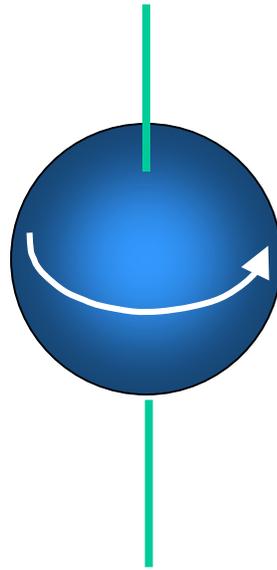
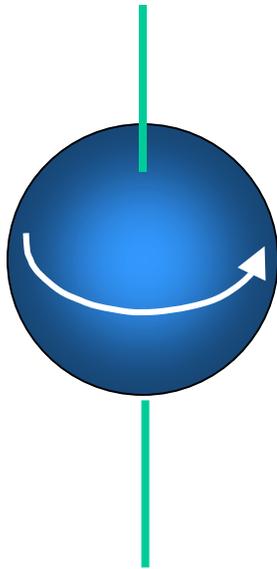


# Electron Spin, a Source of Energy?



©Cyril Smith, October 2013, revised June 2022

# What is electron spin?

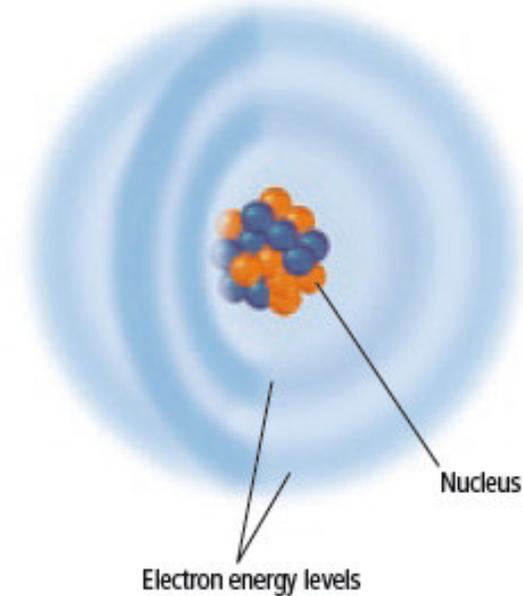
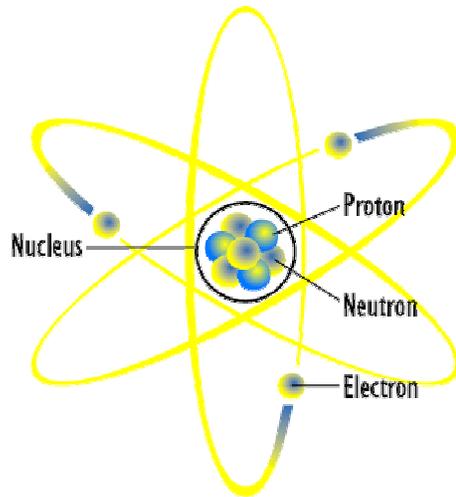


- An electron has mass
- An electron has charge
- An electron has angular momentum *as though the mass were spinning*
- An electron has a magnetic dipole moment *as if the charge were spinning*

We don't know that the electron is actually spinning but a spinning spherical mass model fits the known angular momentum and a spinning spherical charge model fits the known dipole moment.

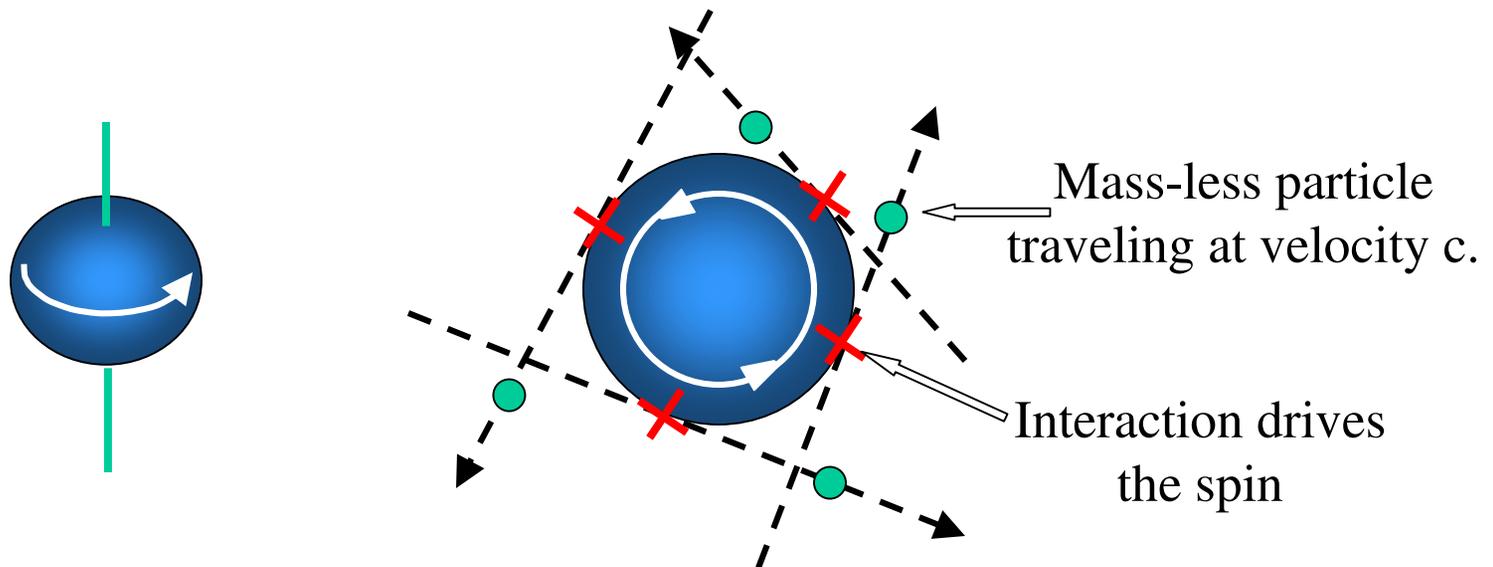
# Electron, Particle or Cloud?

Modern theory has moved away from the electron being a small particle circling the atomic nucleus in a known orbit to one where it has become a fuzzy probability-density cloud.



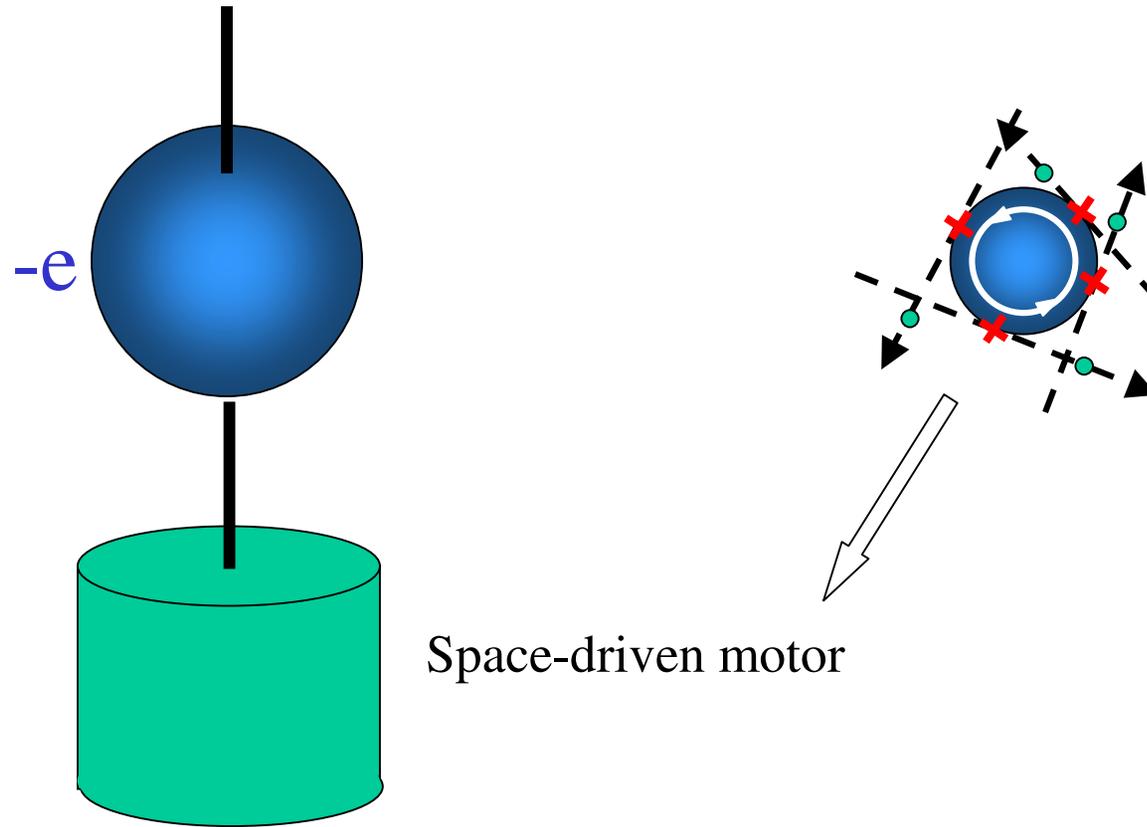
Interaction with the virtual particles of space accounts for the uncertainty, the fuzziness, which is expressed as a probability function. But the electron remains a particle.

# What keeps the electron spinning?



We don't really know what keeps the electron spinning, but we can imagine that the virtual-particle continuum of space somehow interacts with the spherical surface.

# Space-driven motor concept

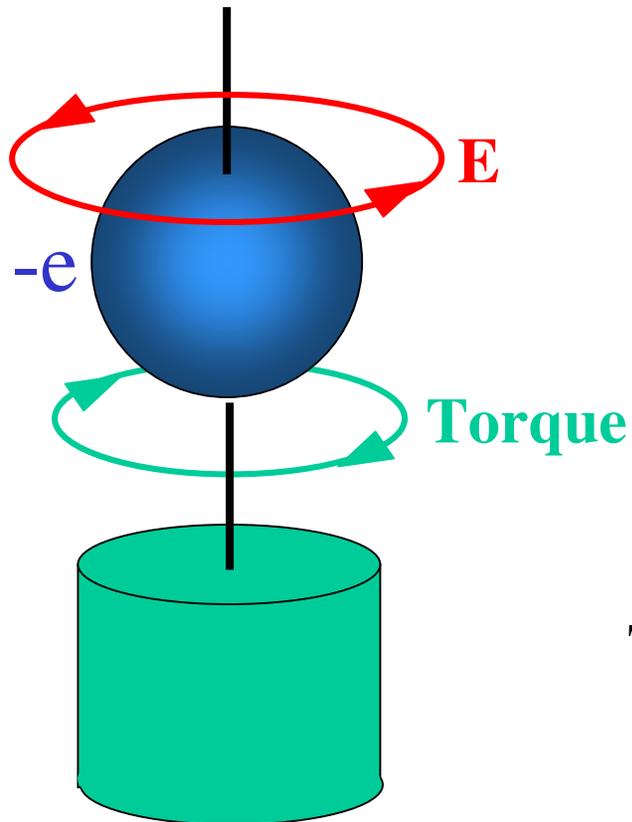


Space-driven motor

We can imagine the space particles “driving” the spin at constant speed, as though the electron were connected to a drive motor.

# Can we change the spin speed?

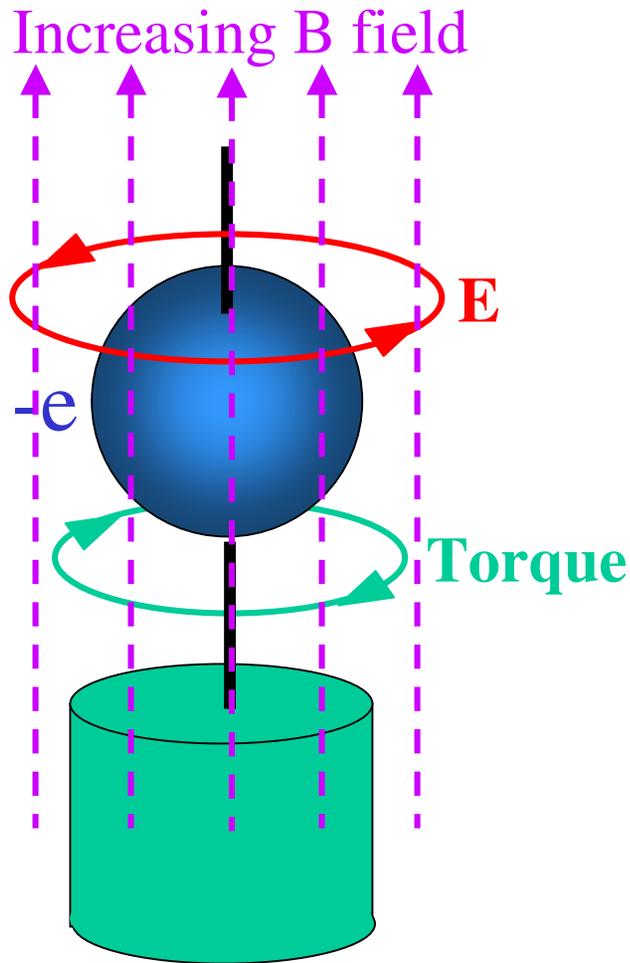
We can try but we won't succeed, the spin is a set value.



Trying involves applying a circular electric field to the spherical charge. Because the electron charge is negative, the sphere obtains a torque that opposes the direction of the E field.

The constant-speed space motor sees that torque.

If we can apply torque, can't we extract energy?

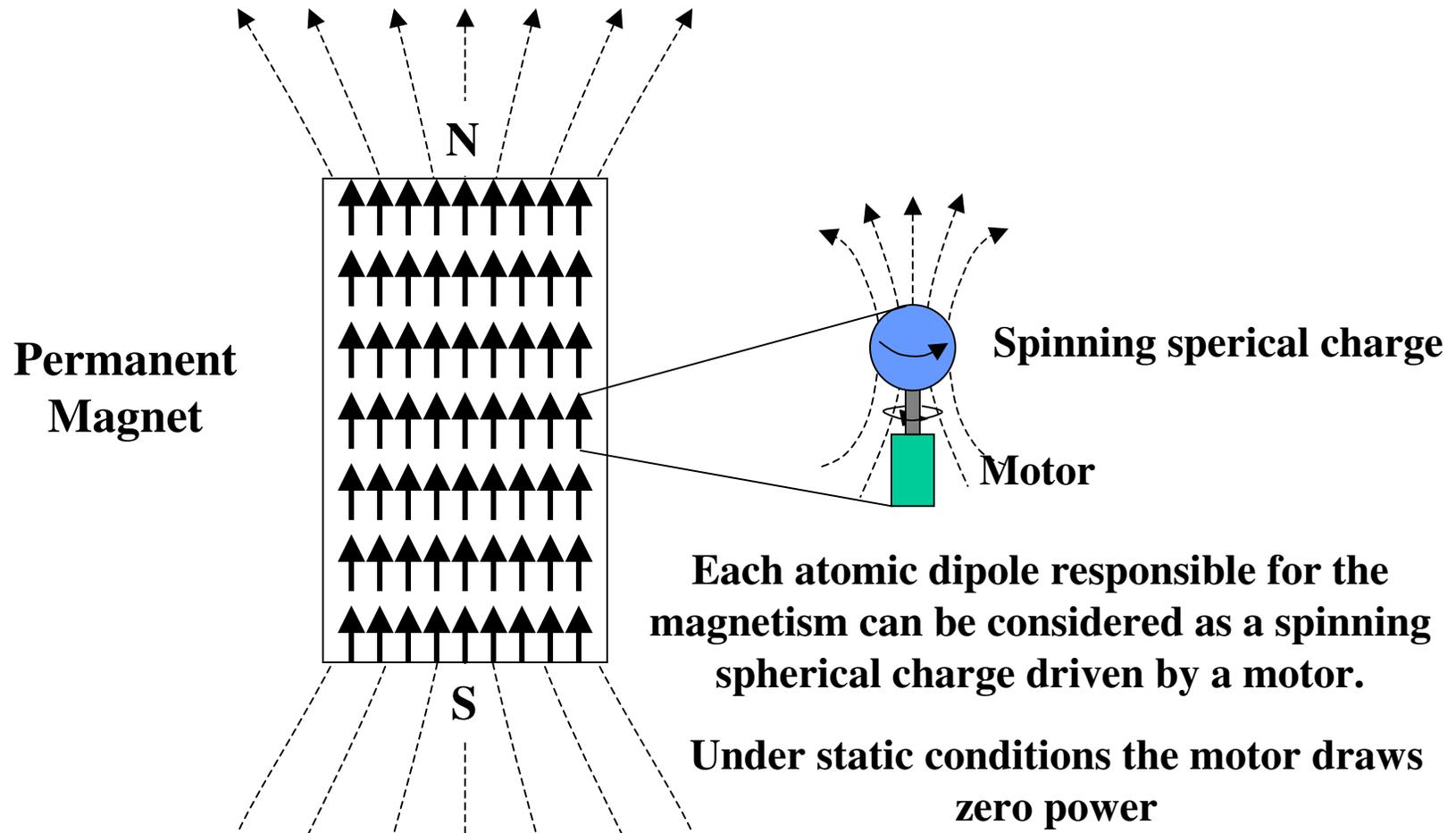


Yes we can! Creating the circular E field involves applying a magnetic field that is changing with time. When we look at the sum of the applied field and the magnetic field from the spinning electron we find magnetic energy being taken from or fed back to the electron.

*The amount of energy is accounted for by the torque applied to the space-driven motor.*

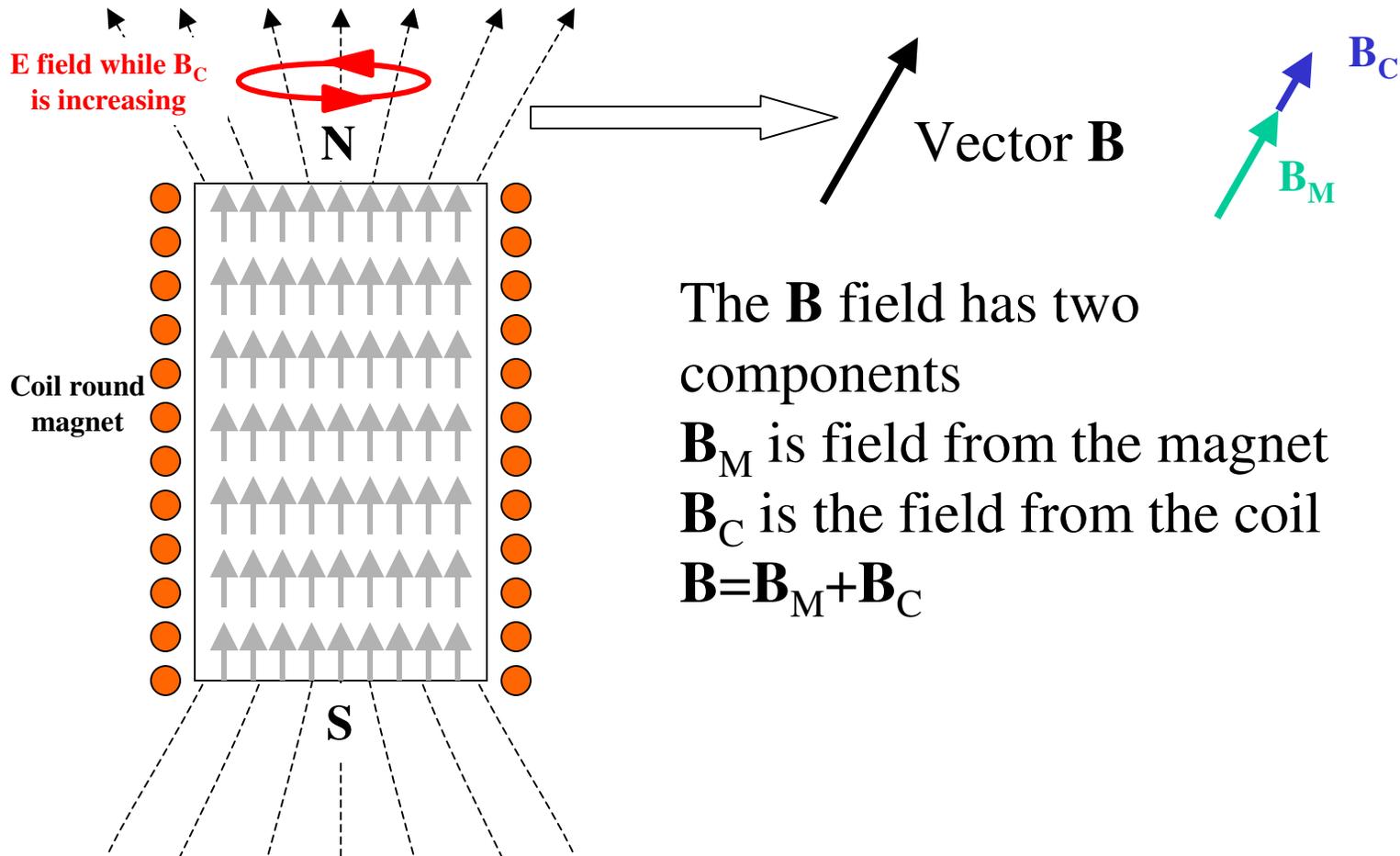
# Why hasn't this energy been discovered?

**It has, it involves modelling a Permanent Magnet as an array of spinning charges**



# Why hasn't this energy been discovered?

When a coil is placed around a magnet the combined field from coil and magnet contains an anomalous term.



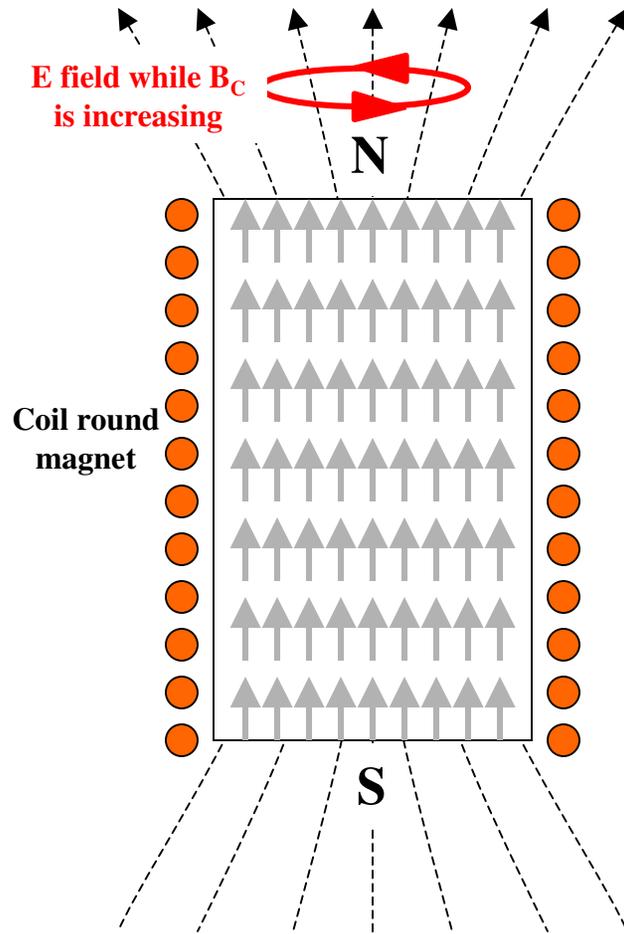
The  $B$  field has two components

$B_M$  is field from the magnet

$B_C$  is the field from the coil

$$\mathbf{B} = \mathbf{B}_M + \mathbf{B}_C$$

# Anomalous Energy Term



Energy density at any point is  $\frac{B^2}{2\mu_0}$

$$= \frac{1}{2\mu_0} (B_M + B_C)^2$$

$$= \frac{1}{2\mu_0} (B_M^2 + 2B_M B_C + B_C^2)$$

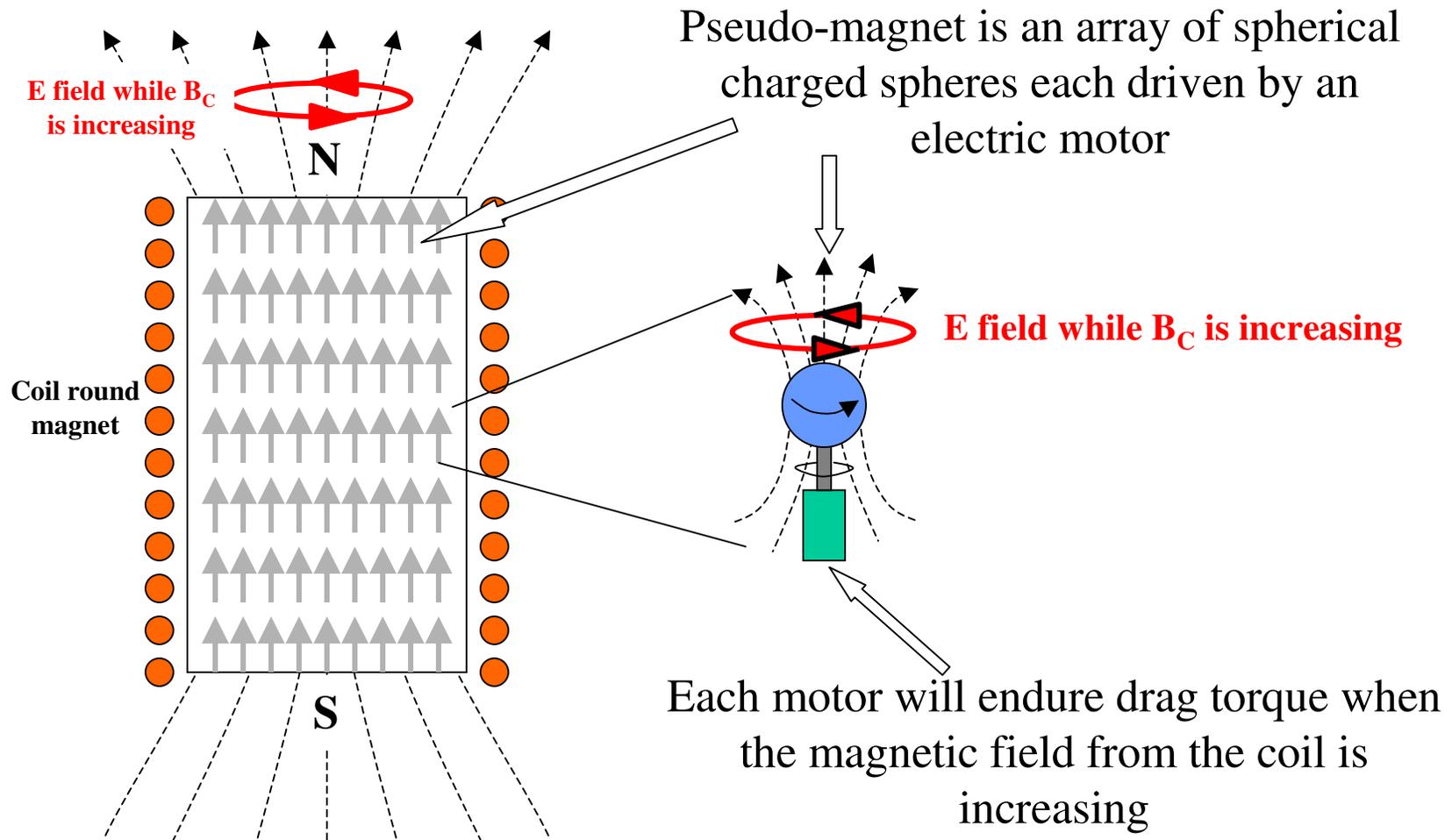
Energy from magnet

Energy from coil

**Anomalous energy!**

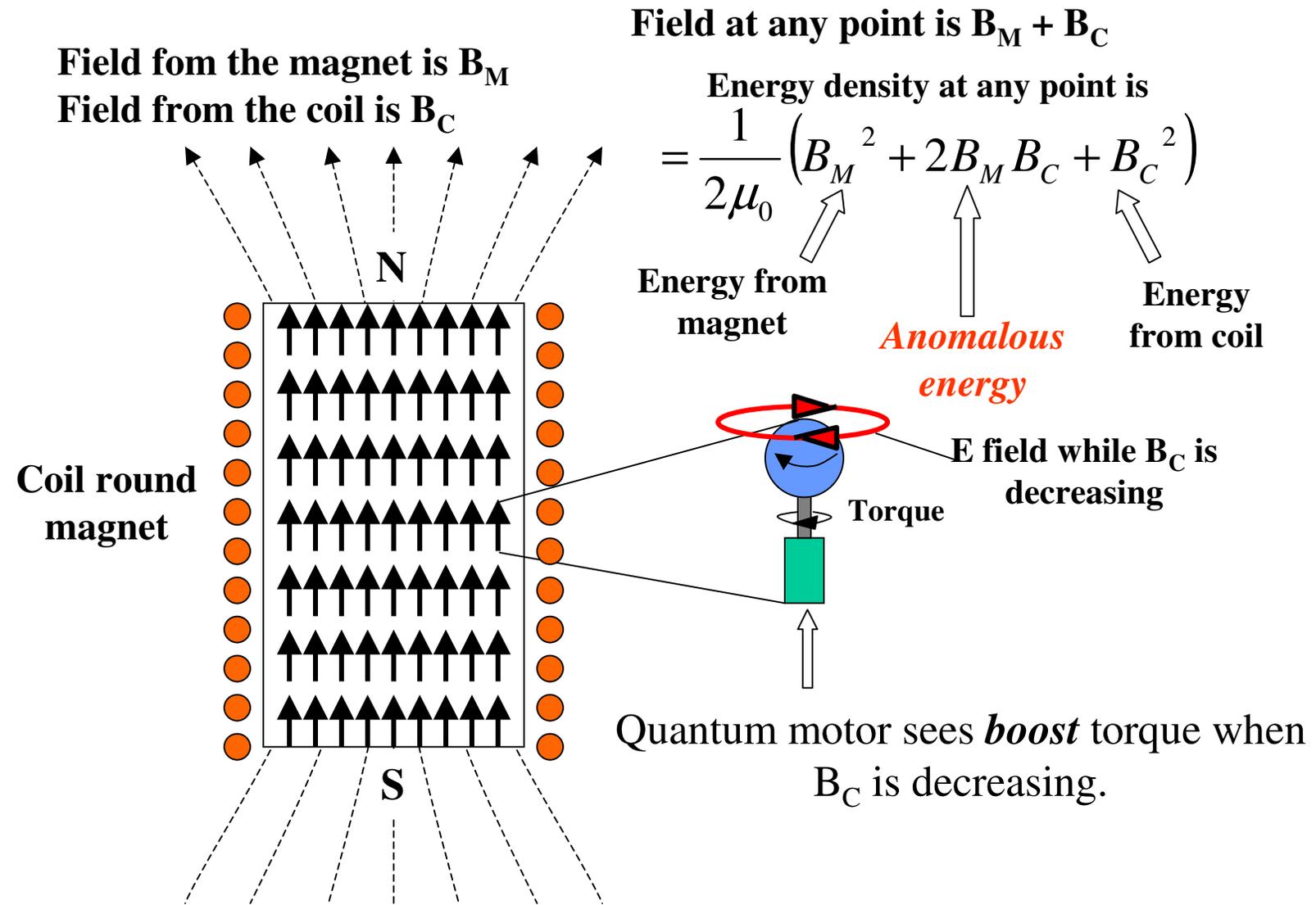
*It can be shown that the anomalous energy comes from the spins in the magnet.*

# We could make a pseudo magnet!



*The energy supplied to the motors exactly accounts for the anomalous magnetic energy.*

# Keeping hold of that energy is difficult!



*All anomalous energy gained is clawed back over a full cycle.*

Is there any way we can continuously extract energy?

Yes there is, but it requires electron spins to be effectively turned on and off or modulated, but *not* magnetically.

If we could have spins present while an applied magnetic field is rising, then not present (or better still reversed) while the applied field is falling, we break the claw-back reciprocity.

The control of spin leads us into the world of spintronics.

# The Magnetoelectric Effect

The Magnetoelectric Effect (ME) is the control of electric polarization by a magnetic field or the control of magnetization by an electric field. The latter is sometimes called the Inverse Magnetoelectric Effect (IME).

The relatively new science of spintronics is aggressively researching the IME as a means for storing and manipulating digital data.

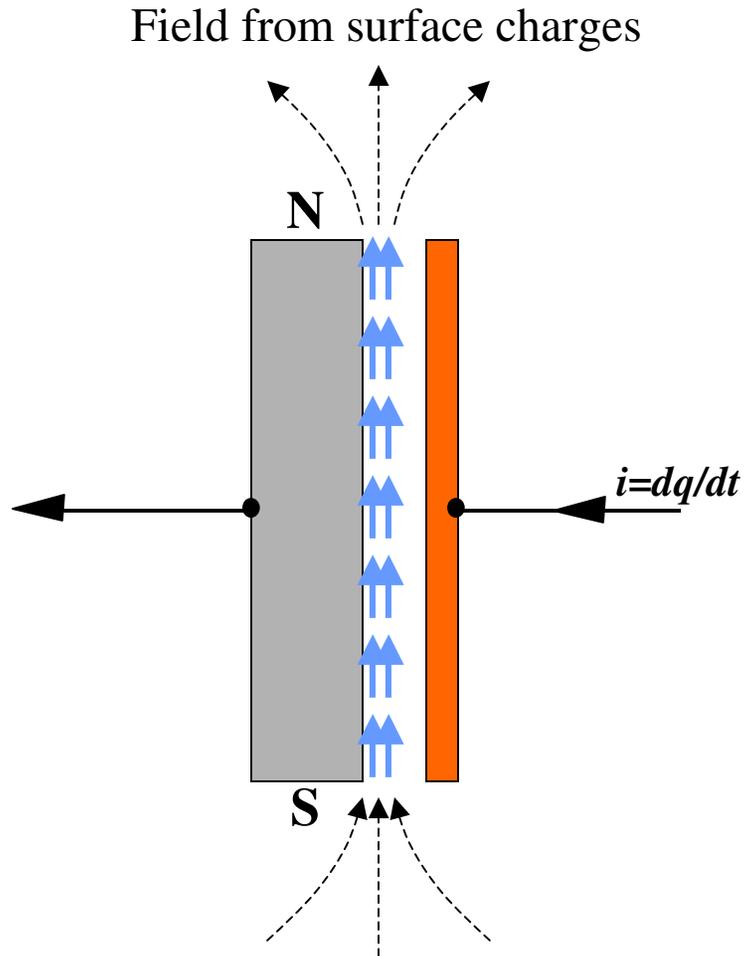
Digital storage requires switching (reversal) of polarization or magnetization.

This occurs easily in small material volumes which suits the nano-world of computer chips.

Hence there is little or no research into using the ME for other larger applications.

*Luckily, the research gives us a window into the Surface Magnetoelectric Effect (SME) that applies to larger systems.*

# The Surface Magnetolectric Effect



The Surface Magnetolectric Effect (SME) appears at the surface of a conducting ferromagnet.

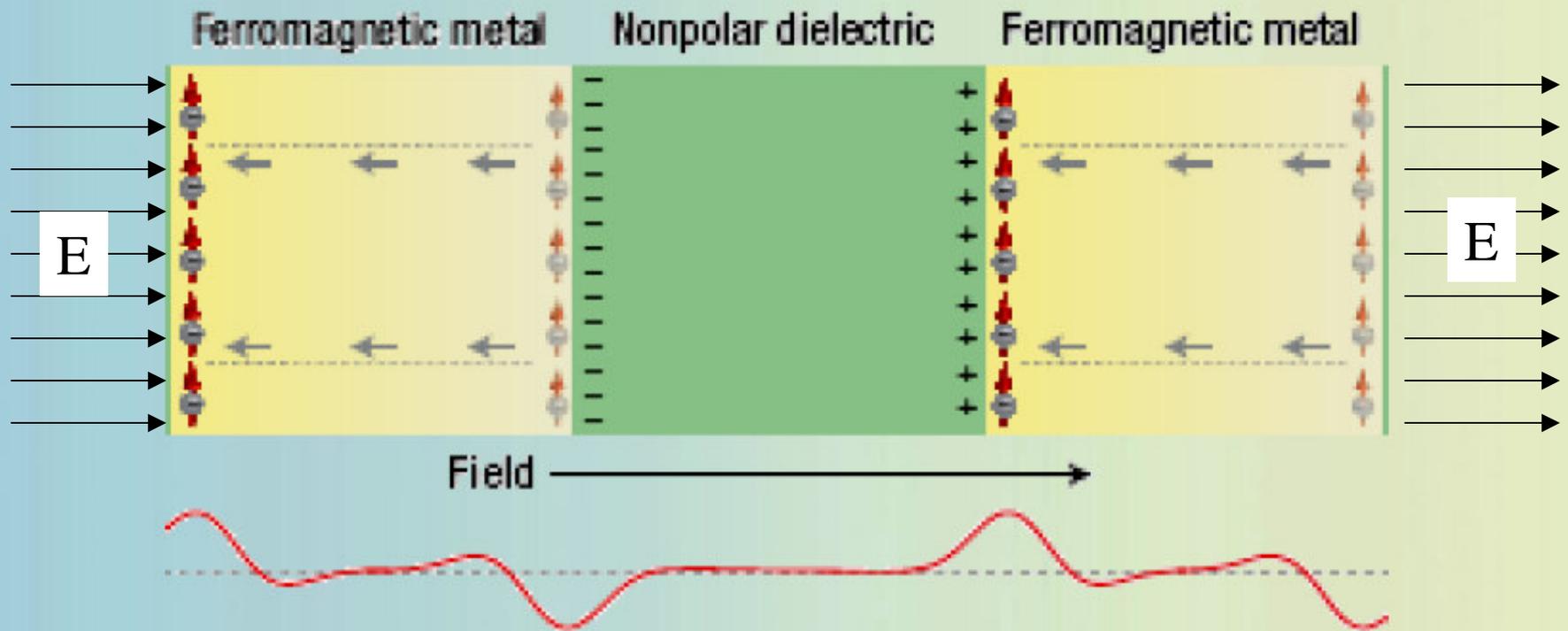
The application of an electric field (e.g. from a nearby electrode) will induce positive or negative charge on that surface.

Because the conduction electrons in the ferromagnet are spin-polarized, the surface charge will create increased or decreased magnetization.

Taken from A P Pyatakov “Multiferroic and Magnetoelectric Materials”

[http://www.kantiana.ru/innopark/nano\\_material/baltic\\_school/Presentation/Pyatakov\\_2.pdf](http://www.kantiana.ru/innopark/nano_material/baltic_school/Presentation/Pyatakov_2.pdf)

## H. Kroemer “the interface is the device”

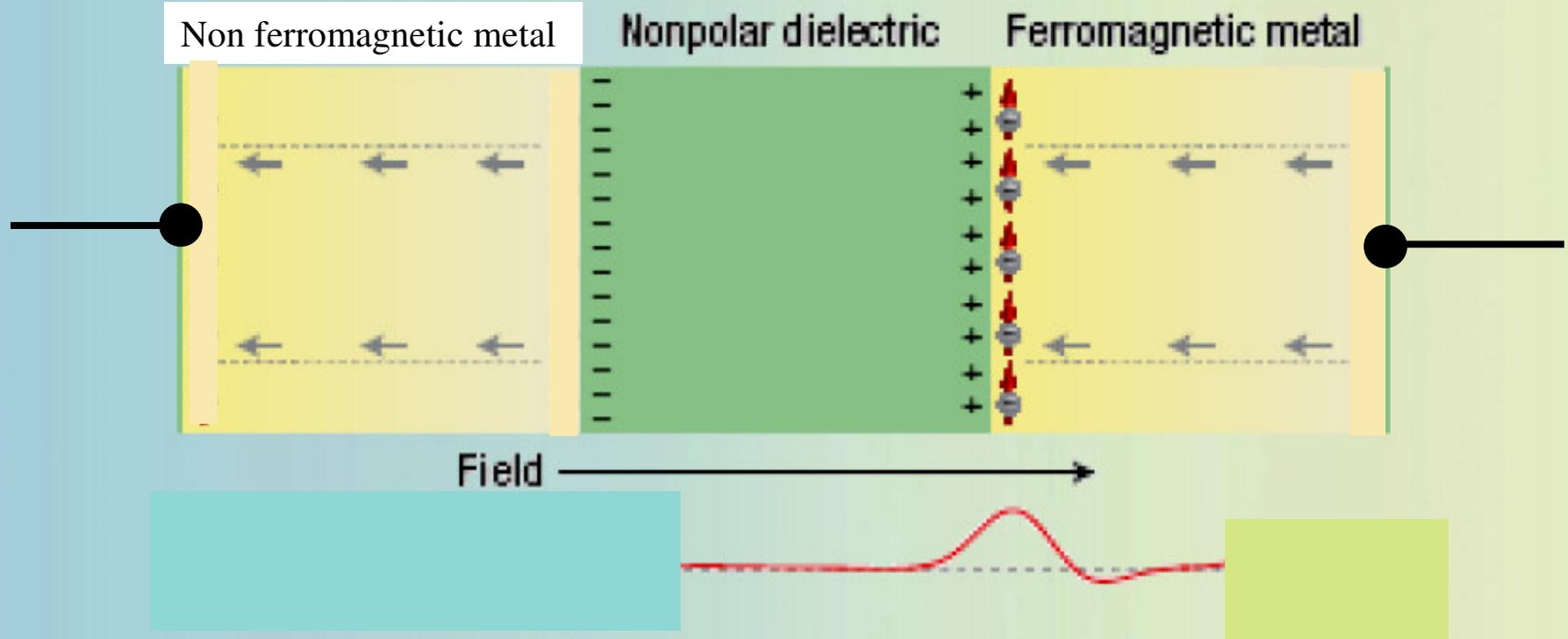


Carrier-mediated magnetoelectricity in complex oxide heterostructures

*J. M. Rondinelli et al, Nature nanotechnology 3, 46 (2008)*

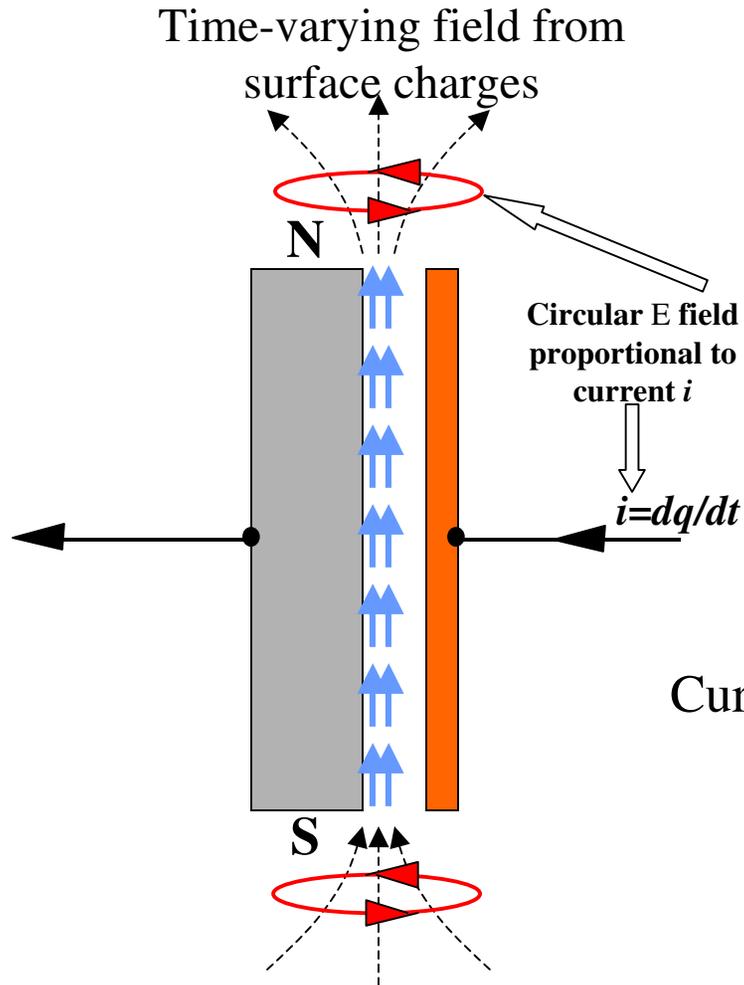
Taken from A P Pyatakov “Multiferroic and Magnetoelectric Materials”  
[http://www.kantiana.ru/innopark/nano\\_material/baltic\\_school/Presentation/Pyatakov\\_2.pdf](http://www.kantiana.ru/innopark/nano_material/baltic_school/Presentation/Pyatakov_2.pdf)

## H. Kroemer “the interface is the device”



Carrier-mediated magnetoelectricity in complex oxide heterostructures  
*J. M. Rondinelli et al, Nature nanotechnology 3, 46 (2008)*

# The Surface Magnetolectric Effect



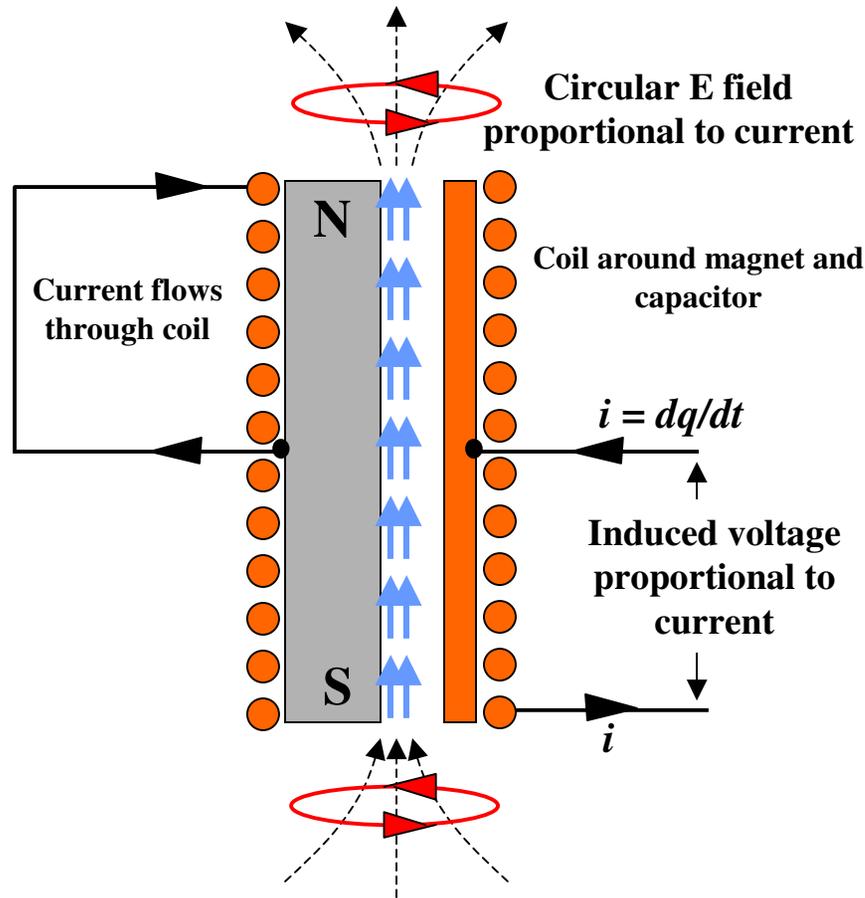
The controllable magnetization, if driven at RF, will produce significant circular **E** field.

The surface magnetization  $M$  is proportional to the surface charge  $q$ . Then since  $i = dq/dt$  we find the circular **E** field from  $dM/dt$  is directly proportional to current  $i$ .

Current into the SME capacitor is either in-phase or in anti-phase with the circular **E** field, depending on the polarity of the magnet..

# SME inside a Coil

Time-varying field from surface charge  $dq/dt$

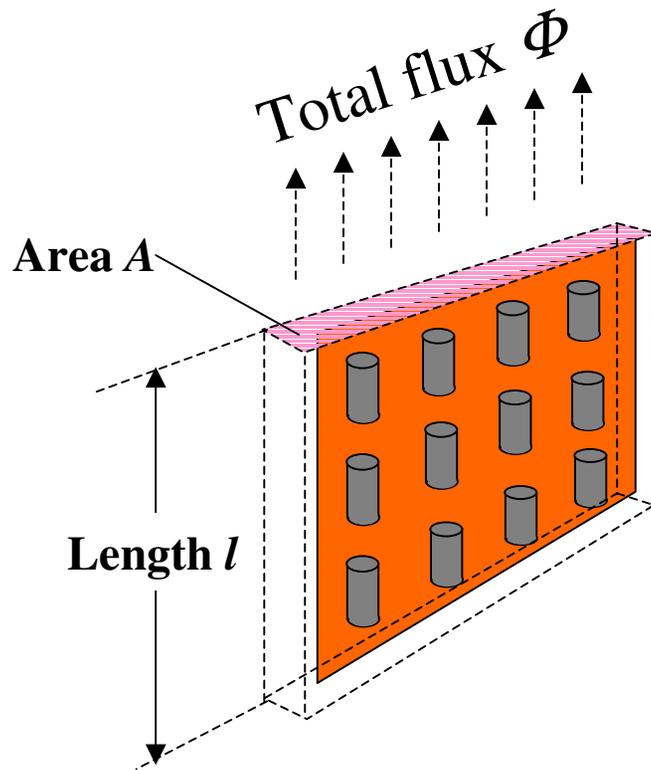


When the SME capacitor is placed inside a coil the voltage induced in the coil is in-phase or in anti-phase with the capacitor current.

If that same current flows through the coil the induced voltage has two components:-

- The normal inductive component in phase quadrature
- The component from the SME in-phase or anti-phase.

# Surface charge as magnetic sheet



Total surface charge  $q$

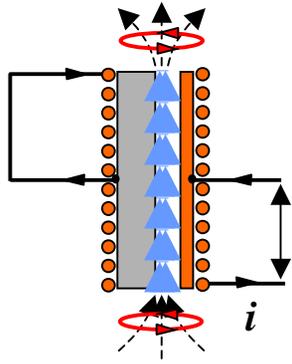
Surface spin polarization  $P$

Total dipole moment  $\mu = \frac{Pg\mu_B}{e}q$

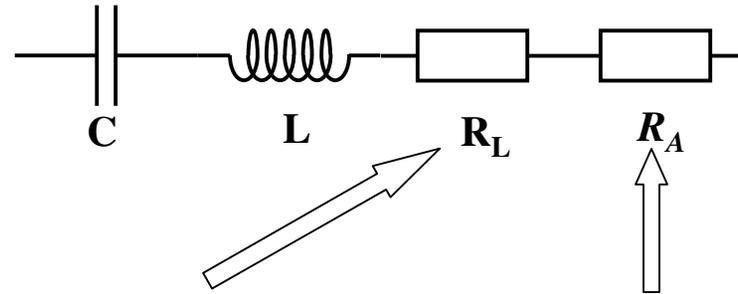
Magnetization  $M = \frac{\mu}{Al}$

Flux density  $B = \mu_0 M$

Flux  $\Phi = BA = \frac{P\mu_0 g\mu_B}{e} \frac{q}{l}$



# Equivalent Circuit



**Conventional  
circuit losses**

**Anomalous induced  
resistance. *Can be negative!***

$$R_A = -\frac{NPk}{l} \left( \frac{\mu_0 \mu_B g}{e} \right) \leftarrow (1.455 \times 10^{-10})$$

$N$  = number of turns

$P$  = surface-charge spin-polarization

$k$  = inductor geometric and permeability factor

$\mu_0$  = free space permeability

$\mu_B$  = Bohr Magneton

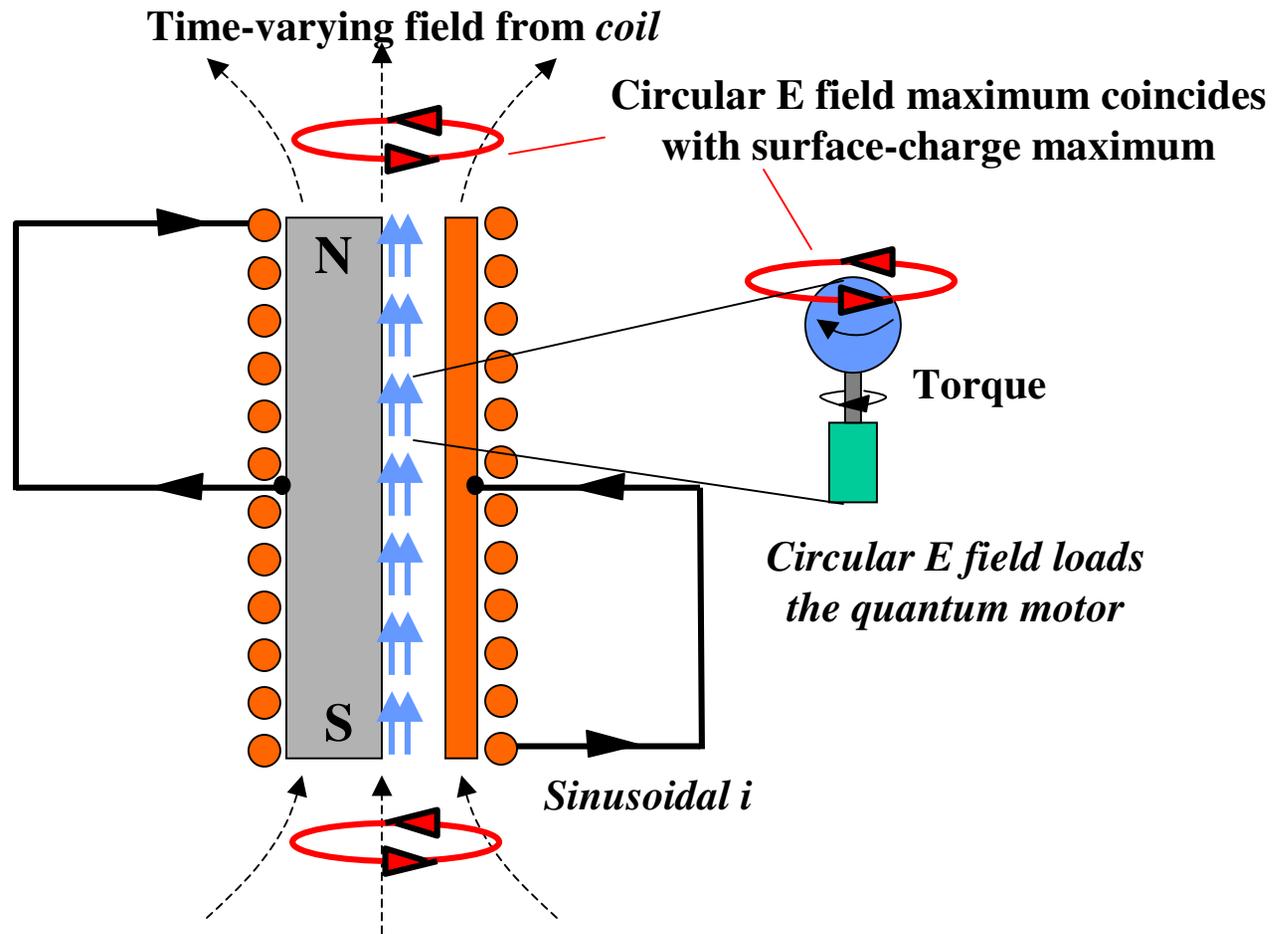
$g$  = electron g factor

$e$  = electron charge

$l$  = inductor length

***If negative  $R_A > R_L$  self oscillation occurs in closed circuit!***

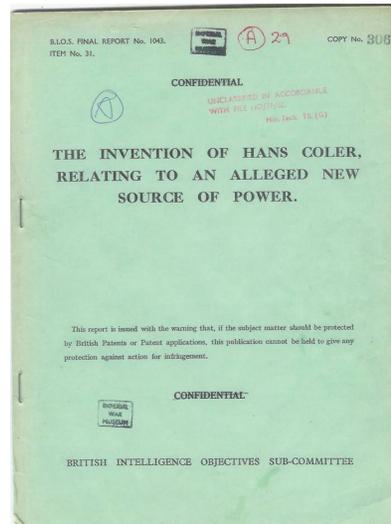
# Where does the energy come from?



*The energy is transduced from the electron spins!*

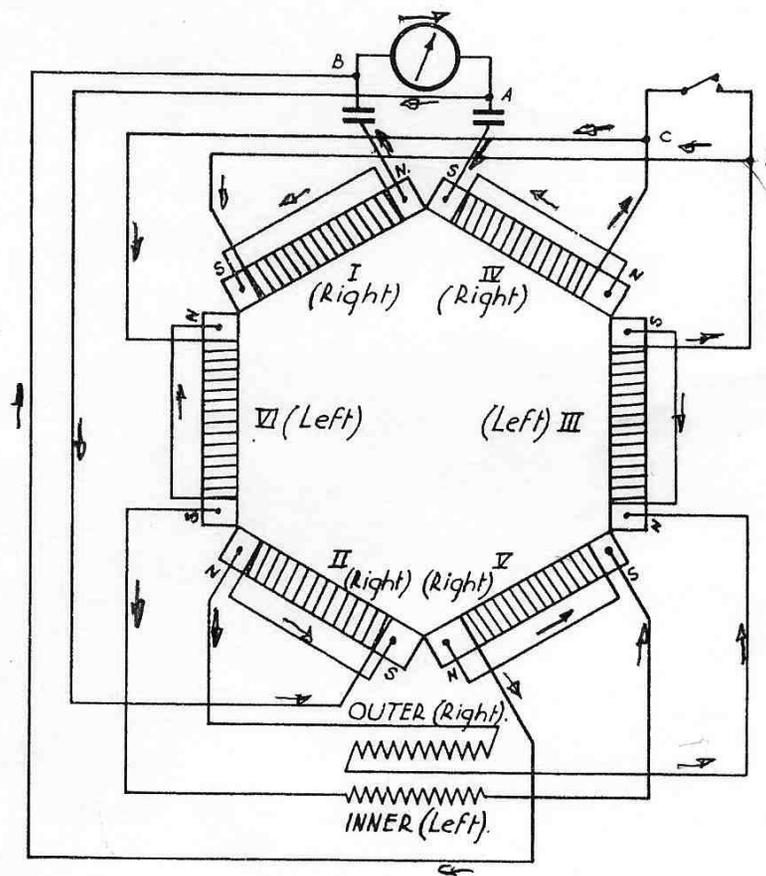
# Isn't there an energy penalty in creating the SME?

Yes, but whether this counters the energy taken from the spins is not proven. The devices in British Intelligence 1945 Report “The Inventions of Hans Coler Relating to an Alleged New Source of Power” showed anomalous effects that can be explained by the SME.

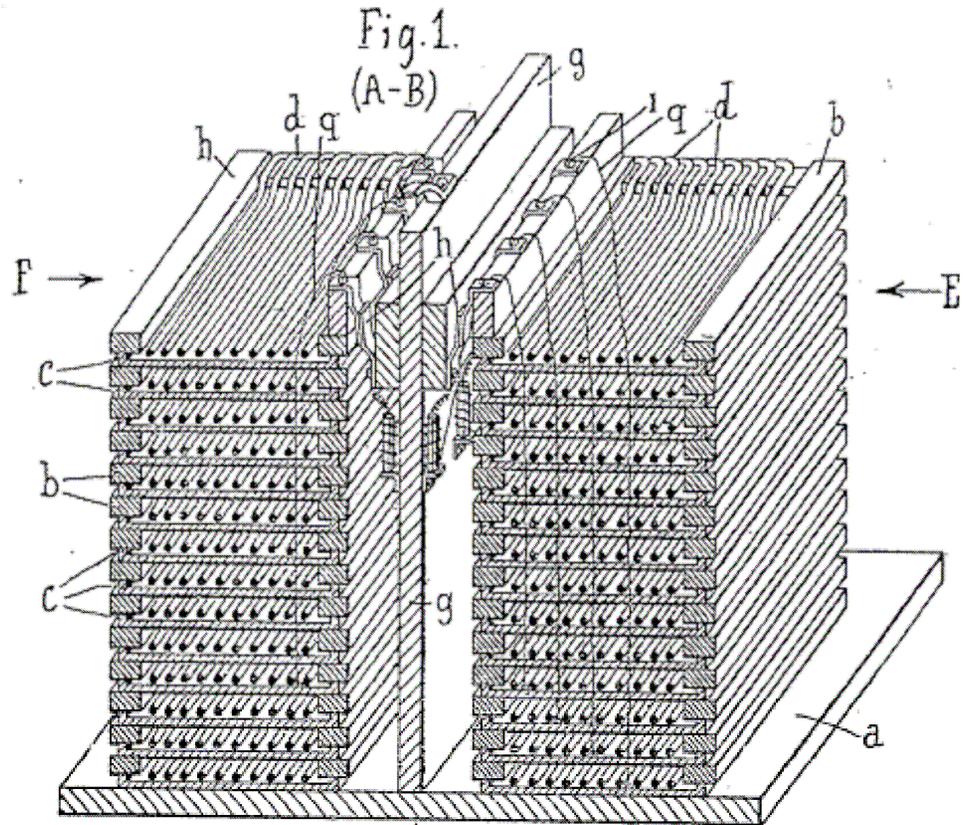


# British Intelligence 1945 Report

Magnetstromapparat



Stromerzeuger



Both use electrical connection to conducting ferromagnets

DAILY

## "MIGHTY ATOM" IN A MAGIC BOX.

**BERLIN SCIENTISTS HOAXED BY ALLEGED  
NEW SOURCE OF ENERGY.**

**BRITISH SYNDICATE'S OFFER OF A MILLION FOR  
SECRET—IF GENUINE.**

From the "Daily Chronicle" Special  
Correspondent, George Renwick.

BERLIN, Monday.

Herr Willi von Unruh, a Leipzig engineer, has lately fluttered the German scientific doves as they have not been fluttered since the finding of radium.

He announced a discovery towards which the whole scientific world has for years been earnestly striving, a discovery which would revolutionise the world to an extent almost beyond human imagination.

**LIMITLESS POWER.**

Herr Unruh said he had found a method of breaking up the atom. What he claimed to have done is what nature does over an infinitely extended period of time, and on an extremely small scale, in the case of radium.

By breaking up the atom, or dis-

tionised for a while yet, and Herr Willi will go down in history, with Signor Ulivi, who six years ago played the role of great inventor with an imposture about wonderful "ultra-red" rays.

By reason of his "invention," Ulivi managed to elope with an admiral's beautiful daughter, but Herr Willi has added no such romance to his fraud. He has been mundane enough to make his alleged discovery the means of obtaining a considerable amount of other people's money, it is said, and so it is that his romance ends undramatically in a dull prison cell.

For some time to come certain German professors will be exceedingly snappy on the subject of breaking up the atom.

GEORGE RENWICK.

First Demonstration of the Stromerzeuger

It was never proved the demonstration was fraudulent.

# 1926 Investigation

In 1926 the Stromerzeuger was investigated by Professor W. O. Schumann (Munich), and Professors M. Klossé and R. Franke (Berlin).

They could find no evidence of fraud.

They stated there was an unknown source of energy.

They forbade publication of their reports!

# Further details

R. Sandberg (Norway) and Dr. F. Modersohn (Germany) separately witnessed the Stromerzeuger.

Both put money into the project, and vied for the pickings after the war.

A 6KW version was destroyed by allied bombing.

Coler tried to replicate one in 1947 but died before completion.

# SME applied to the Coler devices

In these devices the active capacitance is between the ferromagnet and the coil around it.

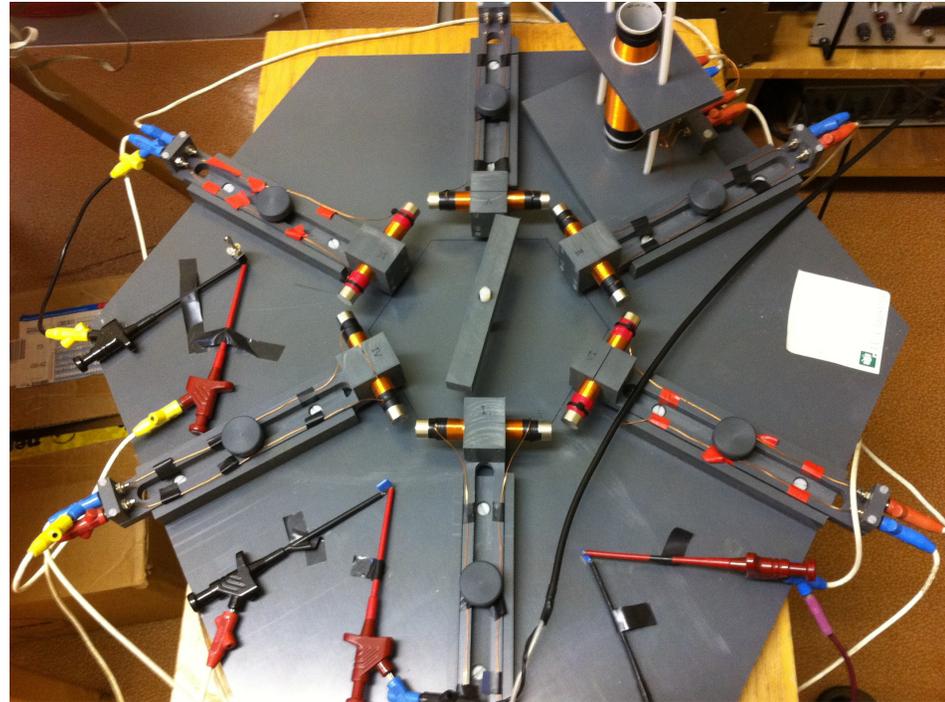
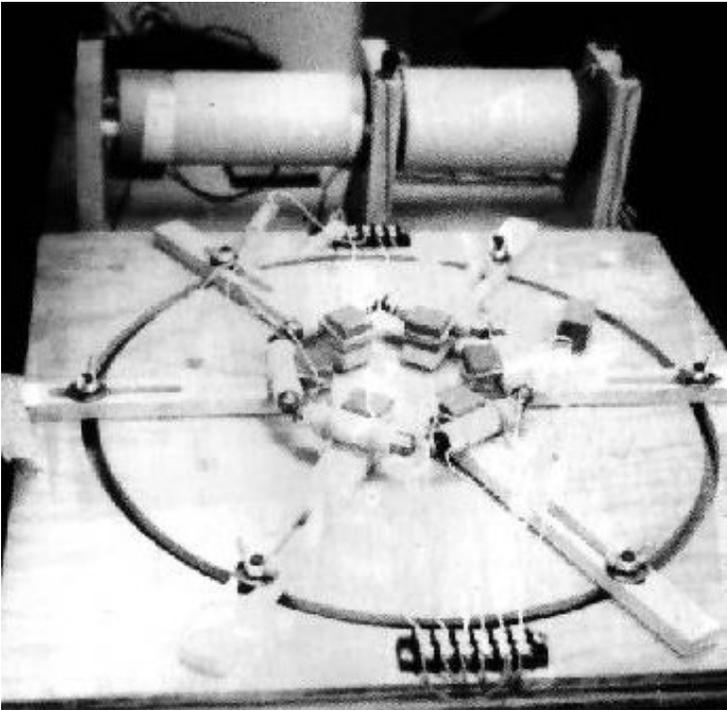
The dielectric and ferroelectric properties of the insulation between coil and ferromagnet may be important.

In the Stromerzeuger the magnetized cores are connected to the RF circuit capacitor plates hence obtain RF potential. When self oscillating RF current flows through the active capacitance

In both cases current also flows *through* the ferromagnets, and although this may assist operation via Hall and Corbino effects it is not considered to be the source of the anomalous energy.

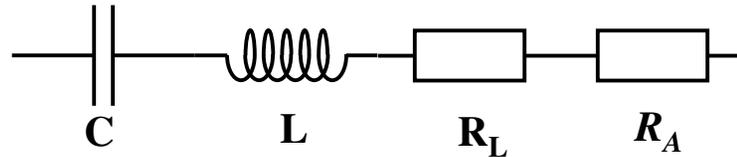
# Intermission

## Magnetstromapparat replications



There are no known replications of the Stromerzeuger

## Conditions needed to maximise negative resistance



$$R_A = -\frac{NPk\mu_R}{l} \left( \frac{\mu_0\mu_B g}{e} \right) \leftarrow (1.455 \times 10^{-10})$$

- **Very high inductor  $k$  factor, hence must use soft material near saturation where permeability is large**
- **Magnetic circuit must be closed to make full use of the high permeability, hence use ring core and toroidal coil**
- **Low frequency to minimise core and copper losses**
- **Maximise capacitance**

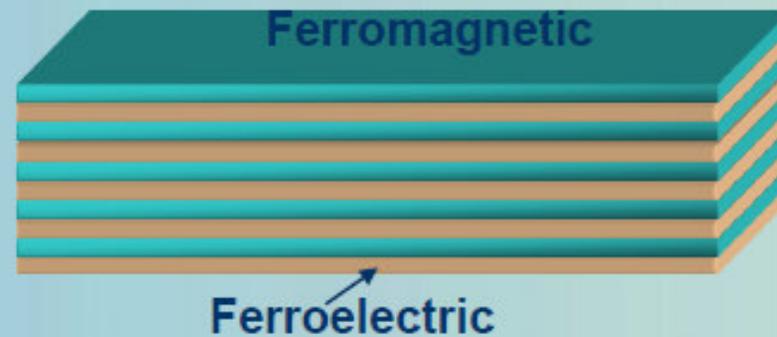
# Improving the SME

- Putting a dielectric adjacent to the ferromagnet increases the SME for a given capacitor voltage.
- Better still the use of a ferroelectric dielectric creates more because of spin-coupling (creating the Giant Magnetoelectric Effect).
- Granular composites (granular mixtures of ferromagnetic and ferroelectric materials) offers great potential.
- Layered composites (alternate layers of ferromagnetic and ferroelectric materials) should also be considered.

Taken from A P Pyatakov “Multiferroic and Magnetoelectric Materials”

[http://www.kantiana.ru/innopark/nano\\_material/baltic\\_school/Presentation/Pyatakov\\_2.pdf](http://www.kantiana.ru/innopark/nano_material/baltic_school/Presentation/Pyatakov_2.pdf)

## FM/FE superlattice

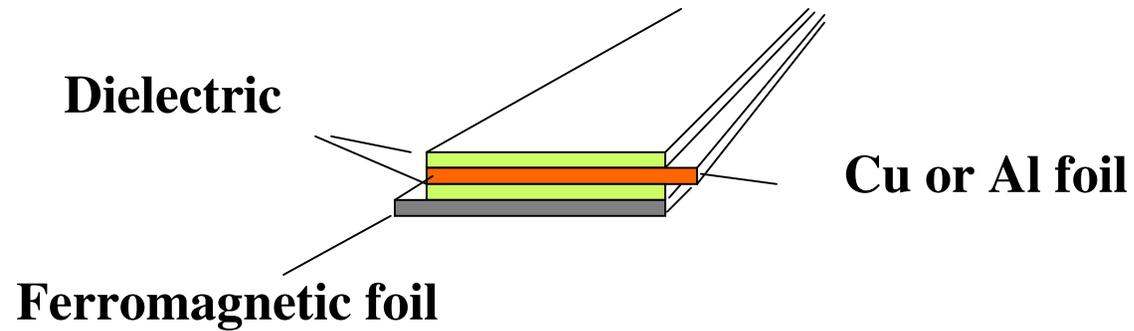


Thickness of the layer -> unit cell

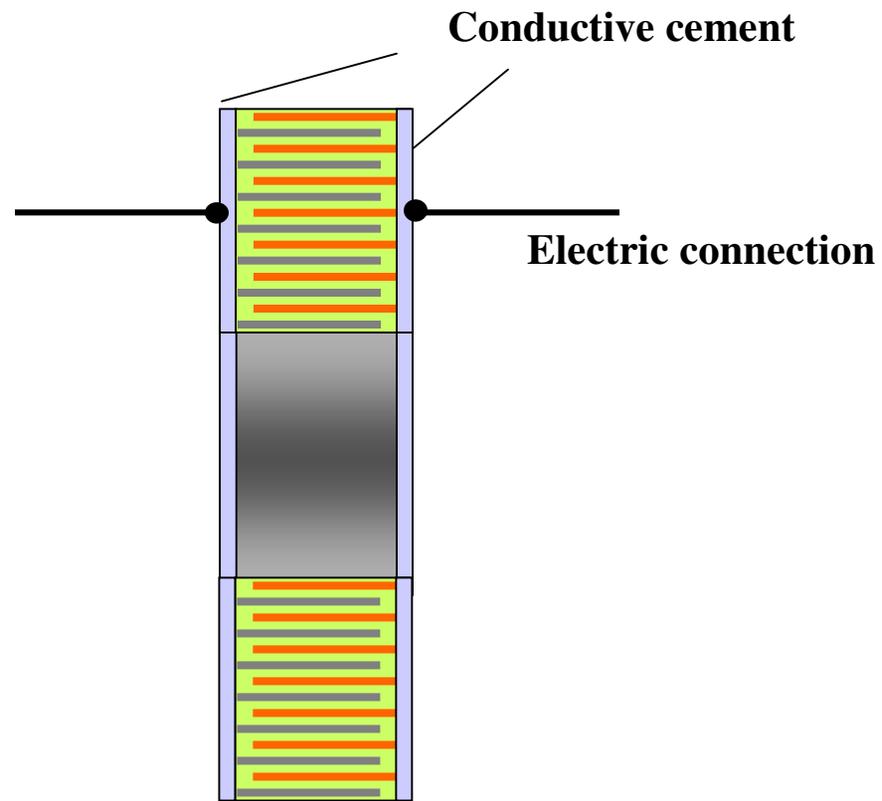
S. Geprags, M. Opel, S. Goennenwein, R. Gross, Phil. Magazine Lett. 87, 141 (2007)

# Solution

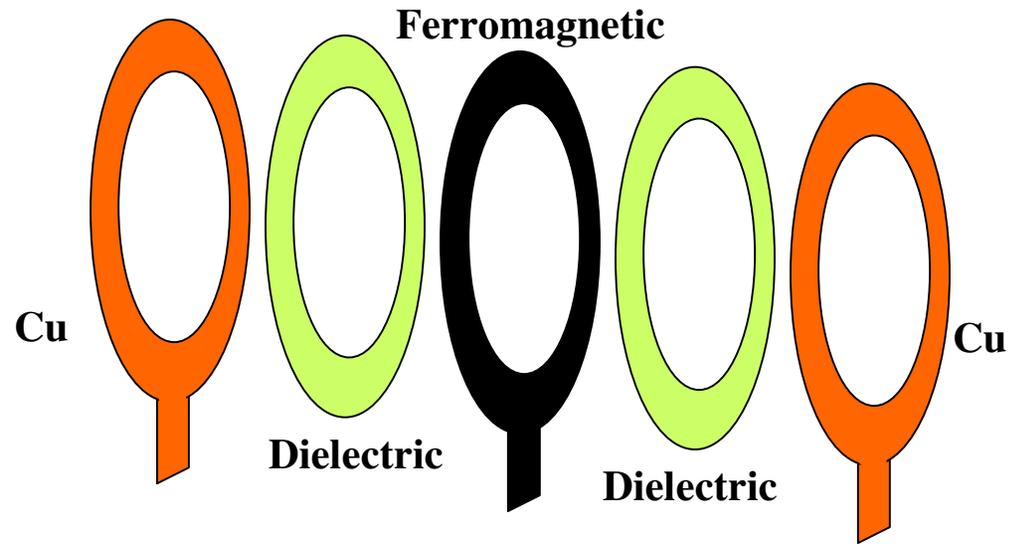
Use construction technique for foil capacitors and tape-wound cores to wind a special core.



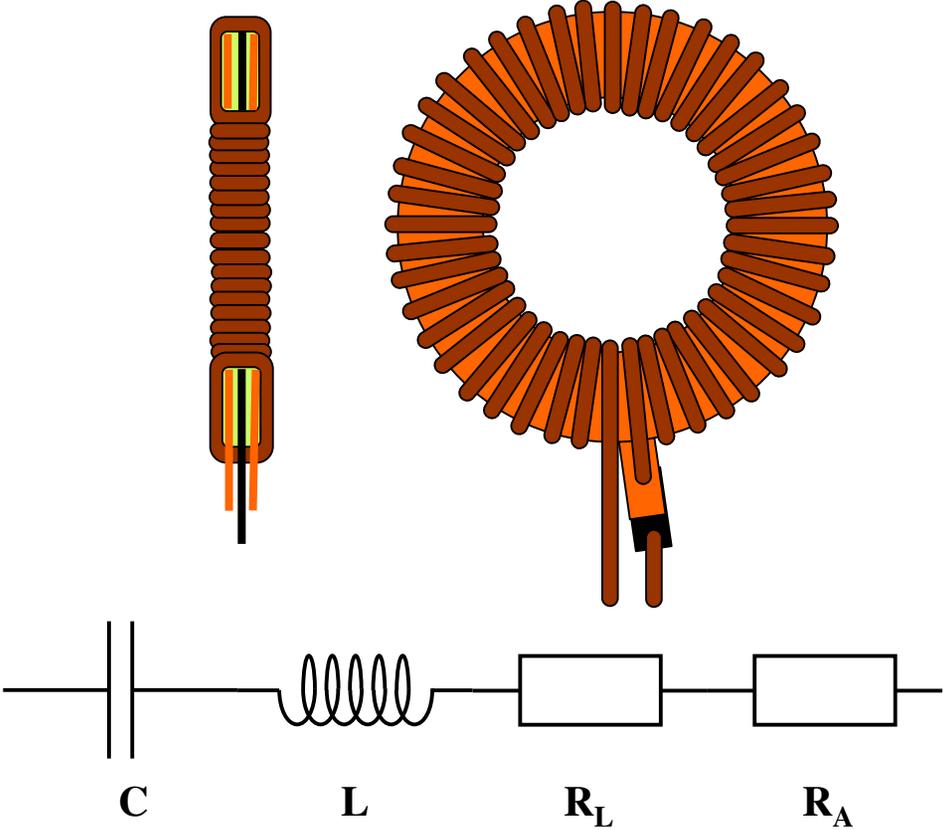
# Cross section of tape-wound core



# Simpler form



The toroidal inductor-capacitor arrangement could be sold as a component.



## Some calculations

The surface charge  $Q$  in the SME capacitor is  $Q = CV$

The total dipole moment  $\mu$  of all the electron spins is  $\mu = Q \left( \frac{\mu_B}{e} \right)$  where  $\mu_B$  is the Bohr magneton and  $e$  the electron charge, assuming 100% spin polarization.

Treating the capacitor as a magnet the magnetization is  $M = \frac{\mu}{Al}$  where  $A$  is the cross section area and  $l$  the magnetic path length

The flux density  $B$  is given by  $B = \mu_0 \mu_R M$

The flux  $\Phi$  is obtained from  $\Phi = BA$

The volts per turn is given by  $T_{TURN} = \omega \Phi$

Output voltage is then  $V_{TURN} = \frac{\omega \mu_0 \mu_R CV}{l} \left( \frac{\mu_B}{e} \right)$  volts per turn.

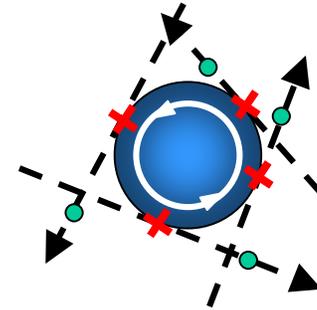
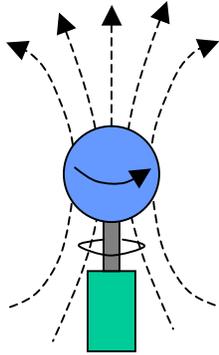
## Example

Take a ring core that is 100mm OD and 80mm ID giving a path length  $l$  of 283mm. Let it be made from a 10mm high stack of annuli having thickness 0.4mm with dielectric separation of 0.1mm having a relative permittivity of 2. Capacitance will be 0.01 $\mu$ F. With this capacitor driven at a frequency of 1MHz and a voltage of 100V the output from a 100 turn coil will be 0.029 volts as obtained from

$$V = \frac{\omega \mu_0 \mu_R C V N}{l} \left( \frac{\mu_B}{e} \right)$$

This voltage is readily detectable

Note that  $\left( \frac{\mu_B}{e} \right)$  has a value  $5.788 \times 10^{-5}$



Thank you for your attention.

Do you have any questions?

