Photographs of a Ferrofluid Cell

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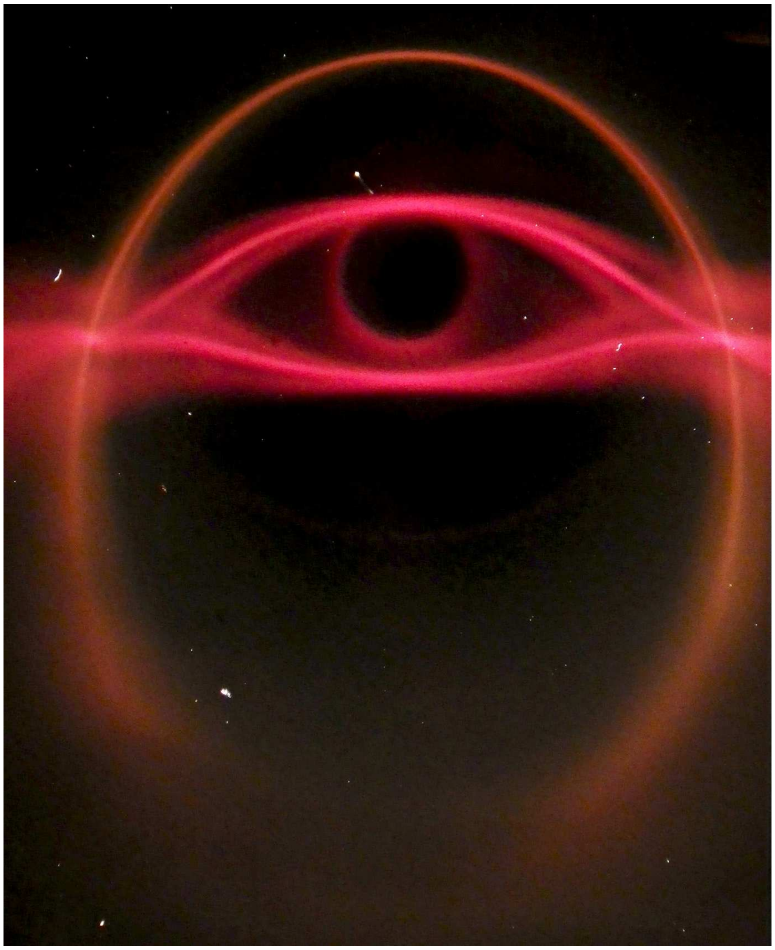

Abstract:

This document is an update to my paper "Photonic Dipole Contours of Ferrofluid Hele-Shaw Cell" arXiv:0805.4364v2 . Photographs are the primary datasets and makeup the majority of the document. The overall argument is that the ferrofluid cells are basically spin based radar systems that show photon scatter off of electron flows inside of the ferrofluid cell; induced by external magnetic fields. In other words, we are watching sparks cascading through an irregular lattice like lighting jumping cloud to cloud.

Main Body:

Starting with the Ferrofluid Cells presented in arXiv:0805.4364v2; The new experimental setup is a tungsten light source with an incident angle of 45 degrees to the Ferrofluid Cell and a camera directly above the cell.

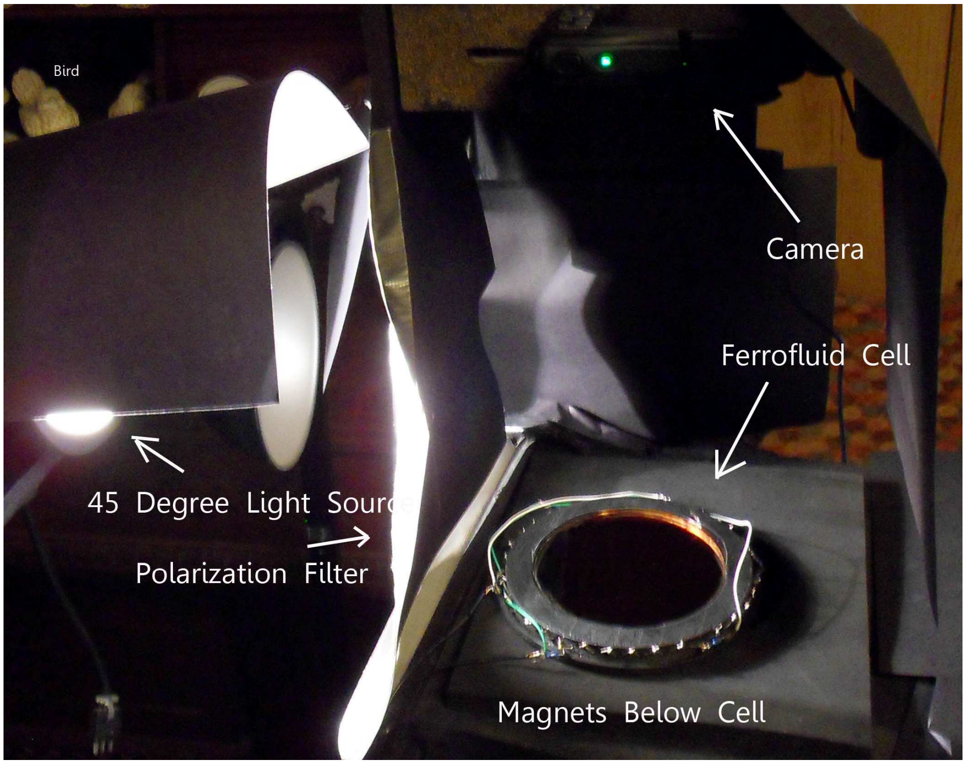

Figure 2 - Experimental setup with 45 degree light source.

Figure #1 on the title page, is the result of placing an north pole of a single cylinder shaped neodymium magnet below the Ferrofluid cell with the magnets flat pole face flush with the bottom of the cell. The light source in Figure #1 is coming from the top of the photograph and in Figure #2 the light source is from the left of the cell. Light source alignment can be observed by the first arc of scatter from the top of the photograph. The concave direction of the arc is away from the light source. This line/arc I have labeled a bow shock line because of the shape.

For completeness, the bow shock lines are labeled as spin left and spin right in Figure #3. This labeling is for the reason that the brown lines have been observed interacting with other brown lines. The interaction seen in the basic magnetic configurations of a few magnets tends to be a foggy area between two vertical brown lines or a foggy area between a set of two horizontal bright lines.

This foggy interaction reminds me of ions recombining into a neutral species. Sparks/ions cascading through an irregular lattice within a strong magnetic field, might not be a bad explanation for the images observed in the Ferrofluid Cells.

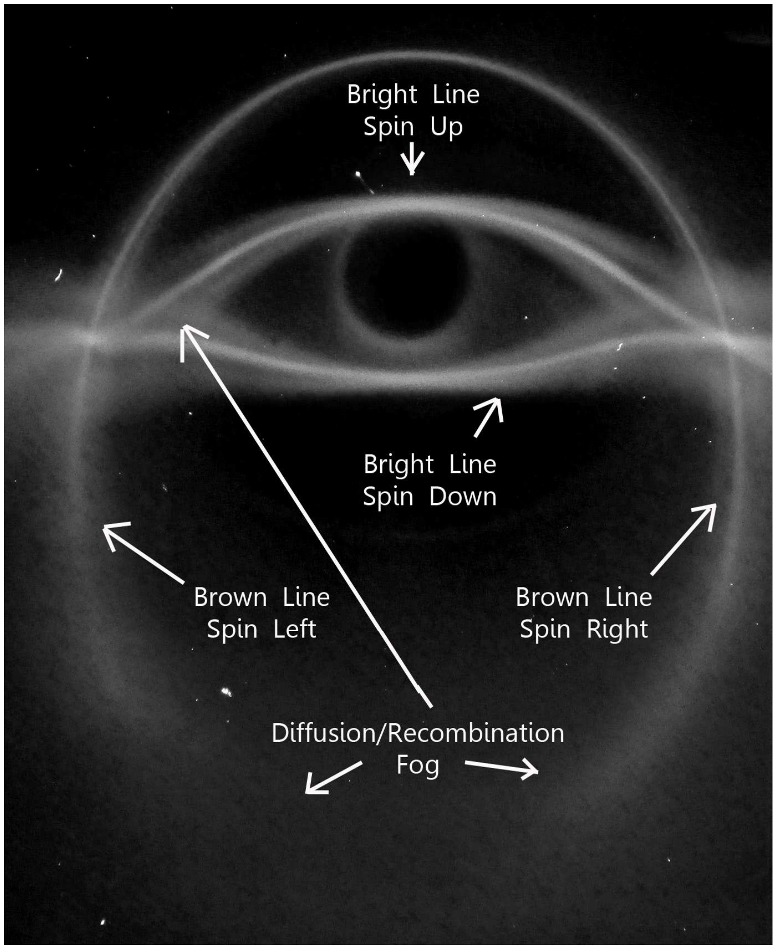

Figure 3 - Labeled features of a single north pole.

The primary focus of this document is the two bright lines seen in both Figure #1 and Figure #3. The important characteristic of these bright lines is when they reach the highest gauss areas then the bright lines separate the most; and at the lowest gauss areas they seem to combine back together.

Because we know that a neodymium magnet is a spin device in the sense that it is made of rigid lattice of molecules with unbalanced spins, then one can characterize the separation of the bright lines in the high gauss field areas as showing spin polarization of the two lines.

Figure 4 - Alignment of five neodymium magnets.

Figure 4 show five magnets in a plastic jig. The outside perimeter of the magnets are aligned with the north pole at the top and the center magnet has a south pole alignment.

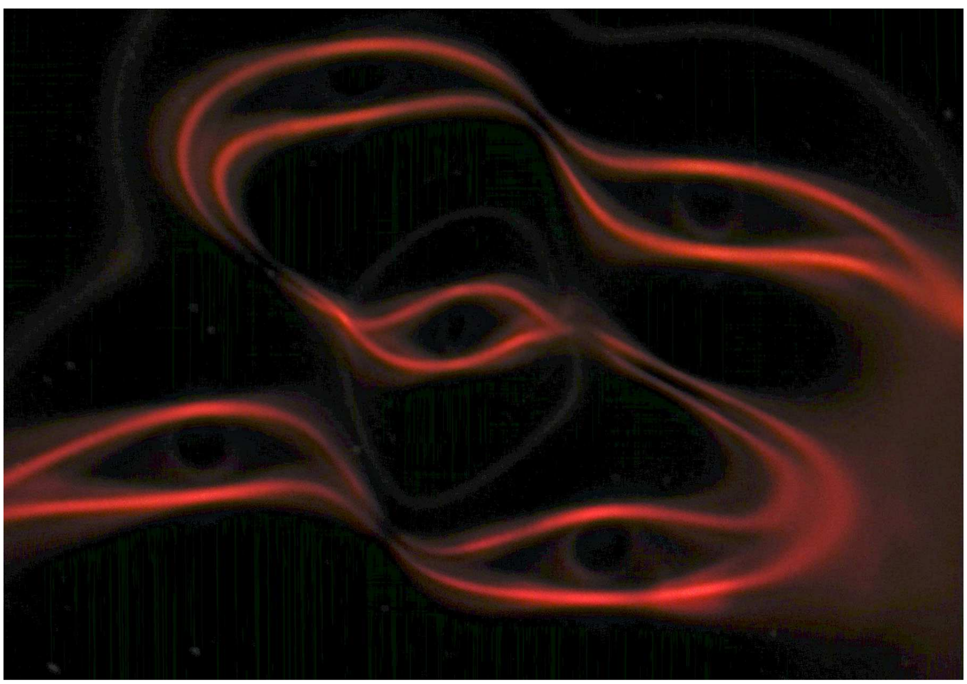

Figure 5 - The results of the applying the magnets in Figure #4.

In Figure #5, see the bright lines cross twice in the center, going around the south pole, this strongly suggests that each line has a different spin polarity and wishes to flow on the other side of the pole. The darker brown lines seem to demarcate the areas of spin. In Figure #5, the south pole which has the opposite spin, is fully surrounded by a dark line.

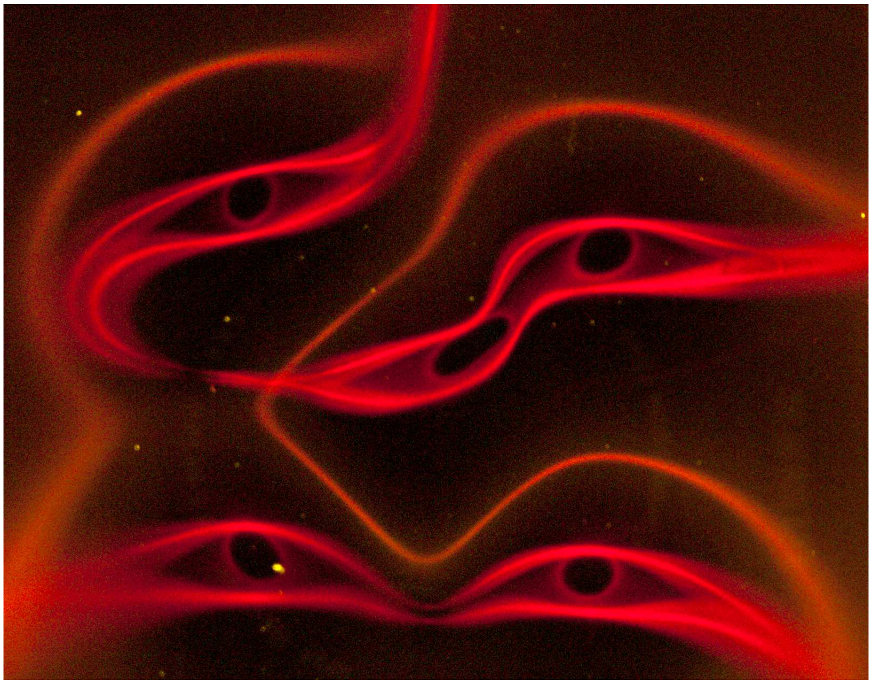

Figure 6 - The results of the applying three north and two south pole magnets.

In Figure 6, I have taken the same magnets from Figure #4, and flipped one of perimeter magnets. Now three magnets are aligned north and the center plus one other magnet are aligned south. In the picture you can clearly see the brown spin demarcation line with three magnets to the left and two magnets to the right.

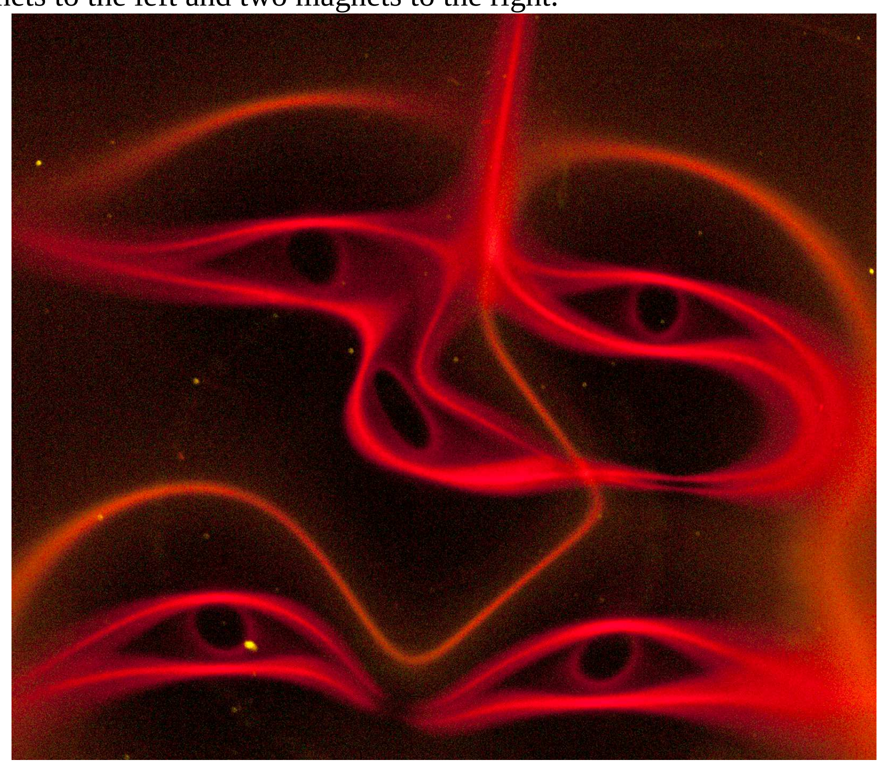

Figure 7 - Same magnets as Figure #6 with a different Poynting vector.

In Figure #7, I have the same magnets with different alignment relative to light source, basically I twisted the plastic jig and kept it flush to the bottom of the cell. Clearly you can see the bright lines crossing each other on their way to the center of the cell.

Now the difference between Figure #6 and Figure #7 gives us new information. All that I changed between the two pictures was the Poynting vector of the light source relative to the five magnets. This is telling us that the light source is playing a role in creating the images. In fact, I believe the light source is supplying the energy to create the lines of scatter. The images seem to be a function of photon momentum and the external magnetic field.

I envision that the photons from the light source supplying uniform energy into the ferrofluid, and then a certain magnet alignments creates or greatly extends the lifetimes of some excitation states. If you could see a slice of a 3d laser cavity during operation, it might look like a ferrofluid cell image with ionic current and so forth. Could the ferrofluid medium with the right field have meta-stable states just like a HeNe laser?

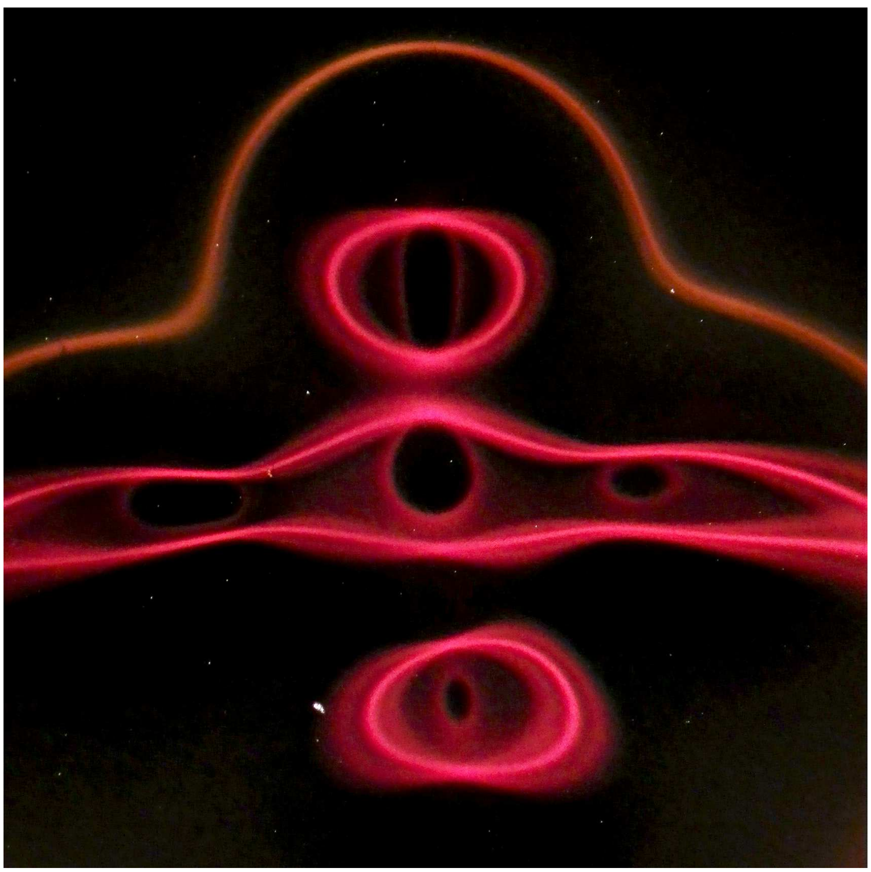

Figure 8 - Same magnets as the other figures, all aligned north poles.

In Figure 8, I am applying five north poles to the Ferrofluid Cell. We observe that the top and bottom magnets have a bright circle around them. I explain this as the up spin and down spin bright lines joining together end to end and together they make a circle.

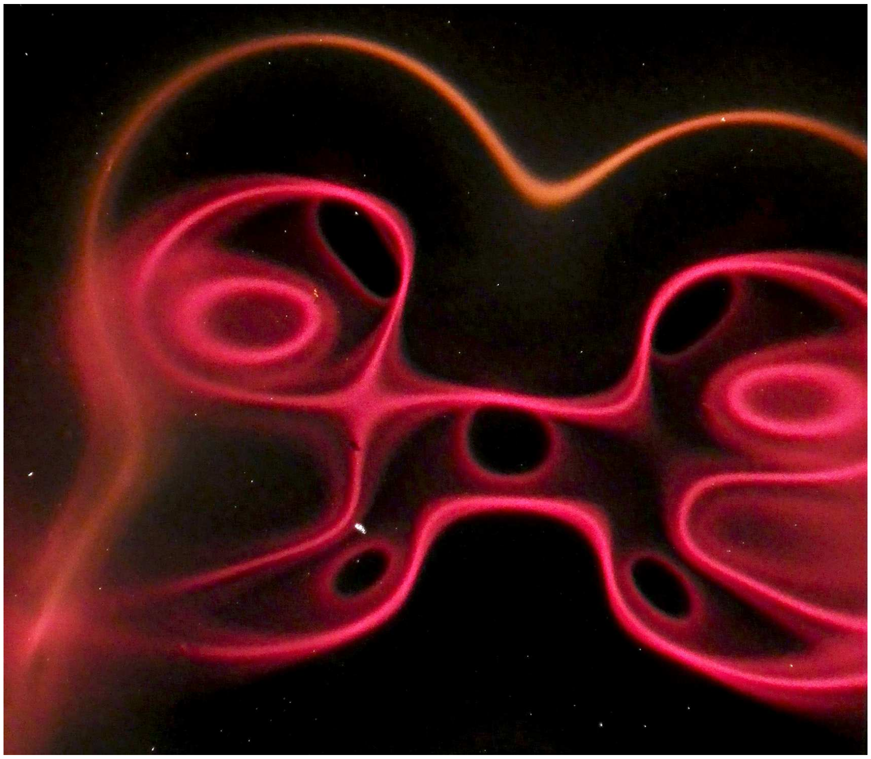

Figure 9 - Same five north pole magnets with different Poynting vector.

Showing in Figure 8, through Figure #10, that using the right photon momentum and external field that you can trap the excited states into circles within circles. Clearly the Ferrofluid cells are spin based radar systems, showing electron currents inside the cell.

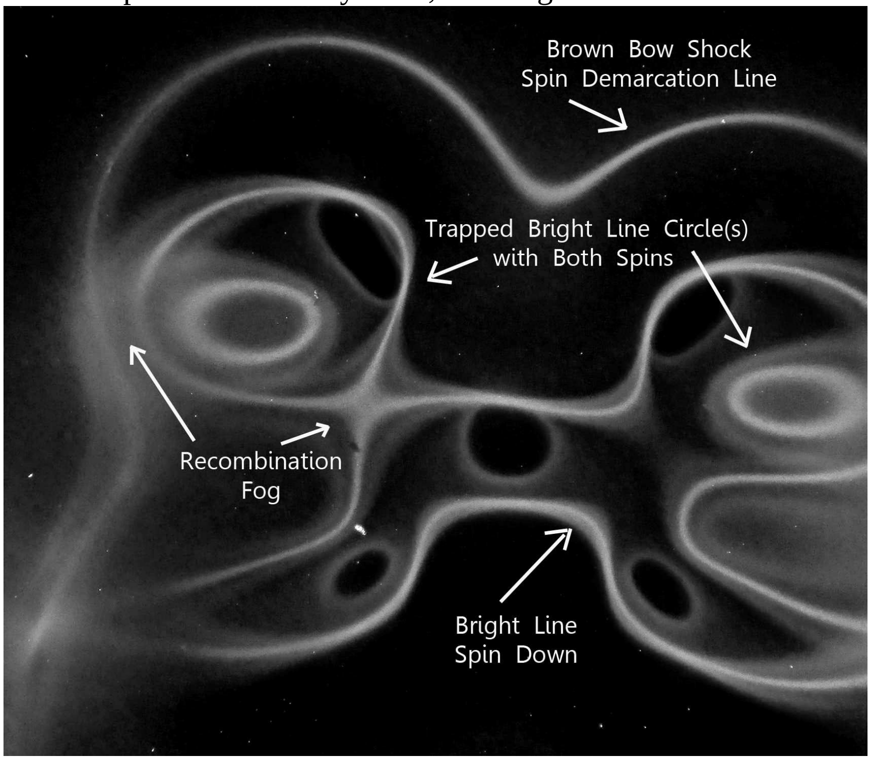

Figure 10 - Labeled features of the five north poles of Figure #9.

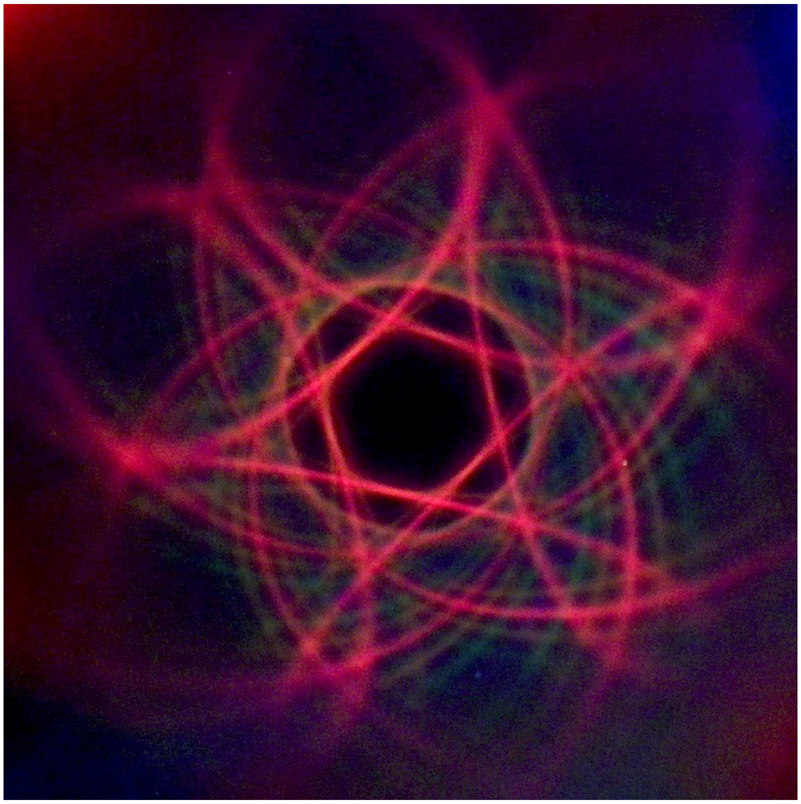

Figure 11 - Single magnet LED operation, note the even pairs of bright lines.

Using what we have learned in Figure #10, lets examine Figure #11 which shows LED operation with a single north pole in the image. The ring of 36 LEDs can be seen in Figure #2 . What should be apparent is that the bright lines come in pairs and part of the brown line arcs from Figure #1 has become the inside perimeters of the circle(s). You could rotate Figure #1 multiple times and stack the images and they would closely resemble Figure #11, with a difference being that the incident angle of the light sources is close to 90 degrees for the LED operation.

Summary:

Cell operation is like lightning jumping from cloud to cloud. The small ionic currents in the cell jumping from irregular lattice to irregular lattice. When currents flow inside the lattices, they scatter light. The patterns of the ionic flows are complex, but make sense if you assign spins to each line of current. The reason the photographs look like plasma flows is because they are ionic flows. Sometimes you just have to believe your eyes.

References & Resources:

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