if and when this would happen, because the work he did with Joe Taylor had tremendous impact in astrophysics, and more broadly in physics. It has provided a wonderful laboratory for testing key aspects of general relativity - in particular the radiation of gravity waves - which really cannot be studied anywhere in our solar system.

JL: On behalf of *Against the Grain* readers, thank you so much for taking the time to let us know about the marvelous science/engineering you and your colleagues are doing.

Dr. Goldston: It is a pleasure to tell you about our activities. Fusion Energy Science is vibrant with new and subtle science. Plasmas are wonderful tricksters, but when the tricks are revealed they are uniformly beautiful. And we are making dramatic progress towards a new energy source. I encourage your readers to look to science both for useful discoveries and for beautiful insights into how the world operates. 

This column is dedicated to the memory of Jolanda von Hagen who inspired it. — JL