# A Magneto-optic Lens Displays an Electromagnetic Field Anomaly in a Magnetic Bloch Wall

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## Abstract

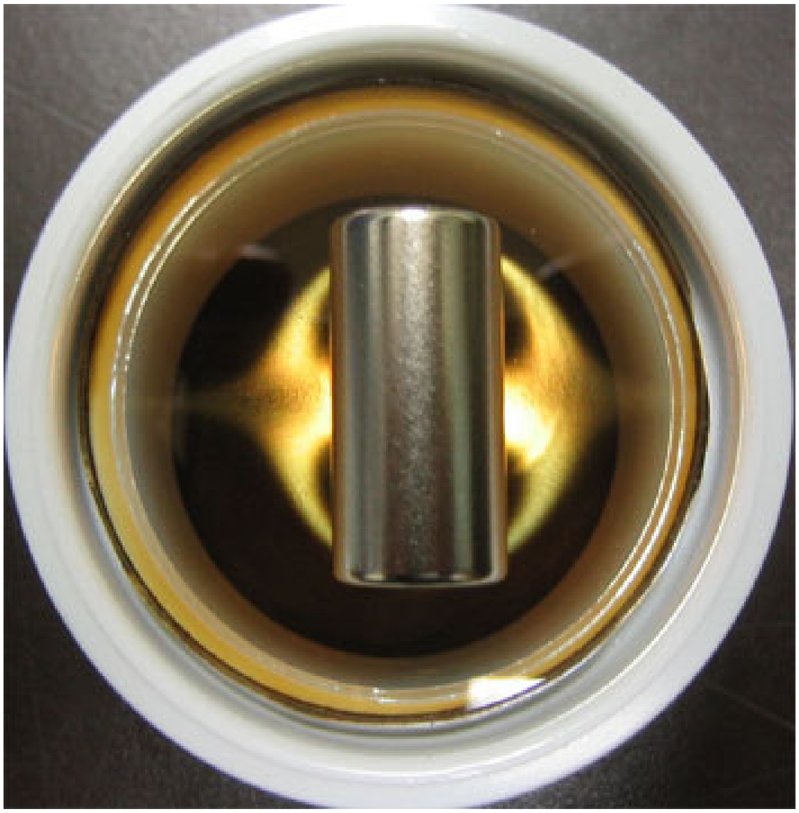
With the development of the Superparamagnetic Lens by Timm A. Vanderelli, a method of displaying Maxwell's magnetic vector fields as it relates to the magnetic domain or Bloch wall in a uniform magnetic field is analyzed. A previously unknown magnetic anomaly is also considered.

## Introduction

The purpose of this article is to offer a hypothesis as to the natural forces at work as displayed by this unique lens. J. Clerk Maxwell's work in magnetism and electromagnetic wave dynamics provided a basis for the thought experiment leading to the development of this Superparamagnetic Lens.

*" I have therefore preferred to seek an explanation of the fact in another direction, by supposing them to be produced by actions which go into the surrounding medium as well as in the excited bodies, and endeavoring to explain this action between distant bodies without assuming the existence of forces capable of acting directly at sensible distances".*

*A Dynamical Theory of the Electromagnetic Field*
*By J. Clerk Maxwell FRS 1864*



**A new look at Electromagnetic Force**

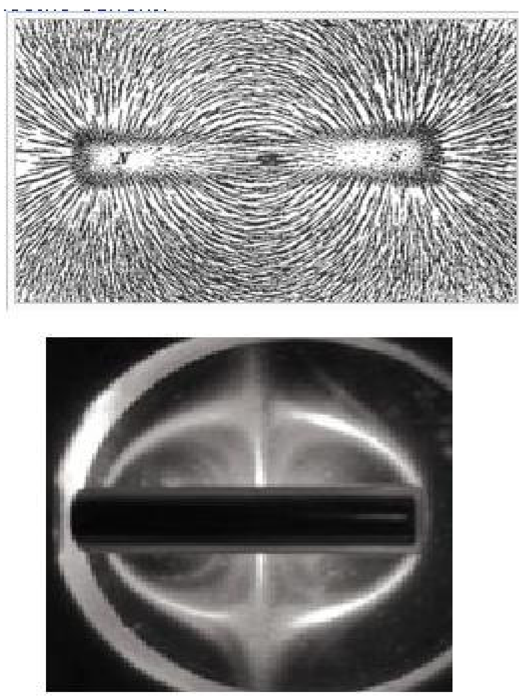
Recently a device was invented that allows what we consider the display of Maxwell's magnetic vector flux field. This device aptly named the Superparamagnetic Lens provides far-field diffraction patterns under normal lighting conditions of an extraordinary sort. The images provide additional insight into the natural forces that compose the fields surrounding today's high Tesla magnets. A magnetic anomaly occurs at the mid-point crossover of the flux stream, which we believe underscores our misconceptions concerning the nature of electromotive force.

A large range of spatial effects can be observed when a Gaussian light beam interacts with the nonlinear colloidal solution of mineral oil and the ferromagnetic nanoparticles of iron oxide constituting a Kerr medium in the presence of an external magnetic field.

In this short introductory paper we shall try to convey the differences between the electric field and what we currently believe to be an image of the magnetic Bloch wall or the magnetic domain wall. To investigate this device first we must describe the physical device and the properties involved.

The device is composed of two panes of optical quality glass with a ferromagnetic colloidal sealed between the two panes of glass that present a very large nonlinear refractive index. The ferrofluid contains ferromagnetic nanoparticles of iron oxide that are prepared by the condensation method and are approximately 2 to 20 nanometers in size. Each gain is a magnetic dipole and has a limited degree of freedom between the glass panes. The lens utilizes the Cotton-Mouton effect in that the double refraction (birefringence) of a light beam in a liquid in a magnetic field is at right angles to the direction of light propagation.

Figure 1.




The Superparamagnetic Lens in its simplest form is basically photons passing through a ferrofluid influenced by a uniform external magnetic field. This simple apparatus provides images of the electromagnetic field in a much higher resolution than previously obtainable.

However, there are many processes involved in this simple device:

**Ferromagnetic nanoparticles:**

In the presence of a strong uniform magnetic field these non-interacting single-domain ferro particles oscillate at the Neel point. Under the influence of a magnetic field the suspended grains of ferromagnetic nanoparticles undergo a micro-rotation until reaching a state of saturation in the form of chains as they align at the boundary of the uniform magnetic field. This Magnetic Domain wall once formed will remain in place as long as the magnetic field remains.

At this magnetic boundary the ferromagnetic nanoparticles reach a saturation level or resonance. This resonance image size is dependant upon the particle size, which plays a fundamental role in both the magnetic and optical behavior, and the magnetic field strength. The lens image is not directly influenced the luminous intensity of the light source. However as the luminous intensity increases this expands the width of the ring structure of the image but does not directly influence the overall physical size of the image.

**Photons:**

A phase shift occurs that changes the incoming photon wavelength to a lower frequency as the photons travel through the magnetic field. The forward and backward propagating of the photonic waves increase within the lens due to the reflectance incurred between the two ¼ wave glass panes.

The propagation of electromagnetic waves through the lens (a stratified media) will have a normal dispersion except near the resonance point of the Bloch wall.

The photon experiences a spin relaxation (polarization) due to the magnetic field and the polarization provided by the two-¼ wave glass panes and ferrofluid that we suspect effectively increases the reflectance of the interaction of the photons and the ferromagnetic nanoparticles suspended at the paramagnetic Bloch wall.

A magnetic domain wall is a soliton like structure and is driven by the spin torque up of many local phase shifted electron spins. Each ferromagnetic nanoparticle acts as magnetic monodomain and includes a magnetic moment. At resonance this magnetic moment is oriented along the magnetization axis with the ferromagnetic nanoparticles arranged and aligned in multi ferro-nanoparticle chains at saturation. And it is at this point that of minimal particle interaction that superpramagnetism occurs.

A closer look at the image (uniformly induced magnetic interference patterns) clearly shows a bulge at the center sections of the single magnet as the flux lines crossover. Each pole of the magnet apparently has a “down loop” and the opposite polarity has an “up loop”. This is an interesting magnetic anomaly and is as yet not well understood.

This anomaly raises interesting questions as to the nature and character of Maxwell's Electromagnetic field as it pertains to the magnetic domain wall.

A Self-phase modulation occurs within the Lens as a nonlinear optical effect of the light beam interacts with the nanopartcles and the influence of the uniform magnetic field. A beam of light, when travelling in a medium, will induce a varying refractive index in the medium due to the optical bifringence of the Cotton-Moulon effect. This variation in refractive index will produce a phase shift or polarazation of the light beam, leading to a change of the light beams frequency spectrum.

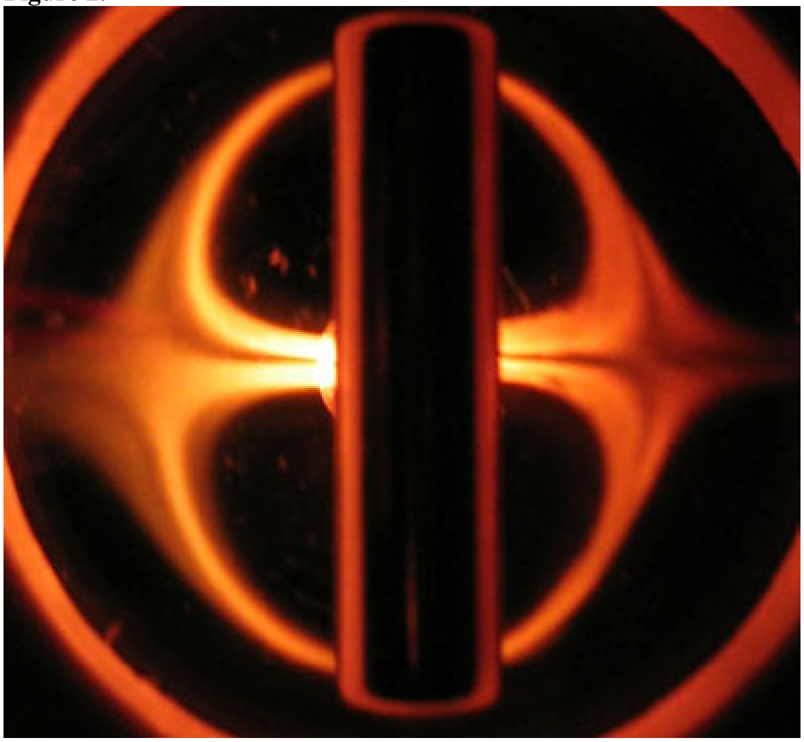
The refractive index is influenced by the optical quality ¼ wave glass, and the Zeeman effect of the uniform magnetic field. Also the Lens manufactuing technique maintains a partial vacuum of the ferrofluid colliodial mixture which limits the degree of freedom of these ferromagnetic particles.

It has been observed in experimentation that a 23-degree incidence angle of the incoming light beam provides the maximum scattering of the photons and produces the higher quality images. These interference waves are not only influenced by the frequency of the incoming polarized light but also by changing the angle of incidence of the light beam that causes the view of the image to intensify to a certain degree. The intensity of the image will fade or intensify depending upon the amount of photonic energy that is trapped by the magnetic field.

**Anomaly:**

An anomaly was observed when viewing the electromotive force with this lens. A closer look at the image (uniformly induced magnetic interference patterns) of figure 2 clearly shows a bulge at the center sections of the single magnet as the flux lines crossover. Each pole of the magnet apparently has a "down loop" and the opposite polarity has an "up loop". This is an interesting magnetic anomaly and is as yet not well understood. This anomaly raises interesting questions as to the nature and character of Maxwellian electromagnetic field as it pertains to the magnetic domain wall.

**Figure 2.**



## Conclusion

Hopefully this introductory article has provided an interesting hypothesis for the consideration of Maxwellian electromagnetic fields in the creation of a magnetic Bloch wall. The observed magnetic anomaly of the flux field crossover at magnetic midpoint is as yet not well understood and will require further study. This further study of these phenomena is ongoing.