



Lawrenceville Plasma Physics, Inc

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

Focus Fusion Report

May 21, 2012

Summary:

- **LPP and Iran's Plasma Physics Research Center sign collaboration for scientific publications**
- **International press coverage of FF-1**
- **Testing of new cathode begins**

Plasma Physics Research Center, lead institution in Iran's fusion program, and LPP agree to collaboration to create and publish scientific papers on aneutronic fusion

In a direct response to the "Fusion for Peace" initiative of LPP's Eric Lerner and fusion physicists from Iran and Japan, the Plasma Physics Research Center of I. Azad University in Tehran, Iran, and LPP signed a contract on May 20 committing the two institutions to collaboration "in the Creation and Publication of Scientific Papers in the Fields of Aneutronic Fusion and the Dense Plasma Focus". The Plasma Physics Research Center (PPRC) has over 150 graduate students, including 50 PhD candidates. By comparison, there are about 90 plasma physics PhD students in the entire US. Iran is the only country at present, other than the US, which has a substantial research program in aneutronic fusion.

The collaboration will involve exchange and analysis of data on DPF experiments, simulations, consultation on instruments, work on design of research DPFs, joint supervision of PhD theses, and an annual meeting among participants. The results of the collaboration will be published in scientific journals and online. The two institutions agreed that the collaboration will be open to expansion to other participants. (The signed agreement is attached to this report).

"This agreement can greatly aid the development of aneutronic fusion," said LPP's Lerner. "While we all publish our results in scientific journals already, this new systematic collaboration in data exchange, analysis, and design of experiments will substantially accelerate the creation and publication of scientific results. The PPRC has large resources of highly trained personnel, and LPP can offer its many years of experience as a leading center in aneutronic fusion."

The agreement falls within an exemption to the otherwise broad sanctions of the US against Iran. The US Department of Treasury's [regulations](#), include a general license which "authorizes collaborating with **“academics and research institutions”** of sanctioned countries on the...**creation and enhancement of written publications.**"

The collaboration was first proposed to LPP on April 17 by Dr. Mahmood Ghoranneviss, Dean Professor of PPRC, and the chief organizer of Iran's fusion research effort. Dr. Ghoranneviss was responding to the April 10 broadcast of a report on the "Fusion for Peace" proposal by the Person (Farsi) language TV channel of Voice of America (Persian News Network). On that broadcast, Lerner and Rezwana Razani, Executive Director of the Fusion Energy League and co-director of the Focus Fusion Society, described the initiative, which proposes a \$200 million intergovernmental collaboration between the US and Iran on aneutronic fusion. Such a collaboration, if successful, would make uranium enrichment for nuclear energy obsolete and thus make the current dispute over Iran's enrichment program moot. Dr. Ghoranneviss was also informed of the proposal by Hamid Reza Yousefi, a professor at PPRC and one of the signers of the Fusion for Peace proposal.

In just one month, Dr. Ghoranneviss got approval for the collaboration from Iran's Vice President for Science and Technology, Nasrin Soltankhah, allowing LPP and PPRC to finalize the one-page agreement.

While the agreement adds no extra money to the aneutronic fusion effort, it will substantially improve the efficacy of the present funding. In addition, it can be seen as a step toward the much broader "Fusion for Peace" proposal, which does envision major new expenditures. That proposal has been conveyed to both Iran's Vice President Soltankhah and to the US Secretary of Energy, Steven Chu, with the suggestion that it be included in the multi-party negotiations on May 23. We will see!

UK, Russian, and hometown media shine spotlight on FF-1

LPP's progress in testing the feasibility of Focus Fusion is garnering attention in a steadily growing number of media outlets, helping to increase awareness and understanding of this promising technology. Building on LPP's publication of [record temperature fusion confinement in Physics of Plasmas](#), Mark Helper informed his SmartPlanet readers of the "[Fusion Breakthrough](#)," along with chief scientist Eric Lerner's "[Fusion for Peace](#)" initiative.

Coverage by the [Russian news agency, RT](#), received a very enthusiastic response, with over 4,000 "recommends" while triggering healthy discussions on [Reddit](#) and Digg. A televised report by RT's Anastasia Churkina is embedded below. Especially fun for the LPP team was to go to the local news stand and see team members pictured on the front page of not one but two papers, the Home News Tribune and Courier News, both [MyCentralJersey](#) publications. Thanks to reporting there by MaryLynn Schiavi, word of the potential fusion fast-forward reached the UK as [Richard Chirgwin at The Register](#)

picked up the story. Trevor Curwin noted "[Nuclear Fusion Edges Closer to Commercialization](#)" at CNBC.

More coverage is expected, so stay tuned to [@LPPFusion on Twitter](#) for breaking developments.

Tests of new cathode begin, but arcing interrupts for a week

After months of waiting for parts from machinists, FF-1 started firing again on May 8 with a new cathode, using a tungsten ring with a serrated edge instead of the tungsten pins previously used. The ring is expected not only to be far more robust than the pins, but also to produce much more regular and tightly pinched vortex filaments of current. This will lead to greater density and more fusion yield when the filaments converge in the focus area at the end of the anode.

Unfortunately, the first method that we tried to firmly join the tungsten ring to the copper cathode plate did not work well. A thermal interference fit was used, in which the copper is heated to expand it and the tungsten is dropped in the hole. However, the connection was not tight enough, leading to arcing between the pieces. After consultation with experts in the field, LPP has decided that the best way to join the pieces is through vacuum brazing. This operation will be done in the coming week, allowing us to resume firing before the end of May.

**Contract between the
Plasma Physics Research Center, Islamic Azad University, Iran and
Lawrenceville Plasma Physics, Inc.
For Collaboration in the Creation and Publication of Scientific Papers in the Fields of
Aneutronic Fusion and the Dense Plasma Focus**

To create and publish papers in scientific journals, the Plasma Physics Research Center (PPRC), I.Azad University and Lawrenceville Plasma Physics, Inc. (LPP) agree to enter into a scientific collaboration which will include:

- 1) The exchange of data on experiments with the dense plasma focus (DPF) and aneutronic fusion
- 2) Analysis of such data
- 3) Simulations of DPF functioning
- 4) Consultation on instrumentation for such experiments
- 5) Mutual work on designs of high current and high energy DPFs for advanced fuel fusion, including a standardized design of a DPF of around 100 kJ energy that would be affordable to construct in industrializing nations.
- 6) An annual meeting between the participating institutions.
- 7) Joint supervision of PhD student theses in this research field

The results of this collaboration will be prepared by PPRC and LPP for publication in scientific journals and online.

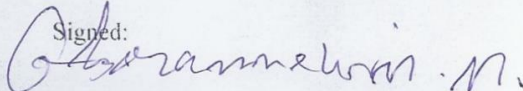
PPRC and LPP agree to jointly apply to the IAEA for funds to assist with this collaboration, including but not limited to funding of the annual meeting.

As much as possible, PPRC and LPP agree to coordinate our collaboration with existing international collaborations in the DPF field, specifically including the efforts of the Institute for Plasma Focus Studies in Singapore and the International Centre for Dense Magnetized Plasmas in Warsaw. The collaboration will be open to expansion to other participants, with the agreement of PPRC and LPP.

Details of this collaboration agreement will be administered by the below-signed individuals: Mahmood Ghoranneviss, Dean Professor, Plasma Physics Research Center, I.Azad University and Eric J. Lerner, President and Chief Scientist, Lawrenceville Plasma Physics, Inc.

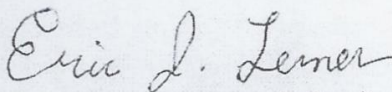
This agreement will go into effect upon signature by both parties and is of unlimited duration, but may be terminated by either PPRC or LPP upon 90 days notice of the other party.

Signed:



Date: 20 MAY 2012

Mahmood Ghoranneviss
Dean Professor
Plasma Physics Research Center,
Islamic Azad University, Tehran, Iran



Date: May 19, 2012

Eric J. Lerner
President and Chief Scientist
Lawrenceville Plasma Physics, Inc.
Middlesex, NJ, USA