Report November 30, 2022

Summary:

- **Switch Current Up, Negative Pulse Down**
- **New Grant, But More Needed**
- **Plasma Filaments, Not Dark Matter, Rule the Outer Galaxy**
- **Impossible Galaxies Video**

Switch Current Up, Negative Pulse Down

Continued testing of LPPFusion's dual switches have demonstrated that they can **increase current** when firing at the same time, a key goal of using the new switches. The LPPFusion research team has also **reduced the undesirable negative pulse** from the switches by a factor of three, a big step towards reliable firing. But parts for our latest design were delayed and so important tests still lie ahead in the coming weeks.

While the team had expected to receive parts for a new Teflon-Kapton armored switch design in October, the parts did not actually arrive until well into November, so there has not yet been time to test them. But the team made good use of the two-switch testbed while awaiting the new parts.

First, on LPPFusion Research Scientist Dr. Syed Hassan's suggestion, the team put the old, larger single switch on the testbed to use as a control for the new switches. Surprisingly, the old switch generated the early negative pulse of electricity that had affected the firing of the new dual switches. This was puzzling, as in previous experiments on the FF-2B fusion experimental device, the negative pulse had only been produced by the new switches, not by the old ones. Since the correct firing of the switches allows current to flow from the positively-charged capacitor, the team had long identified the negative pulse as a sure symptom of misfiring switches.

To try to more closely replicate the conditions that the large switches originally functioned under, Dr. Hassan installed the old resistors in the trigger head. The trigger head transmits the negative trigger pulse from a trigger generator to the switch's spark plug to fire the device (fig 1). We found that the **negative pulse was smaller in these shots by a substantial factor of three**, dropping from a range of 12-16 kV to a range of 4-6 kV What was better was that when we put the dual switches on, the much smaller negative pulse was repeated (fig. 2). This was good news!

It was also somewhat unexpected, as in previous shots with the dual switches attached to FF-2B, a faster-rising trigger pulse, allowed by the new "low-inductance" resistors, led to faster and somewhat more reliable firing of the switches. (Inductance is a measure of how much magnetic field energy a device generates for a given current. More inductance slows devices down.) But in the new tests, the **slower-rising** trigger current for the older, high-inductance, resistors actually caused a **faster breakdown** of the switch. (Breakdown is the point at which gas starts conducting current) Faster breakdown means the

switch passes the positive current vertically through the switch gas before the undesirable horizontal breakdown, which carries the negative pulse, has time to develop (Fig.3). Why this apparently paradoxical behavior occurs needs more study.

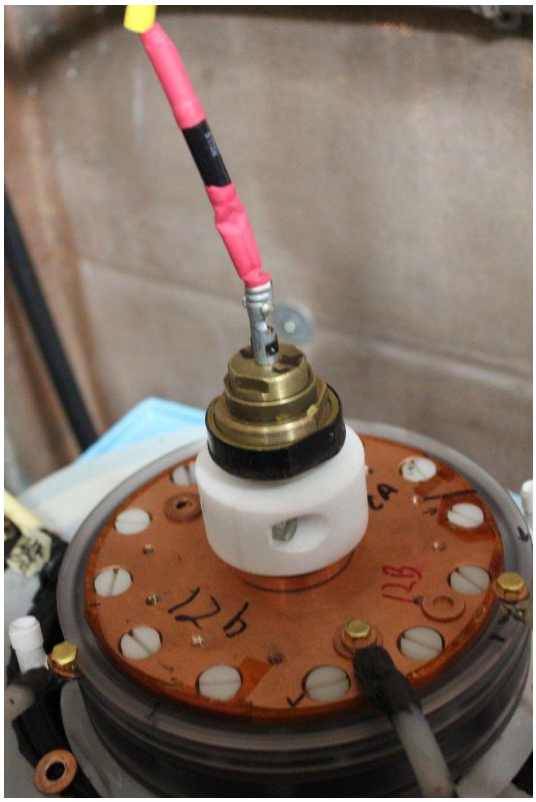

*Figure 1. The newer "low-inductance" resistor (**top left** inside pink plastic) was replaced by the old resistor (**top right** inside black plastic and tape) in the trigger head that feeds current to the spark plug.*

*Normally, the resistors are hidden within the PVD trigger head housing (**bottom**).*

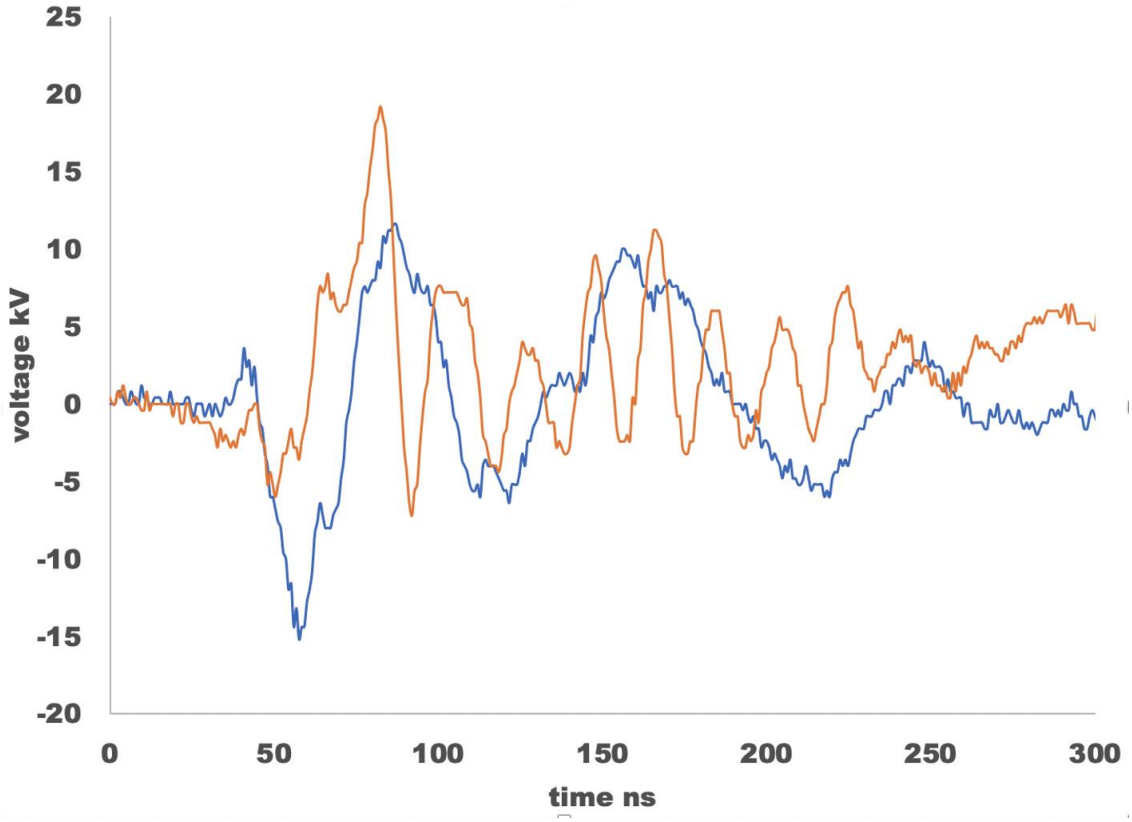

*Figure 2. **Switch Voltage Comparison:** The 16 kV negative pulse typical of earlier performance of the dual switches (blue line, test shot 1 September 24) has been reduced in more recent shots to 4-6 kV (orange line, test shot 1 November 8). Changes in the oscillations are also due to the different resistors in the trigger head but will be studied further in upcoming tests.*

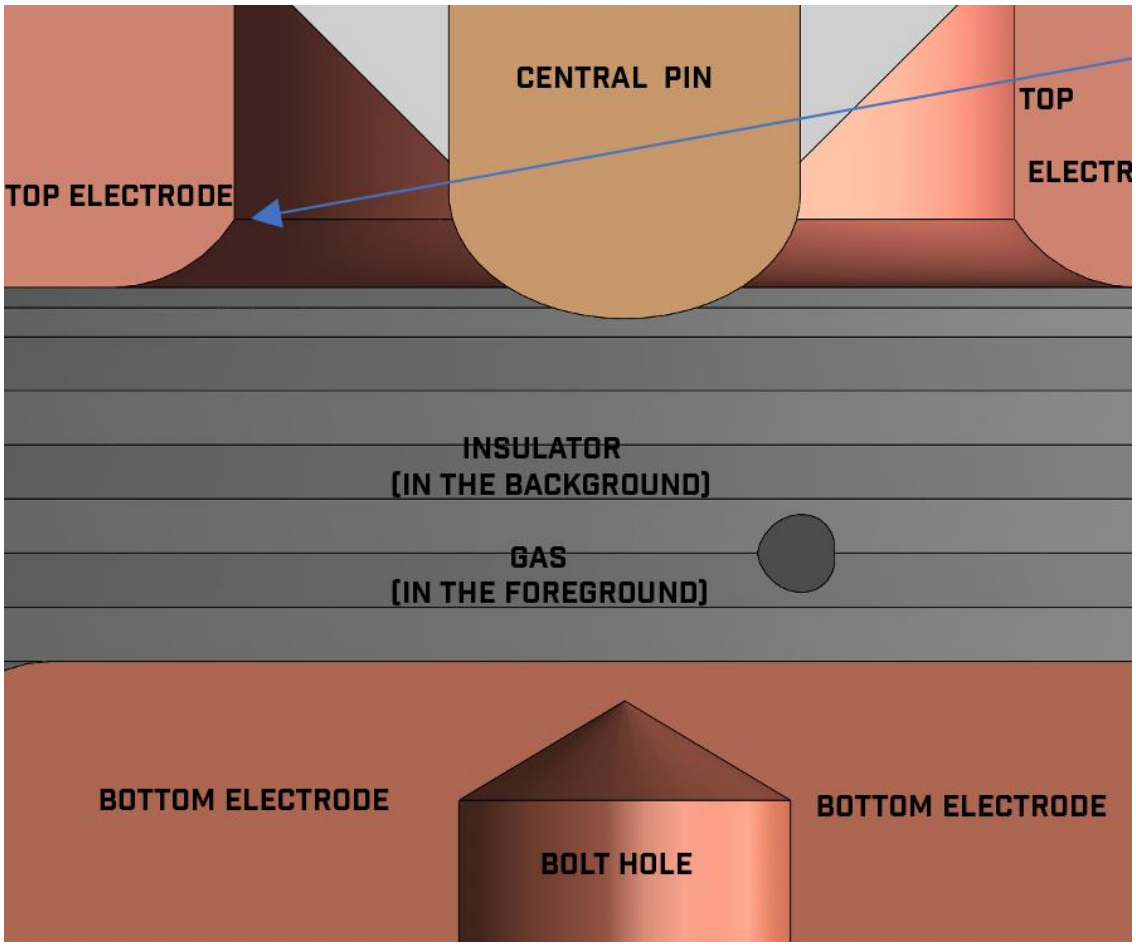

Figure 3. ***Inside The New Switch:*** *(Repeated from October 5 report) Horizontal breakdown between the top electrode (arrow) and the central pin (beige) prevents proper switch functioning. The intended breakdown is between the central pin and the bottom electrode (lower copper-colored strip) which releases the charge in the capacitor. Current then rapidly jumps over to connect the top and bottom electrodes to complete the circuit.*

The placement of the old resistors in the trigger head allowed us to **fire the dual switches simultaneously** (within 20 ns) of each other for five shots on Nov. 8. In turn, this made it possible for the

LPPFusion team to measure how much improvement in current-production is possible with the dual switches. By measuring the time to peak current (rise-time) for the dual switches, for the old switch and for a single new switch LPPFusion Chief Scientist Eric Lerner was able to calculate the inductance for each set-up. He used two independent methods of calculations: one just using the differences in rise-times among the shots and a second using the calculated inductance of the rest of the circuit—mainly of the cables connecting the switches to the dump chamber.

Both methods arrived at the same answer—the dual switches have only two-thirds the inductance of the old single switch. Combined with other known reductions in inductance in the plates that connect the switches to the rest of the FF-2B device, the new switches **can increase overall current in the machine by 30%.** This is an important gain—but is only achievable if all 16 switches can fire reliably together.

More testing is still needed to achieve that reliable firing. For 16 switches to fire together even 4 times in a row, misfires have to occur less than 1.5% of the time for each switch. It will take 32 shots with a single dual-switch pair to demonstrate that. We now have a few alternate designs to try out, starting early December. We'll be using an upgraded testbed, with closer imitation of conditions on the FF-2B device.

LPPFusion Gets New Grant From Focus Fusion Society

The Focus Fusion Society (FFS), a non-profit organization devoted to advancing research into fusion with hydrogen-boron fuel and the

dense plasma focus device, has granted LPPFusion an additional $81,000 for further research, extending a grant previously made. The funds for this new grant came mainly from a donation to FFS by the Whitefish Community Foundation. These funds will be used in completing the switch tests and making the final-design switches that emerge from the tests. Thanks to all who made this possible!

Together with the $245,000 in investments raised so far on Wefunder, this new grant brings LPPFusion's total cash inflow in the second half of 2022 to $326,000. However, this falls some $ 174,000 short of our self-imposed goal of raising $100,000 a month, a goal we have determined is absolutely essential for minimally adequate funding of our vital fusion research.

With only **ten days left** until the December 9 end of our current Wefunder round, we need to raise another $274,000 before year-end. As we pointed out last month, our reports, videos and social media posts are regularly seen by over 20,000 people a month. We guess that most of you want to see this technology developed to benefit all humanity. But that research is only possible with funds that come from some of you. **If just half of our supporters invested in one share for $200, we would raise $2 million.** The quarter million we need right now should be a lot easier to raise. **Make fusion happen.**

Plasma Filaments, Not Dark Matter, Rule the Outer Galaxy

The hypothesis of the mysterious (and wholly non-existent) Dark Matter has been dealt another heavy blow by new analysis of the rotation of stars in our own Milky Way galaxy. The data in the analysis, collected by the GAIA mapping satellite, show that dark

matter is not needed to explain the galaxy's rotation velocity. **Combined with existing data on the motion of plasma in the outer reaches of the galaxy, the new analysis, circulated online this month, confirms that the motion of those galactic outskirts is controlled by magnetic plasma filaments, not the imaginary dark matter.** Enormously scaled-down versions of these plasma filaments are crucial to the achievement of fusion energy and are used in LPPFusion's FF-2B device.

Spiral galaxy "rotation curves" have been pointed to as one of two key pieces of evidence for the existence of dark matter. A "rotation curve" is what astronomers call the graph of the rotation velocity of a region of a galaxy plotted against the distance to the center of the galaxy, as in fig 4. (The other piece of evidence cited for dark matter involves clusters of galaxies, which we'll be discussing in a near-future report.) It has long been known that in these curves, **velocity rises to a plateau that extends far from galactic centers**. For gravitating disks like the spirals, whose mass is concentrated towards the center, the velocity curves should decrease, not rise or plateau. So theoretical astrophysicists have long argued that only a mysterious dark matter, in a large halo surrounding the visible galaxy, can account for this flat, or even rising velocity trend, since the larger the velocity at a given radius, the larger the gravitating mass inside that radius. This phenomenon has been observed in our own galaxy, the Milky Way - see the orange line in Fig. 4.

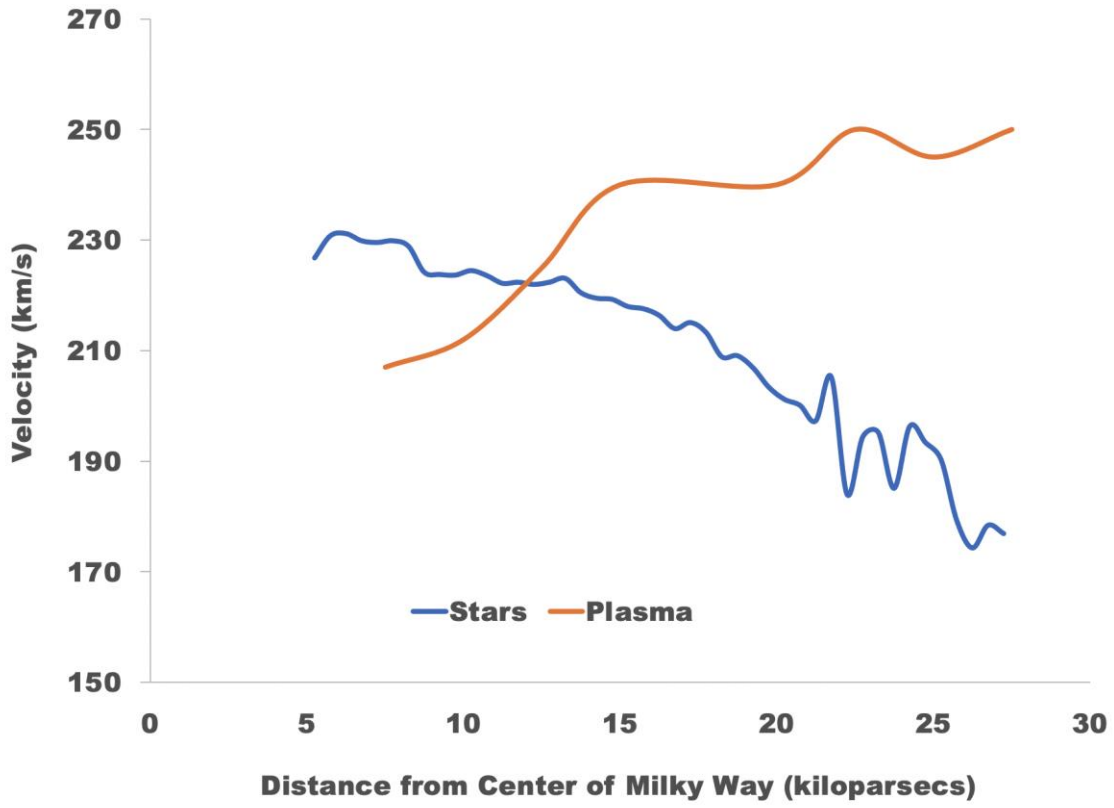

Figure 4. ***Rotation Curves Graph****: New data from a billion-star survey shows that rotation velocity of stars in the Milky Way galaxy (blue line) decreases with increasing distance from the galactic center, as would be expected with no dark matter. In contrast the rotation velocity of plasma clouds (orange line) increases with distance, clearly showing they must be confined by magnetic fields as well as gravitation.*

These observations were made by measuring the Doppler shifts of **radio-frequency emission from gas or plasma in our galaxy and other galaxies**. The radio radiation can be observed out to large distances from the galactic centers, where the stars were too few and faint to observe. But as early as 25 years ago, researchers began to measure the velocities of stars in the outer reaches of our own galaxy,

where stars can be observed to large radii due to our closeness to them. They found that the stars were moving a lot slower than the gas. Since gravity affects all matter equally, that meant the high gas velocities could not be due to gravity alone. Other researchers, starting with Hannes Alfven, had pointed out that magnetic fields could be confining the plasmas in huge filaments, accounting for their high velocities with no need for dark matter.

Now that hypothesis has been dramatically confirmed with the release of the new analyses. Contained in a paper by H.F. Wang(Centro Research Enrico Fermi, Rome) , Z. Chrobakova, (Comenius University, Bratislava), M. Lopez-Corredoira (Instituto de Astrofisica de Canarias, Tenerife) and F. Sylos-Labini (Centro Research Enrico Fermi, Rome), the analysis uses velocities from almost one billion stars in the galaxy (about 1% of ALL stars in the galaxy). For each star, the GAIA satellite has been able to measure its radial velocity from Doppler shifts, its velocity in the plane of the sky from ultraprecision location measurements, and its distance. The distance is measured from the parallax-caused change in position of the star on the sky as the earth travels in its orbit around the sun.

From this enormous mass of data, the researchers derived the rotation curve for stars in our galaxy - the blue curve in figure 4. Unlike the well-known rotation curve from gas, the stellar rotation curve actually **decreases with increasing radius,** just as would be expected without any dark matter. The stellar curve diverges increasingly from the gas curve**, so that at the largest radii, the stellar rotation velocities are almost 30% less than the gas velocities. The gas - really plasma - is flowing past the stars at a zippy 70 km/s**. This proves that the plasma velocity measurements can't reflect gravitational fields alone and must involve magnetic confinement as well.

Since we have no reason to believe that there is anything peculiar about our Milky Way galaxy, this new analysis strongly implies that the radio-frequency-based rotation curves for all other galaxies also must involve magnetic confinement as well as gravitational confinement.

In a follow-up paper still under preparation, the researchers use the new rotation velocity curve to calculate that the actual mass of the Milky Way is 160 billion times the mass of our Sun. This is only twice as much as the visible mass in stars. The rest is likely contained in the remnants of burnt-out stars, such as white dwarfs and neutron stars, and in dense cold gas that is too dim to observe. There is no need for dark matter, and no room for it either! In the meantime, more observations of the magnetic filaments that confine the plasma are being made - which we will cover in future reports.

Impossible Galaxies Video

In the fourth episode of LPPFusion video series, "JWST and the Big Bang Never Happened Debate", LPPFusion Chief Scientist Eric J. Lerner shows **how data from the ALMA telescope further contradicts the Big Bang hypothesis,** and its expanding-universe model. Independent measures of the sizes of distant galaxies based on rotation velocities show that the Big Bang formulae for galaxy sizes can't be right. The formula would lead to impossible galaxies that have smaller size than these independent measures permit (Fig. 5), yet we know these galaxies are real. It is the Big Bang hypothesis that is impossible. Full story in the video!

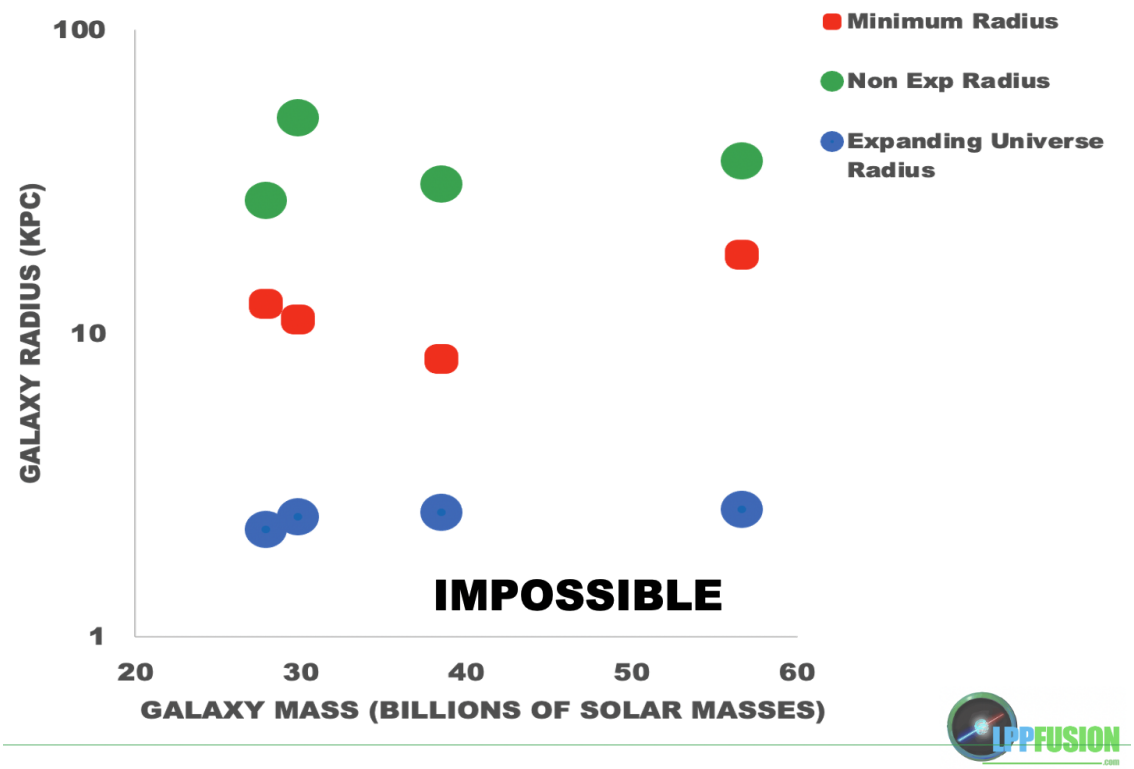

Figure 5. ***Impossible Galaxies graph:*** *Measurements of rotation velocity of gas associated with distant galaxies can be used together with measurements of gas mass to determine the minimum radius of four distant galaxies at a redshift of 4-5(red dots). If velocities are enhanced by magnetic fields, as is likely, the galaxy radius is even bigger. Linear radii calculated from observed angular size assuming a* ***non-expanding*** *universe(green dots) are well above the minimum. But when the expanding universe assumptions are used, the calculated radii (blue dots) are 3-4 times smaller than the minimum, making the galaxies "impossible" for the Big Bang hypothesis. Yet they exist. See the video for full explanation.*