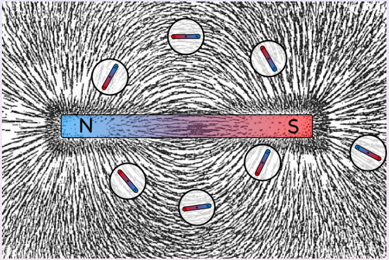
Paramagnetic and Diamagnetic Field Experiments

Robert M. Haralick, Guy Obolensky, Loren Zanier

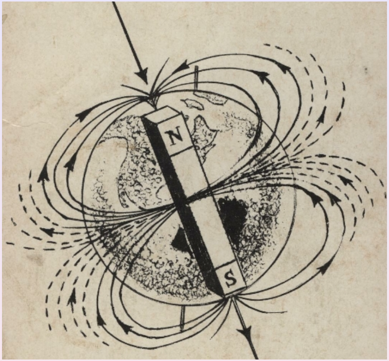
Outline

Classically Portrayed Magnetic Fields



The magnetic field of the magnet induces the iron filings to each become a magnet and what is portrayed is the result of the interaction of the magnetic field of the bar magnet with the magnetic field of the iron filings.

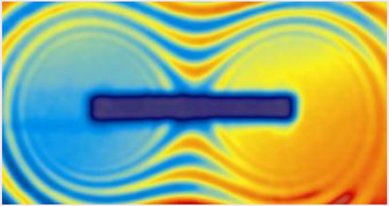
Davis and Rawls



Albert Roy Davis and Walter C. Rawls,
Magnetism and Its Effects on The Living System,
(second edition)
Exposition Press, Hicksville, 1976.

Spinning Neutrons

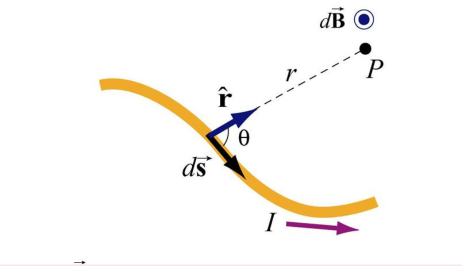
Spin-polarised neutrons irradiate a region. The magnetic moments of the neutrons begin to rotate around the magnetic fields and the direction of their spin changes.



Nikolay Kardjilov, Hahn-Meitner Institute Berlin Germany

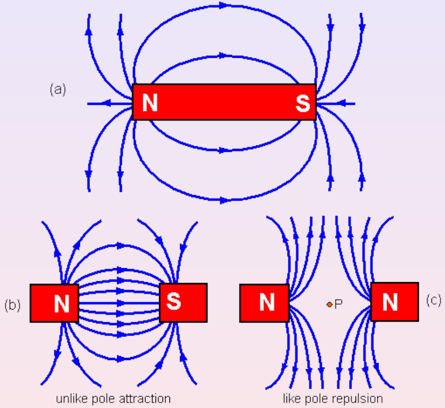
Biot-Savart Law

Superposition the magnetic fields caused by the current in each segment of a wire.

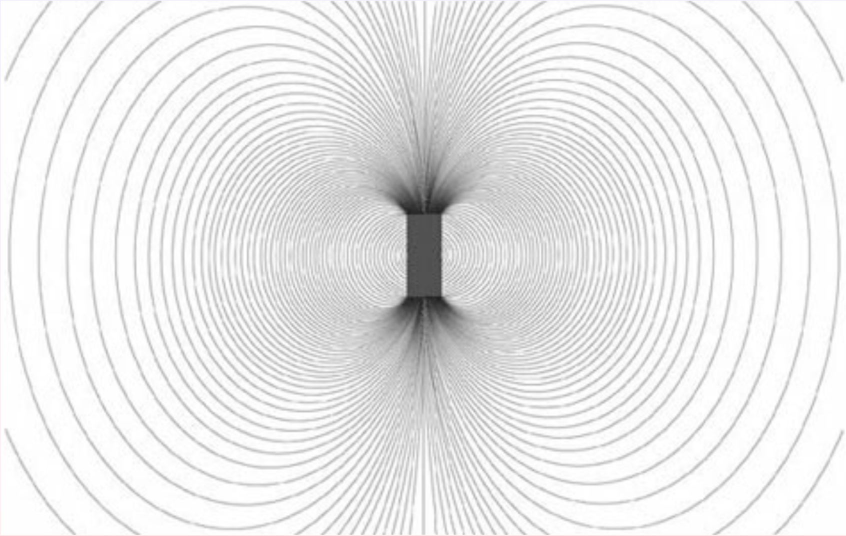


$$
\begin{aligned}
d\vec{B} &= \frac{\mu_0}{4\pi} I \frac{d\vec{s} \times \vec{r}}{|r|^2} \\
\vec{B} &= \frac{\mu_0}{4\pi} I \int_S \frac{d\vec{s} \times \vec{r}}{|r|^2}
\end{aligned}
$$

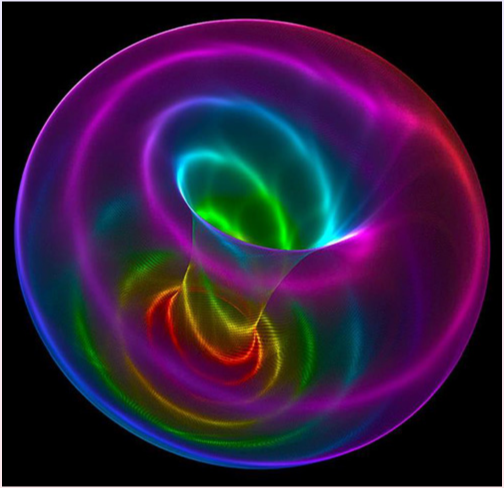
Attraction and Repulsion Field Lines



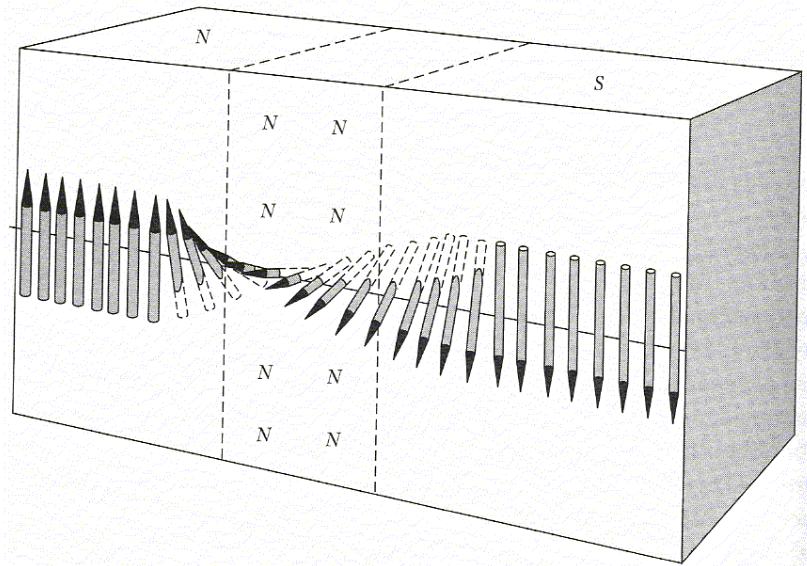
Cylindrical Bar Magnet



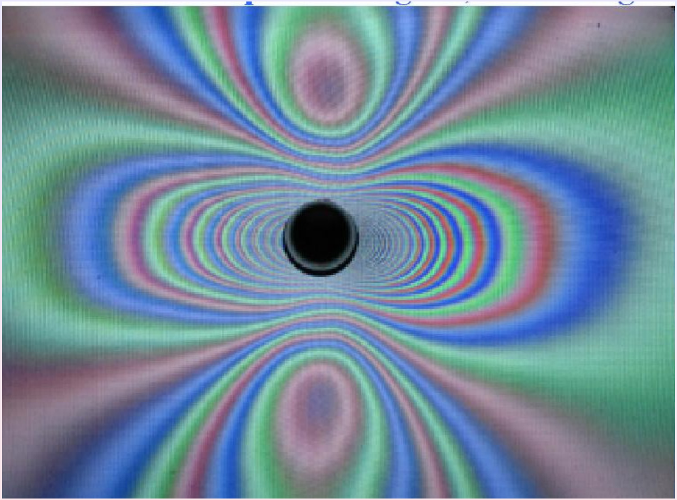
Torus



Bloch Wall

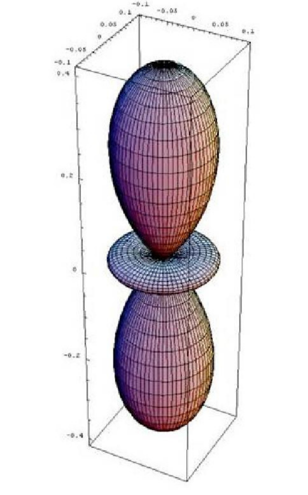


Ken Wheeler



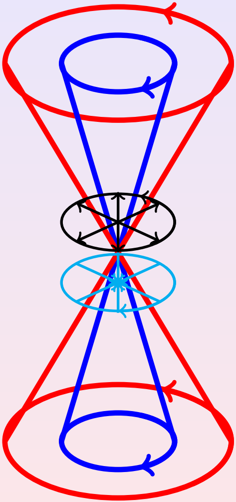
Ken Wheeler, *Uncovering the Missing Secrets of Magnetism* (third edition) p.85

Paramagnetic and Dielectric Inertial Plane



Ken Wheeler, *Uncovering the Missing Secrets of Magnetism* (third edition) p.185

Paramagnetic and Diamagnetic Field



Diamagnetic Field

The Diamagnetic Field is not in current physics theory.
It

- Is not a force field
- Alters space *geometry*
- Preconditions Space
- Raises the *Gauge*
- Is biologically active

Perspective

- In the reality we know about, interactions are entropic
- In the reality we do not know about, interactions are negentropic
- These realities are connected when the *gauge* is raised
- The *gauge* can be raised by fast rise time pulses
- The *gauge* can be raised by diamagnetic fields
- The interaction exchanges
    - Mass for Spin
    - Entropy for Negentropy

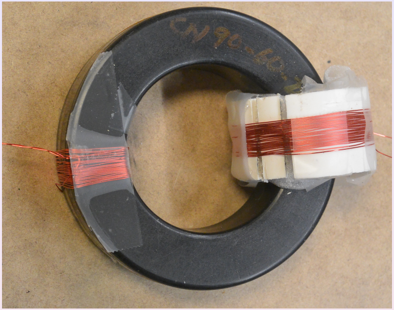
Crazy Idea

- The interaction exchanges
  - Mass for Spin
  - Entropy for Negentropy
- Devices can be built which produce more energy than they consume
- Devices can be built which get cold, rather than hot, when producing energy
- Devices can be built which lose mass when in operation

Science

- It does not matter what in the past has been asserted
- It does not matter who made the assertion
- It only makes a difference that what is asserted
  - Corresponds with observations
  - It fits into a theory which is self-consistent
  - Theory corresponds with all relevant observations
- The eye is always directed toward the truth

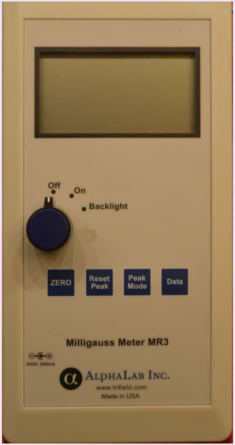
Transformer Question



- Current flow in primary causes a field in the toroid
- The field is entirely contained in the toroid
- A changing field within the toroid induces a changing voltage across the secondary which is outside of and surrounds the toroid cross-section

By what principle does the changing field in the toroid cause an action at a distance: the changing voltage in the secondary?

Field Measurements

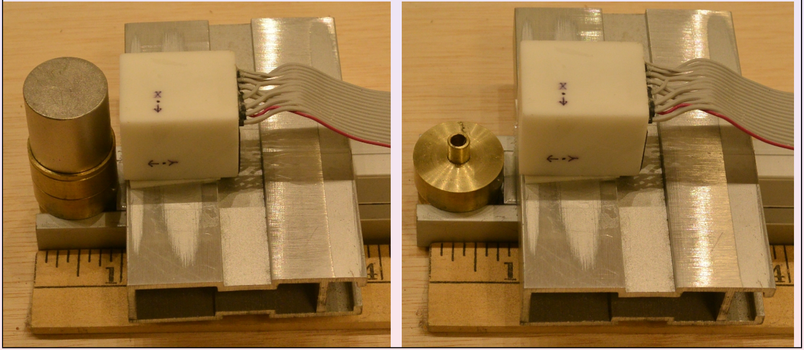


Field Measurements were made with a three-axis AlphaLab Milligauss Meter MR3 that uses magneto-resistive sensors. The maximum reading is 2000 milligauss on any one axis.

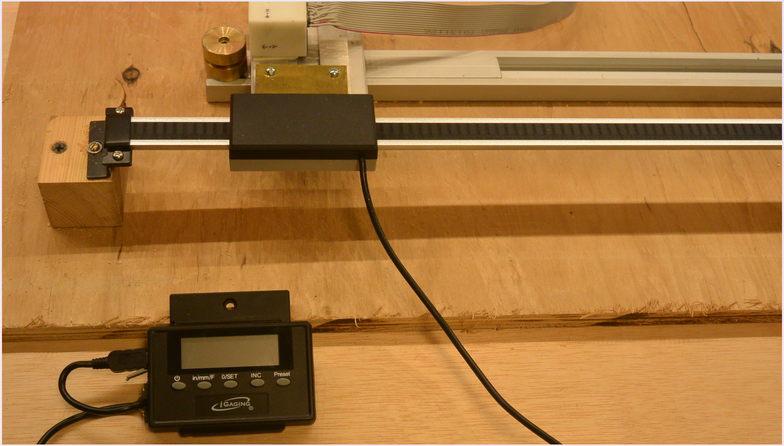
Protocol

- Use Neodymium Cylinder Magnet
  - .92 inch diameter
  - 1 inch long
  - 5700 Gauss in the center
  - North pole up
- X direction back to front
- Y direction right to left
- Z direction down to up
- Take measurements at increments of .125 inch from 1 to 4 inches
- Take measurements at increments of .5 inch from 4 inches to 12 inches
  - With Magnet Present
  - Without Magnet Present
  - Magnet Present - Magnet Not Present

Initial Setup

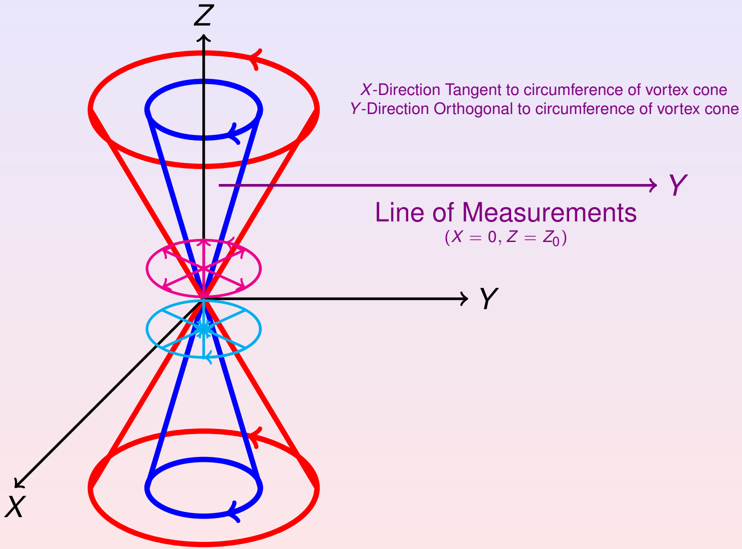


Final Setup

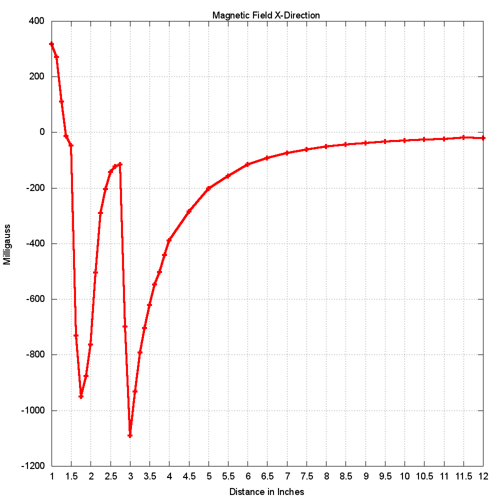


The ruler has been replace with a slide gauge that reads to three decimal places.

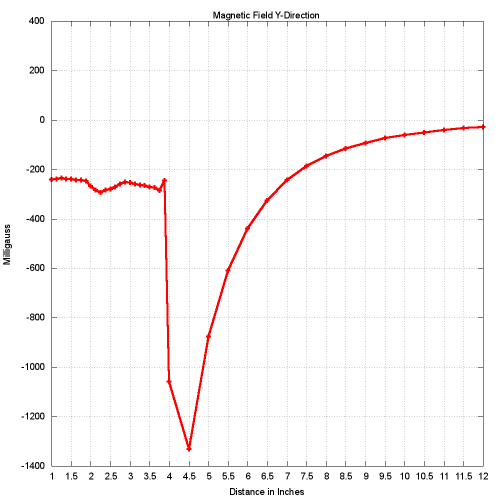
Paramagnetic and Diamagnetic Field



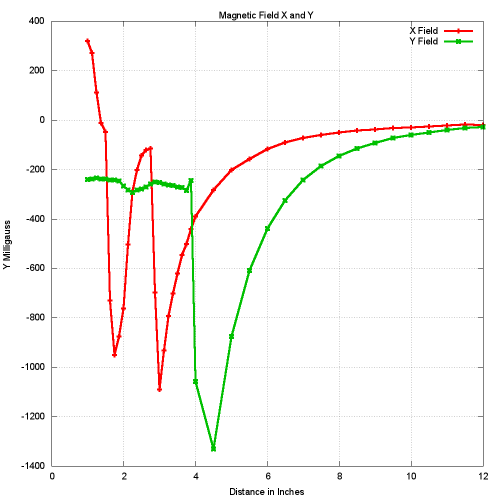
Magnetic Field X-Direction



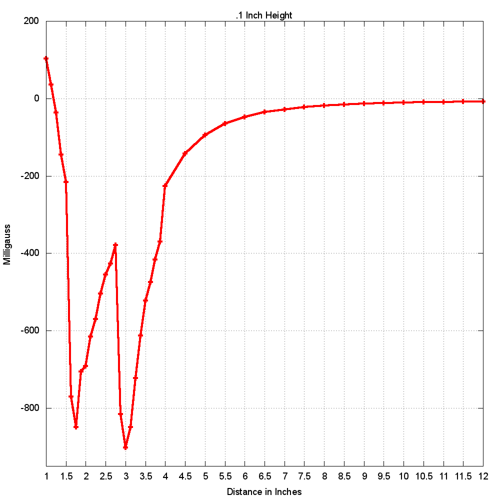
Magnetic Field Y-Direction



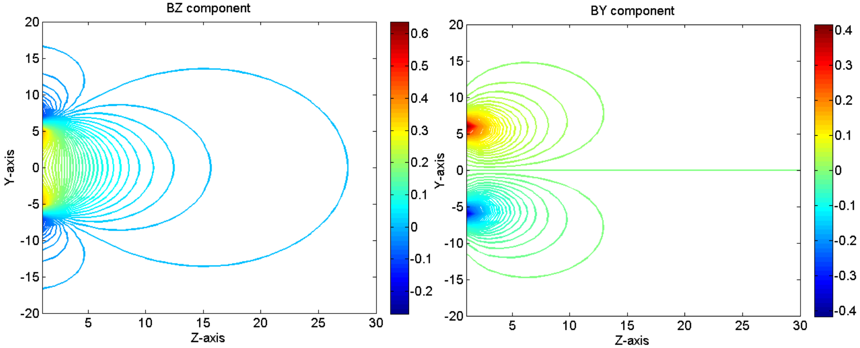
Magnetic Field X and Y Direction



Magnetic Field X-Direction .1 inch Lower



Magnetic Field Contour Plots by Simulation

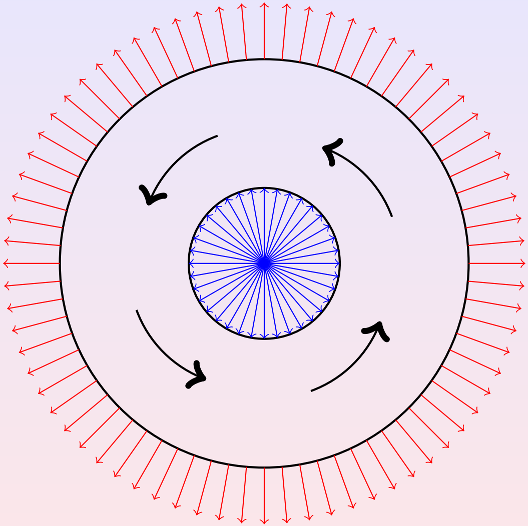


Solenoidal Coil is in XY-plane
Magnetic Field is computed at every point in the YZ plane (X=0)
Using Biot-Savart law

Comments and Questions

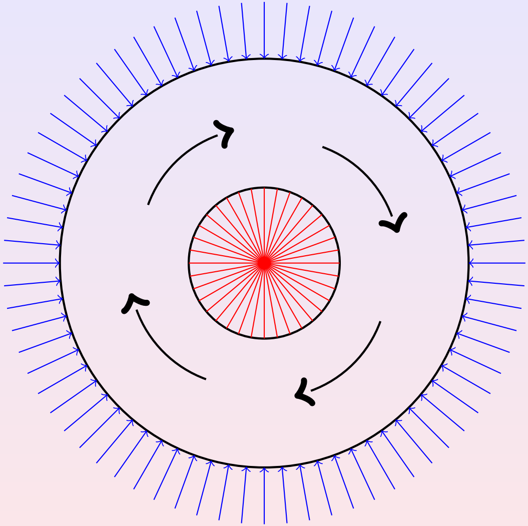
- These Observations are repeatable using Hall Effect sensors
- Are the results due to artifacts?
- Does sensor saturation in one direction cause artifacts in another?

Circumferentially Magnetized Ring



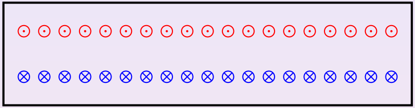
Top View

Circumferentially Magnetized Ring



Bottom View

Circumferentially Magnetized Ring



Key
- $\odot$ Out (The head of the arrow)
- $\otimes$ In (The tail of the arrow)

Side View

The Initial Idea

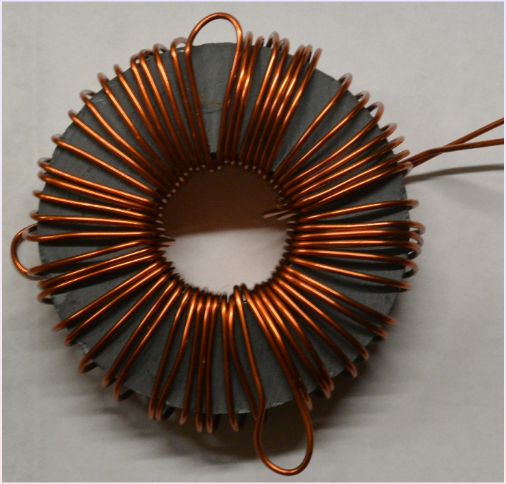
- Rotate a circumferentially magnetized ring in a ferrite ceramic toroid
- The outer toroid has a winding
- The rotating diagmagnetic field will condition the outer toroid
- Permitting a paramagnetic field to flow through the toroid
- Causing a DC current to flow

Failure and Success

- Nothing happened!
- Too uniform
- Need a configuration that breaks uniformity
- Break up uniformity by opposing sectors: this succeeded

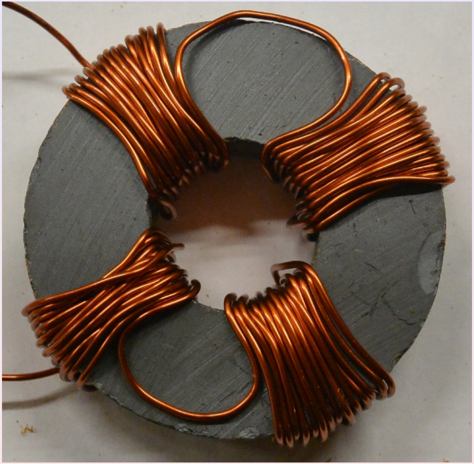
The Ceramic Ferrite Ring

The Coil On The Ceramic Ferrite Ring

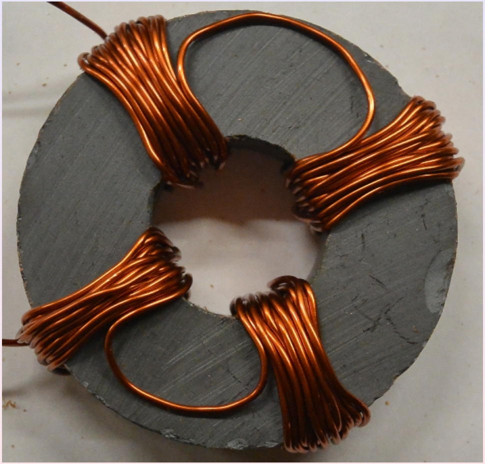


Wound with 18 AWG magnet wire.

Ping 1



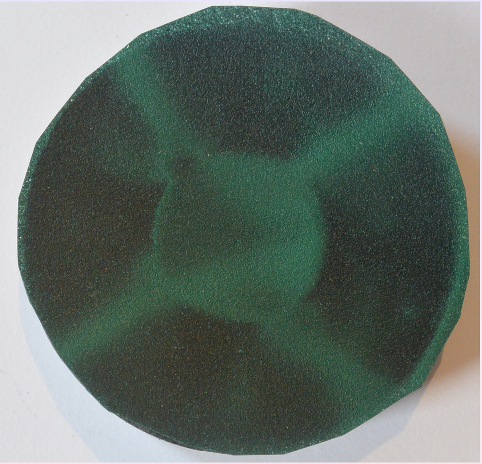
Ping 4



Top Side Viewing Film

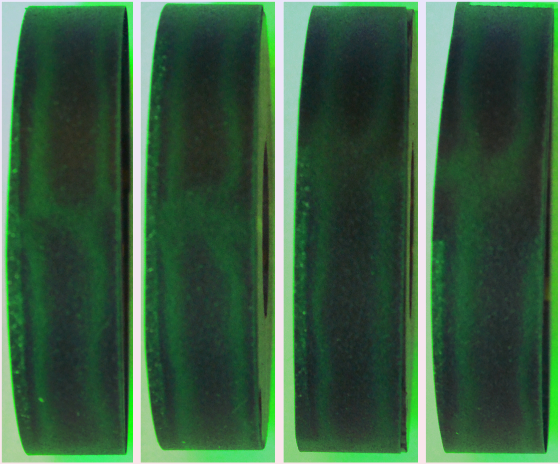
The bright lines show the Bloch region.

Bottom Side Viewing Film



The bright lines show the Bloch region.

Circumferential Bloch Regions



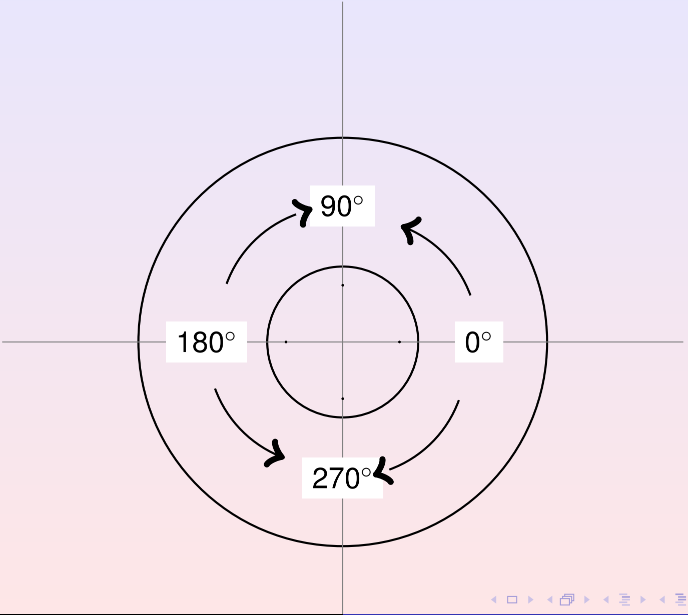
(a) Bloch 1 (b) Bloch 2 (c) Bloch 3 (d) Bloch 4

(e) 4 Pole Bloch Top

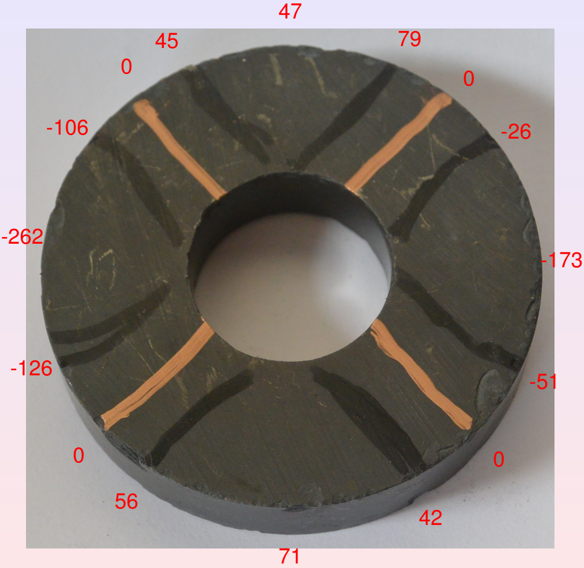
(f) 4 Pole Bloch Bottom

The Bloch lines are marked in bronze. The black lines are the edges of the winding segments.

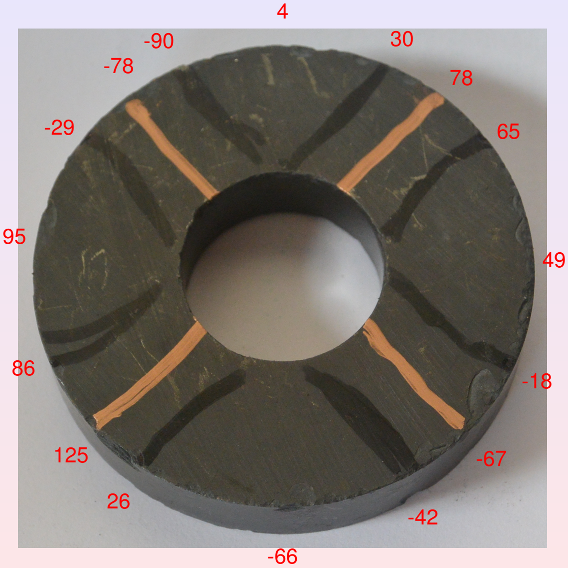
The Ideal 4 Sector Circumferential Polarization



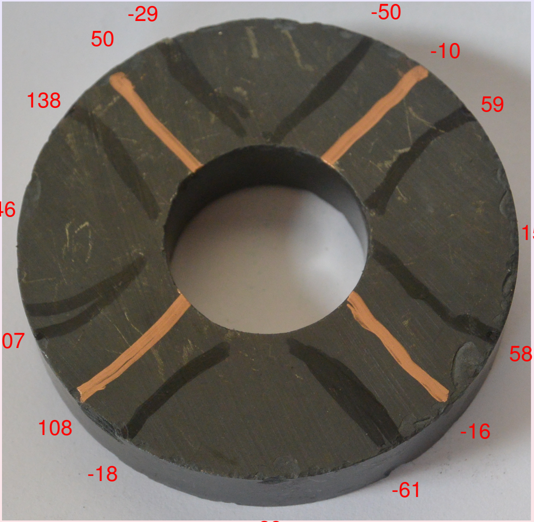
Radial Spot Readings On Circumference(Gauss)



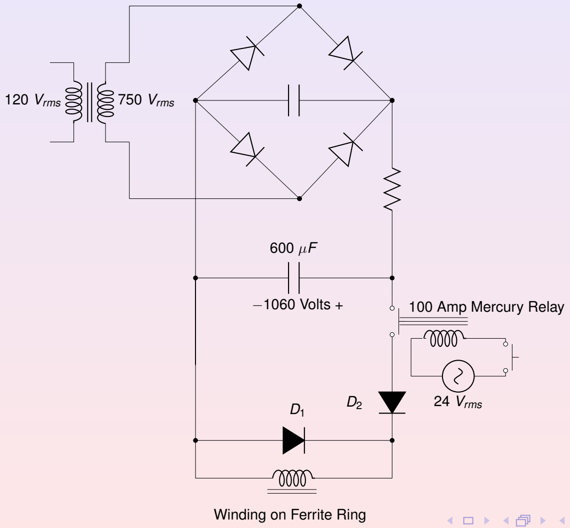
Vertical Spot Readings On Circumference(Gauss)



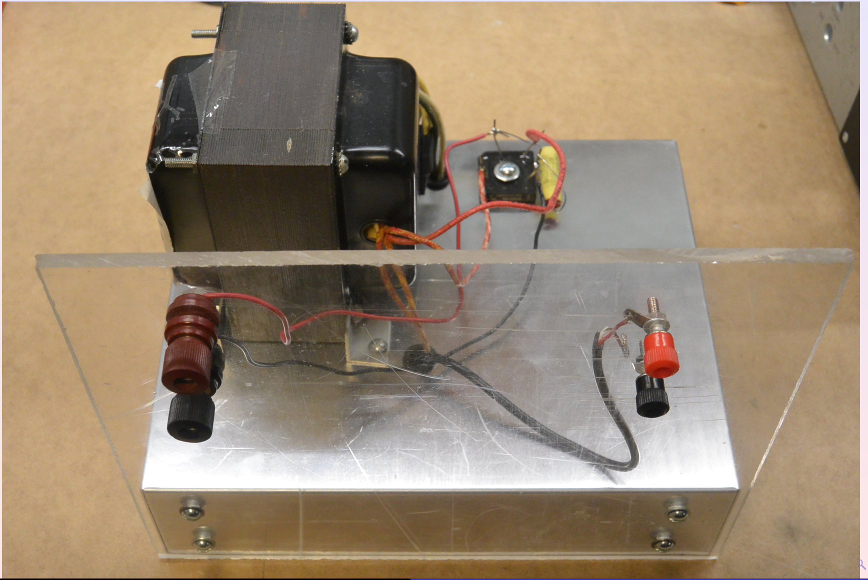
Circumferential Spot Readings On Circumference



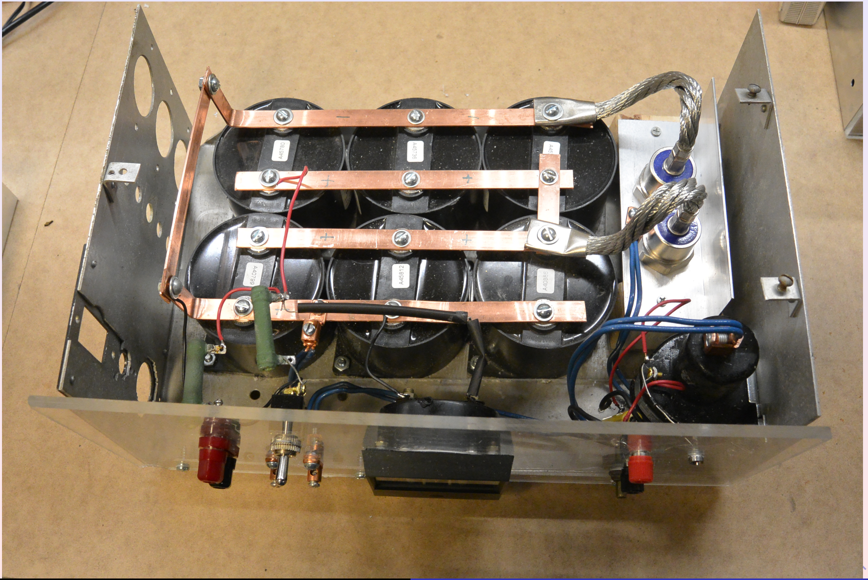
The Magnetizer Electronics



The High Voltage Power Supply



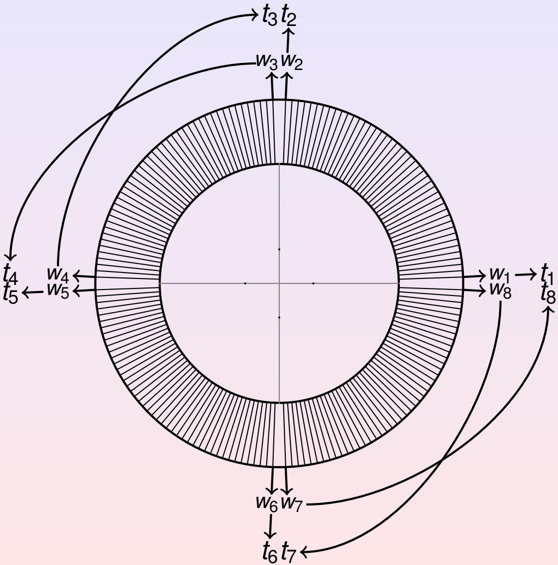
The Pulser Apparatus



The Outer Toroid Winding

- Wind a coil all the way around the toroid
- Cut the winding every 90 degrees
- Each sector's winding is wound in the same direction
- Connect successive sectors opposite from the usual way

The Outer Toroid Winding



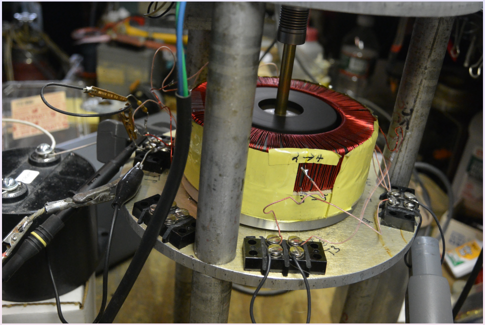
Guy Obolensky

How the Generator Works

- The North end of a sector on the magnet enters the beginning of sector 2 of the toroid
- The South end of the sector on the magnet enters the beginning of sector 1 of the toroid
- But the winding of sector two makes the current flow the opposite direction of the current flow in sector 1
- Therefore the fields in sectors 1 and 2 add
- The voltages generated add
- There is no switching

John Bedini's No Force Motor

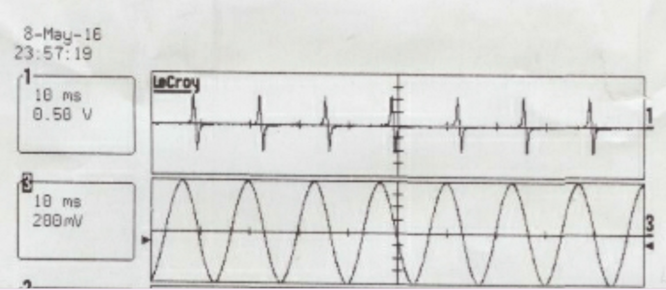
The Experimental Apparatus



Shows the experimental apparatus with the terminal blocks.

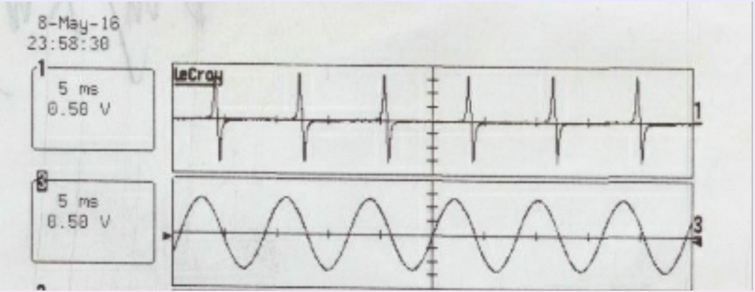
- The framework is aluminum.
- The axle is brass.
- The plug for the ring magnet is aluminum.

Oscilloscope (No Load)



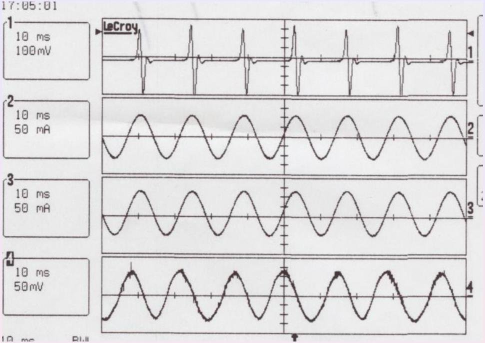
- The time axis is 10 milliseconds per division.
- Upper trace shows the axle sensor signal. It is produced twice a cycle.
- The rotation period is about 25 milliseconds, 2400 RPM.
- Lower trace shows the voltage output of the four quadrant toroid coil.
- The sinusoidal signal is about 400 millivolts volts peak to peak.

Oscilloscope (No Load)



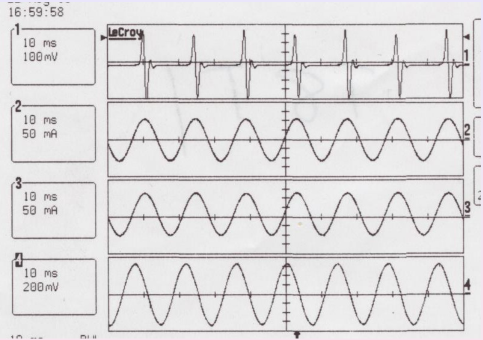
- The time axis is 5 milliseconds per division
- The Upper trace shows the axle sensor signal
- The rotation period is about 17 milliseconds, 3529 RPM
- The lower trace shows the voltage output of the four quadrant toroid coil
- The signal is about .75 volts peak to peak

Inductor Load: 11.7mH



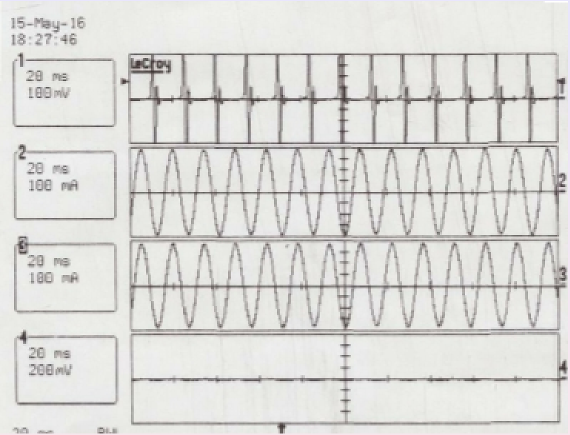
Trace 1 is the shaft sensor signal
Trace 2 is the current flow from Terminal T3 to Terminal T2
Trace 3 is the current flow to load
Trace 4 is the voltage across quadrant 1

Inductor Load; 11.7mH



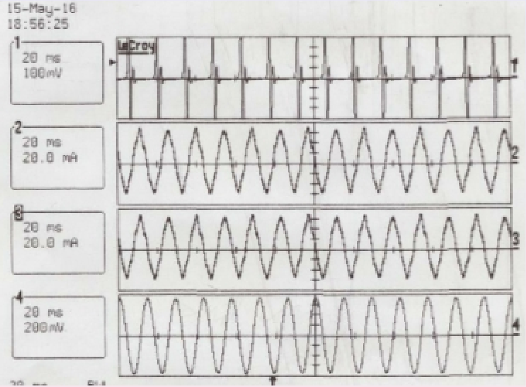
Trace 1 is the shaft sensor signal
Trace 2 is the current flow from Terminal T3 to Terminal T2
Trace 3 is the current flow to load
Trace 4 is the voltage across all quadrants

Short Circuit



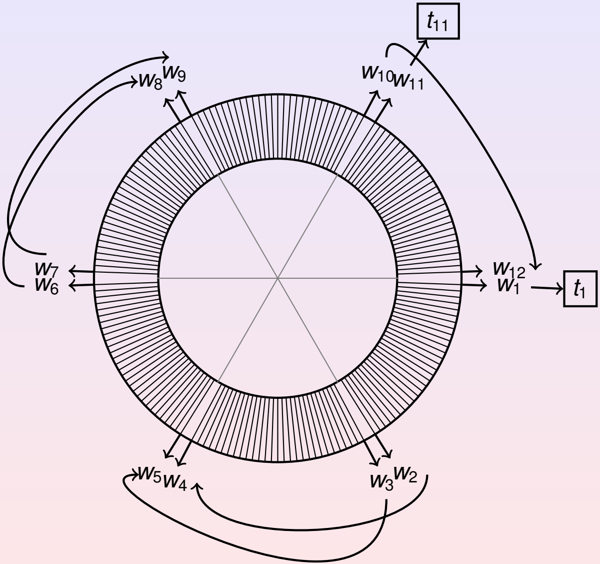
Trace 1 is the shaft sensor signal
Trace 2 is the current flow between quadrants 1 and 2
Trace 3 is current flow between quadrants 3 and 4.
Trace 4 is the voltage across the short circuit

Capacitive Load: 328 uFd

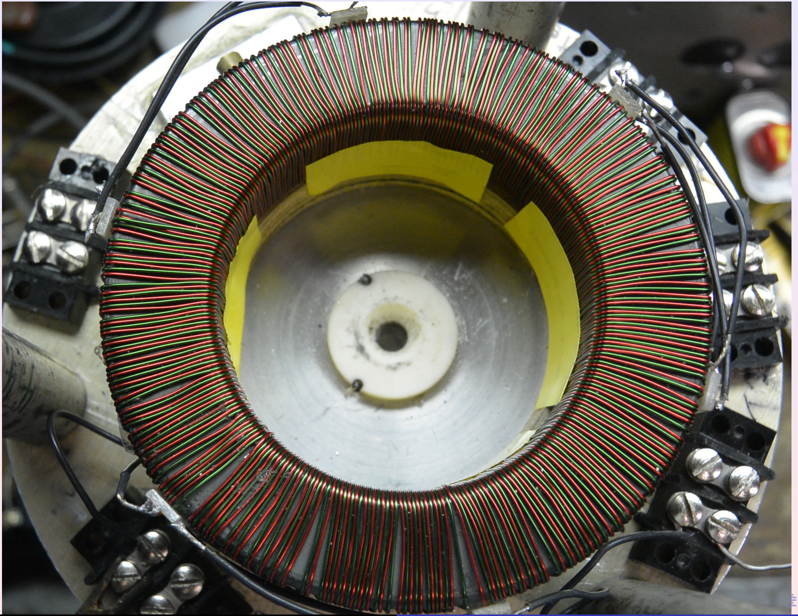


Trace 1 is the shaft sensor signal
Trace 2 is the current flow between quadrants 1 and 2
Trace 3 is current flow between quadrants 3 and 4
Trace 4 is the voltage across the capacitor

Six Sector Toroid



Six Sector Winding on Outer Toroid

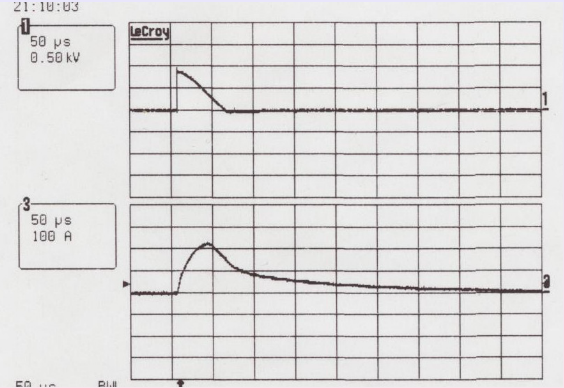


Guangmin Haralick

Six Sector Ring Magnet

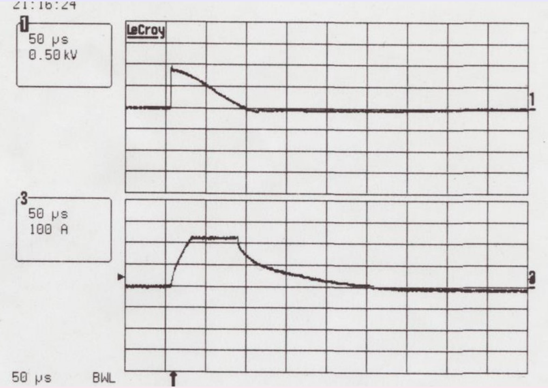
Shows the winding after magnetization of the 6 pole ceramic ferrite ring. Notice how the winding associated with each sector has clustered together.

Magnetizing the Six Sector Ring



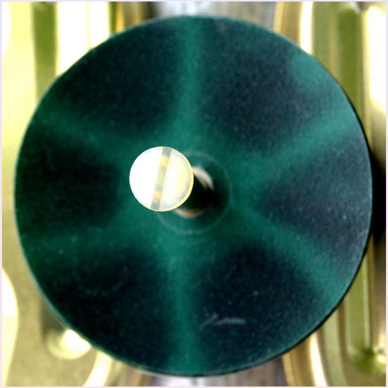
Shows the oscilloscope trace for the voltage and current across the winding on the ceramic ferrite ring during the magnetization process. One 100ufd capacitor was used. The current scale is 10 times that shown.

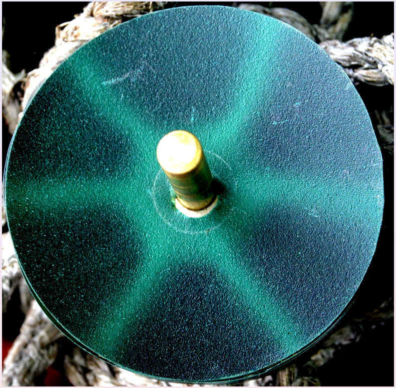
Magnetizing the Six Sector Ring



Shows the oscilloscope trace for the voltage and current across the winding on the ceramic ferrite ring during the magnetization process. Two 100ufd capacitors were used. The current scale is 10 times that shown.

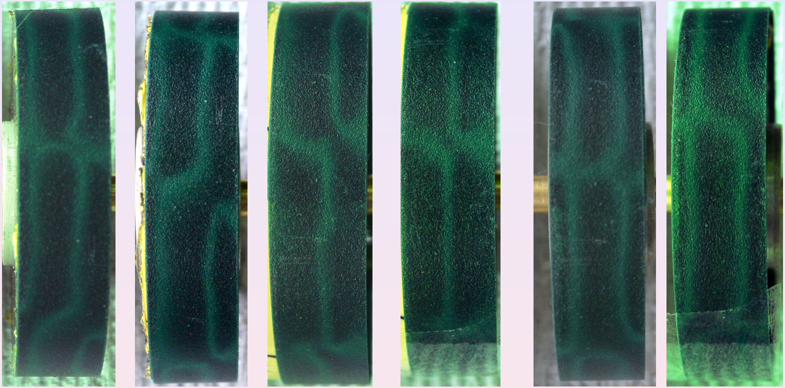
The Bloch Regions





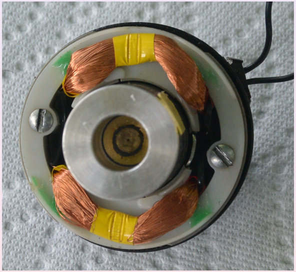
Shows the Bloch lines on the six pole circumferentially polarized ring magnet.

The Bloch Regions

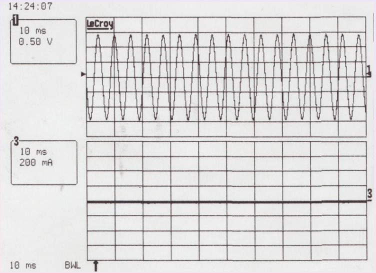


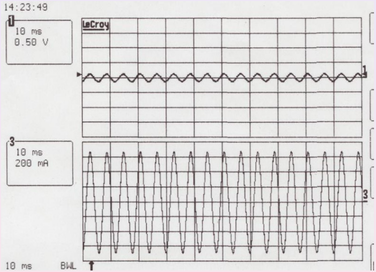
Shows the Bloch regions on the circumference of the six pole circumferentially polarized ring magnet.

The Shaded Pole Motor



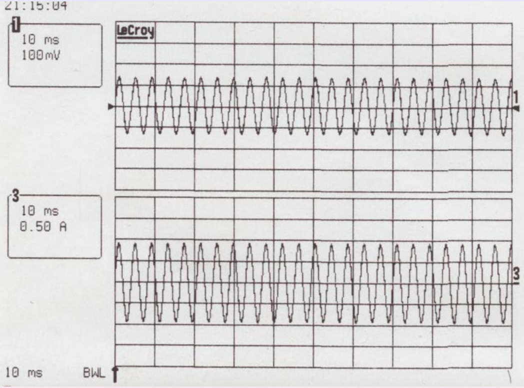
Open Circuit and Short Circuit Oscilloscope Traces





Shows the open circuit voltage and short circuit current generated when the 6 segment circumferentially magnetized ring magnet is spun by the brushless shaded pole motor. The rotation rate is about 3578 RPM.

Resistive Load: .075 ohms

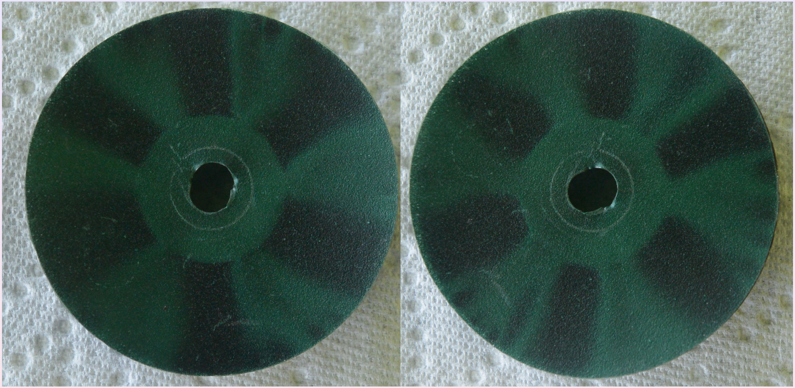


.075 ohms resistor load
Drive the motor by a 90 Hz source
The top trace shows the voltage
The bottom trace shows the current
The rotation rate is about 4980 RPM

Glued Wire

- The high voltage pulse made the windings of each sector group together in a very tight bundle
- What happens if the windings were held in place by glue.
- The winding was covered with Seal-All glue
- Put a coat of epoxy on top of it
- Magnetized it with 6 100 uFd capacitors

The Bloch Regions

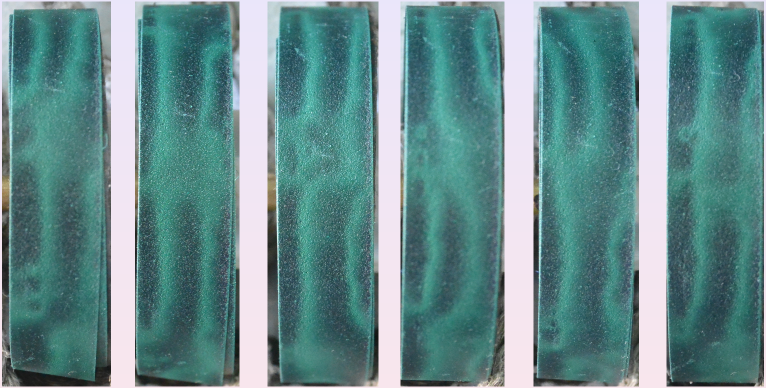


The top and bottom surfaces with the viewing film.
The Bloch lines became sectors!

The Bloch Regions

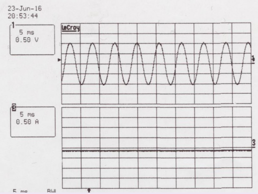
- When the winding is allowed to move
  - Each sector's winding gets crunched up
  - The magnetized field is linear
  - The Bloch region for a straight paramagnetic field is a line
  - The line is half way between the north and south poles
  - The line is perpendicular to the paramagnetic field
- When the winding is held in place,
  - The paramagnetic magnetic field in the sector is not a line
  - It is circumferential and therefore curved.
  - The Bloch lines now become sectors

The Bloch Regions

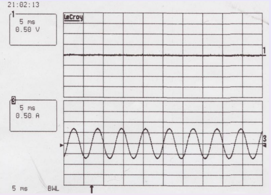


Shows the Bloch regions on the circumference of the six sector circumferentially polarized ring magnet.

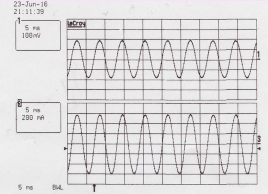
Oscilloscope Measurements For Different Loads



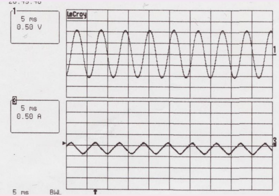
Open Circuit



Short Circuit



Resistor Load



Capacitor Load

Voltage is shown on the top trace and current on the bottom trace.

Rotational Kinetic Energy

The rotating motor and magnet have angular kinetic energy $E_{rotational}$:

$$E_{rotational} = \frac{1}{2} I \omega^2$$

I	Moment of Inertia around axis of rotation (ML^2)
ω	Angular velocity $(radians/second)$

Time To Stop

I	Rotational Inertia
ω_0	Initial Angular Velocity
τ_f	Frictional Torque
α	Deacceleration Rate

$$\begin{aligned}
\tau_f &= I\alpha \\
\omega(t) &= \omega_0 - \alpha t \\
&= \omega_0 - \frac{\tau_f}{I} t \\
0 &= \omega_0 - \frac{\tau_f}{I} T_{stop} \\
T_{stop} &= \omega_0 \frac{I}{\tau_f}
\end{aligned}$$

Power Lost to Friction

$$
\begin{aligned}
P(t) &= \tau_f \omega(t) \\
&= \tau_f(\omega_0 - \frac{\tau_f}{I} t)
\end{aligned}
$$

Energy Lost Due To Friction

$$
\begin{aligned}
E &= \int_0^{T_{stop}} P(t)dt \\
&= \int_0^{T_{stop}} \tau_f(\omega_0 - \frac{\tau_f}{I}t)dt \\
&= \tau_f \omega_0 T_{stop} - \frac{\tau_f^2}{I}\frac{T_{stop}^2}{2} \\
&= \tau_f \omega_0^2 \frac{I}{\tau_f} - \frac{\tau_f^2}{2I}(\omega_0 \frac{I}{\tau_f})^2 \\
&= \frac{1}{2} I \omega_0^2
\end{aligned}
$$

The Electro-Mechanical Power Balance

Mechanical Power Input	$P_{M_{in}}$
Frictional Losses	F
Eddy Current Heat Losses	H
Electrical I^2R Losses	E
Electrical Power Output	$P_{E_{out}}$

$$P_{M_{in}}(t) = P_{E_{out}}(t) + E(t) + F(t) + H(t)$$

Time To Spin Down

Protocol:
Spin up the shaded pole motor. Then turn the motor off and observe the time for the ring magnet to stop spinning under different load conditions. If T_{stop} is the time taken to stop then,

$$E_{rotational} = \int_0^{T_{stop}} E_{out}(t) + E(t) + F(t) + H(t) dt$$

When the motor turns off the kinetic energy is reduced by the energy lost due to frictional losses, eddy current losses, electrical $I^2 R$ losses and electrical power output.

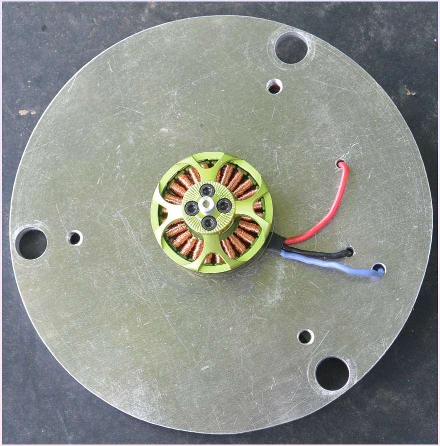
Load	Time to Spin Down
Open Circuit	33 Seconds
.29 Ohm Resistor	41 Seconds
Short Circuit	38 Seconds
200 uFd Capacitor	60.5 Seconds

Time To Spin Down

Load	Time to Spin Down
Open Circuit	33 ± 1 Seconds
.29 Ohm Resistor	41 ± 1 Seconds
Short Circuit	38 ± 1 Seconds
200 uFd Capacitor	60.5 ± 1 Seconds

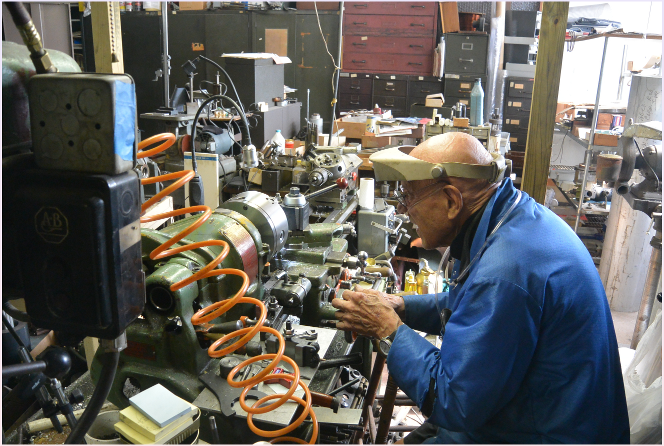
- In the open circuit
  - there are no losses because of E_{out}, E, H
  - The only loss is for F
- Then why when there is only frictional loss is the open circuit, the time to spin down the smallest?
- When there are losses for E_{out}, E, and H why is the time to spin down greater?
- Why is the spin down time for the capacitor the greatest?
- Is there extra energy coming in?

The Turnigy Motor

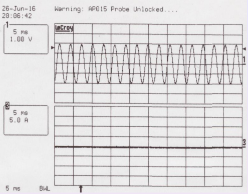


Shown mounted on the bottom side of the top plate.

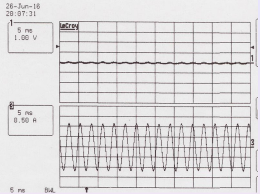
Guy At His Lathe



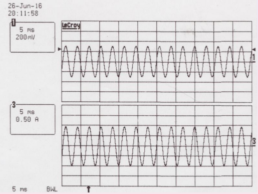
Oscilloscope Measurements



Open Circuit



Short Circuit



.29 ohm Resistor

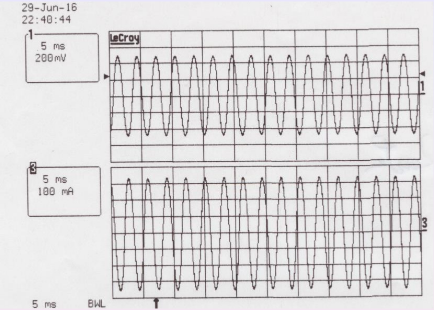
Shows the results when spinning the ring magnet to about 6736 RPM. The voltage is shown in the top trace and the current on the bottom trace.

Power Delivered To Resistor

- The rotation rate is about 6400 RPM
- The voltage across the .29 ohm resistor is about .6 volts peak to peak
- The current through the resistor is about 2 amperes peak to peak.
- The power P dissipated by the resistor is about

$$\begin{aligned} P &= .6 * 2/8 \\ &= .15 \text{ watts} \end{aligned}$$

Resistor: 1.37 Ohm Load



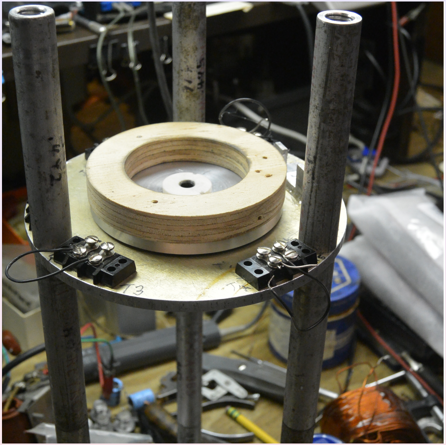
- The rotation rate is about 6521 RPM
- Voltage on the upper trace is about .875 volts peak to peak
- Current on the lower trace is about .66 ampere peak to peak
- The power P dissipated by the resistor is about

$$
\begin{aligned}
P &= .875 * .66/8 \\
  &= .072 \text{ watts}
\end{aligned}
$$

Inconsistencies

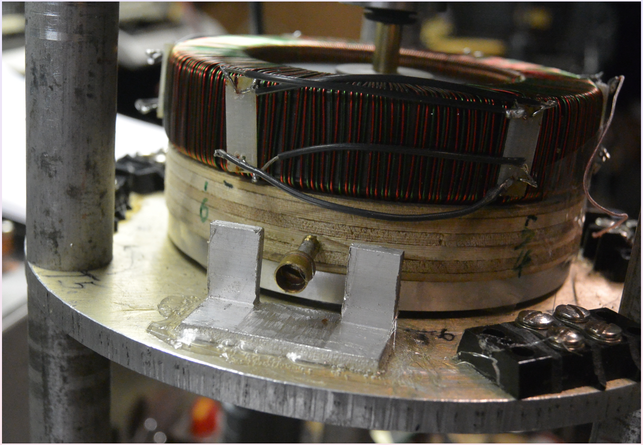
- The resistance of the toroid winding was measured with a milliohm meter at 1.37 ohms
- Using 23 awg wire and knowing the length of the wire and the resistance per unit length we calculate a 1.58 ohms
- Based on some other voltage and current observations the toroid winding resistance is about 1.78 ohms
- Why is the power delivered to the .29 ohm resister greater than the power delivered to a 1.37 ohm resistance, if the internal resistance is 1.37 ohms?

Floating Platform



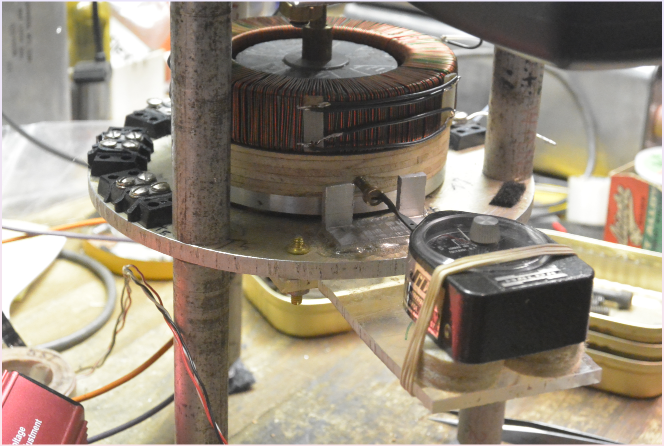
The floating platform is free to rotate.

Floating Platform



The Torque can be measured by a tension gauge.

Tension Gauge



Torque Measurement

- The ring magnet rotates at about 6500 RPM
- 108.33 RPS
- 680.678 radians per second,
- Used a 10 gram Halda tension gauge
- 6.35 centimeter moment arm
- Load
  - Open Circuit
  - Short Circuit
  - 1.37 ohm resistor

Torque Measurement

- Torque τ (gram-centimeters)
- Moment Arm L (centimeters)
- Force F (grams)
- Angular Velocity ω (radians/second)
- Power P (watts)

When the force is perpendicular to the moment arm, the relationship between Torque, Moment arm and Force

$$\tau = LF$$

The relationship between power, Torque, and angular velocity is

$$P = \tau\omega$$

Torque Measurements

The conversion between gram-centimeters to Newton-Meters is:

1 gram centimeter is equal to $9.80665 * 10^{-5}$ Newton-Meters.

6700 RPM = 111.667 RPS = 701.621 radians/second

Condition	Force	Torque	Torque	Power
Open Circuit	1.25 gram	7.94 Gram-Centimeters	.000786 Newton-Meters	.5515 Watts
1.37 Ohm Load	3 gram	19.05 Gram-Centimeters	.001868 Newton-Meters	1.3106 Watts
Short Circuit	3 gram	19.05 Gram-Centimeters	.001868 Newton-Meters	1.3106 Watts

The difference between the torque power with the resistive load and power with the open circuit is .7591 Watts.

- Why is there no difference between the torque for the 1.37 ohm resistor and the short circuit?

Power Difference

- The total power generated is the sum of the internal electrical power losses plus the external power delivered to the 1.37 ohm resistor.
- The open circuit voltage is 4 volts peak to peak or $V = \sqrt{2}$ volts RMS.
- Total resistance: The 1.37 ohm internal resistance plus the 1.37 ohm external resistor load = 2.74 ohms.
- The current I is

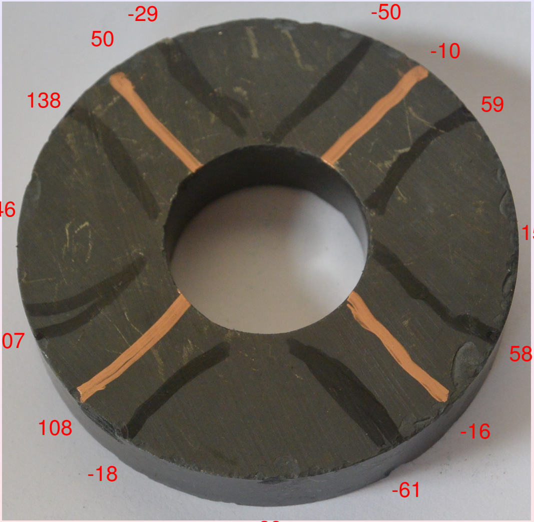
$$I = \sqrt{2}/2.74 = .5161 \text{ Amperes RMS}$$

- The total power generated P is then

$$\begin{aligned} P &= VI \\ &= \sqrt{2} * .5161 = .7299 \text{ Watts} \end{aligned}$$

- The total power internal and external is .7299 Watts
- The measured additional torque power is .7591 Watts
- There is back torque! But why?

Circumferential Spot Readings On Circumference



iBalance 5500 Precision Scale

The scale can weigh items as much as 5500 grams to a precision of .1 gram.

Scale Reading Affected by Rotation

We placed the experimental apparatus on a *My Weight iBalance 5500* precision scale.

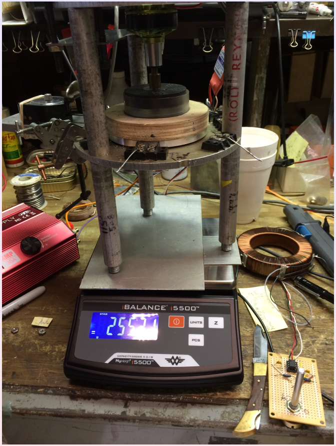
- We observed the weight when there was no rotation.
- We turned on the motor to full speed
- We observed the weight reported by the scale to be between .1 gram and .2 grams less at full rotation speed,
- We repeated this about one hundred times with consistent results

Scale Reading Affected by Rotation

We removed the outer toroid and placed the experimental apparatus on the *My Weight iBalance 5500* precision scale.

- We observed the weight when there was no rotation
- We turned on the motor to full speed
- We observed the weight reported by the scale to be between .1 gram and .2 grams less at full rotation speed,
- We repeated this about one hundred times with consistent results

No Rotation



Scale reads 2552.1 grams

Full Rotation

Scale reads 2552.0 grams, a loss of .1 gram

Future Research

- Time to spin down
  - Find the conditions under which the time to spin down is much larger
- Are the back torque measurements accurate?
- Outer Toroid Winding Resistance Inconsistencies
- Why is there interaction of the spinning ring magnet with the scale
  - Is there really a weight loss?
  - If so, what kind of experiment can prove this
  - Or does the Diamagnetic Field of the spinning ring magnet only influence the weight sensor?
  - Or does the vibrations influence the weight sensor?
- Is there a resonance condition that substantially changes things?
- Design Detectors for Diamagnetic Field

Replication

- Science Depends on Public Replication
- I am willing to help and work with you on replications
- And development of any further ideas
- Contact me at robert@haralick.org
- Slides available at http://haralick.org/measurement_slides.pdf

Rainbow On The Way Home