Report December 30, 2022

Happy New Year to All!

Summary:

- **Success! Switch Tests End, FF-2B to Fire in January**
- **Independent Team Confirms Cosmic Non-Expansion, Debate Grows**
- **NIF Advance Builds Support for Fusion**
- **Wefunder Campaign Ends, New Campaign on the Way**

Success! Switch Tests End, FF-2B to Fire in January

LPPFusion's testing of switch designs has ended successfully this month with the achievement of a switch configuration that cures the problems we have encountered since 2019. The tests showed that we have eliminated random pre-fires, surface flashovers, late and non-synchronous firing, excessive soot production, excessive current oscillations and the notorious negative voltage pulse. **The switch pair has demonstrated repeatable synchronous firing with 5 ns (billionths of a second.)** While we were not able to meet our initial goal of 32 synchronous shots in a row, we're convinced that is due to limitation of the test set-up, not of the switches. This success will lead to a resumption of firing in January of our FF-2B experimental fusion energy device.

In November, we demonstrated that the new dual switches could pass a greater current than the single switches. However, the greater current turned out to be too much for our spare test capacitor, which failed. Fortunately, we were able to locate a smaller, used but suitable capacitor within days and got back to testing after only a few weeks down. We upgraded our test bed to include coils of wire acting as a resistor. These coils limit the current and harmlessly dissipate energy (see Fig.1). We also attached old plasma focus electrodes into the circuit and pumped the vacuum chamber down to better simulate the actual firing conditions of the FF-2B device.

Our first week of firing with the upgraded testbed started tensely as we were plagued with loose connections and similar gremlins. But the coils functioned exactly as calculated to reduce the currents to safe levels for the capacitor. We were able to systematically test various combinations of design configurations suggested by Research Scientist Dr. Syed Hassan and Chief Scientist Eric Lerner.

On December 13th, we achieved success, with one configuration yielding 8 shots in a row with the switches firing with an average difference of only 5 ns, well within our goal of 10 ns. Examination of the switch interiors

confirmed that the surface breakdowns that had plagued earlier switch designs, and the random pre-firing and soot production that they caused had disappeared. The cracking of the outer Lexan insulator which we had seen on earlier designs had also disappeared. There was also strong evidence that current oscillations were smaller than previously. However, oscillations are a product of the interaction of the switches and the entire device circuit, so we can't be sure they have been reduced far enough for good functioning until we go back to firing FF-2B.

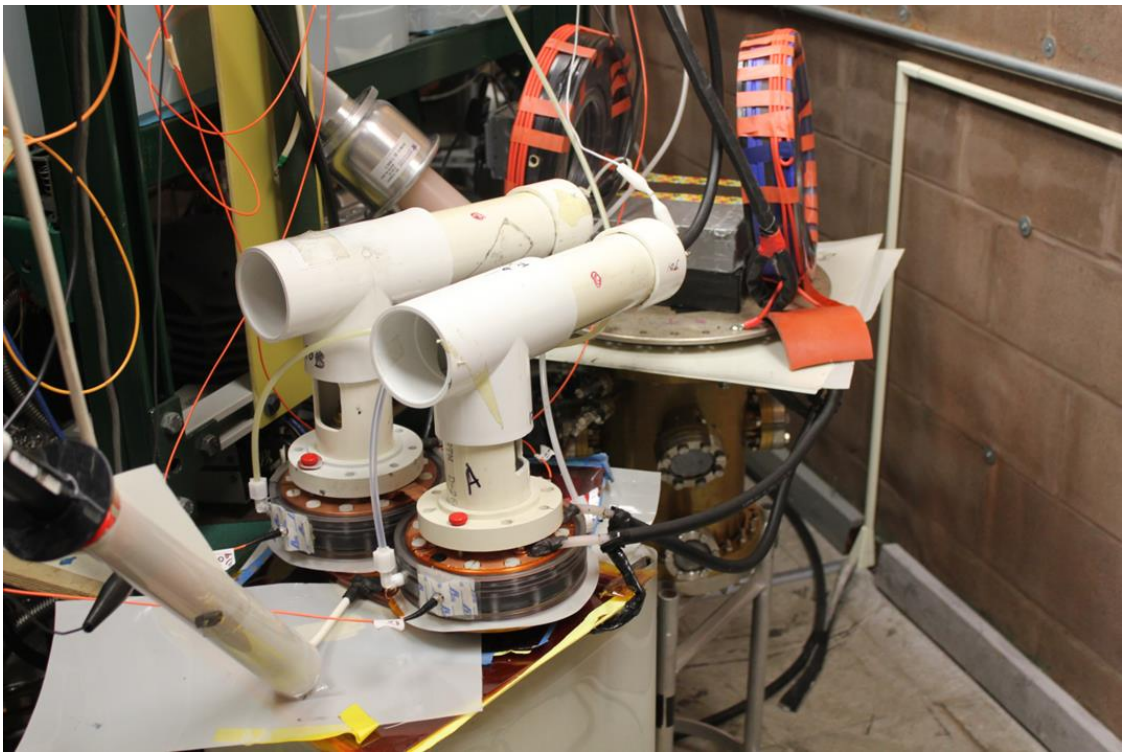

Figure 1. The upgrade testbed includes cable coils (red circles of wire) to limit current to safe levels for the new capacitor (barely visible under the switches in the foreground). The switches are the thick disks underneath the plastic housings of the trigger heads. The vacuum chamber is the golden-colored cylinder in the background.

We were at first concerned that we encountered some shots when only one of the pair of switches fired, after the initial good run of 8 shots. But we concluded that this was due to the non-optimized functioning of the external circuit and the lower level of current in the new set-up. When the current and voltage rose fast enough, both switches maintained the current throughout the pulse. However, when the current fell, due to variability in the external circuit, the current flickered out in one switch. We don't see this being a problem when the switches are installed on FF-2B, as in that case a much faster rise in current and voltage always occurs. The situation is similar to that of a garden hose: at low pressure the stream will wiggle back and forth but at high pressure, it will be steady.

Based on the tests and the new switch configuration we have ordered parts for the full 16 switches to go on FF-2B. While waiting for the parts, we intend to carry out some control shots using the old single switches. We expect these tests in January and February will lead to advances in FF-2B's performance and fusion yield, kicking 2023 off to a good start.

Independent Team Confirms Cosmic Non-Expansion, Debate Grows

In a big step forward in the developing revolution in cosmology, a group of researchers based in Russia and the UK have independently confirmed that, as they write, "**the first JWST observations of high-redshift objects cannot be explained by the expanding-Universe model".** In a paper published December 1st in the peer-reviewed journal *Galaxies*, Nikita Lovyagin of St. Petersburg State University and his colleagues came to the same conclusion as did LPPFusion's Eric Lerner and colleague Riccardo Scarpa that the size of the galaxy images obtained with JWST contradicted the prediction of the Big Bang, expanding-universe hypothesis that objects should look larger at greater redshifts. Instead, the paper showed that the image sizes were just what would be expected for a non-expanding universe, as Lerner and Scarpa had predicted prior to the JWST image releases.

This is an extremely important development in the debate over the validity of the Big Bang that was set off by Lerner and Scarpa's analysis and the initial widespread publicizing of this analysis in Lerner's popularized article "The Big Bang Didn't Happen" in IAI News. An essential step in validating any scientific discovery is replication by independent groups of researches and the *Galaxies* paper is the first published replication of Lerner and Scarpa's work on the JWST data. As such it adds a great deal of credibility to the evidence against the dominant Big Bang model and undermines efforts by Big Bang supporters to dismiss the evidence as the work of a single heretical group or individual.

Like Lerner and Scarpa, Lovyagin and colleagues compared the angular size of galaxy images (their apparent size on the sky), using multiple data bases to plot how angular size change with redshift, and thus with increasing distance (see Fig.2). While Lerner and Scarpa had compared only the brightest and therefore largest galaxies, Lovyagin and team compared all galaxies, so got a larger scatter in size. But they reached the same conclusion: **the JWST images at the highest redshift continued the downward trend in angular size with distance expected in a non-expanding universe and showed no sign of the sharp upward trend towards larger apparent sizes predicted by the expanding-universe theory.**

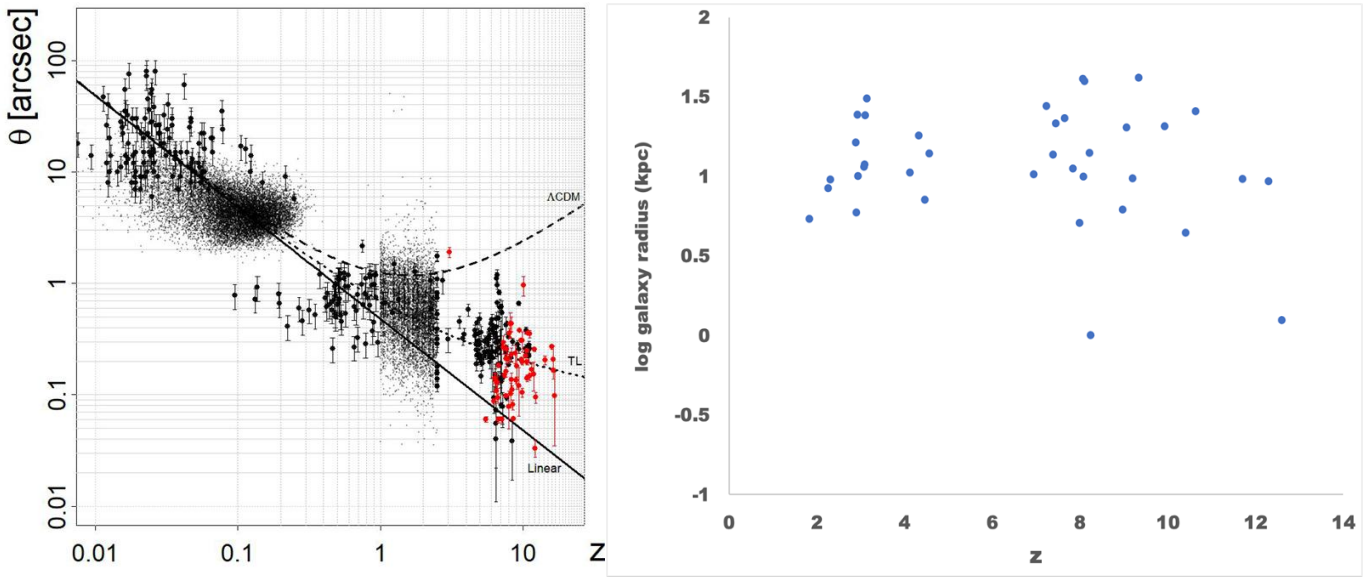

Figure 2. Two ways of viewing the same conclusions: The graph on the left, from the new Lovyagin paper plots the ***angular*** *diameter of ALL galaxies observed against redshift, showing the decline predicted by the non-expanding*

*universe hypothesis. On the right, Lerner's own latest unpublished plot, based on JWST data show that the **linear** size of the brightest galaxies remains the same with redshift, as predicted with the same non-expanding hypothesis.*

The Lovyagin paper does not directly reference Lerner and Scarpas' recent work on the JWST data, but does cite Lerner's 2018 paper on the same subject based on Hubble Space Telescope data. Lerner has contacted the authors to explore possible collaborations.

This independent confirmation will no doubt feed the growing public debate over the validity of the Big Bang hypothesis. Already, the debate, bubbling on the web since August, is spilling into prominent general-circulation publications for the first time. In the December 17 issue of *Spectator* magazine, University of Rochester astrophysicist Adam Frank has replied to Lerner. *Spectator* is the oldest continuously-published weekly, starting in 1828. Although it is not massively circulated, it is prominent in the UK, especially in Conservative Party circles, with Boris Johnson serving as editor on his way to becoming Prime Minister.

Dr. Frank ignored Lerner's key point about image size, but did acknowledge another big problem for the Big Bang in JWST data: **the galaxies observed seem to be too old for the Big Bang**. Their spectra indicate they have a lot of older stars, which tend to be redder, far too many for their hypothesized age as just a few hundred million years after the Big Bang. Frank writes that this is "like going to a nursery to visit your newborn and finding a room full of teenagers."

However, Frank concludes that the Big Bang is still in great shape and that the correct conclusion is that, to paraphrase him: " Gee, those babies grew up awfully fast!" *Spectator* prevented Lerner from posting a comment on Frank's article, but the debate is continuing.

The in-person debate of Lerner with astrophysicist Claudia Maraston and Julian Barbour is now available online, although at the moment only to IAI subscribers. We'll share it when we get a free link.

NIF Advance Builds Support for Fusion

As fusion fans no doubt have heard, on December 5th the National Ignition facility (NIF) at Lawrence Livermore National Laboratory in California achieved a major fusion advance with its giant laser. We at LPPFusion join in congratulating the three thousand researchers and staff at NIF on their achievement.

What exactly has been achieved? The December 5th shot for the first time achieved plasma net energy: more fusion energy out of the plasma than was put into the plasma by the laser. The laser focused 2.1 MJ (megajoules) of energy onto a tiny pellet of deuterium-tritium fusion fuel. The fusion yield was 3.1 MJ, a doubling of NIF's previous best yield, achieved last year, of 1.6 MJ. This is certainly a significant advance, as getting more energy out of the plasma that goes into it is a necessary step toward practical fusion energy generation.

However, as much reporting has correctly emphasized, this achievement is quite different from the ultimate goal of the fusion energy research effort: **device net energy**. This is when more energy comes out of the fusion generator than is drawn into it from the grid. So, device net energy is thus the ratio of the total system energy out divided by total energy in, not just the plasma net energy. We at LPPFusion refer to it as "net energy" or "**wall-plug efficiency**" and we strive to deliver a device where a total energy out of the device is larger than the total energy

in. However, the language in media uses unclear terms such as Q for total fusion yield where Q is often just a plasma net energy, and not a total wall-plug efficiency measure. For NIF's latest shot, 300 MJ was used to run the lasers, almost 100 times more than the fusion energy produced. This 1% "wall-plug efficiency" is still a record, surpassing the previous record of 0.6% set by the JET tokamak device, located in the UK.

NIF's giant laser approach is not likely to close the gap in **wall-plug efficiency** any time soon. Lawrence Livermore's own leadership estimated that it will take 30 years for their approach to produce commercial fusion energy.

However, we at LPPFusion join the rest of the fusion research community in viewing the NIF announcement as helping the whole field, mainly in public perception. **The new advance, despite its limitations, drills through the popular narrative that there is no progress in fusion energy and that records set 20 years ago never get surpassed.** The US government's trumpeting of the NIF's results help to ensure that fusion energy will from now on be included in the options available to shift from fossil fuels' energy sources. Overall, this will certainly aid LPPFusion as well as others in getting the needed funding.

Interestingly, this advance may prove to be a "last hurrah" for the purely inertial confinement approach that NIF has used. In this approach, no magnetic fields confine the plasma, which just does not have time to expand during the fusion burn. But NIF was unable to replicate its record shot of 2021 and may not be able to replicate the December 5th shot as well. To overcome this super-sensitivity to nanometer flaws in the fuel pellet, NIF researchers have done initial experiments using a hybrid laser- magnetic confinement approach. They run current through a thin coil of wire around the pellet (see Fig.3) and then use the laser to compress the resulting magnetic field. This hybrid approach has promised to be more repeatable than the pure inertial confinement and may well be NIF's future.

At LPPFusion, we hope to catch up with and surpass NIF's achievement of 1% wall plug efficiency. To do so, we will transition from deuterium to our final pB11 fuel, and we hope to do that soon. Stay tuned!

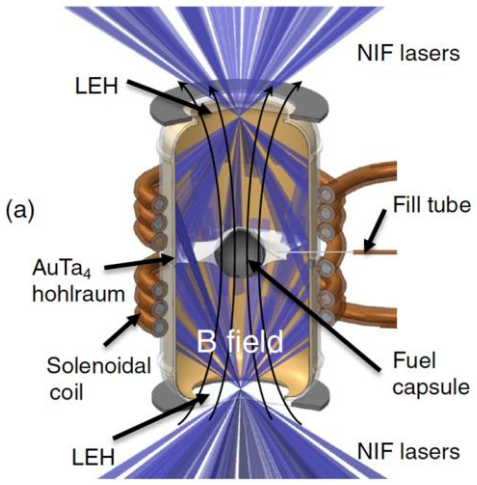

Figure 3. In recent experiments (not the Dec. 5th record one) NIF researchers used this hybrid pellet with a solenoidal coil to supply an initial magnetic field. When hit with laser light (purple) the pellet contracted rapidly, intensifying the magnetic field and briefly helping to contain the hot fusion plasma.

Wefunder Campaign Ends, New Campaign on the Way

The LPPFusion 2022 Wefunder campaign closed on December 9th, with a total raised of $316,520 from 386 investors. We thank all who invested! Unfortunately, the campaign did not meet our full goals for it. The campaign only raised half as much as we did last year, from fewer than half as many investors. To a large extent, this reflected the 45% fall in US total crowdfunding investments for all companies from last year, a product of the global economy's impact on small investors.

Together with the $81,000 grant from Focus Fusion Society, the reduced Wefunder round left us well short of our goal of $100,000 a month in the past six months. To catch up with this goal, and surpass it, we are planning to restart very soon crowdfunding on the StartEngine platform, reaching a new audience of over a million investors. We have also received interest from a number of potential larger investors. We will be trying out some new ideas to better publicize our work. The good news that we're sharing in this report should help reassure wary investors of our progress!

Accredited investors can still invest in our Reg. D round at the same $200/share price, with a $5,000 minimum.