Focus Fusion Eco Safe * Green * Clean * Virtually Unlimited * Cheap

Lawrenceville Plasma Physics, Inc

High technology research, development and consulting in plasma physics, X-ray sources, and Focus Fusion

Focus Fusion Report
October 17, 2017

Summary:

- **UC San Diego CER to Collaborate**
- **Two More DPF Groups Aim to Use pB11 in 2018**
- **IEEE Spectrum Reports on LPPFusion**
- **Former Fusion Chief Advocates pB11 in *Physics Today***

UC San Diego Center for Energy Research, LPPFusion to Collaborate on Fusion Energy Research

The ideal energy source is the goal of a new collaboration between the Center for Energy Research (CER) at UC San Diego and LPPFusion, Inc. The collaboration, formalized with an agreement on October 2, aims at the development of the dense plasma focus (DPF) device for fusion energy. "The alternate fusion schemes offer a potential route to fusion energy that could be faster and much cheaper than other approaches," explains CER Director, Farhat N. Beg. "LPPFusion is a leader in this field and will make available to CER its research data and expertise to help us set up our own DPF facility at UC San Diego."

LPPFusion's FF-1 device is one of only a few mega-ampere DPFs in the world. Our research in the coming year will involve the first experiments using hydrogen-boron fuel. This fuel produces energy in the form of charged particles only, not neutrons, which both eliminates radioactive waste and makes possible inexpensive direct conversion of energy to electricity.

"The collaboration with the Center for Energy Research will help us to better analyze and understand our data," said LPPFusion President and Chief Scientist Eric J. Lerner. "Their expertise in plasma simulation will aid our efforts in modeling our experiments. We also expect that, once their own DPF is functioning, we can perform joint experiments that will help demonstrate how the DPF energy output scales with energy input. That is crucial to achieving the goal of getting more energy out of the device than we put into it."

LPPFusion is already collaborating with two DPF efforts in Poland, one at the Institute of Nuclear Physics of the Polish Academy of Sciences in Krakow and the other at the Institute of Plasma Physics and Laser Microfusion in Warsaw. For the Center for Energy Research, the LPPFusion collaboration will add a new approach to the fusion collaborations the Center already has with other leading fusion labs, including JET, the world's largest tokamak in Culham, England and Princeton Plasma Physics Laboratory.

Two More DPF Groups Aim to Use pB11 in 2018

Two dense plasma focus teams in Poland plan to use hydrogen-boron fuels in their experiments in 2018. This will mean that, including the planned experiments with LPPF's FF-1 device there will be three devices simultaneously experimenting, for the first time, with the combination of DPF and pB11 that LPPF has long called "Focus Fusion". The two Polish groups are the teams using the PF-1000 device in Warsaw and PF-24 device in Krakow. The three groups have informally agreed to collaborate and exchange results. The plans were announced at the annual meeting in Warsaw Poland of the International Scientific Committee for Dense Magnetized Plasmas (ISCDMP), a coordinating group for plasma focus work around the world.

The three experiments will take somewhat different approaches to using the fuel, which is widely considered the ideal fusion fuel, producing no neutrons in the main reaction. While LPPF will introduce both hydrogen and boron to the chamber as a gas, using the compound decaborane, the PF-1000 group will puff the gas into the device right before the pinch compression and the PF-24 team will vaporize boron with a laser to add to a hydrogen plasma. "Having three approaches sharing data will allow us to get more useful results faster," explains LPPF's Lerner.

LPPF had established a collaborative relation last year with the PF-24 group led by Dr. Marek Scholz at the Institute of Nuclear Physics of the Polish Academy of Sciences in Krakow (see Oct 28, 2016 Focus Fusion report). The PF-24 is very similar physically to FF-1 and the two groups are already comparing results with deuterium fuel. The PF-1000 at the Institute of Plasma Physics and Laser Microfusion is by contrast a much larger machine with electrodes 4 times as large as those of FF-1. Researchers using that device, including Dr. Pavel Kubes of the Czech Technical University have observed in detail the formation of the same plasmoids that occur in FF-1.

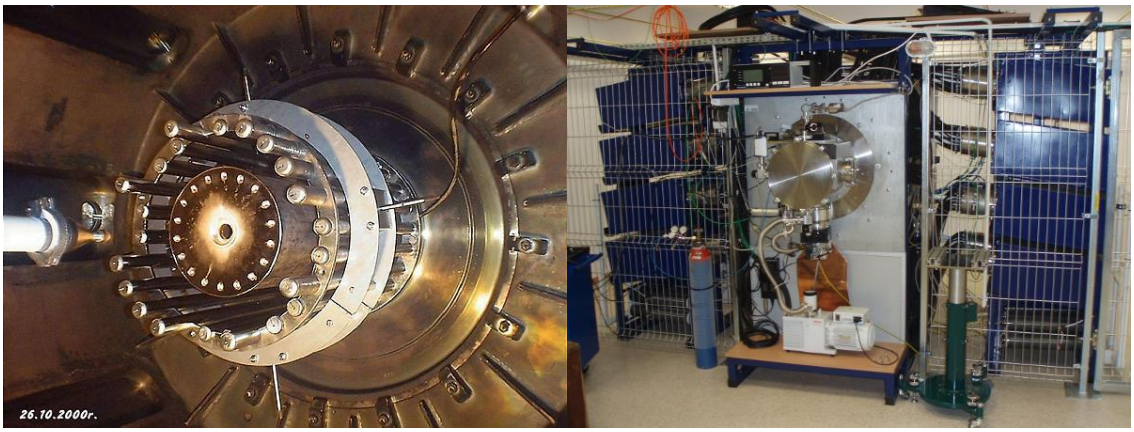

Figure 1. The PF-1000 (left) and the PF-24 (right) will join the FF-1 in experiments with pB11 fuel in 2018.

At the same meeting of the ISCDMP, the assembled researchers started a process to arrive at a common set of top research priorities for DPF work globally. On an initiative by Dr. Sunil Aulick the process will generate in the coming month a list of key goals to achieve and questions to be resolved, as well as specific proposals for joint research. The committee also voted unanimously to add new members, including Lerner, who will represent the United States in the committee.

IEEE Spectrum Reports on LPPFusion

IEEE Spectrum, journal of the world's largest technical organization, the Institute of Electrical and Electronics Engineers with a half-million members, published a profile of LPPFusion. The article, titled, "Startup: LPPFusion Embraces Instability" was published online Sept. 22 and in the October print issue. It gives a good description of our approach and our position relative to other efforts. It is the most prominent of a new round of reporting on LPPFusion.

Startup: LPPFusion Embraces Instability

Rather than fighting to control plasma, this startup's device exploits instabilities to fuse atoms

Posted 22 Sep 2017 | 19:00 GMT

By **MARK ANDERSON**

Since nuclear fusion's earliest days, the sun has served as the ultimate prototype. It's the closest continuously functioning large-scale fusion reactor, after all. Why not copy from the best? So tokamaks, stellarators, and laser ignition facilities all strive to create high-pressure and high-temperature plasmas that behave like microcosms of the sun's core.

uclear/national-ignition-facility-achieves-record-energies

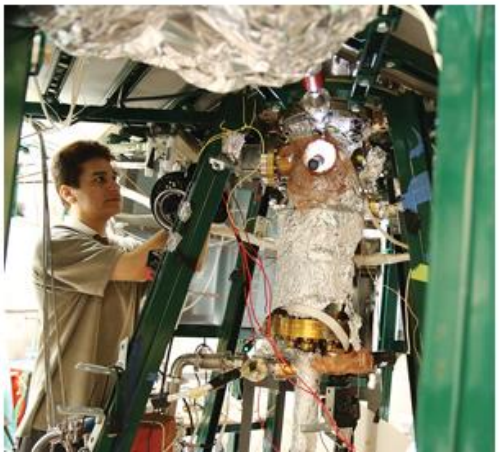

Figure 2. Dr. Syed Hassan, LPPF Research Physicist, appears in IEEE spectrum profile.

Former US Fusion Chief Hirsch Advocates pB11 in *Physics Today*

Former director of the U.S. fusion energy program Robert L. Hirsch advocated moving research efforts to "a much cleaner fusion reaction"—hydrogen-boron (pB11)—in a letter to the editor published by *Physics Today*, the widely-read popular journal for the American Physical Society. In a major contribution to the debate on the direction of governmental fusion research programs, published in the journal's October issue, Dr. Hirsch sharply criticized the present governmental focus on the tokamak and especially the huge ITER project.

Hirsch, who headed the U.S. fusion energy program in the 1970's, pointed out that as early as 1994, studies indicated that the tokamak would be 60 times as massive as a fission reactor core of the same power, and thus far more expensive. Given the fundamental problems of huge size and cost and the radioactivity induced by the deuterium-tritium (DT) fuel, "one can only guess at why ITER continues to be built", Hirsch wrote.

Instead of continuing to focus on tokamaks and DT fuel Hirsch contends that "moving to a much cleaner fusion reaction would seem appropriate. Of particular interest is the proton and boron-11 reaction, which involves significantly more challenging physics but produces no neutrons directly. The absence of neutrons would largely eliminate the risks due to radioactivity and thereby dramatically enhance economics, regulatory simplicity, and public acceptance." He points out that, "Thankfully, a few privately funded projects in the U.S. and elsewhere are pursuing p–^{11}B". Among those projects is of course LPPFusion. (In December, 2013 Dr. Hirsch headed a four-scientist review committee that concluded that LPPF's efforts deserve "a much higher level of investment … based on their considerable progress to date."

Physics Today solicited a reply to Dr. Hirsch's letter from Steven Crowley, former CEO of the UK Atomic Energy Authority. Dr. Crowley, however, while defending ITER and tokamaks, did not respond to Dr. Hirsch's alternative of pB11 approaches. The exchange in such a prominent publication is likely to spur further debate within the physics community on aneutronic fusion and the overall allocation of government fusion research efforts.