Report August 9, 2024

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$300,000 Investment Brings Syndicate Close to Success

In March, LPPFusion launched a syndicate among our larger investors with the goal of raising the $1.2 million we need to hire more people. Last month we adjusted the goal to $1 million, in light of our anticipated crowdfunding and we received $186,000 in new pledges. Now LPPFusion has received a $308,000 investment, the largest single investment we've gotten in the last seven years. Thanks very much to James Elam of Canada, who had also invested previously last year. Now, we are only $154,000 away from completing the syndicate. **Once we do, the investors who made the pledges will immediately invest the money, allowing us to start hiring vitally needed help for our laboratory research and for everything else.** This will greatly speed our research with proton-born fuel, which we expect to start in September (see next news item.)

If you are an accredited investor and can afford to pledge or immediately invest $5,000 or more, please join the syndicate by sending your pledge to invest@LPPFusion.com. We know that over 175 individuals have already invested $5,000 or more in our vital fusion effort. Of course, not all of you are in a position to increase your investments right now. But if you are, doing so now will make a big difference. We need only 31 pledges of $5,000 or 16 of $10,000 or only six of $25,000, or some combination. Our goal is to complete the syndicate by September 1, so we can start looking for the top people to hire.

As a thank-you, everyone who invests through this syndicate will be acknowledged by name in our next technical paper. So, make your mark on fusion history!

Of course, if you are not accredited or don't have $5,000 you can still invest through Wefunder. We need more there, too! (See third news item.)

Tungsten Control Experiments End --Boron Getting Close

LPPFusion's research team has completed the control experiments with the tungsten electrodes and is moving swiftly to the next set of experiments with beryllium electrodes and hydrogen-boron fuel, now planned for September. The July test runs succeeded in optimizing the preionization circuit, allowing the doubling of fusion yield at higher fill gas pressure. As reported earlier, the team has been trying to resolve the problems created by the more difficult breakdown-- the transition to plasma where electrons flow freely--at these high pressures. With deuterium, the higher pressures are needed to create higher densities in the plasmoid and thus higher fusion yields.

The tiny preionization currents, while only microamperes in strength, create a zone of ionization around the insulator that in turn surrounds the anode at the heart of the FF-2B fusion device**. In this zone, currents can start to flow faster than in the outer gap between the anode and the cathode vanes (see Fig 1) because some electrons are already free to move, having been stripped from the neutral atoms as part of the preionization current.** By making breakdown of deuterium into ions and electrons faster even with higher fill gas pressure, this zone also makes the breakdown more symmetrical, leading to a more symmetrical current sheath. This sheath in turn compresses to a denser plasmoid with more fusion reactions.

The ionization zone helps solve another problem that is caused by high pressure. Higher pressure makes it easier for current to jump directly across from the cathode vanes to the anode (the straight horizontal red arrow). Such a radial breakdown is undesirable, as it creates a separate current sheath that runs ahead of the main one, again disrupting a symmetrical, tight compression. Preionization counters this problem by smoothing the path along the insulator, making it easier for the desirable vertical breakdown to take up all the current, preventing radial breakdown.

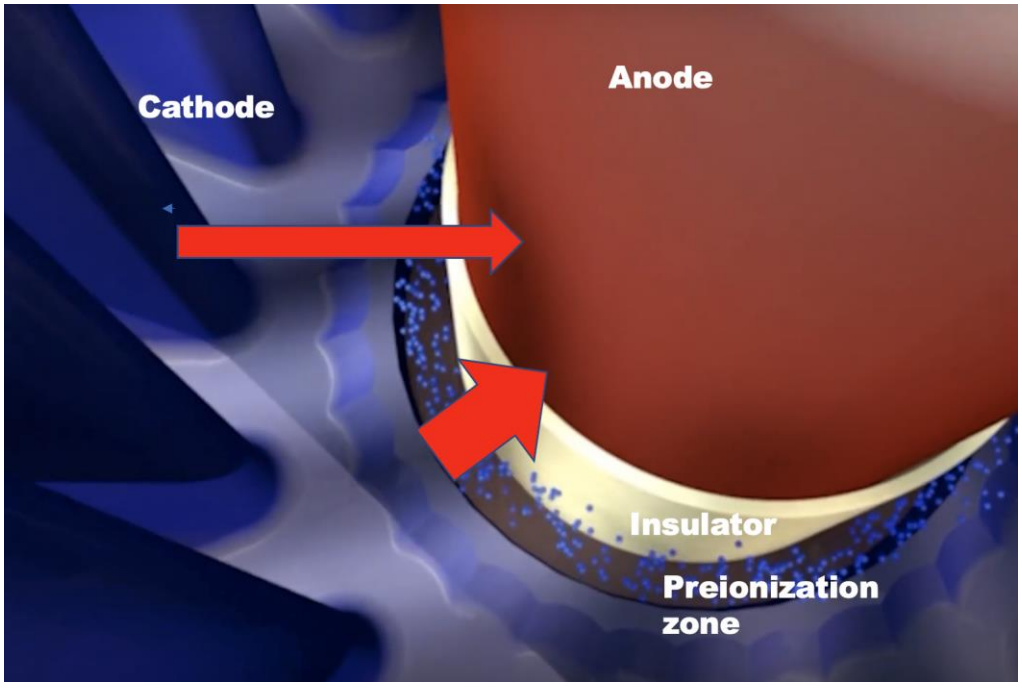


Figure 1 A small preionization current (blue dots) makes it easier for the correct breakdown current to flow along the insulator (diagonal red arrow) rather than radially from the cathode vanes (horizontal red arrow). This improves symmetry and thus fusion yield

On July 14, LPPFusion Chief Scientist Eric Lerner tested the new preionization circuit with a pulse from our trigger circuit. The trigger circuit generates 30 kA (30,000 amps) of current—far less than the nearly 2 MA (2 million amps) of current of the main bank, but enough to test the breakdown conditions created by the preionization current, which runs continuously for several seconds before the trigger circuit fires. We can see how symmetrical the kilo-amp breakdown is, indicating how symmetrical the megampere breakdown will be.

Almost perfect symmetry was achieved in the breakdown with 41 torr pressure (viewed in Fig. 2 A from below and a bit off-axis). This is a great improvement from the breakdown without preionization (Fig. 2 B) where the current starts at only a few bright spots.

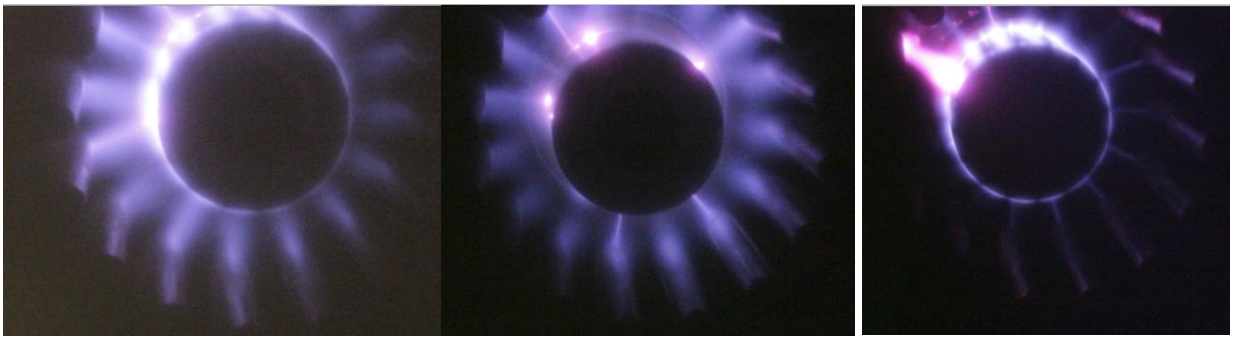


Figure 2. Almost perfect symmetry is observed with a trigger shot and intermediate preionization current (2A), much better than with no preionization (2B) or with high preionization, breaking down to the roughest vane (2C).

However, when Lerner increased the preionization current much further, into the milliamp range, he found by July 25 that complete symmetry had not been achieved. With the higher preionization current, there was radial breakdown (Fig 2C), always to the same specific cathode vane. This indicated that the visible roughness on the tungsten cathodes was still making radial breakdown easier. One vane had a rougher surface than others, concentrating the electric field like tiny lightning rods and leading to the persistent asymmetry. Fortunately, this is a problem we won't encounter with the beryllium cathode vanes in the next experiment set, as those vanes have remained completely smooth after over 400 shots. The reduced erosion was one big reason that we switched from tungsten electrodes to beryllium ones in 2019.

Using the intermediate level of preionization that produced the highest symmetry with the trigger shots, Lerner and Research Scientist Syed Hassan fired the full bank's 2 MA on August 1. They were able, on the best shot, to double the fusion yield from earlier high-pressure shots in June to 0.15 J of energy with 27 torr pressure. But this was still only 60% of the record yield achieved with less current back in 2016. The effect of the persistent asymmetry was evident in these shots as the neutron pulse, which should show one peak, in this and other shots showed two peaks (Fig.3).

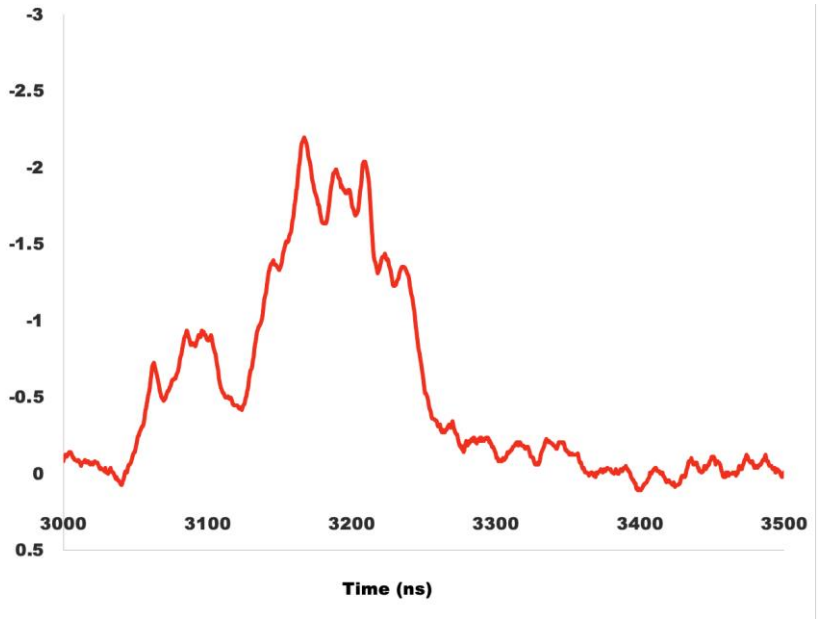


Figure 3. The neutron pulse emitted on shot 3, August 1, 2024 shows a double peak, with a smaller one 100 ns ahead of the larger one. This indicates two current sheaths arriving to form two plasmoids, greatly reducing the plasma density and fusion yield. All the shots in this series had similar pulse shapes.

Despite the remaining asymmetry, the tests demonstrated that preionization could clearly improve results at high pressure, one key aim of the control shots with the tungsten electrodes .

We are now preparing for important testing with pB11 with beryllium electrodes. We will report on more important results from last month's tests in the next report, coming next week.

Our Crowdfunding is Much Better than Average—But Not Good Enough!

A recent report from Crowdfund Capital Advisors on eight years of crowdfunding in the United States gives us a good way to compare LPPFusion's crowdfunding efforts with those of other companies. We're doing a lot better than average—but not good enough yet for our needs.

Perhaps the report's most interesting number is the one measuring how many people have invested in crowdfunding. It's only two million. That's just about equal to the number of US residents who are accredited investors and were able to invest in start-ups before crowdfunding began in 2016. That means that the total population engaged in investing has only doubled—and the amount of income available has far less than doubled.

From these two million people total crowdfunding raised over the eight years has been $2.4 billion, which went to 6500 companies. Since this is an average of $370,000 per company, LPPFusion has done far better. In the last eight years we've raised $5 million, over 13 times as much as the average crowdfunding company. That's not mainly because our investors have each put in more money on average—it's because we have far more investors- - seven times as many as the average company.

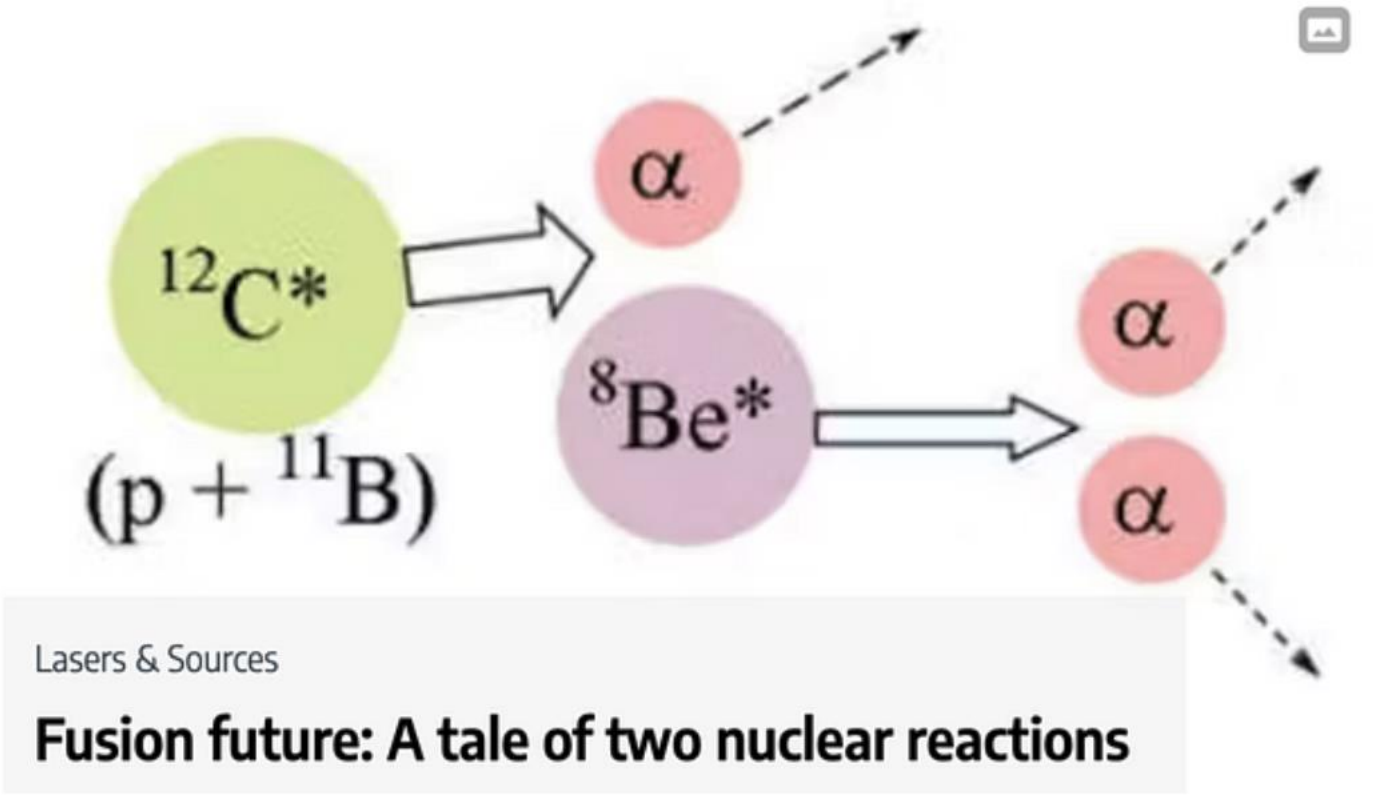
Also, we're a bargain in terms of the ratio of our valuation to money actually raised. Our company valuation (stock price times shares sold) is just 7.4 times the cash we've actually raised. For the average crowdfunding company that ratio is a whopping 33, over four times ours.

So, we're not doing badly compared with everyone else in crowdfunding. But, as you know if you've been reading our updates, we need almost twice as much as we have been raising if we are to progress towards fusion energy as fast as we can. Our syndicate is giving us a big boost with medium-sized investors (see first news item). But we need more small investors. Clearly, the problem is that we need more investors to know about us! If we could get only three new investors per day, every day, we would get the $100,000 a month that we need.

We're doing our best to reach out to everyone. But we need your help. Other than investing yourself, the best thing you can do to help fusion energy is to tell others about us and urge them to invest. Tell them how easy it is to invest through crowdfunding. A hundred million people or more can afford small CF investment - a lot more than the two million now investing.

And if they give you a reason for not investing in LPPFusion, please tell us about it! We can give answers to these reasons, but we need you to tell us what the objections are.

LPPFusion in Laser Focus World



In a major article in a technical news publication, *Laser Focus World* has. covered LPPFusion and others companies' efforts to develop hydrogen boron fusion. The article, **Fusion future: A tale of two nuclear reactions**, by Vittorio Lippay explains the advantages of hydrogen-boron fuel over the deuterium tritium fuel that has been the center of most fusion research in the past. It covers the work of both LPPFusion and other companies, such as HB11, that are using lasers to trigger hydrogen-boron (pB11) fusion.

Laser Focus World is a major technical publication in the laser industry, with 80,000 subscribers. Lippay provides an in-depth look at LPPFusion's work, quoting LPPFusion Chief Scientist Eric Lerner explaining our effort to exploit the quantum magnetic field effect, which reduces the cooling of the fusion-producing plasma as well as our basic approach of imitating plasmas in nature: "The DPF approach rests on using the natural instabilities of the fusion plasma rather than fighting them—it goes against much conventional engineering practice," Lippay quotes Lerner as saying. "Almost all machines are designed to function stably, suppressing instabilities. This is just not possible with plasma. Imitating nature, we use the instabilities to create fusion plasma in a reliable way."

While we still need mass media outlets like the New York Times to report on our work, articles such as this one in technical news magazines help build our credibility with the media as a leading fusion contender.

Class on Second Law of Thermodynamics Online

The latest class on the Evolution of Physics is now available on YouTube. In this class , LPPFusion Chief Scientist and class participants discuss the origins of the second law of thermodynamics and the controversies this set off, which continue until today. The class took place June 22, 2024. Some readings are below.
https://zapatopi.net/kelvin/papers/on_the_age_of_the_suns_heat.html
https://www.chemeurope.com/en/encyclopedia/History_of_entropy.html

LPPFusion Presentation and Picnic

In an effort to restart in-person events in the NJ-NY metropolitan area, LPPFusion Chief Scientist Eric Lerner will be giving a presentation on the Fastest Route to Fusion, including the latest on our laboratory results at the Science Festival, InfoAge Science and History Museums, 2201 Marconi Road, Wall Township, NJ, 07719. The presentation will be at 10:30 AM, Saturday, August 17. After the presentation there will be a picnic for LPPFusion supporters at noon at a nearby location. For those who want to get up early, Lerner's presentation will be proceeded by a presentation by Frank O'Brien of the Museum on recent observations using JWST (and other telescopes) and their implications for the Big Bang model. We expect a lively discussion. If you intend to come, please let us know at fusionfan@lppfusion.com.