Artificial Black Holes of Electromagnetic Fields

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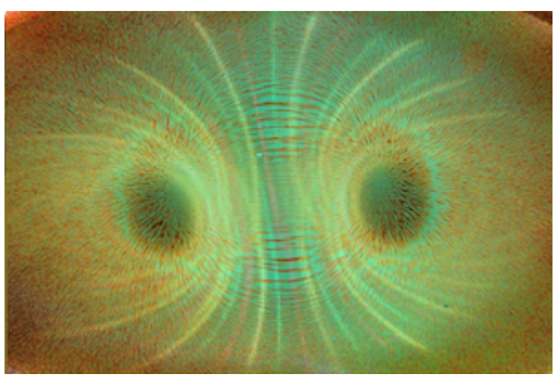
Abstract: A series of observations made during experiments by the author[1] and soon after by others[2,3] have revealed an unusual magneto-optical phenomenon. The anomaly described herein is due to the response of Nano-sized (~10 nm) magnetite particles, coated with a soap surfactant and suspended in a carbon-based carrier fluid. Commonly known as Ferrofluid[4], this Ferrohydrodynamic liquid is normally opaque to light. When converted into a thin-film less than 10 um and used in the transmission mode, this fluid exhibits very unusual optical properties when influenced by a magnetic field. The fluid used in the following examples is a proprietary mixture made by the author, but any Ferrofluid will perform in a similar manner. Although the active mechanisms are Nano-sized, it is the visual, macroscopic event these particles create that is the focus of this paper.

Keywords

Artificial Black Holes; Magnetic Black Holes; Electromagnetic Black Holes;
Optical Thin-films; Electromagnetism; Photonics; Ferrofluid; Nanotechnology; Quantum 3-D Event

Introduction

The optical properties of Ferrofluids have been exhaustively studied and their experimental results published since the early 1960s[5]. In this paper, we first observe the reaction of micro-sized iron filings to a magnetic field and next we observe how the Nano-sized particles inside a Ferrolens react to the same field. A visual comparison via a transparent overlay of these two methods reveals how the physical size of iron reacts differently to the influence of a magnetic field when compared with an image presented by a Ferrolens[6], as seen in Example 1.

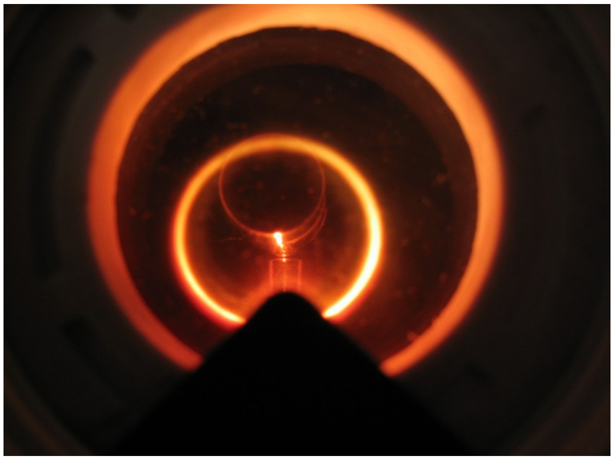


Filings vs. Lens Example 1

Iron filings become "little magnets" and assemble into the typical Gaussian pattern the "whole of electromagnetics" has been built upon. Recently, it has been suggested the Ferrolens is revealing a Quantum representation of a magnetic field[7]. The Superparamagnetic properties of Ferrofluid[8] does not allow for the magnetization of its Nano-iron. Other factors, including steric repulsion[9], Van Der Waals Forces[10] and the Rosensweig Instability[11] all contribute to the Ferrofluids response. Initial tests during early development of this Ferrohydrodynamic liquid revealed the phenomena of buoyant levitation and the formation of "liquid spikes"[12]. Inside the Ferrolens, the suspended nanoparticles are free to rotate with six degrees of freedom[13], plus they can be moved into any location and remotely activated within the influence of a magnetic field[14].

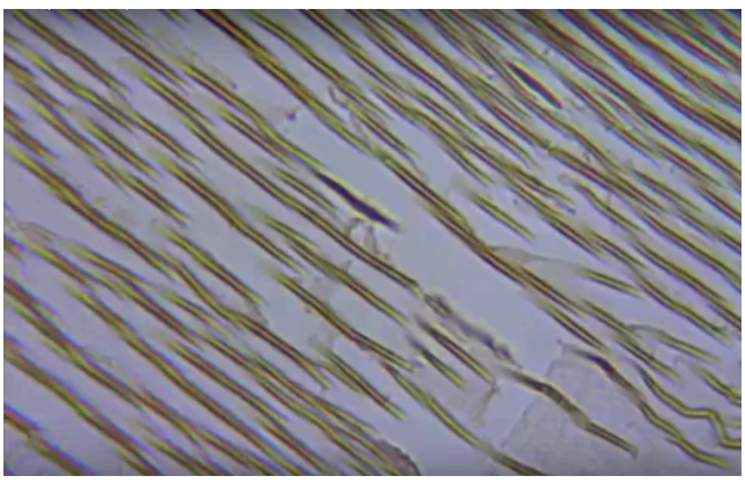
Other Examples

When using a Ferrolens to view magnetism with a single point source of light we see an absence of field lines. Instead we see a luminous ring of light, apparently in 3-D space. This ring of light forms inside the Ferrolens, as seen in Example 2, where a small cylinder magnet is located 4 mm below the cell. Here we see a brightly lit ring, slightly offset from center and above the magnets pole. A single small incandescent light source is under the black pyramid at the bottom of the image, blocking the direct rays of light.



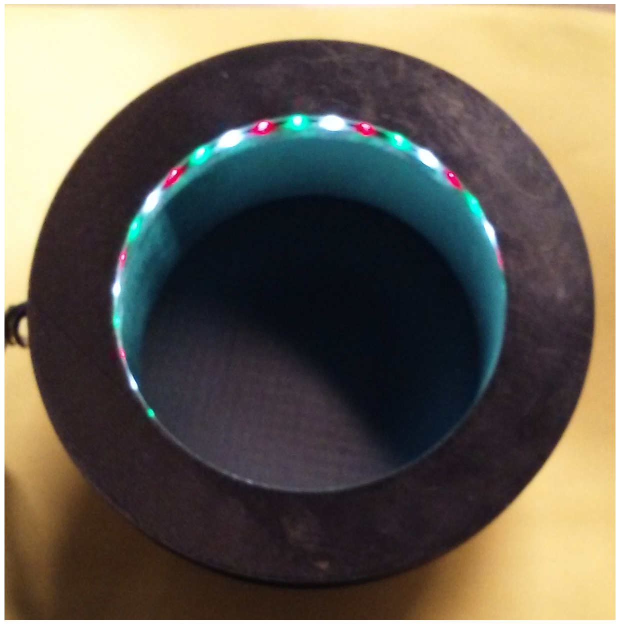
Ring of Light Example 2

Below, in Example 3 we see a 2500X magnification dark-field photo[15] of magnetite nanoparticles inside the lens forming chains in the presence of a magnetic field. These chains are approximately 100 to 150 um in length, about the size of a magnetic domain, and in motion. The chains will continue to migrate from south magnetic pole to north magnetic pole within the suspension until the entire hydrodynamic system reaches equilibrium. This activity can take up to several hours at room temperature. Once the system has reached zero, the field can be removed but the image remains. Over a period of several days the particles will dissipate back into their isotropic state and the image slowly fades.
When in the streaming phase, particle chains cluster in bundles very similar to a mega-multi-slit aperture, as they scatter light to create the 3-D ring pattern as seen above in Example 2.



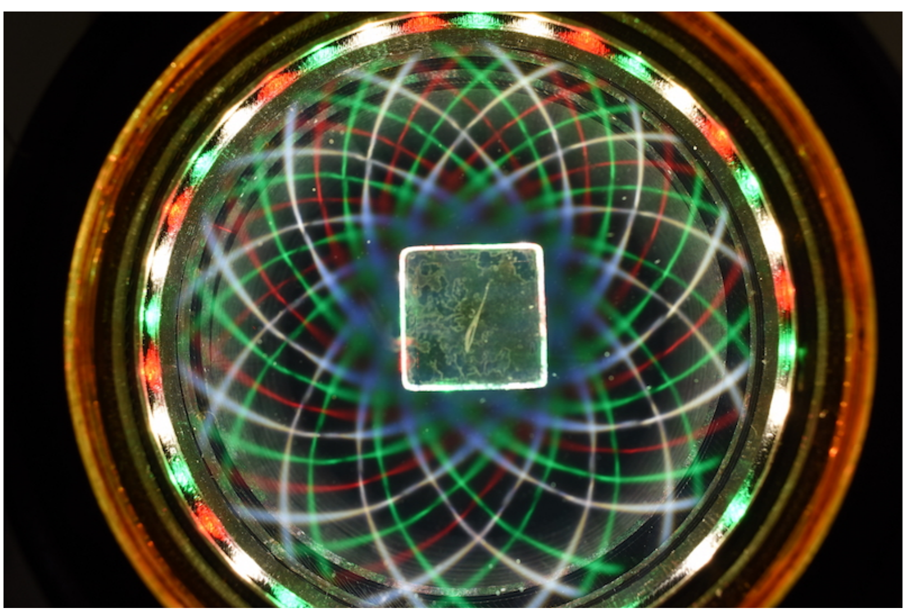
2500x magnetite chains Example 3

A plastic ring of thirty-six alternating red, green and white LED's are used as light sources, separated 10 degrees apart. Multiple wavelengths allow the viewer to see phase shifts and other optical phenomenon the lens creates. In the following examples, the lens was mounted inside the ring with the LED's pointing inward toward the center. The light ring used is shown in Example 4 (without Ferrolens). Michael M. Snyder[16] conceived of and built the first ring in 2007 exclusively for his Masters' Thesis using a Ferrolens.



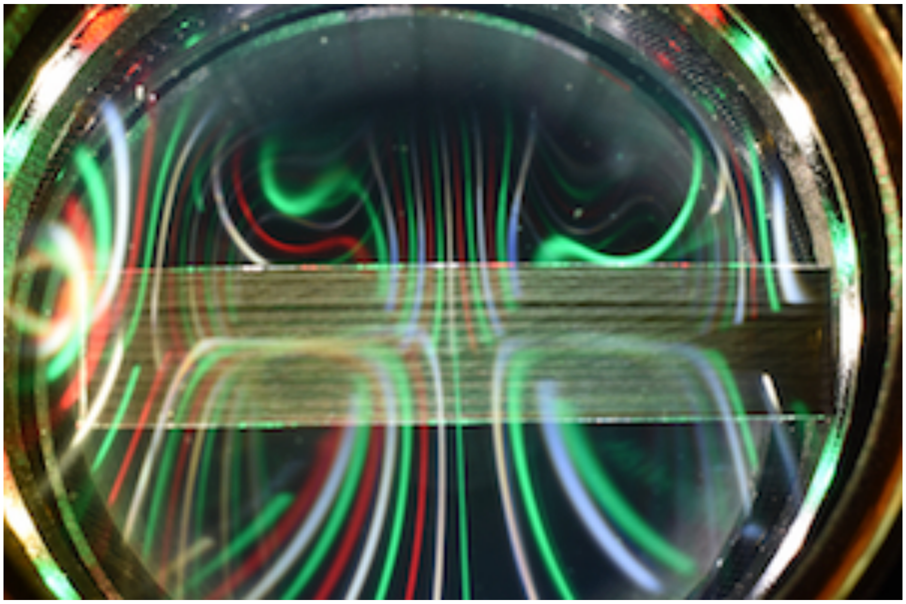
Light Ring Example 4

In the following test, a Ferrolens reveals multiple bands of light forming geometric patterns as seen by the viewer. Each band of light scatters from its source into two rings, with one ring passing over the north magnetic pole and another passing over the south magnetic pole; at a different offset and all apparently located in 3-D space. This geometry is determined by the offset angle of each source light around the outer circumference of the magnet as seen in Example 5, where a 20 mm cube magnet was placed on the top surface of the Ferrolens, with its north pole facing the camera.



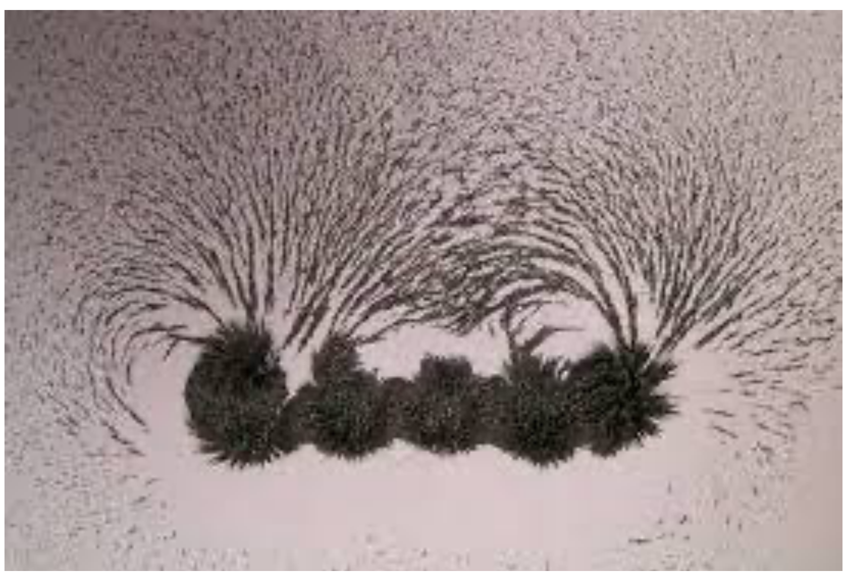
Offset Rings Example 5

A more complex presentation of this effect is seen in Example 6, where the side of a typical five-element Halbach magnet array encased in black plastic was located below the lens and illuminated with the same red, green and white LED ring as the previous test. Here we see how the 8000 Gauss fields from each 12.7 mm cube magnets interact with one another when in close proximity (4 mm).



Halbach Array Example 6

A comparison of the same magnet array using iron filings on white paper[17] is seen below in Example 7.

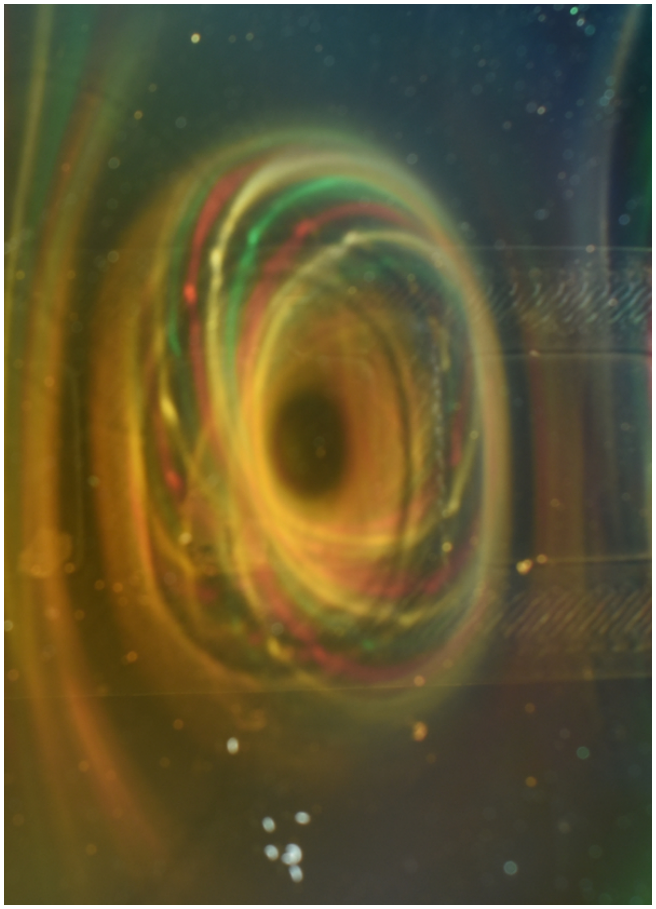


Halbach Array using Iron Filings Example 7

It becomes obvious to the observer that iron filings are a poor indicator of a magnetic field. They alter the field by creating a plethora of micro-magnets through induction. Whereby a more detailed and realistic representation can be resolved using a Ferrolens. The superparamagnetic particles inside the lens are too small to be magnetized; therefore, they do not alter the field, they are only influenced by it.

Artificial Black Hole Experiments

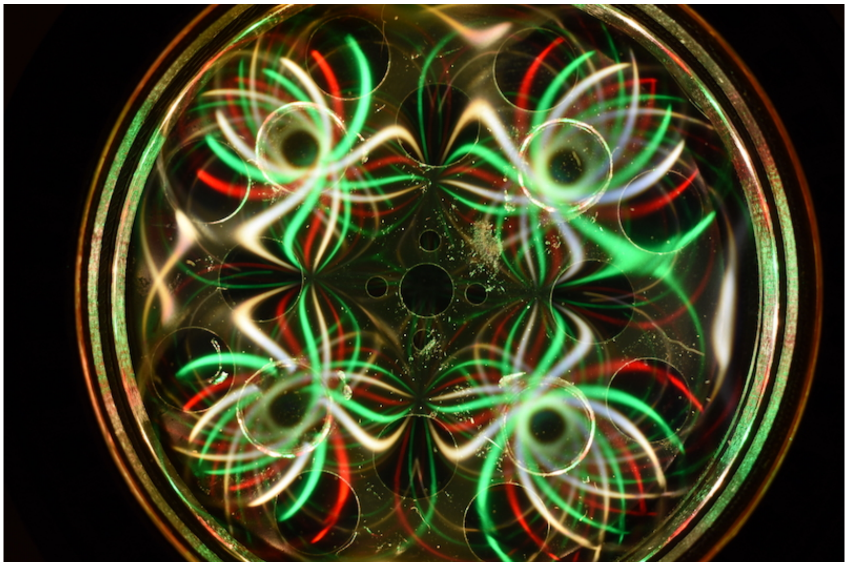
An 8000 Gauss magnetic pole is located at a one-centimeter distance from the rear of the Ferrolens where it is positioned at a "focal point" to produce an artificial magnetic black hole, apparently in Euclidian Space. Its location is determined by the physical size of the magnetic material, magnet strength (B) and magnet distance from the fluid layer. We see the lights scatter into a vortex encircling the pole around an apparent horizon, but not illuminating the center as seen here in Example 8.



Artificial Magnetic Black Hole Example 8

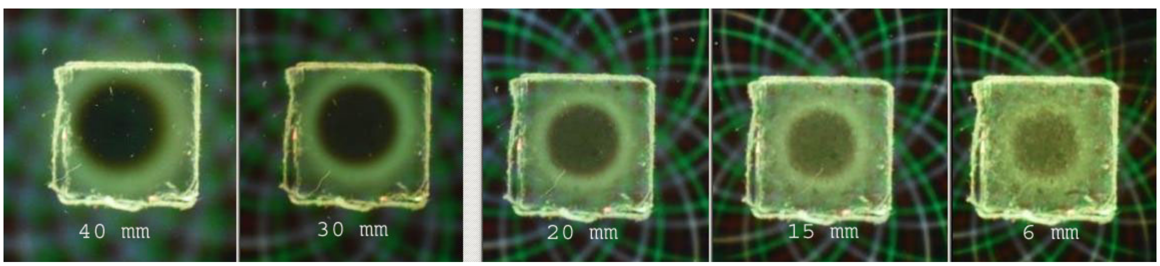
While looking at these black hole images, it becomes obvious to the observer this lens is responding to torques inherent to the dual and opposing chirality of a magnetic field. We see the nanoparticles scattering and intermingling direct light into paths determined by the magnetic field. And, it's apparently happening in 3-D space. This naturally occurring event could never be seen with iron filings nor programmed into any commercial magnetic simulation software. And, it's not perfect, just like a typical magnet.

It appears to the viewer that both north and south fields are interwoven and inseparable, as seen in Example 9, where four north poles of cylinder magnets face the camera; positioned below the lens. Magnets are secured into an aluminum plate, painted black with a few extra holes drilled through it (for alternate magnetic configurations).



Four North Poles Example 9

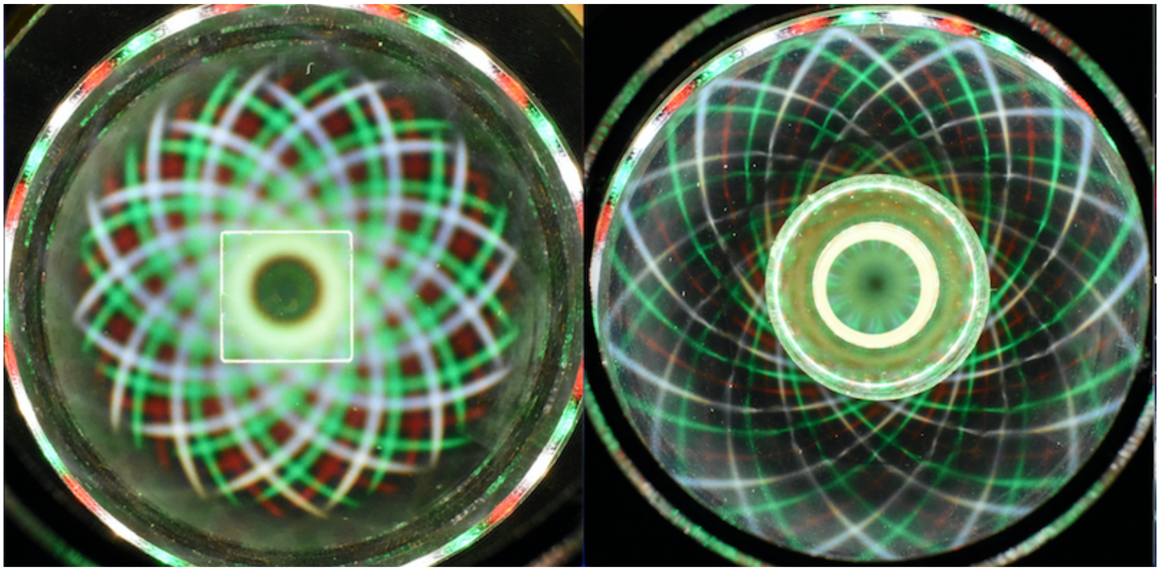
Here in Example 10, both the camera and magnet remained fixed in position. Varying the distance from the pole of a 10,000 Gauss Neodymium cube magnet to the bottom of the Ferrolens alters the intensity of the apparent black hole:



Varying intensity with Distance Example 10

Close examination reveals the colored rings of light are out of focus when the black hole is “blackest” and it exhibits the most distinct “horizon” at 30 mm distance. However, the colored rings become clearly focused when the black hole reaches minimum blackness with the least distinct horizon at 6 mm. This simple experiment indicates we are experiencing a 3-dimensional event. It’s the best proof I can show, given the limited 2-D of paper or screen.

Another interesting experiment results from viewing a black hole from the center of a solid-pole magnetic field compared to an air-pole magnetic field. I used a 20 mm cube magnet and a 40 mm OD x 20 mm ID ring magnet for comparison, seen in Example 11. The small, bright white inner ring is a plastic spacer under the ring magnet.



Solid pole (L) and Air pole (R) Example 11

Summary

This report is based on observations. I realize visual experiments are considered archaic physics at best, but this is ultimately our reality and not theory or artificially produced. I present these experiments with the hope they will generate conversation and debate about this interesting phenomenon. I've shown how a Ferrolens can display an electromagnetic field with greater detail and dimension than iron filings do. By utilizing a Ferrolens with electromagnetism, we can control light to a greater degree and evolve beyond the limits of substrate-based systems. I've shown here how this simple, passive device can be used to explore the Nano-world and Quantum forces between electromagnetism, light and matter. The experiments shown here are easily re-created[18,19] by anyone. I look forward to reading the opinions, reviews and discussions generated from this paper. I conclude our ability to view the influence of magnetism in 3D space opens up new possibilities for electromagnetic research and product development by affording us a fresh perspective to contemplate from and remind us to constantly re-evaluate our known beliefs.

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Disclosures

All photographs, except Examples 1, 2, 3 and 12 were taken by the author using a Nikon D7200 camera with Nikon AF-P Nikkor 18-55 mm lens. No flash. Manual settings: Shutter=1/50th, F8, ISO=4000. Example 2 was taken by the author using a Fuji Finepix F20, automatic settings without flash. No digital enhancement or alterations were made to any photographs.