Method for Controlling the Motion of Non-Magnetic Objects Utilizing Proton Vibration Energy

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Summary

Gravity is explained by Albert Einstein as the warping of spacetime. His equations for general relativity and gravity are undisputed in mainstream physics, although the warping of spacetime itself is difficult to prove. Enthusiasts of the Standard Model of subatomic particles presume that gravity is governed by a particle known as the graviton, since the model claims a particle for all other known forces. The graviton particle has yet to be found.

What if there is a simpler explanation for gravity? What if the equations for gravity and electromagnetism could be merged into one? What possible products might result from a better understanding of the mechanics of gravity?

For starters, there would be a mechanism to convert electrical or magnetic energy into gravitational energy, either to make gravity stronger or to weaken it. If gravity is weakened, the weight of objects will decrease and at some point, as the effect continues to weaken the gravitational force, it can reverse and accelerate an object in the opposite direction. The latter is referred to as antigravity.

Over the last two decades, electromagnetism experiments using superconductors have witnessed gravitational anomalies. Most of these experiments are written off because theoretical physics does not account for such behavior in general relativity or in the Standard Model. Furthermore, most of the reported forces are small so skeptics are quick to point out potential errors in experimental apparatus. Meanwhile, enthusiasts and believers in the potential of "gravito-electric" often have a difficult time replicating superconductor experiments due to the significant funding required.

This paper takes a different approach. A new theoretical model explains the motion of a single electron and proton in lattice materials and uses simple, Newtonian physics to model the energy transfer of single particles. Using the conservation of energy, the energy of particles focused in a crystal lattice are then calculated for the cumulative energy and force that is applied on an external object. The equations produced in the new model are then applied to recent experiments, supporting the observations that an electric charge, and often an accompanying magnetic field, can produce a force on a mass, whether it is magnetic or non-magnetic. Due to this property, this force appears to be more like the gravitational force than the magnetic force. It will be shown that a force can be modeled with a power equation (force over a distance in a given time), such that a power in the direction away from Earth can overcome gravitational power and cause a weight loss in an object, or with sufficient power, accelerate it from Earth.

By understanding the commonalities of previous gravity experiments, and by creating an equation that can model their behavior, a new set of experiments can be proposed that will truly generate an undisputed gravitational force. Then, at scale, it can be used to build commercial products that revolutionize the way objects can be controlled.

1. Terminology

Notation

Notation	Meaning
A_x A_y A_z	"x, y, z" - coordinates relative to Earth where z is perpendicular to Earth's surface
A_a A_b A_c	"a, b, c" - coordinates of lattice material (lattice parameters)
r_e	"e" – electron (e.g. electron radius)
m_p	"p" – proton (e.g. proton mass)
a_g	"g" – gravity (e.g. acceleration due to gravity)
α_{ge} α_{gp}	"ge", "gp" – gravity of electron, proton
f_0	"0" – resonant frequency (in *a* axis)
v_d	"d" – drift (e.g. electron drift velocity)

Table 1.1 – Notation

Constants

Symbol	Definition	Value (units)
α_{ge}	Gravitational coupling (electron)	2.4005×10^{-43} - *dimensionless*
r_e	Electron classical radius	2.8179×10^{-15} - *m*
E_e	Electron energy	8.1871×10^{-14} - *J*
f_e	Electron frequency (EWT)	1.0639×10^{24} - s^{-1}
m_e	Electron mass	9.1094×10^{-31} - *kg*
m_p	Proton mass	1.6276×10^{-27} - *kg*
g	Earth's surface gravity	9.807 – m/s^2
K_e	Electron wave centers (EWT)	10 - *dimensionless*
q	Elementary charge	1.6022 – *C (meters in EWT)*

Table 1.2 – Constants

1. Background of Antigravity Experiments

The motion control of objects in the vertical direction on Earth is explored in this paper – devices which counter the effect of gravity. Today, devices such as elevators, cranes and rockets have the ability overcome the gravitational force. In these cases, the object that is lifted has a sufficient force applied by electrical, magnetic or chemical energy. This is a known science and the necessary force for a given mass can be calculated to move an object. While the science for lifting objects is known, gravity is a force that is subject to further research. Experiments continue to search for a theoretical particle called the graviton, which is the particle in the Standard Model that supposedly allows particles to communicate their gravitational effect between masses.

This paper reviews an alternative explanation for gravity that is based on gravito-electric effects, which expands on the Einstein-Maxwell equations. In the works of Li and Torr, it was predicted that a rotating superconductor may cause a gravitational field.[1] Subsequent experiments showed varying results that this is indeed possible. If this is the case, how do the electric and gravitational fields converge? In the explanation of the gravitational force at the quantum level, Yee and Gardi proposed that gravity is a slight loss of electrical energy due to particle spin, as a conservation of energy as electric energy is converted to magnetic energy.[2] [3] Gravity is therefore a side effect of magnetism.

The study of gravity at the quantum level should lead to a better understanding of possible antigravity devices – ones that use the same mechanism as gravity itself to lift an object. In fact, some experiments in the past two decades have stumbled upon a gravitational effect. The Russian scientist Evgeny Podkletnov inadvertently found smoke rising above a superconductor before performing further gravitational experiments. Discrepancies were also found in Gravity Probe B and its superconducting gyroscopes.[4] In other experiments, such as Martin Tajmar et al, superconductors were used with accelerometers to test predictions using modified gravito-electric equations. The experiments of Podkletnov and Tajmar are of particular interest in this paper because they both conducted two different types of experiments each, with commonalities seen across the four experiments between the two authors. Their experiments have been replicated to varying success. Another Russian scientist, Alexey Chekurkov, recently demonstrated a device which amazingly lifts without the use of propellants or other known methods to generate such lift. These experiments are summarized in more detail in the following sections.

It is worth noting that replicating their experiments is not simple for a few reasons: 1) the experiments are costly (one estimate is over $500,000 for the Podkletnov setup), 2) they are difficult to replicate exactly given the lack of specifications on each apparatus in the experiments, and 3) there is a belief by many physicists that the graviton is the cause of gravity and that it is only an attractive force (the Tajmar and Podkletnov experiments demonstrate a repulsive force).

1.1. Podkletnov

In 1992, Podkletnov observed a gravitational anomaly when working on a YBCO superconductor. Later, in 1997, he published a paper claiming up to 2% weight loss on suspended objects above the superconductor.[5] The experiment used a YBCO ring of 10 mm in height and a diameter of 270 mm (80 mm diameter hole). An alternating current supplied a magnetic field that generated a current in the superconductor. Electromagnetics were placed under the superconductor that generated a field of up to 2 Tesla.

Key Data from 1997 Podkletnov Experiment:

- Weight loss was experienced in various objects, including non-magnetic, directly above the superconductor. It was a constant repulsive force/weight loss and did not vary based on the square of distance from the superconductor.

- Weight loss was found at certain AC frequencies, with a maximum around 3.2 to 3.8 MHz.
- With an AC current only, the maximum weight loss was 0.05% of mass.
- With an AC current and electromagnets, the maximum weight loss was around 0.5% of mass when the disk rotated at 5,000 rpm.
- With an AC current and electromagnets, weight loss temporarily increased to ~2.0% of mass when the disk decelerated using braking, from 5,000 rpm to 3,300 rpm in roughly 20 to 30 seconds (multiple tests were performed).

Following his first experiment, Podkletnov then attempted to build a device capable of a larger force. In 2002, he published a paper on an Impulse Gravity Generator.[6] The 2002 experiment utilized a high-voltage generator to run a massive current across a superconductor, aimed horizontally at an object on a pendulum to measure energy based on its displacement from rest. The new apparatus also used a YBCO superconductor with a magnet behind the superconductor (relative to the direction the force was applied). However, instead of an alternating current, high-voltage discharges of 100 kV to 2000 kV were run through the superconductor in short bursts (hence the title "impulse"). He ran two experiments with varying heights of the superconductor at 4 mm and 8 mm.

Key Data from 2002 Podkletnov Experiment:

- For the 8 mm thick superconductor, at 2000 kV, the pendulum deflected 12.7 mm in height for an estimated energy of 23.1×10^{-4} joules. This is the maximum energy value provided by the report.
- At the same voltage, the energy values of the 8 mm thick superconductor are roughly double the energy values of the 4 mm thick superconductor. This leads to the possibility that the energy is proportional to the height (thickness) of the superconductor.
- The energy values produced by the burst from 500 kV to 2000 kV are not linear. In other words, the energy burst on the pendulum is not 4 times larger from 500 kV to 2000 kV. It is about 6 or 7 times larger.

1.2. Tajmar

Tajmar et al performed different experiments and published results in 2006 in *Measurement of Gravitomagnetic and Acceleration Fields Around Rotating Superconductors*.[7] Tajmar and De Matos then filed a patent in 2006 on a method for generating a gravitational field.[8] While the patent does not contain experimental results, there are key elements that show similarities to the 1997 experiment from Podkletnov. The apparatus includes rotating superconductors in the vertical direction while simultaneously rotating around a second, horizontal axis.

Key Data from 2006 Tajmar Patent:

- From the view of the horizontal plane, electrons in a current in the rotating superconductor would appear like an alternating current (similar to Podkletnov's experiment).
- Tajmar suggests a large diameter of rotation for the horizontal plane of 1 meter in diameter. Further, he suggests a rotational speed between 8,000 and 12,000 rpm. This would have a significant linear velocity at where the superconductors spin at the edge.

Although little data is given in the patent, Tajmar continued to perform experiments. Further experiments include measurements of the effect of the gravitational field on accelerometers that were placed above and inside a spinning, superconducting ring. In both the apparatus in the patent and also the paper, there is no external magnetic field such as the Podkletnov experiments. However, Earth's magnetic field can be assumed and is illustrated by the results of the Tajmar experiment and a replicated experiment in both hemispheres of Earth. In the 2007 experiment, the core is a superconducting ring with an outer diameter of 150 mm, a wall thickness of 6 mm and a height of 15 mm. Niobium (Nb) was used as the material for the superconductor and spun with velocities up to 650 rad/s and acceleration up to 1500 rad/s^2.

Key Data from 2007 Tajmar Experiment:

- The accelerometers, placed above the disk and inside the disk (ring) measured signals that were proportional to the acceleration of the superconducting disk.
- At 1000 rad/s^2 angular acceleration, the above-ring accelerometer measured a signal of 5.94 x 10^{-5} m/s^2.
- The Tajmar experiment conducted in Austria (northern hemisphere) saw signals when the disk was spinning in a clockwise direction. A similar experiment conducted in New Zealand by Graham et al (southern hemisphere) saw signals when the disk was spinning in a counter-clockwise direction. This leads to the possibility that Earth's magnetic field is involved in the signals.

1.3. Chekurkov

Alexey Chekurkov, a Russian hobbyist, posted a video in August 2018 of a homemade device that generates significant lift to cause vertical motion of his device, apparently without using known scientific methods for generating such lift. The homemade video, and subsequent videos that attempt to explain the construction of the device, is on YouTube at: https://www.youtube.com/channel/UCzZxKT3BzBZOVVy8_YzP6Yw.

Key observations from the Chekurkov experiment:

- When in operation, the small apparatus is self-contained such that it generates lift and moves with the force, i.e. the apparatus is shown to lift from the ground without the use of propellers. Chekurkov also demonstrates that there are no clear wires or other physical connections to lift the device.
- The device operates at room temperatures.
- The device consists of three round disks, two of which are rotating with fixed magnets.
- Although detailed data is not provided on the experiment, such as rotation rates of the disks or the voltage and current used, a schematic of the electrical components is provided.

In some respects, it appears too good to be true given the significant lift the device generates, and that it is at room temperatures. Although it is possible the video is created with special effects, it is listed in this paper because it contains many similarities to other experiments with gravitational anomalies as will be explained in later sections.

1.4. Replication Experiments

Variations of the Podkletnov and Tajmar experiments have been attempted by various scientists to limited success. Some of these experiments have published results of forces that appear to counteract gravity and others have failed and cast doubt on the possibility of antigravity. The following summarizes some of these experiments:[9]

- In the late 1990s and early 2000s, NASA attempted to replicate the Podkletnov experiment at the Marshall Space Flight Center. Insufficient funding did not allow the experiment to be completed with the rotational system and thus the Podkletnov experiment was not validated.

- A second attempt by NASA was made after hiring Podkletnov as a consultant. The results of the second attempt were not published.

- In 2001, Woods et al attempted to replicate the 1997 Podkletnov experiment, but failed to detect any weight loss. The alternating frequency of 10 kHz was significantly lower than Podkletnov's 3.2 MHz to 3.8 MHz, where the maximum weight loss was found. Woods also used a second alternating field of 1 MHz for disk rotation, but this is also well below Podkletnov's.

- In 2003, Hathaway attempted to replicate the 1997 Podkletnov experiment but failed to detect weight loss greater than 0.001%. This experiment setup differed from Podkletnov and Hathaway managed to get a maximum rotation of 550 rpm, whereas Podkletnov reached 5,000 rpm.

- In 2012, Junker replicated the 2002 Podkletnov experiment as close as possible, but made some modifications that were thought to enhance the experiment's potential for replication. The Junker experiment concludes with partial findings and states that the full report will be published soon, although no further paper has been found on his experiment.

- The Tajmar experiment was partially replicated by Graham et al at Canterbury University in New Zealand. The results showed the strange behavior of superconductor rotation in the southern hemisphere, where results were seen with a counter-clockwise rotation in the southern hemisphere, while Tajmar saw it with a clockwise rotation in the northern hemisphere (Austria).

As of the writing of this paper, the Chekurkov experiment has not been replicated either, although it has only been a few months since it was first posted. A pessimist would review these replication attempts and rule out Podkletnov, Tajmar, Chekurkov, the Gravity Probe B, or numerous experiments that witnessed gravitational anomalies as failures – likely blaming equipment or failing to account for something. However, an optimist would find that there is much in common with all of these experiments that cannot be dismissed. It is entirely likely that the difficulty in replicating these experiments is not just the cost which prohibits many from attempting it in the first place, but given the wide range of results with similar superconductors and lattice materials, it is quite possible that certain frequencies are required to see intended results, much like a resonant frequency.

The common elements across these experiments can be described visually:

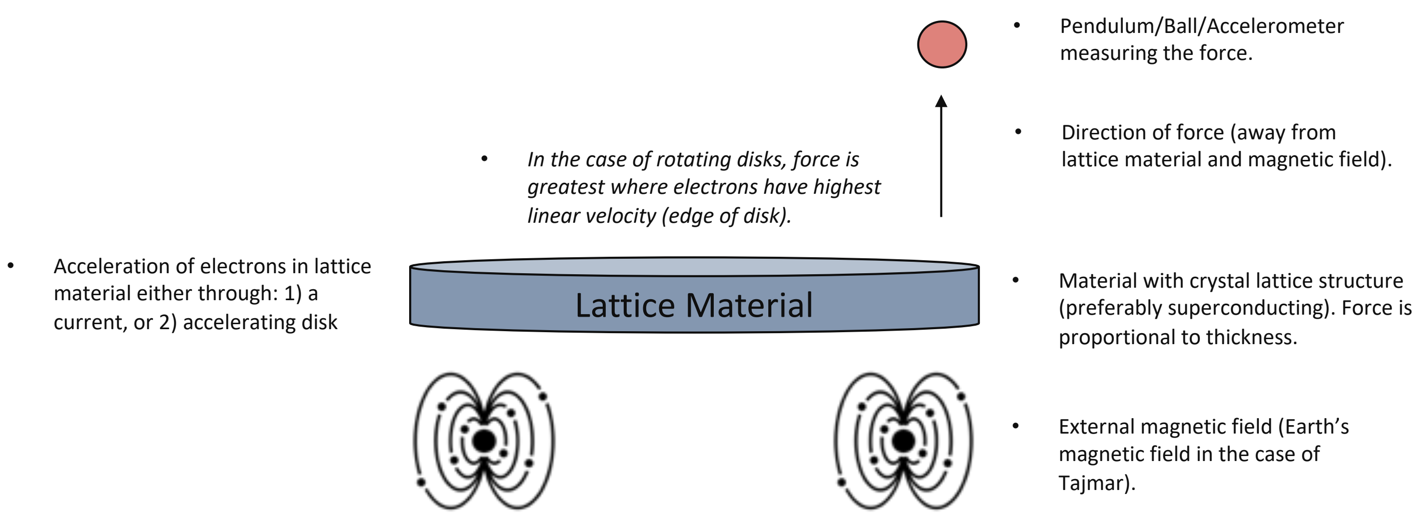


Fig 1.3.1 – Common elements of experiments producing antigravitational forces

2. Antigravity Equations

It will be shown that a force can be generated from a lattice material that is perpendicular to electron motion, causing proton vibration in the direction of the force. The force has the ability to move objects of any type, magnetic or non-magnetic, and is proportional to the mass of an object. Thus, it has the appearance of gravitational force but it is in fact simply a classical force, following Newton's second law of motion.

The force is a result of a conservation of energy at the quantum level, as it will be explained in this section. It appears in crystal lattice materials (hereafter referred to as lattice material), especially ones that are superconductive, due to:

- A crystal lattice has the organizational structure to align protons such that the vibration is coordinated in a single direction.
- Superconductors have little to no resistance, therefore energy is not wasted with particle collisions. The energy from an electron can be transferred to a proton.

Although it is a conservation of energy, the equation to model the effect on a remote object from a lattice material is based on power (P), as frequencies differ based on currents in the lattice material and external frequencies such as gravity. The following power equation will be derived in this section, explaining how the power in the z direction relative to Earth's surface (P_z) is based on energy (E) times frequency (f). The energy is calculated at the quantum level for the motion of each electron (E_c) and proton (E_p), including the effects of magnetism (E_m) and gravity (E_g). Because this is calculated at the quantum level for each particle, the energy is multiplied by the number of valence electrons in a lattice material unit cell (n_e) and then multiplied by the number of unit cells (n_c) in the direction of the force. The power equation is based on the frequency of proton vibration (f_c) and direction of the lattice material relative to Earth's z axis (θ), which is the direction away from the surface. Each component of the final equation for power (Eq. 2.1) will be explained and derived in detail in this section.

$$P_z = n_c n_e \left(E_c + E_m \left(\frac{E_c}{E_c - E_g} \right) + E_p \right) f_c \cos(\theta) \qquad \textbf{(2.1)}$$

Power generated by lattice material in z direction

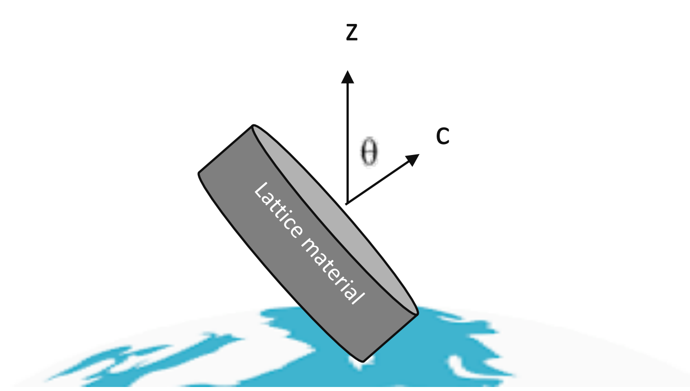
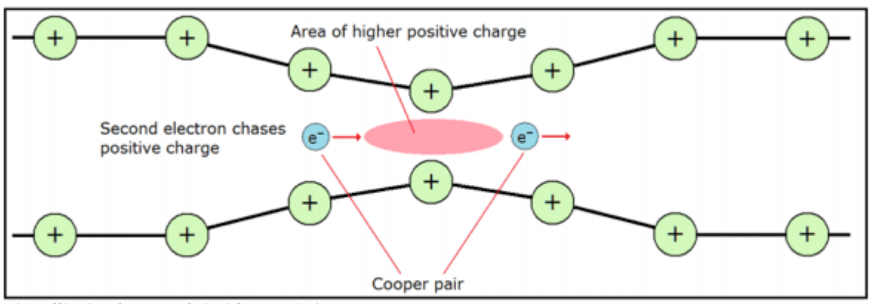


Fig 2.1 – Lattice material power direction (c) relative to Earth (z)

2.1. Deriving Electron Motion Energy (E_c)

A current in any material has energy. Electrons in motion are energy. Within a superconductor with lattice structures, electrons flow freely, but there is a known property of Cooper pairs of electrons that cause an attraction of protons such as Fig. 2.1.1. Superconductors have little to no resistance, thus the energy equations in this section and later sections assume a complete transfer of energy from electrons to protons without energy waste. The same principles would likely apply to lattice materials at temperatures above superconductivity, but energy waste would need to be considered.



https://dc.edu.au/wp-content/uploads/cooper-pair-phonon.png

Fig 2.1.1 – Cooper pair of electrons causing proton vibration

This motion of electrons transfers energy to protons to create a vibration that is perpendicular to electron motion. This causes a vibration of the proton at a frequency (f_c) and energy (E_c), where c is the direction of proton motion using lattice parameters. From the view of the lattice material, a single proton in vibration and the frequency in lattice parameters would appear like the following:

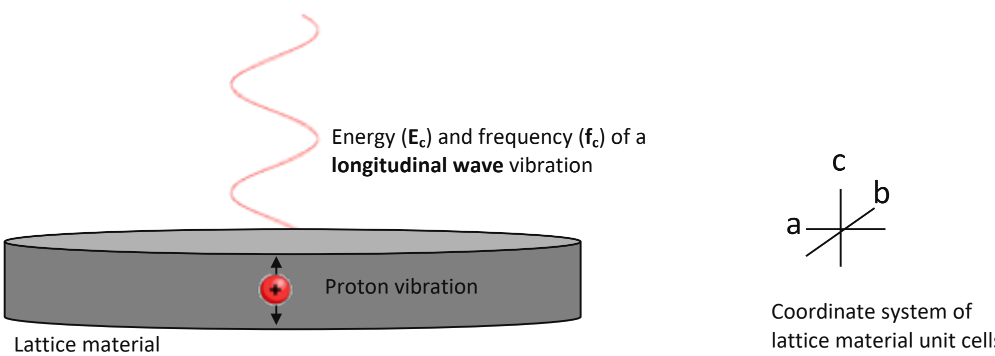


Fig 2.1.2 – Lattice materials and proton vibration

Energy is released in this process but how can it be controlled? The answer may be modeled by studying a particle using Newtonian physics to determine the energy of an electron that is both in motion and spinning. A lattice material is first broken into its smaller parts, where each *unit cell* is known to repeat across the material. An example is the YBCO superconductor unit in Fig. 2.1.3 that illustrates the position of copper (Cu), oxygen (O), yttrium (Y) and barium (Ba) atoms in the cell. This structure is then repeated in each of the lattice directions as shown by a, b, c in the figure. In this YBCO unit cell, the electrons flow across the copper planes, and the direction of proton vibration is in the c direction.

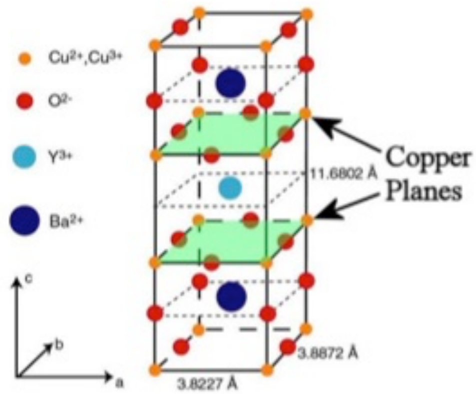


Fig 2.1.3 – YBCO superconductor unit cell

The unit cell can be further dissected to be a single electron and proton to determine the energy transfer (Fig. 2.1.4). As an electron moves across the plane to fill the next hole, it moves a distance of d_a (subscript "a" refers again to unit cell lattice parameters). The energy of a single electron will be referred to as E_a. As the electron crosses the plane, the proton moves closer to the electron and then returns to its original position (it has completed one cycle).

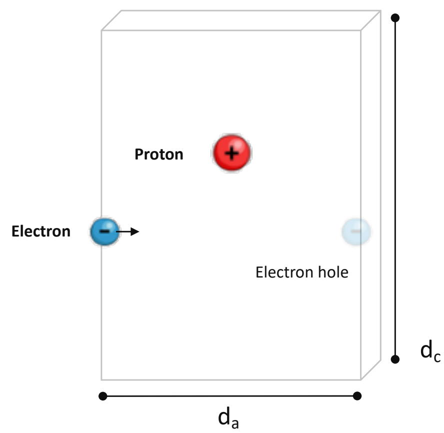


Fig 2.1.4 – Single electron and proton in a unit cell

When an alternating current is applied with frequency **(f)**, the electron will change direction and pass the proton a second time. While the electron has completed one cycle as it alternates (e.g. from left-to-right in Fig. 2.1.4, then from right-to-left), the proton completes two cycles in the c-axis as it is attracted twice. In terms of lattice parameters, the proton vibration frequency **(f_c)** is expressed as:

$$f_c = 2f \qquad \textbf{(2.1.1)}$$

If the energy of an electron crossing the plane is E_a, then the total energy transferred to the proton in a full cycle for the electron, is the following (where E_c is the energy in the direction of proton vibration):

$$E_c = 2E_a \qquad \textbf{(2.1.2)}$$

From Fig. 2.1.4, it becomes clear how **resonance** works at the quantum level. If the electron reaches the electron hole at distance d_a prior to returning, it is the optimal frequency at which the proton vibrates. The proton has maximum amplitude at this frequency. If the timing is too short to reach the distance, or too long and it surpasses this distance, the proton does not reach maximum amplitude. Thus, the frequency of the proton (f_c) will ultimately be described as an equation that considers the actual frequency and resonant frequency (shown later in this section).

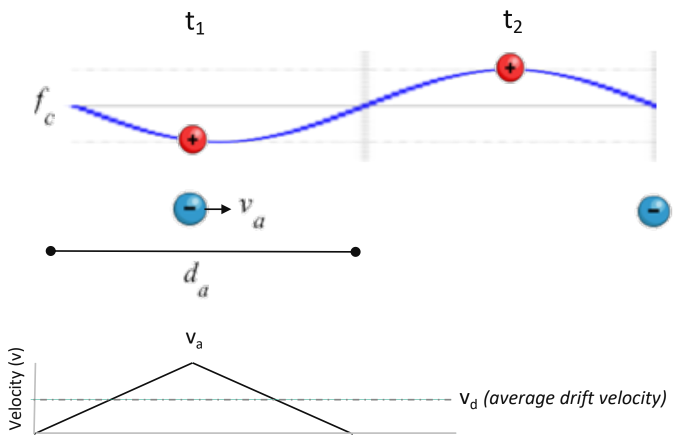


Fig 2.1.5 – Electron velocity across unit cell

In Fig. 2.1.5, the electron's position is illustrated. It is assumed that at time t_0, the electron is at the starting position in the unit cell (not illustrated). It accelerates and reaches the closest position to the proton at time t_1 and then reaches the end of the unit cell (total distance d_a) at time t_2. During this time, the proton has completed a full cycle.

At a resonant, alternating frequency, the **electron will pass the proton with maximum velocity (v_a)** in the a-axis when the electron and proton are at their closest point. In a unit cell such as YBCO, where Y and Ba atoms are in the center of the unit cell, this is half the unit cell distance (½ d_a). Assuming constant acceleration, the maximum velocity is twice the average velocity (drift velocity - v_d) of the electron, expressed as:

$$v_a = 2v_d \qquad \textbf{(2.1.3)}$$

At a resonance frequency, the average velocity would be ideal if it crossed the unit cell distance in the frequency of the proton oscillation (f_c). This can be described as:

$$v_d = f_c d_a \qquad \textbf{(2.1.4)}$$

The velocity is expressed in terms of maximum velocity (v_a) using the frequency of the proton by substituting Eq. 2.1.4 into Eq. 2.13.

$$v_a = 2f_c d_a \qquad \textbf{(2.1.5)}$$

Alternatively, the input frequency (f) can also be used. Because f_c is 2f, the equation becomes:

$$v_a = 4fd_a \qquad \textbf{(2.1.6)}$$

The ideal time (resonance frequency) for the electron to travel the unit cell distance (d_a) is expressed as a function of the average velocity and the distance. However, the electron is often not at this resonance frequency **(f_0)**, and so the effective frequency is described later. Eq. 2.1.4 describes the ideal frequency.

$$f_0 = \frac{v_d}{2d_a} \qquad \textbf{(2.1.7)}$$

The electron's spin, illustrated in Fig. 2.1.6, can be modeled classically as a centripetal force where the mass is the electron's mass (m_e) and the electron's radius (r_e) at velocity v_a (Eq. 2.1.5). From energy wave theory, all electromagnetic equations are a conservation of energy when the force is measured at the electron's radius.[10] Eq. 2.1.9 is the centripetal force of the electron over this distance, to become the energy of E_a.

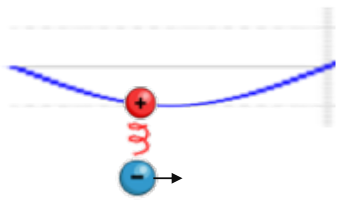


Fig 2.1.6 – Force and energy of electron

$$F_a = \frac{m_e v_a^2}{r_e} \qquad \textbf{(2.1.8)}$$

$$E_a = \frac{m_e v_a^2}{r_e}(r_e) \qquad \textbf{(2.1.9)}$$

Substituting Eq. 2.1.6 into Eq. 2.1.10 and then simplifying, the energy in the c-axis direction (E_c) of the lattice can be expressed in terms of mass, distance and frequency.

$$E_c = 2m_e v_a^2 \qquad \textbf{(2.1.10)}$$

$$E_c = 2m_e (4fd_a)^2 \qquad \textbf{(2.1.11)}$$

$$E_c = 32m_e (fd_a)^2 \qquad \textbf{(2.1.12)}$$

Electron motion energy

With the exception of Section 2.2, which will compare Eq. 2.1.10 against a known resonance equation, the calculations use the input frequency (f) instead of proton vibration frequency (f_c). The alternative equation using input frequency substitutes Eq. 2.1.6 into Eq. 2.1.8:

$$E_c = 2m_e(4fd_a)^2 \quad \textbf{(2.1.13)}$$

$$E_c = 32m_e(fd_a)^2 \quad \textbf{(2.1.14)}$$

Electron motion energy

2.2. Deriving Frequency (f_c)

In an alternating current, the power generated by a proton depends not only on the energy of electron motion but also on the frequency of the current. As described earlier, the maximum proton amplitude is at resonance frequency. Fig. 2.2.1 now expands an earlier view to be a Cooper pair of electrons in an entire cycle of the electron, attracting two protons.

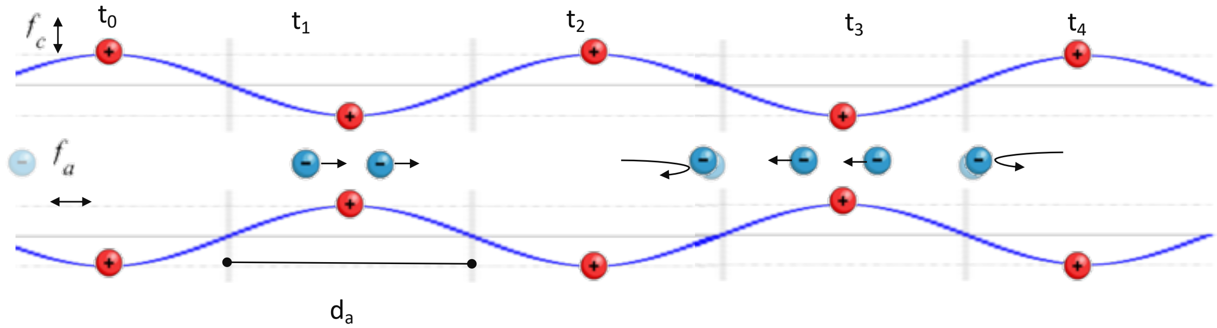


Fig 2.2.1 – Cooper pair of electrons – Complete cycle

The resonant frequency provides the maximum proton amplitude. If the actual frequency of the alternating current is not the resonant frequency, then the amplitude is lower. The frequency will be needed to compute power. The frequency of the electron in the a-axis direction is based on the alternating current input frequency (f) and the resonance frequency (f_0):

$$f_a = \left(\frac{f_0^5}{f^4 - f^2 f_0^2 + f_0^4}\right) \quad \textbf{(2.2.1)}$$

Electron motion frequency

The frequency of the proton in the c-axis direction is two times the electron frequency because it cycles twice for each cycle of the electron.

$$f_c = \left(\frac{2f_0^5}{f^4 - f^2 f_0^2 + f_0^4} \right) \tag{2.2.2}$$

Proton motion frequency

Combining Eqs. 2.1.12 and 2.2.2 for a power equation, where P=Ef, this is the power of a single proton due to electron motion.

$$P_c = 32 m_e (f d_a)^2 \left(\frac{2f_0^5}{f^4 - f^2 f_0^2 + f_0^4} \right) \tag{2.2.3}$$

It is important to note that the resonant frequency (f_0) is dependent on time and distance, which is velocity. Since the electron's velocity is a function of force/voltage, the resonant frequency will differ based on material and voltage. **If the drift velocity is known and the unit cell distance is known, then the resonant frequency can be determined**.

The proof for Eq. 2.2.3 requires a quick review of units for current, voltage, resistance and induction. From energy wave theory, Coulomb charge is wave amplitude, and the units are meters. This was established in the correct derivation of fundamental physical constants and units.[11] When charge is replaced by meters, the SI units for current becomes a velocity, voltage becomes a force, induction is a mass, and resistance is a measurement of mass transferred by time. The following derives these units:

$$I_{units} = A = \frac{m}{s} \tag{2.2.4}$$

$$V_{units} = \frac{kg\,(m^2)}{s^3\,(A)} = \frac{kg\,(m^2)}{s^3 \left(\frac{m}{s}\right)} = \frac{kg\,(m)}{s^2} \tag{2.2.5}$$

$$R_{units} = \frac{kg\,(m^2)}{s^3\,(A^2)} = \frac{kg\,(m^2)}{s^3 \left(\frac{m}{s}\right)^2} = \frac{kg}{s} \tag{2.2.6}$$

$$L_{units} = \frac{kg\,(m^2)}{s^2\,(A^2)} = \frac{kg\,(m^2)}{s^2 \left(\frac{m}{s}\right)^2} = kg \tag{2.2.7}$$

By understanding the units, the root mean square voltage (V_{rms}), resistance (R), and induction (L) can be written in terms of a single electron as follows. Voltage is a force of the electron mass, distance and time (frequency) squared.

Resistance is the electron mass in a given time (frequency). Inductance is the electron mass. Root mean square voltage (Eq. 2.2.8) is the average time that it takes an electron mass (m_e) to **exactly** cross a unit cell (d_a). Time in this case, is a half-cycle of the electron, which is the same as a full proton cycle (f_{c0}). It is temporary labeled with sub-notation "c0" as the resonance frequency of the proton because of the ideal time to exactly cross the unit cell.

$$V_{rms} = m_e d_a f_{c0}^2 \qquad \textbf{(2.2.8)}$$

$$R = m_e f_{c0} \qquad \textbf{(2.2.9)}$$

$$L = m_e \qquad \textbf{(2.2.10)}$$

Similar to Fig. 2.1.5, the peak velocity needs to be determined where the electron transfers energy. The peak-to-peak voltage needs to be considered. This is the maximum proton vibration (peak-to-peak of wave amplitude). The relation of peak-to-peak voltage (V) to the root mean square voltage (V_{rms}) is well known in electronics and expressed in Eq. 2.2.11. Then, Eq. 2.2.8 is substituted into this equation to become Eq. 2.2.12.

$$V = 2\sqrt{2} \cdot V_{rms} \qquad \textbf{(2.2.11)}$$

$$V = 2\sqrt{2} \cdot m_e d_a f_{c0}^2 \qquad \textbf{(2.2.12)}$$

The equations for voltage (V) and resistance (R) are modified to express the value in terms of input frequency (f) and electron resonance frequency (f_0). The relationship is similar to Eq. 2.1.1, where f_c=2f, because the proton cycles twice for every cycle of the electron. The same relationship would be true of the resonance frequencies (Eq. 2.2.13). This is substituted into Eqs. 2.2.12 and 2.2.9 for voltage and resistance.

$$f_{c0} = 2f_0 \qquad \textbf{(2.2.13)}$$

$$V = 2\sqrt{2} \cdot m_e d_a (2f_0)^2 \qquad \textbf{(2.2.14)}$$

$$V = 8\sqrt{2} \cdot m_e d_a f_0^2 \qquad \textbf{(2.2.15)}$$

$$R = 2m_e f_0 \qquad \textbf{(2.2.16)}$$

A **known equation in electronics** for the power in a resonant series circuit can be used, where V, L and R are known.[12] **The equation is shown in Eq. 2.2.17.**

$$P_c = \frac{V^2 R f_c^2}{R^2 f_c^2 + L^2 (f_c^2 - f_{c0}^2)^2} \qquad \textbf{(2.2.17)}$$

Again, the frequency is changed from the proton frequency to electron frequency, which is 2x. Substituting Eqs. 2.2.1 and 2.2.13 into Eq. 2.2.17:

$$P_c = \frac{V^2 R (2f)^2}{R^2 (2f)^2 + L^2 ((2f)^2 - (2f_0)^2)^2} \qquad \textbf{(2.2.18)}$$

Using the values from L, V and R values from Eqs. 2.2.10, 2.2.15 and 2.2.16 and inserting them into Eq. 2.2.18, yields the following once simplified:

$$P_c = \frac{(8\sqrt{2} \cdot m_e d_a f_0^2)^2 (2m_e f_0) (2f)^2}{(2m_e f_0)^2 (2f)^2 + m_e^2 ((2f)^2 - (2f_0)^2)^2} \qquad \textbf{(2.2.19)}$$

$$P_c = \frac{64 (m_e^3 d_a^2) f_0^5 f^2}{f^4 m_e^2 - f_0^2 f^2 m_e^2 + f_0^4 m_e^2} \qquad \textbf{(2.2.20)}$$

$$P_c = 32 m_e (f d_a)^2 \left(\frac{2 f_0^5}{f^4 - f^2 f_0^2 + f_0^4} \right) \qquad \textbf{(2.2.21)}$$

After simplifying, the equation for power in a resonant series is identical to Eq. 2.2.3. It is the energy of the electron in motion at a given frequency. This frequency is the right term in parentheses of Eq. 2.2.21 and previously established in Eq. 2.2.2. When the frequency is the resonant frequency, power is at its maximum because the energy transferred to the proton is at its maximum. The resonant power equation in electronics can now be derived by understanding the energy transfer of a single electron and proton.

2.3. Deriving Electron Magnetic Energy and Gravitational Energy Loss (E_m and E_g)

An external magnetic field will have an effect on an electron. As it increases velocity, it generates more spin and energy. This is seen in electromagnetics as force is proportional to velocity. In Fig. 2.3.1, an electron Cooper pair is illustrated while under a magnetic field (source at bottom of image). The increased spin causes a greater attraction/repulsion of the proton, creating a larger amplitude.

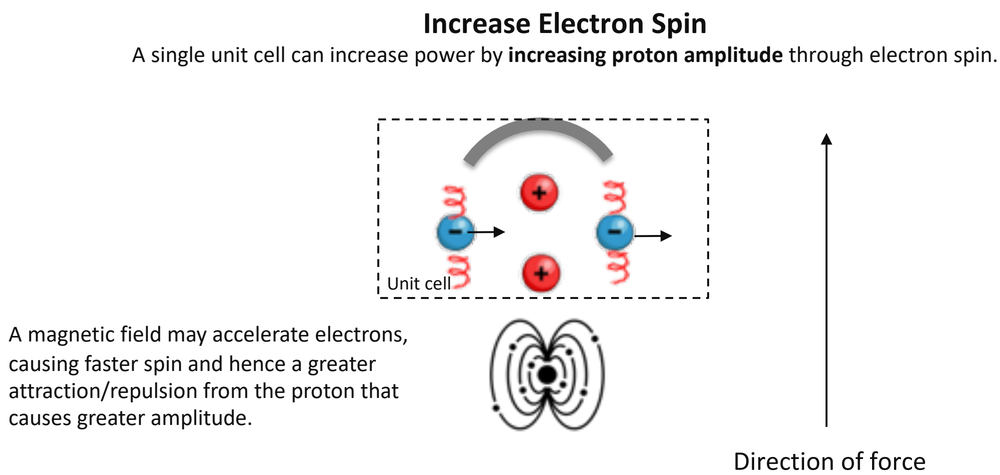


Fig 2.3.1 – Increasing proton amplitude from electron magnetic energy

The force from a magnetic field (B) for a single electron with charge (q) at velocity (v) is a well-established law shown in Eq. 2.3.1. When expressed in terms of energy, where energy is force at distance (E=Fd), the energy of half the unit cell is considered (½ d_a) as the electron generates two spin waves in opposite directions (half of this energy affects one of the protons – the other half affects the other proton). This is expressed as E_m in Eq. 2.3.2.

$$F = qvB \tag{2.3.1}$$

$$E_m = \frac{1}{2} qvBd_a \tag{2.3.2}$$

From Eq. 2.1.7, it was shown that the energy of a single electron's spin can be calculated with classical laws as a centripetal force equation. This will be proven later in experimental data that the following is true when comparing the energy using classical terms and electromagnetic equation terms:

$$E_m = \frac{m_e v_m^2}{r_e}(r_e) = m_e v_m^2 = \frac{1}{2} qvBd_a \tag{2.3.3}$$

The energy from an external magnetic field can be transferred in different ways, but energy is always conserved. Superconductor disks are often found spinning, or forced away, from the magnetic source. This is because nature attempts to balance in accordance with the conservation of energy law. If the magnetic source is assumed to be below the superconductor (relative to Earth's position), such as Fig. 2.3.1, the superconductor may be lifted as it is forced away from the magnetic source. At the quantum level, it can be explained in Fig. 2.3.2.

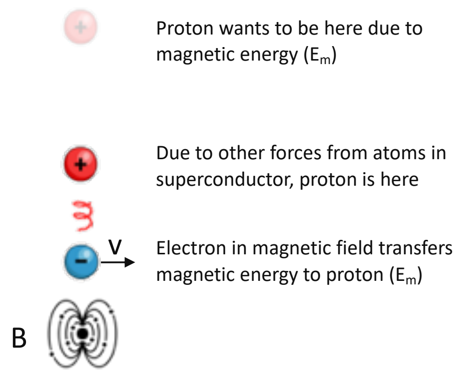


Fig 2.3.2 – Potential magnetic energy due to proton's position relative to magnetic field

If there was only a single electron and proton in the lattice material, at superconductive temperatures, the conservation of energy would force the pair away to a position where energy is equal, or the sum of the forces is zero. However, in the lattice material, numerous atoms exist that are affected by forces (such as gravity). This keeps the proton in a position where it absorbs magnetic energy from the electron, causing greater amplitude. For a proton that is affected by gravity, it is a function of height (distance) from the magnetic field source. This affects the electron magnetic energy as a ratio described by the term α_c (it is a dimensionless value similar to coupling constants, hence the α symbol is used).

$$E_{m'} = \frac{1}{2} qvBd_a (\alpha_c) \tag{2.3.4}$$

The energy that is used as the proton is forced away is gravitational potential energy. It is the proton's position while the lattice material is lifted to a height (h), where g is the surface gravity of Earth and θ is the angle of the lattice material's c-axis direction relative to Earth's z direction.

$$E_g = m_p gh(\cos(\theta)) \tag{2.3.5}$$

One way to consider the relationship between the magnetic energy and gravitational potential energy is that if all of the magnetic energy (Eq. 2.3.2) were used, the proton would be at a height described in Fig. 2.3.2. Since it reaches a lower height due to other forces, the remaining energy is potential magnetic energy. Energy needs to be conserved, so this spin energy causes a greater attraction/repulsion of the proton and it is transferred to longitudinal wave vibration of the proton. The relationship of the magnetic energy ratio is shown in Eq. 2.3.6. It will be proven when comparing experimental data of the lift of superconductors in later sections.

$$\alpha_c = \frac{E_c}{E_g + E_c} \tag{2.3.6}$$

Combining Eqs. 2.3.4 and 2.3.6 gives the effective magnetic energy that can be transferred to the proton.

$$E_{m'} = \frac{1}{2} qvBd_a \left(\frac{E_c}{E_g + E_c} \right) = E_m \left(\frac{E_c}{E_g + E_c} \right) \tag{2.3.5}$$

Effective electron magnetic energy

2.4. Deriving Proton Motion Energy (E_p)

In certain cases, the proton may also accelerate relative to the electron. For example, when a lattice material accelerates or decelerates due to a force other than the external magnetic field calculated in section 2.3. This may be when a disk is manually turned by a rotor or a secondary magnetic force for acceleration or braking of the disk.

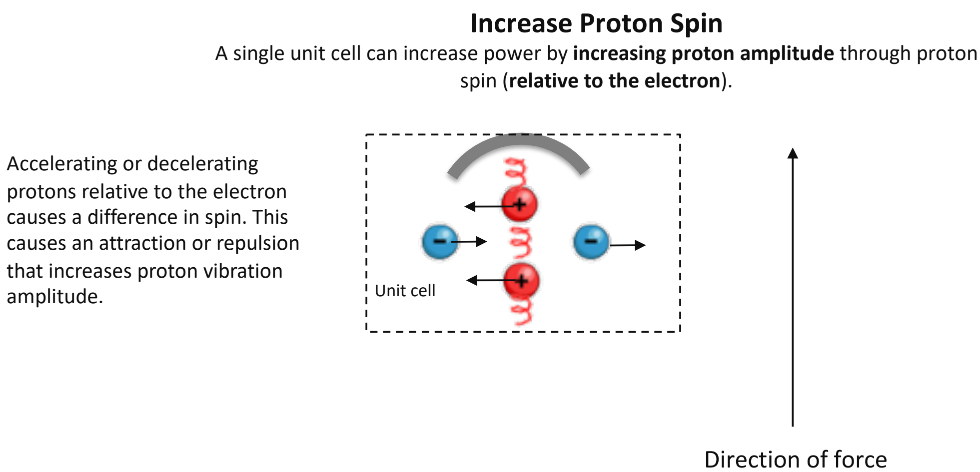


Fig 2.4.1 – Increasing proton amplitude from proton motion energy

If the acceleration of the disk is known, it can be assumed to be the acceleration of the proton (in the a-axis direction of the lattice). This is because the combination of atoms (including their protons) is the structure of the disk. As the disk spins, so do the protons that form its structure. Therefore, the energy of a single proton mass (m_p) across the unit cell distance (d_a) can be expressed in classical terms from Newton's second law of motion as the force ($m_p a_p$) at distance, described by:

$$E_p = m_p a_p (d_a) \tag{2.4.1}$$

Proton motion energy

2.5. Deriving the Final Equation (P_z)

The final equation is expressed in terms of power, which is energy over time. To review the derivation of energy from the previous sections 2.1 to 2.4, it is calculated based on a single electron-proton interaction. They are described in terms of variables that are known in experiments, such as electron velocity (v), magnetic field (B), and unit cell distance (d_a), but all can be expressed in terms of classical Newtonian physics. At the quantum level, a particle is in motion while it is spinning. The three elements of energy for electron motion (E_c), electron-proton magnetic energy (E_m) and proton motion (E_p) are used to calculate the total energy that may be transferred to the proton's vibration energy. The effect of gravity (E_g) reduces the total potential magnetic energy as the particles move to minimize the effect from the magnetic field. This is summarized below in Fig. 2.5.1.

Term		Description	Expanded Term	Classical Equivalent
E_c		Energy from electron acceleration	$E_c = 32 m_e (f d_a)^2$	$m_e a_e (d_a)$
E_m		Energy from proton-electron magnetic attraction	$\frac{1}{2} q v B d_a$	$\frac{m_e v^2}{r_e} (r_e)$
E_p		Energy from proton acceleration	$m_p a_p (d_a)$	$m_p a_p (d_a)$
E_g		Energy used for gravity	$m_p g h (\cos(\theta))$	$m_p g h (\cos(\theta))$

Fig 2.5.1 – Quantum energy of electron-proton interaction and relation to classical physics laws

Energy transfer is always a conservation of energy, and quantum particles can be modeled similar to two non-quantum, spinning objects colliding. Non-quantum in this sense are two objects larger than the size of atoms (e.g. two bowling balls) that are calculated with Newtonian physics. It is important to remember that these objects consist of protons and electrons which never physically touch. The close proximity of these particles causes an energy transfer which is seen as a force on colliding objects. The interaction modeled here with a superconductor follows these same principles but now shows what happens at a particle level. The laws of physics are the same, whether applied to an individual particle or an object made of multiple particles. For the latter, the force is the sum of all the particles involved in the interaction.

Therefore, the total energy of a single electron-proton interaction needs to be determined first. Later, the number of interactions will be summed for the energy of the entire object (or lattice material in this case). The energy of a single electron-proton interaction is shown in Eq. 2.5.1, where the effective magnetic energy is used due to the potential loss of energy as nature balances itself (in this case with gravity). In Eq. 2.5.2, the effective magnetic energy is expanded using Eq. 2.3.5.

$$E = E_c + E_{m'} + E_p \tag{2.5.1}$$

$$E = E_c + E_m \left(\frac{E_c}{E_g + E_c} \right) + E_p \tag{2.5.2}$$

In a unit cell, there may be one or more valence electrons that are in motion during a given frequency that contribute to the total energy transfer. In addition, a lattice material has multiple unit cells which contribute to the total energy transfer. The force is based on the direction of proton vibration (c-axis direction of lattice), so the summation of unit cells is also in this same direction. Thus, the force is proportional to the height, or thickness, of the lattice material which is measured in the c-axis direction of the lattice. This is illustrated in Fig. 2.5.2.

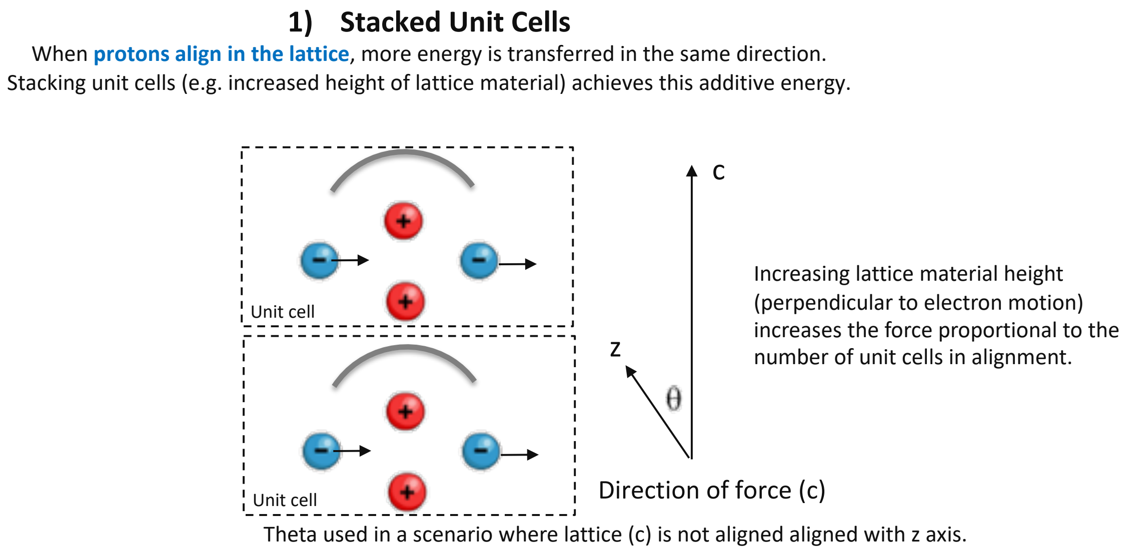


Fig 2.5.2 – Increasing energy with proton alignment in direction of force (unit cells)

Since the total energy is proportional to the number of valence electrons in a unit cell and the number of unit cells in alignment in the c-axis direction, each is given a variable for the final power equation:

- n_e – number of valence electrons in a unit cell
- n_c – number of unit cells in alignment in the c direction of lattice

Because power will ultimately be measured in relation to the fixed z axis, perpendicular to Earth's surface, the angle of force relative to the lattice material's c-axis direction and the fixed z direction is used. The simple form of power in the z-axis direction is the sum of energy based on all particles contributing to energy in unit cell alignment at a given frequency, such as:

$$P = n\,(Ef)\,\cos(\theta) \qquad \textbf{(2.5.3)}$$

In Eq. 2.5.3, the number of valence electrons and unit cells in alignment are used to sum all of the contribution of energy (n) for the single electron-proton interaction (E), established in Eq. 2.5.2. Frequency (f) is based on actual frequency and resonant frequency as established in Eq. 2.2.2. Combining these terms together provides the final power equation in the z direction shown at the beginning of this section.

$$P_z = n_c n_e \left(E_c + E_m \left(\frac{E_c}{E_c - E_g} \right) + E_p \right) f_c \cos(\theta) \qquad \textbf{(2.5.4)}$$

Power generated by lattice material in z-axis

2.6. Calculating Force and Weight Loss from Power Equation

Power needs to be converted back to a force, or acceleration, to understand the impacts that P_z (from Eq. 2.5.4) will have on an object. On a given mass, a force is applied in the z-axis direction, perpendicular to Earth's surface. P_z will determine the total acceleration (a_z) of the object. If the object is in free fall, an upwards force will slow the acceleration of surface gravity ($g = -9.807$ m/s^2), or if the force is significant, it can counter surface gravity and levitate the object (where a_z=0), or accelerate it away from Earth ($a_z > 0$).

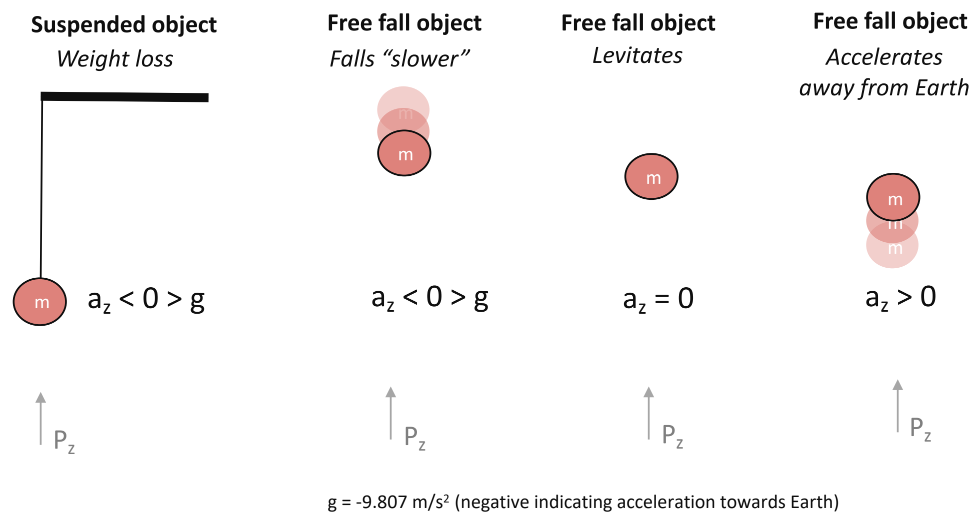


Fig 2.6.1 – The effect of P_z on suspended or free falling objects

The applied force is an exchange of energy over time. Since the frequency of energy from the lattice material is at a different frequency than the particles affected by gravity, the latter's frequency needs to be determined. From energy wave theory, the frequency of the electric wave is simply based on the speed of light (c), electron's radius (r_e) and the number of wave centers (K_e=10). The value of the electron's frequency (f_e) is constant and found in Table 1.2. Since it is the frequency from the electron for the electric wave, it also affects the proton. It is shown in Eq. 2.6.1, and how it can be used (Eq. 2.6.2.) to accurately calculate the energy of the electron when replacing c in E=mc^2, where the energy matches the electron's rest energy (8.1871 x 10^{-14} joules).

$$f_e = \frac{K_e c}{r_e} = 1.06 \cdot 10^{24} \qquad \textbf{(2.6.1)}$$

$$E_e = m_e \left(\frac{r_e f_e}{K_e}\right)^2 = 8.1871 \cdot 10^{-14} \qquad \textbf{(2.6.2)}$$

In the simplest scenario of an object on Earth, a single proton is considered above a lattice material as illustrated in Fig. 2.6.2. All objects accelerate at the same rate due to gravity, including a single particle.

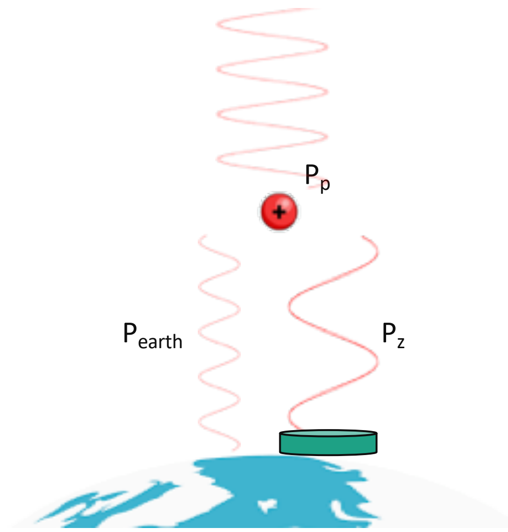


Fig 2.6.2 – The power effect of lattice material (P_z) on a proton (P_p) affected by Earth's gravity (P_{earth})

The power exerted on the proton is gravity. It will be countered by the power from Earth and also the lattice material, where energy is always conserved over time, leading to Eq. 2.6.3.

$$P_p = P_{earth} + P_z \tag{2.6.3}$$

In energy wave theory, the explanation for gravity is a net shading effect relative to the longitudinal (electric) waves approaching the particle from all directions. The waves have more energy at the top of the proton, and less energy at the bottom of the proton due to energy being absorbed by Earth's mass. The missing energy results in acceleration towards Earth. A counter force acting up in the z-axis direction can reduce the acceleration. A lattice material can do this with vibrating protons, which creates longitudinal waves.

To consider the net acceleration of a proton, power is substituted for its parts. It is a force in the z-axis direction ($F=m_pa_z$), over a distance of the electron's radius ($E= m_pa_zr_e$), at the electron's frequency ($P= m_pa_zr_ef_e$). As a reminder, the electron's properties apply to the proton in this case as they can be substituted for wave speed c in Eq. 2.6.1 and still accurately calculate a proton's energy. The power of the proton (P_p) and for a single particle from Earth (P_{earth}):

$$P_p = m_p a_z r_e f_e \tag{2.6.4}$$

$$P_{earth} = m_p g r_e f_e \tag{2.6.5}$$

In a scenario where the lattice material is turned off and there is no power coming from it (P_z=0), Eq. 2.6.3 can be substituted using the values above to prove that the acceleration in the z-axis direction (a_z) is simply surface gravity (g):

$$m_p a_z r_e f_e = m_p g r_e f_e \tag{2.6.6}$$

$$a_z = g \qquad (2.6.7)$$

This is already known for a particle, or an object which is a collection of particles, as it will accelerate towards Earth at g. However, the full power equation is needed now when turning on the lattice material as the energy it generates is likely at a different frequency and f_e will not cancel now like it does in Eq. 2.6.7. Solving for Eq. 2.6.3 by substituting Eqs. 2.6.4 and 2.6.5 yields:

$$m_p a_z r_e f_e = m_p g r_e f_e + P_z \qquad (2.6.8)$$

Now, solving for acceleration is a function of surface gravity (g), proton mass (m_p), electron radius (r_e) and the power generated by the lattice material (P_z). With the exception of P_z, which now has an equation to calculate power, the remaining are constants. Thus, acceleration (a_z) can be determined from P_z.

$$a_z = g + \frac{P_z}{m_p r_e f_e} \qquad (2.6.9)$$

Rearranging terms from Eq. 2.6.1 to get rid of energy wave theory constants, and substituting the value 10 for K_e, the above equation can also be expressed in terms of known constants in modern physics:

$$a_z = g + \frac{P_z}{10 m_p c} \qquad (2.6.10)$$

Net acceleration of an object with external power supplied in z-axis (P_z)

Note: In this frame of reference, acceleration towards Earth is negative and away from Earth is positive. Therefore, g is negative (-9.807 m/s^2). A negative value of a_z means that it still falls towards Earth, a value of zero levitates, and a positive value accelerates away from Earth.

In some cases, experimental evidence is measured as a weight loss. In a suspended object, a negative acceleration that is less than g will feel a weight loss. Weight is a force, typically measured as the mass times surface gravity. It will be given the term W_g for gravitational weight (Eq. 2.6.11). Similarly, a counteracting force on the weight is mass times acceleration. In the z-axis direction, this is expressed by the initial force from the lattice material in Eq. 2.6.12.

$$W_g = mg \qquad (2.6.11)$$

$$W_z = m a_z \qquad (2.6.11)$$

Eq. 2.6.10 is the net acceleration on the object. The acceleration contributed by the lattice material is the component when surface gravity is not considered. It is:

$$a_z = \frac{P_z}{10 m_p c} \tag{2.6.12}$$

Weight loss is measured as a ratio, in percentage terms, so it becomes the relation of the force that reduces weight (W_z) over the initial weight from gravity (W_g). Since weight is typically measured as a positive value, the equation is put in absolute terms and multiplied by 100 to get to a percentage value. Eq. 2.6.12 is then substituted into Eq. 2.6.13 to become the final equation that is used when calculating weight loss percentage from power (P_z).

$$\frac{W_z}{W_g} = \left| \frac{m a_z}{m g} (100) \right| \tag{2.6.13}$$

$$\frac{W_z}{W_g} = \left| \frac{P_z}{10 g m_p c} (100) \right| \tag{2.6.14}$$

Weight loss % of an object with external power supplied in z-axis (P_z)

3. Experiments – Constant Antigravitational Force

Some of the experiments from Section 1 can be explained and their experimental results validated with the power equation derived in Section 2. The experiments will be separated into two major sections: 1) Section 3 includes experiments where a constant antigravitational force is applied and 2) Section 4 includes experiments where short bursts of forces were applied and measured. Since the experiments in Section 3 are consistent, it should allow accurate measurements (excluding other noise-related factors). The Podkletnov experiment has different methods, so it will be expanded in this section called Experiments 1, 2 and 3, although all come from the 1997 paper that he published.

3.1. Podkletnov '97 – Experiment 1

The 1997 Podkletnov experiment used a $YBa_2Cu_3O_{7-x}$ superconductor with unit cell lattice parameters of a a=0.381nm, b=0.387nm and c=1.165nm. The superconducting disk was a toroid with a diameter of 275 mm and an inner diameter of 80 mm. The height (thickness) of the superconductor was 10 mm, but Podkletnov found that ~3 mm of the structure was not superconductive, leaving about 6.5 – 7 mm of height to be superconductive.

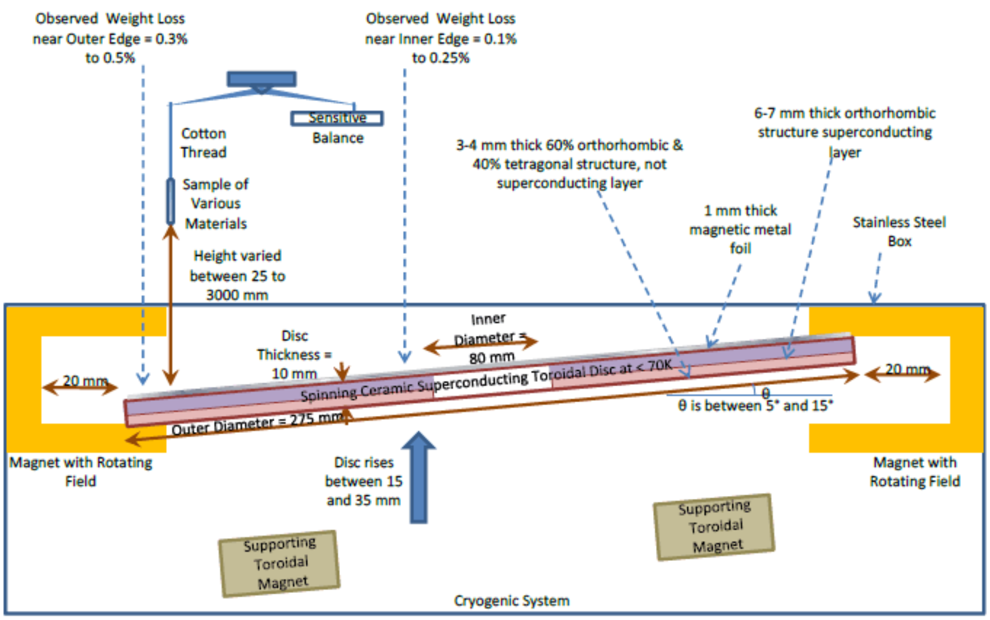


Fig 3.1.1 – Diagram representing features from Podkletnov's 1997 experiment

The unit cell of YBCO is shown again in Fig. 3.1.2, illustrating the direction of the c lattice parameter and the direction of the valence electrons in the Copper planes.

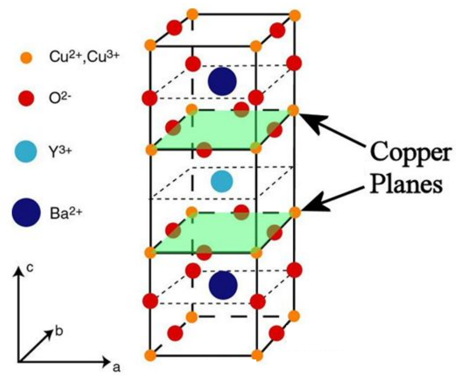


Fig 3.1.2 – YBCO unit cell

The distance the electron travels in the copper plane is based on the a-axis parameter distance of 0.381 nm. From Podkletnov, this distance is:

$$d_a = 0.381 \cdot 10^{-9} \tag{3.1.1}$$

Given the c-axis parameter distance of 1.165 nm and the estimated height of the superconducting layer around ~7 mm, the number of total unit cells in the c direction (n_c) can be calculated. It is one of the variables of the power equation:

$$n_c = \frac{7 \cdot 10^{-3}}{1.165 \cdot 10^{-9}} = 6.01 \cdot 10^6 \tag{3.1.2}$$

Another factor of the power equation is the number of valence equations in each unit cell during a given frequency. Reviewing Fig. 3.1.2, there are four copper atoms that have valence electrons that will cross the plane. Although there are eight total copper atoms in the two copper planes, if one assumes a direction of travel (e.g. left-to-right in the diagram), half of the atoms would contribute to the next unit cell. Thus, four (4) copper atoms are assumed for the calculations. It is known that the YBCO configuration has a strange valence count of 2.33 electrons per atom.[13] While it would be impossible to have a fractional electron, it is assumed that some atoms have two valence electrons, and others have three, averaging out across unit cells to be 2.33. The total valence electrons per unit cell in a given frequency (n_c) can be calculated as follows:

$$n_e = 4 \cdot 2.33 = 9.32 \tag{3.1.3}$$

In the first experiment, Podkletnov ran an alternating current through magnets (highlighted yellow in Fig. 3.1.1) which caused a current in the superconducting disk. The frequencies he attempted varied, but a maximum weight loss he measured in the first experiment was 0.05% when frequencies were in the 3.2 MHz to 3.8 MHz range.

The power equation needs a resonant frequency for the calculations. It can be derived from the average drift velocity of electrons, but since this is not known, another method needs to be used. Since Podkletnov attempted so many frequencies, he likely stumbled across the resonant frequency for his configuration. In his paper, the maximum recorded weight loss occurred at 3.6 MHz. Thus, this frequency is used as the resonant frequency (f_0) of the configuration in the a and c directions of the lattice – recall that the proton vibrates two cycles in c direction for each cycle the electron traverses the unit cell in the a-axis direction). The input frequency f_1 is the same as resonance.

$$f_0 = 3.6 \cdot 10^6 \tag{3.1.4}$$

$$f_1 = 3.6 \cdot 10^6 \tag{3.1.5}$$

In the first experiment, there is no external magnetic force nor is there an external acceleration of the disk (affecting the protons). Therefore, E_m and E_p are zero. There is only the energy from the superconductor current (E_c). It is also assumed the superconductor height is aligned with the z-axis, so θ is zero. Thus, the power equation in Eq. 3.1.6 reduces to Eq. 3.1.7.

$$P_{z1} = n_c n_e \left(E_c + E_m \left(\frac{E_c}{E_c - E_g} \right) + E_p \right) f_{c1} \cos(\theta) \tag{3.1.6}$$

$$P_{z1} = n_c n_e (E_{c1}) f_{c1} \tag{3.1.7}$$

Note: the sub-notation “**1**” in “c1” refers to Experiment 1.

The energy (E_c) and frequency (f_c) are derived earlier in Section 2. They are from Eqs. 2.1.12 and 2.2.2, shown again below.

$$E_{c1} = 32 m_e (f d_a)^2 \tag{3.1.8}$$

$$f_{c1} = \left(\frac{2 f_0^5}{f_1^4 - f_1^2 f_0^2 + f_0^4} \right) \tag{3.1.9}$$

The variable remaining in the power equation is f_1. When the resonant frequency in the a-axis direction of 3.6 MHz is used (f_0=3.6 MHz), the following is obtained for power, acceleration and weight loss using Eqs. 3.1.7, 2.6.10 and 2.6.14 respectively:

$$P_{z1} = n_c n_e 32 m_e (f_1 d_a)^2 \left(\frac{2 f_0^5}{f_1^4 - f_1^2 f_0^2 + f_0^4} \right) = 2.21 \cdot 10^{-20} \tag{3.1.10}$$

$$a_{z1} = g + \frac{P_{z1}}{10 m_p c} = -9.803 \tag{3.1.11}$$

$$\frac{W_{z1}}{W_g} = \left| \frac{P_{z1}}{10 g m_p c} (100) \right| = 0.045 \tag{3.1.12}$$

At the resonant frequency, the net acceleration is -9.803 m/s^2, which is slightly less than surface gravity (g) at -9.807 m/s^2. This causes a weight loss of 0.045%, which is close to the 0.05% measurement recorded by Podkletnov. Different frequencies (in the a-axis direction of the lattice) are plotted against calculated weight loss percentages using Eq. 3.1.6. In Fig. 3.1.3, the vertical axis is weight loss percentage; the horizontal axis is AC frequency in Hz.

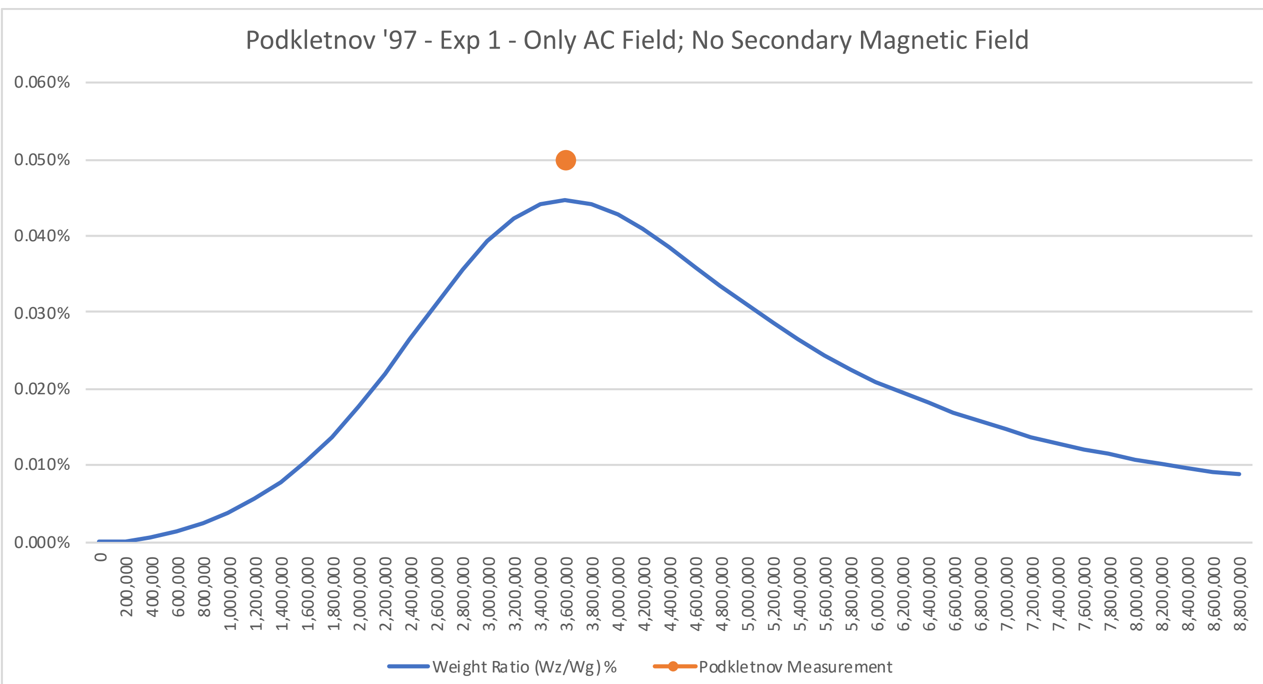


Fig 3.1.3 – Weight loss calculations vs results for various frequencies of Experiment 1

Key Findings:

- The calculation of weight loss is nearly the result obtained by Podkletnov at the peak. Podkletnov did not produce a curve of his findings, so 0.05% has been plotted at 3.6 MHz as the only known data point from this experiment. The calculated value obtained was 0.045%, so it is possible that Podkletnov rounded up.

- The second finding is that weight loss is a resonant curve. This is consistent with Podkletnov's findings where he claimed maximum weight loss around 3.2 MHz to 3.8 MHz.
- The resonant equation is based on electron velocity and distance, which itself is based upon the force/voltage that causes electron motion. This explains why it is difficult to reproduce the experiment. All parameters need to be exactly replicated, otherwise there will be a different resonant frequency for a different configuration.

3.2. Podkletnov '97 – Experiment 2

Further building on Experiment 1, Podkletnov used external magnets placed below the superconductor as shown in Fig. 3.1.1. These electromagnets were powered to produce a magnetic field up to 2 Teslas. In his paper, Podkletnov suggests that weight loss ratios were as high as 0.5%, but his tabular data presented during this phase of the experiment has a maximum of 0.32%.

When the electromagnets were turned on, the superconductor lifted, allowing the freedom for the disk to rotate on its own. In a second variation of his experiment, Podkletnov continued to vary the AC field, but now turned on the electromagnets below the disk. The disk began spinning and this field was fixed when the disk spun at 4300 RPM. Measurements were taken at various frequencies of the AC field. In the presented data, the maximum weight loss of 0.32% occurs at 3.6MHz.

For this scenario, the equation for the power generation in superconductors is revisited in Eq. 3.2.1. This time, there is additional supplied energy from an external magnetic field (E_m) which needs to be considered. But there is no proton energy, so it can be dropped. The angle is zero, so the cos() term is also dropped in Eq. 3.2.2, which is now used to model the Podkletnov second experiment (subscript "2" in the equations):

$$P_z = n_c n_e \left(E_c + E_m \left(\frac{E_c}{E_c - E_g} \right) + E_p \right) f_c \cos(\theta) \tag{3.2.1}$$

$$P_{z2} = n_c n_e \left(E_{c2} + E_{m2} \left(\frac{E_{c2}}{E_{c2} - E_{g2}} \right) \right) f_{c2} \cos(\theta_2) \tag{3.2.2}$$

The equations for n_c, n_e, E_c and f_c, are consistent with the first experiment and the equations can be found in Section 3.1. The difference now in the equation to consider is the energy from the magnetics below the superconductor (E_m) and the energy used by gravitation (E_g). From the explanation and derivation in an earlier section, Eq. 2.3.4 is:

$$E_{m2} = \frac{1}{2} q v_2 B_2 d_a \tag{3.2.3}$$

From this equation, q is known since the energy of a single electron is measured. It is the elementary charge. The velocity (v_2) can be derived from the known rotation of the disk (4300 rpm) and its radius (the radius of the disk is 13.75 cm – r_0). The distance of the unit cell in the a direction is known and fixed (d_a). The challenge for calculating the magnetic energy is obtaining the value of B in the equation.

Podkletnov's report claims the B field measurement was up to 2 Teslas, but varying the field caused different rotation rates and heights when the disk was lifted. Eq. 3.2.3 needs this value to determine the total potential energy that a proton may be forced away from the magnetic source, so B must be obtained.

Using Eq. 2.3.3, it was shown that the spin of the disk is related to centripetal spin of the particles. It is rewritten to show this relationship in terms of maximum values that are known from the Podkletnov experiment (subscript "0").

$$m_e v_0^2 = \frac{1}{2} q v_0 B_0 d_a \tag{3.2.4}$$

The velocity on the right side of the equation can be dropped because it is squared on the left. The remaining velocity is the linear velocity for the angular speed at the maximum distance that is measured (the edge of the disk at r_0). This leads to the following substitutions of Eq. 3.2.4:

$$2\pi\omega_0 r_0 m_e = \frac{1}{2} q B_0 d_a \tag{3.2.5}$$

Using the parameters supplied by Podkletnov for the maximum values where m_e is the electron mass, q is the elementary charge, d_a is the fixed distance of the YBCO unit cell (established earlier), ω_0 is 5000 RPM and r_0 is 13.75 cm, the max value of B is calculated (**B_0=2.1488**):

$$B_0 = \frac{4\pi m_e r_0 \omega_0}{q d_a} = 2.1488 \tag{3.2.6}$$

Podkletnov claimed around 2 Teslas, so this value is near his measurements. The value will be further proven in experimental results as a conservation of energy below.

The results recorded in Experiment 2 are not at the maximum B field, or 5000 RPM. In Experiment 2, the rotation is fixed at 4300 RPM. So, the B field must be derived for this rotation. Since it is a conservation of energy, the B field is proportional to rotation. Therefore, since the maximum values are known, the B field can be derived for 4300 RPM as follows where ω_2 is the 2nd experiment at 4300 RPM:

$$B_2 = \frac{B_0 \omega_2}{\omega_0} \qquad \textbf{(3.2.7)}$$

B field calculation when Max B field (B_0) and Max rotation (ω_0) is known

At 4300 RPM, the B field is **B_2=1.848 Teslas**. This is one of the experimental proofs that the centripetal spin energy of particles is conserved and is the cause of the spin of the superconductor. The classical laws and electromagnetic laws converge. The energy of a single electron is shown as related to the magnetic field in the next equation. Proof of the value B_2 that has been calculated here; proof of the merging of classical and electromagnetic laws.

$$m_e v_2^2 = \frac{1}{2} q v_2 B_2 d_a = 3.49 \cdot 10^{-27} J \qquad \textbf{(3.2.8)}$$

At this point, E_m can be solved from Eq. 3.2.3. But to complete the power equation for superconductors, the gravitational energy used must also be solved (E_g). The superconductor is also forced away (lifted) from the electromagnets, and so some of the energy is used by gravitation. From the earlier explanation, the energy calculated by E_m can be thought of as the total potential energy that would force a single proton into a distance from the magnetic source. However, other factors keep it closer to the magnet and it will use this remaining energy while it vibrates. The distance from the source of the magnet (height) affects the strength.

The equation for gravitational energy used comes from the explanation and derivation in Eq. 2.3.5:

$$E_{g2} = m_p g h_2 (\cos(\theta_2)) \qquad \textbf{(3.2.9)}$$

It is assumed that the angle of gravitational energy is aligned with the force from the disk, so cos() will be dropped from the equation. The mass of the proton is known (m_p) and surface gravity for Earth (g) is fixed, at least near the surface of Earth, at 9.807 m/s^2. This leaves height (h) as the only variable.

In the Podkletnov experiment, heights were measured and were found to rise between 15 mm and 35 mm. But height measurements are not recorded alongside each measurement of weight reduction, so they must be estimated. Since height is also proportional to the magnetic field strength, it can be derived similar to the magnetic field strength in Eq. 3.2.7. Height is proportional not only to the external field below the superconducting disk, but also the AC field current. The ratio to determine height (h) where the maximum values of h_0 at 35 mm, B_0 at 2.1488 Teslas and fa_0 at 3.6 MHz is:

$$h = \frac{h_0 B f}{B_0 f_0} \qquad \textbf{(3.2.10)}$$

The Podkletnov superconductor is a special case where the lower layer of the superconductor disk is non-superconducting (bottom 3 mm). This affects the height where the first superconducting particles are from the magnetic source. The 3 mm non-superconducting layer needs to be added to the height. So, the derivation of the height of the superconductor can be found using Eq. 3.2.11, where .003 is appended to the equation for the 3 mm layer. Note that frequency f_2 affects the height and remains a variable in the equation:

$$h_2 = \frac{h_0 B_2 f_2}{B_0 f_0} + 0.003 \qquad \textbf{(3.2.11)}$$

Height (h) calculation when Max B field (B_0), Max height (h_0) and Max frequency (f_0) are known
(specific equation for Podkletnov YBCO disk where bottom 3 mm layer is not superconductive)

Now, the power equation for superconductors can be used. Using Eq. 3.2.2, the values n_c, n_e, E_c and $f_{c'}$ are found in Section 3.1, as they have not changed in this experiment. The values for E_m use Eq. 3.2.3, where the B field is fixed in this example at 1.848 Teslas, according to Eq. 3.2.7. Lastly, E_g needs to be computed. It will be variable based on the frequency of the alternating current. Eq. 3.2.9 is used for E_g where height (h) will be a function of frequency (f_a) using Eq. 3.2.11.

The power equation is used to plot the results for the power generated in the z direction, using different frequencies of the AC current. The external magnetic field is fixed for a superconductor rotating at 4300 RPM. Then, the power is converted to a weight loss function, similar to the method described in Section 3.1 and is not repeated here. These values are charted below in the blue line. Four measurements from Podkletnov (orange) are plotted for comparison.

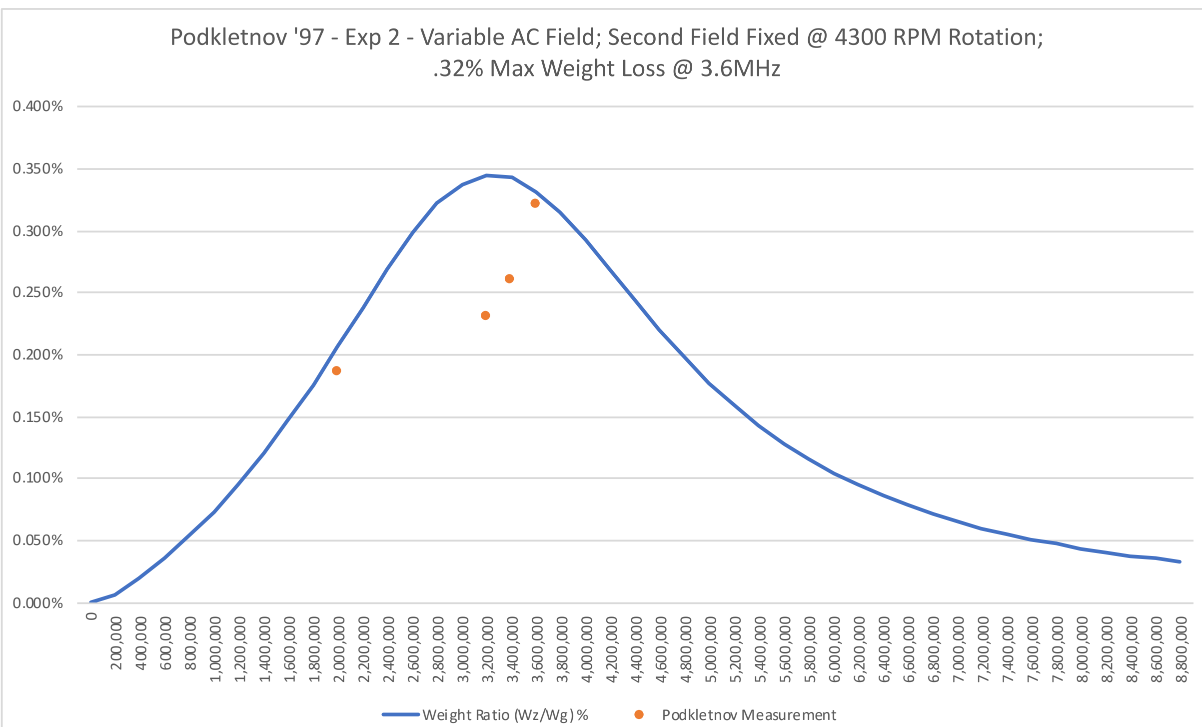


Fig 3.2.1 – Weight loss calculations vs results for various frequencies of Experiment 2

Key Findings:

- A maximum weight loss of 0.33% is calculated, compared to Podkletnov's maximum weight loss of 0.32%.
- Two of the data points from Podkletnov's measurements are very close to the predicted results, while two are off by ~0.1% of weight loss. There are not enough measurements from Podkletnov to establish a pattern, but there does appear to have the indication of a sine wave in Podkletnov's data points, like it is forming the sine wave at higher frequencies than expected. It is possible there may be a time delay between the changing AC frequency, the rotation and then raising of the superconductor, before it affects the mass suspended above it (time delay from recording the AC current to the weight loss).

3.3. Podkletnov '97 – Experiment 3

In a variation of the previous experiment, Podkletnov held the AC current steady and changed the magnetic field to increase or decrease the rotation of the superconductor. According to Podkletnov, the best results occurred when the superconductor spun at a rate of 5000 rpm, although no tabular data is provided beyond 5000 rpm in his results.

Experiment 2 is a fixed magnetic field and variable AC current, while Experiment 3 is a fixed AC current and variable magnetic field. Therefore, the same equations from Section 3.2 are used here, but B is variable now instead of f. The input frequency (f) is fixed at 2 MHz according to the data from Podkletnov. Because a lower frequency than resonance (3.6 MHz) was used, the weight loss percentage is lower than other experiments. But it does show that a maximum weight loss is seen at the highest reported disk spin at 5000 RPM. At 2 MHz and 5000 RPM, a weight loss of 0.23% was recorded by Podkletnov.

Using the power equation for superconductors and then converting to a weight loss percentage using the same methodology from previous sections, the calculated values for weight loss are plotted in blue from 200 RPM to 8800 RPM. They are compared against Podkletnov's measurements (orange) in the 4000 to 5000 RPM range.

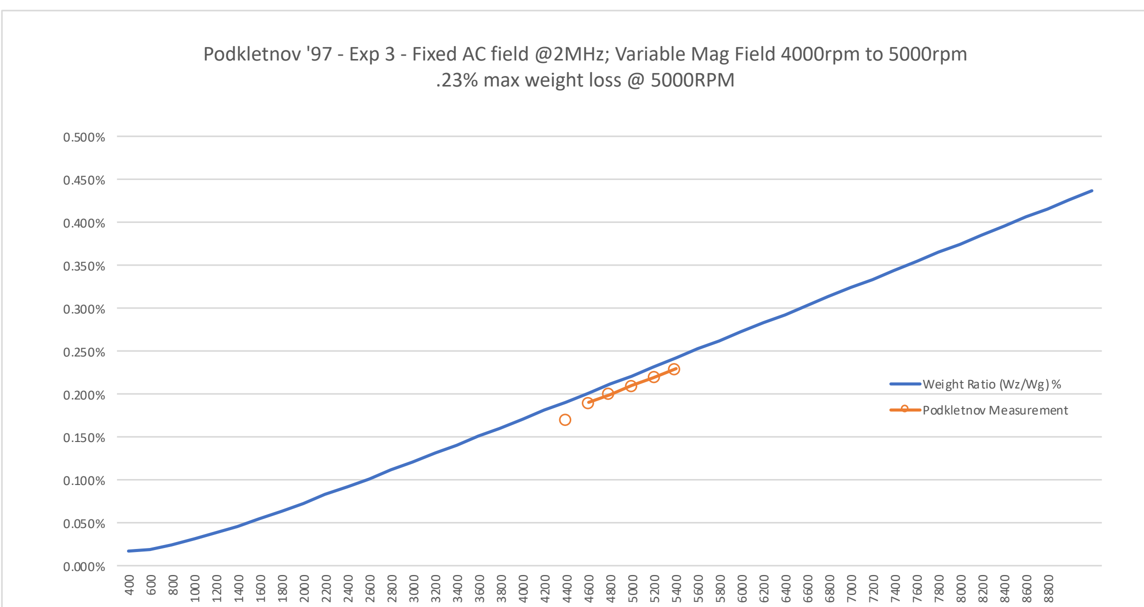


Fig 3.3.1 – Weight loss calculations vs results for various rotational rates of Experiment 3

Key Findings:

- The calculations and the measured results are both linear. Podkletnov did not produce data beyond 5000 RPM, but it is anticipated that power would continue to increase and provide more weight loss. Unfortunately, he was already at 2 Teslas from the external magnets to spin at 5000 RPM, so it would have been difficult to increase it significantly to get to a point of where the object could levitate (assuming it was linear, Podkletnov would have needed 868 Teslas for this particular configuration).
- Similar to Experiment 2, the calculations in Experiment 3 are just slightly larger than the measured results. This leads to the possibility of a slight energy loss somewhere in the system that has not been considered.

3.4. Tajmar '06 – Patent

The 2006 patent by Martin Tajmar unexpectedly shows little in terms of experimental results, but instead focuses on the apparatus and setup, as it is claiming a method for antigravity. The setup is quite different than Podkletnov's setup, and it will be very different than the Gravistics setup, but common elements exist that explain the results and why Tajmar filed the patent.

The Tajmar design has multiple superconductors spinning vertically (perpendicular to Earth's surface) versus the Podkletnov experiment which spins horizontally. In the Tajmar design, vertically-spinning superconductors are then placed onto a system that can also be rotated horizontally. This design allows for high linear velocities when the superconductors are placed at the edge, as Tajmar reports success when the secondary (horizontal) rotation reaches speeds of 8,000 to 12,000 RPM, at a radius of 1 meter.

In short, the effect is similar to the Podkletnov experiment. The electrons rotating in a vertically-oriented superconductor disk would appear to the z axis to be moving back-and-forth (i.e. just like an AC current). Then, these superconductors are also rotated on the horizontal plane, so the electrons gain a very high linear velocity. It is significantly higher than Podkletnov's experiment, but the key difference is that Podkletnov used an external magnet below the superconductors, whereas Tajmar does not. It is very likely that the benefit he achieved with the secondary rotation is to accelerate electrons through Earth's magnetic field. The clue is that one of Tajmar's experiments that was conducted in Austria (northern hemisphere) saw results that were different when the experiment was conducted in New Zealand (southern hemisphere).[14] It is a result of the Earth's magnetic field and the differences between the north and south poles.

Unlike Tajmar's 2007 experiment, which differs from his patent in both the experiment setup and that it has published results, the 2006 patent has no data to be validated against. The 2006 patent is listed here in this section because of its setup. In the right configuration (where an object is rotated along with the superconductor), it could be used to generate a constant force. The 2007 experiment is explained in the next section where experiments are placed for short-bursts of force, but cannot be used for a constant force.

Because it was a patent and little data about the experiment is known, many assumptions are made to prove the possibility of Tajmar's 2006 patent. First, the YBCO configuration from Podkletnov's experiment is used (e.g. the distance of a unit cell, number of valence electrons, resonant frequency, etc). Where the Tajmar patent differs is the magnetic field, the radius of rotation and rotational speeds.

Thus, the same equation for Podkletnov Experiments 2 and 3 are used here, along with the input values from those experiments **except**:

- Earth's magnetic field is estimated at Tajmar's location: B = 5×10^{-5} (Tesla)
- Radius is set to 1 meter: r = 1
- Superconductor spins at 10^5 radians per second converted to Hz: (f_a = 628,319 Hz)
- Height (h) is based on B and f (see calculation below): h = 1.42×10^{-7} meters

$$h_5 = \frac{h_0 B_5 (f_5)}{B_0 f_0} = 1.42 \cdot 10^{-7} \tag{3.4.1}$$

Using the little-known data and assumptions from Podkletnov's YBCO superconductor, the calculated values in terms of weight loss percentage were plotted for a potential result. The red circle highlights the patent's example of high rotation rates (8,000 – 12,000 RPM). In Fig. 3.4.1, the vertical axis is weight loss percentage; the horizontal axis is the secondary (horizontal) rotation in RPM.

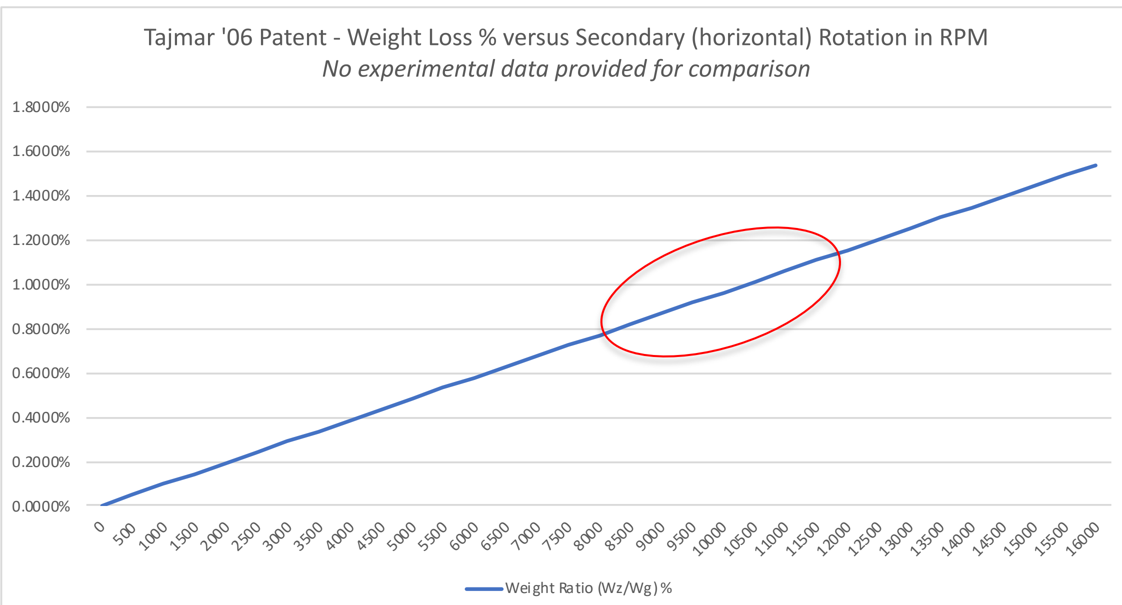


Fig 3.4.1 – Weight loss calculations vs results for various rotational rates of Tajmar '06

Key Findings:

- Tajmar's setup utilized Earth's magnetic field in order to achieve any significant amount of magnetic energy (represented as E_m in the power equation for superconductors). As a result, linear velocity of electrons was significant (relative to Podkletnov's experiment) by doing two things: 1) using a radius 1 meter (Podkletnov's was 13.7 cm) and 2) rotating at up to 12,000 RPM (Podkletnov's max reported was 5,000 RPM). A higher velocity electron in a lower magnetic field can still achieve sufficient energy to see weight loss.
- Tajmar mentions 8,000 RPM to 12,000 RPM in the patent but without indication if there were test results at rotations higher than 12,000 RPM. If there is a resonance function and power declines after 12,000 RPM in the Tajmar setup, it would be conflicting with the calculated results.

- Although there are many assumptions and the calculated values may differ significantly from Tajmar's results, it is worth noting that the YBCO properties used from the Podkletnov experiment cause a 1% reduction in weight loss in the rotational speeds suggested by Tajmar (circled in red in Fig. 3.4.1).

3.5. Boyd – Patent

In 2016, Michael Boyd was granted a US patent for a method to produce gravitomagnetic induction.[15] The claims of gravitomagnetic energy are antigravity, although what is explained in the patent is very small and could be contributed to other forces such as magnetism. However, it is included in this section because of similarities to other experiments and because it has the possibility of a constant force (unlike experiments in the upcoming Section 4).

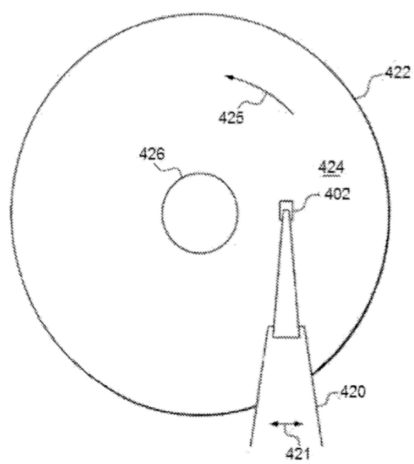


Fig 3.5.1 – Hard disk configuration of gravito-magnetic energy proposed by Boyd patent

From the illustration above, the Boyd patent consists of a hard disk (circle - 422) that is spinning at a high rotational rate while being read by a magnetic head (402). This is used in the computer industry to read and write information to a disk.

It was found that small imprecisions in the disk causes a force. Boyd, with expertise in hard disks, found that nano-pits (small indentations) or nano-bumps (small raises of the disk) can be responsible for what he called gravitomagnetic energy. In short, there is a force applied to the magnetic head.

It is possible that the nano-pits and nano-bumps cause a sudden difference in the organizational structure of atoms, possible aligning protons vertically, much like the lattice structures of superconductors discussed in the previous sections. If this is indeed the case and protons now align (although temporarily only at the bumps and pits), then the force could be concentrated in a direction that is picked up by the magnetic head. Therefore, the similarities between the Boyd experiment and the superconductor experiments are:

- An atomic structure that may align protons to vibrate in a given direction
- A rotating structure that causes electron excitement and energy in the presence of a magnetic field
- A magnetic field (in this case from the magnetic head for the read/write function of the disk)

Unlike other experiments in this section, Boyd's hard disk is not superconductive. **Therefore, the equation derived in this paper is not applied to the Boyd experiment because of energy waste due to resistance**. It is also not suggested to use this setup for large forces as it would be expected to generate only a small force and is difficult to produce large forces without significant scale.

3.6. Chekurkov – Experiment

In 2018, Alexey Chekurkov posted an astonishing video to YouTube of a small device that generates lift from an unknown force (no propellers are used). A few videos illustrate the demonstration of the device achieving lift and its components (the device is shown in Fig. 3.6.1 – the power sources connected to the wiring are found in the videos).

Fig 3.6.1 – Chekurkov Device in Operation
https://www.youtube.com/watch?v=VBrx4O10XkI&t=1562s

Since it is a video, it is possible that special effects are used. At the time of this writing, no paper has been written that documents the data to use the equations in this paper to validate the experiment. However, the schematic of the device is consistent with the energy subsystems in this paper that can generate a force to counter gravity. The schematic of the Chekurkov device is found in Fig. 3.6.2:

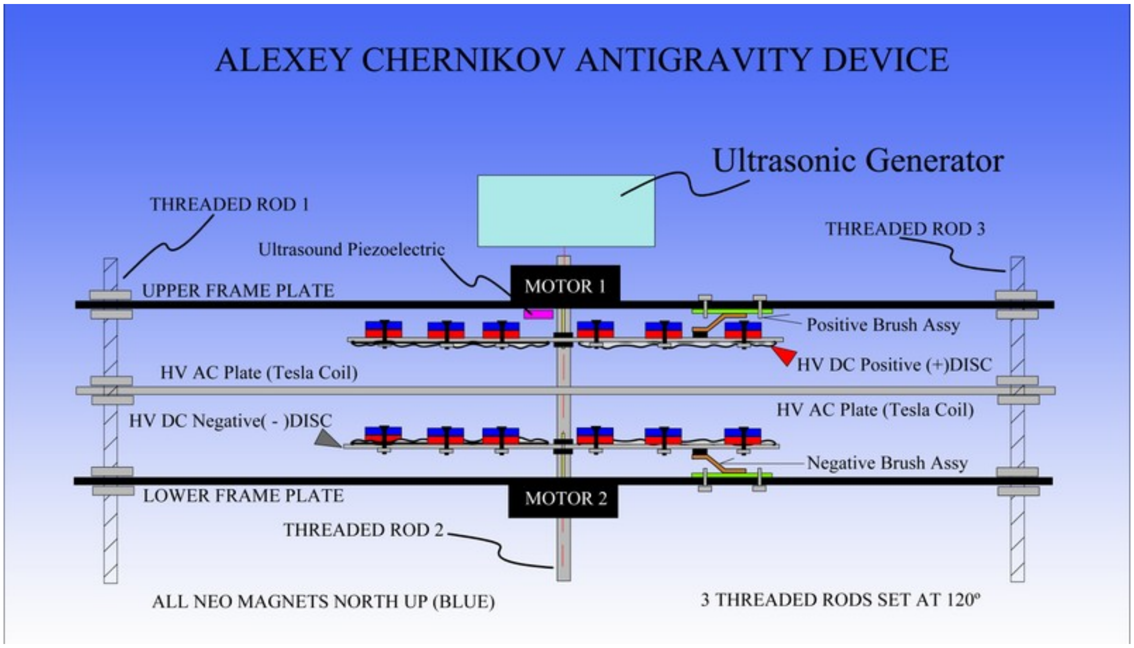


Fig 3.6.2 – Chekurkov Device Schematic

Due to the lack of data provided, the equations in this paper cannot be used to validate the experiment. However, the similarities of the Chekurkov experiment and other experiments with gravitational anomalies are:

- A subsystem for electron motion energy (AC Circuit subsystem), which is the high-voltage AC plate in the middle.
- A subsystem for electron magnetic energy (DC Circuit subsystem), which in this case is fixed magnets on two plates that have a DC current (top plate is positive; bottom plate is negative).
- A subsystem for proton motion energy (DC Motor subsystem), which in this case is the motor spinning the magnetic plates (as opposed to the lattice material). The effect of spin should be the same whether it is the AC plate or DC plate that is spinning.
- The middle plate is apparently made of aluminum, which is a face-centered cubic crystal structure material, with high electrical conductivity, even at room temperatures.
- Chekurkov apparently takes 20-30 minutes in the attempts to generate lift as he configures the settings for the device. It is possible that he is finding the resonance frequency of the AC plate each time. Although the settings may be close to previous attempts, even temperature would have an effect each time on the resistance of the aluminum. The fact that it takes multiple attempts at configuration settings leads to the possibility of a resonance frequency **and is the possible reason it is difficult to replicate.**

4. Experiments – Short Burst Antigravitational Force

The experiments in this section include further iterations from Podkletnov and Tajmar, in addition to others, that generate a temporary force, referred to here as a "short burst". The experiments are included here as further validation of the power equation derived in this paper. They have been grouped into a separate section because the practical applications are limited compared with applications that may be built where a force may be sustained over time, pending sufficient energy. For example, a practical application for a short acceleration burst may apply to a bullet, cannon or perhaps missile. But unlike a constant force, this would not be practical for moving objects requiring slower acceleration and precision such as an elevator, crane or plane.

4.1. Podkletnov '97 – Experiment 4

In the Podklnetov experiment published in the 1997 paper, a further experiment was conducted that slowed the disk from a rotational speed of 5000 RPM to 3300 RPM using braking techniques. He ran into issues below 3300 RPM due to disk vibration so data was only collected at this range, in roughly 20 or 30 seconds of deceleration. During this deceleration, the maximum force increased significantly. The maximum weight loss percentage achieved was between 1.9% and 2.1% according to the paper.

The increase is only reported during deceleration and not acceleration. Although it would appear strange, because Newton's laws should affect a mass that is accelerating or decelerating, it can be explained by the fact that the disk was manually braked. Had it been slowed naturally by the electromagnets that caused the acceleration, the short burst force due to acceleration likely would not have been seen. The answer is because of the conservation of energy. Energy is supplied by the electromagnets to the superconductor. The natural reaction of the superconductor is to lift and to spin. Particles are adjusting to position to minimize energy. As it was explained in Section 2, because of the overall structure of the superconductor, some particles never achieve their optimal position to conserve energy. The remaining energy is used as a vibration of protons.

In this particular scenario, a new consideration of energy needs to be accounted for that is already described in the power equation for superconductors (E_p). In this variation of the Podkletnov experiment, the superconductor was spinning at 5000 RPM. Electromagnets supplied the energy (E_m) that cause the rotation. When external energy is supplied, which is the case of the magnetic braking system used by Podkletnov, the energy difference needs to be accounted for. The superconductor wants to spin at 5000 RPM, but it is being slowed by other forces. This explains why it only occurs when decelerating and not accelerating. There was no external energy supplied during acceleration.

Revisiting the power equation again in 4.1.1, all of the components of energy now need to be considered. Assuming the superconductor's c axis direction is aligned with the fixed z axis of Earth, the last term will be dropped

$$P_z = n_c n_e \left(E_c + E_m \left(\frac{E_c}{E_c - E_g} \right) + E_p \right) f_c \cos(\theta) \qquad \textbf{(4.1.1)}$$

$$P_{z4} = n_c n_e \left(E_{c4} + E_{m4} \left(\frac{E_{c4}}{E_{c4} - E_{g4}} \right) + E_{p4} \right) f_{c4} \cos(\theta_4) \qquad \textbf{(4.1.2)}$$

The variables for Eq. 4.1.2 were solved in previous Podkletnov experiments and are not replicated here. The same values for n_c, n_e are used. And since Podkletnov was measuring the maximum possible, the maximums are used for frequency (3.6 MHz), magnetic field (2.14 Tesla) and rotation (5000 RPM). The term that is different now is the energy for the proton, E_p, as it now accelerates relative to the electron (see explanation in Section 2). The remainder of this section describes the equation that calculates the energy of the proton that is affected in the unit cell of the superconductor. Then, the final equation can be solved in Eq. 4.1.2.

To solve for the linear acceleration (a) of the proton, the known properties of rotational speed, time and radius are used. Again, radius is the edge of the disk because Podkletnov's maximum measurements were at the edge. The angular acceleration of a 5000 RPM disk slowing to 3300 RPM in 20 seconds is as follows (divide 60 to change rotations per minute to seconds and 2 * pi for radians):

$$\alpha_4 = (2\pi) \frac{5000 - 3300}{60} \left(\frac{1}{20} \right) \qquad \textbf{(4.1.3)}$$

Given angular acceleration, the linear acceleration at the edge where r_0=13.75 cm is calculated to be a_{d4}=1.224 m/s^2 when using the following equation.

$$a_{d4} = \alpha_4 r_0 \qquad \textbf{(4.1.4)}$$

Since this is a conservation of energy that is transferred to the proton for each unit cell during the frequency, it is the acceleration from above, multiplied by the mass of the unit cell, across the distance of the unit cell such as $E_p = m_{unitcell} a_d d_a$. It is simply the force (m*a) at distance (d) for the total energy.

However, in the case of the Podkletnov experiment, 30% of the mass of the disk is not superconducting. The bottom layer of 3 mm is not superconducting while the top layer of 7 mm is superconducting. The unit cells in this layer have energy, but since the unit cells do not have protons that are vibrating, it needs to transfer the energy to unit cells that do release the energy. A factor called x_{mass} is created as a dimensionless value that determines the increase of energy for each superconducting unit cell to account for the energy of the non-superconducting unit cells. In this case, it is the following, where 30% is non-superconducting and 70% is superconducting. This leads to an increase of 43% (x_{mass}=1.43) for each superconducting unit cell.

$$x_{mass} = \left(1 + \frac{0.3}{0.7} \right) \qquad \textbf{(4.1.5)}$$

Next, the mass of each unit cell needs to be determined. It is the sum of the atoms in the cell. In the Podkletnov unit cell, there are 2 Ba atoms, 1 Y atom, 18 O atoms and 16 Cu atoms. These become the values for n_{Ba}, n_Y, n_O and n_{Cu} respectively in Eq. 4.1.6. Using atomic mass (u) units, the values for the masses of m_{Ba}, m_Y, m_O and m_{Cu} are

137.328, 88.91, 16 and 63.55 respectively. These values are used in Eq. 4.1.6 and it is found that each unit cell has a mass ($m_{unitcell}$) of 2.77 x 10^{-24} kg.

$$m_{unitcell} = u\left(n_{Ba}m_{Ba} + n_Y m_Y + n_O m_O + n_{Cu}m_{Cu}\right) \tag{4.1.5}$$

Now, the energy transferred to the protons (E_{p4}) in each unit cell can be solved. It is:

$$E_{p4} = x_{mass}m_{unitcell}a_{d4}d_a \tag{4.1.6}$$

In Fig. 4.1.1, the weight loss percentage is plotted for a constant deceleration of 5000 to 3300 RPM in 20 seconds, measured at various rotational speeds, beginning with the point when the disk first starts decelerating at 5000 RPM (shown in blue). At this point in the chart, it is compared to the maximum weight loss percentage witnessed by Podkletnov (orange dot). Since Podkletnov reported results of 1.9% to 2.1%, the average of 2.0% is used for the comparison. He did not report when the measurement was taken during deceleration – only reporting that it was a maximum, so it is assumed to occur shortly after decelerating from 5000 RPM. The vertical axis of Fig. 4.1.1 is weight loss percentage; the horizontal axis is rotations in RPM.

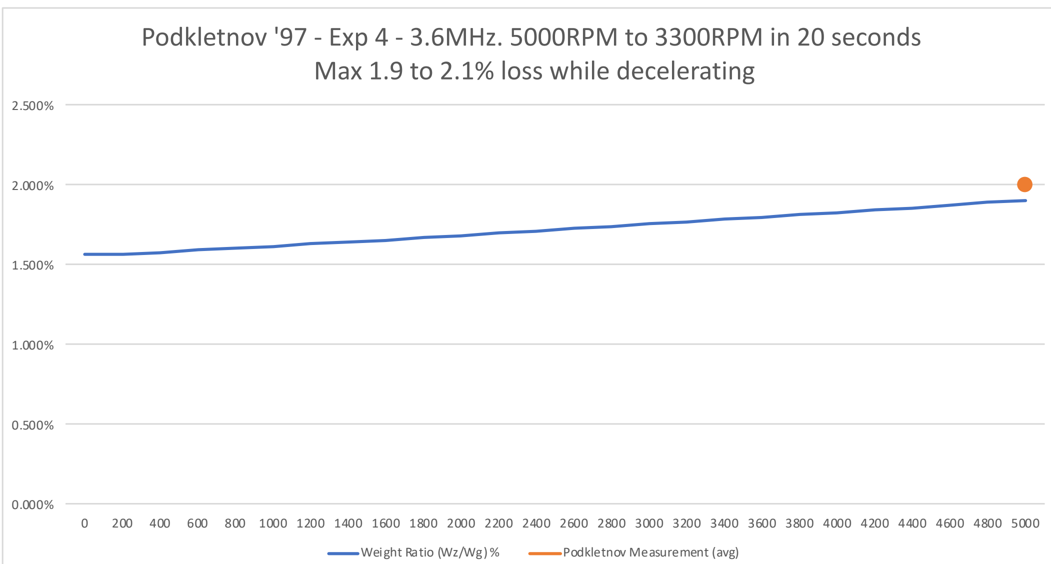


Fig 4.1.1 – Weight loss calculations vs results for rotational rates of Podkletnov '97 Experiment 4

Key Findings:

- A faster acceleration or deceleration of the entire disk, by an external force, causes an energy burst. Without the acceleration, the same disk at 5000 RPM and 3.6 MHz yielded a calculated weight loss percentage of 0.38%. When decelerating the disk with a linear deceleration of 1.224 m/s^2 measured at the edge of the disk, the weight loss percentage increases to 1.9%.

- This method of acceleration or deceleration causes a significant increase in force/weight loss, but it is only in a short burst as the acceleration or deceleration will eventually reach a maximum. In the Podkletnov case, the disk saw extreme vibration at 3300 RPM and was shut down, but even without this vibration, it would have eventually reached 0 RPM and deceleration would cease.

4.2. Podkletnov '01

In 2001, Podkletnov used a different configuration for an experiment that he called the "Impulse Gravity Generator".[6] Once again, he used a YBCO superconductor, given his experience with the material from previous experiments. The main difference in the 2001 experiment is that Podkletnov used a powerful voltage across the superconductor - as high as 2 MV. Positioned horizontally, the impulse device created a short burst force on a pendulum as illustrated in Fig. 4.2.1.

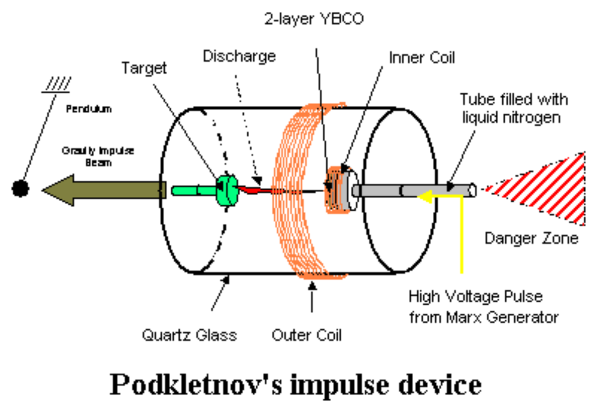


Fig 4.2.1 – Podkletnov 2001 experiment – impulse device

In his 2001 paper, Podkletnov produced results for two superconductors with a height of 4 mm and 8 mm, and voltages ranging from 500 kV to 2 MV. As the results are a force in a horizontal direction, the length and height displacements are measured instead of weight loss, in addition to the calculated energy required to displace the object.

In this experiment (labeled with the subscript "7" in these equations), the energy in the horizontal x axis can obtained by using the power equation, without the time/frequency component. This yields an energy equation such as:

$$E_{x7} = n_c n_e \left(E_{c7} + E_{m7} \left(\frac{E_{c7}}{E_{c7} - E_{g7}} \right) + E_{p7} \right) \quad \textbf{(4.2.1)}$$

There is no indication in the paper of an acceleration or deceleration, so the last term is set to zero (E_{p7}). There is likely a magnetic component, but there is not enough information from the paper to calculate a value, and given the voltage is extreme, the magnetic component may be negligible. It is unclear if this is the case. For the purposes of attempting a calculation, it is assumed to be negligible so that only the current through the superconductor is considered for the energy:

$$E_{x7} = n_c n_e (E_{c7}) \tag{4.2.1}$$

The same method can be used to determine the number of unit cells in the c direction of the superconductor (n_c). For the 4 mm and 8 mm height superconductors, they are 3.43 x 10^6 and 6.87 x 10^6 respectively. For the motion of valence electrons in each unit cell (n_e), it is assumed to be variable since an extremely large voltage may knock additional electrons from their orbitals in a unit cell. This variable was modified to fit the data, as opposed to being directly calculated.

The energy of each electron (E_{c7}) is the following, where F_{volt} is the voltage across the superconductor. See Section 2, where voltage is derived in units to be a force (F).

$$E_{c7} = F_{volt} q \tag{4.2.1}$$

The energy values in the x-axis direction were calculated and plotted against the values provided by Podkletnov for both the 4 mm and 8 mm superconductors and shown below in Figs. 4.2.2 and 4.2.3. The vertical axis is energy (in joules) and the horizontal axis is voltage (V) in these figures. As a reminder, the valence electron variable (n_e) is not derived, since it is unknown. **It is modified to fit the data to illustrate that this approach is possible to calculate Podkletnov's setup.** Further research should be done to calculate valence electrons for each unit cell given various high voltages.

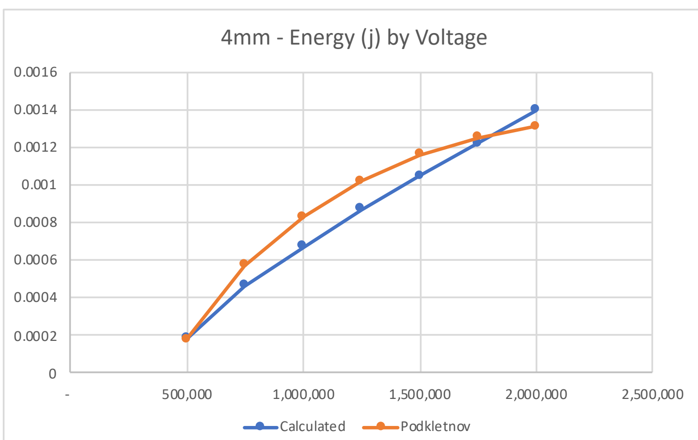


Fig 4.2.2 – Podkletnov 2001 experiment – potential calculations of energy values (4mm superconductor)

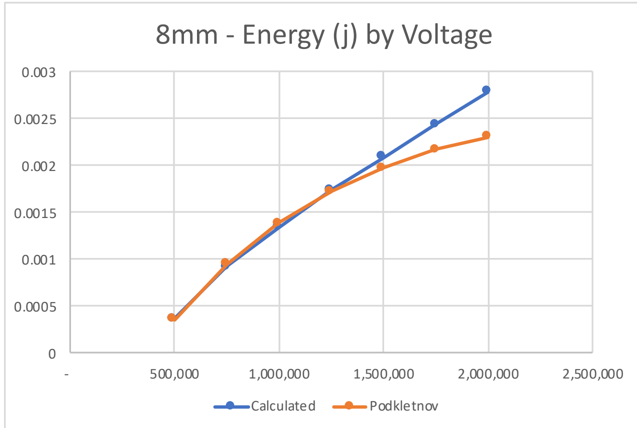


Fig 4.2.3 – Podkletnov 2001 experiment – potential calculations of energy values (8mm superconductor)

Key Findings:

- As expected in the power (energy) equation for superconductors, the energy values of the 8 mm superconductor at each voltage is roughly 2 times greater than the 4 mm superconductor at the same voltage. This is because there are twice as many unit cells in alignment in the c direction of the superconductor, as represented by n_c in the equation.
- The Podkletnov data shows a curve as voltage becomes higher. The assumption is that voltage affects the number of valence electrons, as higher voltage leads to a higher force/energy that knocks electrons from lower orbitals. However, there appears to be a curve such that it is likely harder to knock electrons from position as voltage increases and fewer electrons remain in an ionized atom in a unit cell. This should be studied further to understand the number of valence electrons.

4.3. Tajmar '07

In 2006, Tajmar published his first results of an accelerating superconductor. This experiment is a different configuration than his patent, found in Section 3. In 2007, his team published a second paper with updated results. The experiment consists of a superconductor ring of various materials, although Tajmar found the most success with niobium (Nb) at very low temperatures.[14] Accelerometers were placed above the ring and inside the ring to measure a change in acceleration, in addition to a reference accelerometer as shown in Fig. 4.3.1.

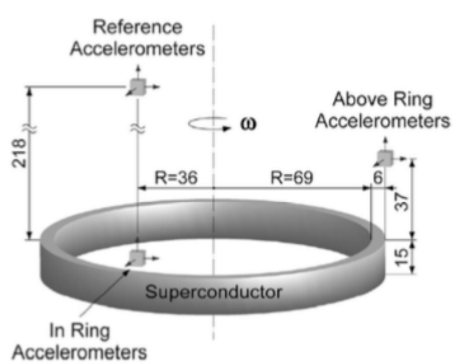


Fig 4.3.1 – Tajmar 2007 experiment – accelerating superconductor

At an acceleration of 1800 radians/s^2, Tajmar measured an acceleration of 2 x 10^{-5} m/s^2. This data, along with the following, is taken from his paper:

- Superconductor height of 15 mm (derived an n_c value of 5.10 x 10^7 based on Nb properties)
- Ring radius of 75 mm to outer edge
- Angular acceleration of 1800 radians/s^2 (at edge, linear acceleration a_t is 1800 * .075 = 135 m/s^2)
- Measurements taken at angular velocity of 350 m/s (at edge, linear velocity v is 26.25 m/s)
- The frequency of the sine wave according to accelerometer data is roughly 1 cycle per second (derived an f value of 1 Hz, and therefore an f_c value of 2 Hz)
- Nb has a density of 8.57 grams per cubic cm (derived an $m_{unitcell}$ value of 2.18 x 10^{-25} kg)
- Nb unit cell distance is calculated based on 2 atoms separated by sharing single molecular bond at 147 pm (derived d_a value of the unit cell at 2.94 x 10^{-10} m).[16]

The following are unknown and are assumptions to determine the number valence electrons per unit cell in Nb:

- The magnetic field is assumed to be Earth's magnetic field at Tajmar's location (B=5 x 10^{-5} Tesla is used).
- Estimated 4 atoms in a crystal structure contributing valence electrons (just like YBCO)
- Estimated 6 valence electrons per Nb atom (the derived value of n_e is therefore 4 * 6 = 24).

The power equation using subscript "6" for the sixth experiment is:

$$P_{z6} = n_{c6} n_{e6} \left(E_{c6} + E_{m6} \left(\frac{E_{c6}}{E_{c6} - E_{g6}} \right) + E_{p6} \right) f_{c6} \qquad \textbf{(4.3.1)}$$

It is assumed there is no external energy for acceleration, so E_{p6} is set to zero. There is no reported data for a height increase of the superconductor, but it is likely negligible due to only using Earth's magnetic field so E_{g6} is set to zero. The remaining variables in the equation are the energy values:

$$E_{c6} = m_{unitcell6} a_t d_{a6} \qquad \textbf{(4.3.2)}$$

$$E_{m6} = \frac{1}{2} q v_6 B_5 d_{a6} \qquad \textbf{(4.3.3)}$$

When assuming the measurements are taken at an angular velocity of 350 m/s (per Tajmar's paper), the power equation is solved and then converted to acceleration using the same methods found in Section 2 and applied elsewhere in this paper. The result is an acceleration of 2.09 x 10^{-5} m/s^2.

The calculations using the power equation show that the measurements in the above-ring accelerometer would be placed near the edge to get the maximum acceleration, and further, that the acceleration varies according to when the measurement is taken as the ring accelerates. Only the angular velocity of 350 m/s matches Tajmar's result for the above-ring accelerometer. The following illustrates this relationship of the calculated acceleration versus angular velocity, when there is a constant acceleration of 1800 m/s^2. In Fig. 4.3.2, the vertical axis is acceleration (m/s^2) and the horizontal axis is angular velocity (radians per second).

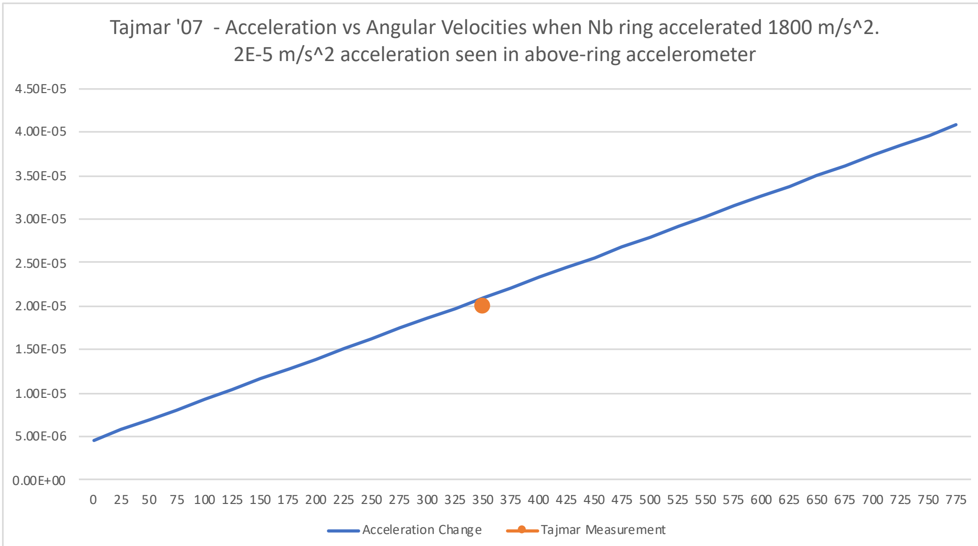


Fig 4.3.2 – Tajmar 2007 experiment – acceleration calculations at various angular velocities when constant acceleration of 1800 m/s^2 applied to Nb superconducting ring

Key Findings:

- A key assumption was used to fit the data. The valence electron count for an Nb unit cell is unknown and was assumed to be 6 valence electrons for 4 atoms in a unit cell, for 24 total. It should be further explored to understand the valence electron count for Nb.
- The equation shows that the acceleration measured in the accelerometers should increase proportional to the angular velocity of the spinning superconductor ring, even with a constant acceleration of the ring.

5. Building a New Prototype

This section includes instructions for building a generic motion control system prototype. The first part (5.1) includes details for the patent application. The second part (5.2) includes a simpler version that will be the first set of tests to prove the concept. It is therefore a subset of the patent application such that subsystems of the motion control system can be built in sequence, expediting the time to prove aspects of the design and control the costs to match funding.

Important: Some of the notation for equations in this section differ from previous sections. This was done to simplify some of the equations for the general public in the patent application. Notably, the input frequency (f) is simplified to match the measured AC frequency. The structure of the equations and their calculations remain the same.

5.1. Patent Application

The following describes the main requirements and schematics that will be submitted in the patent application. The main components of the system are labeled by number in the schematics. The components are:

1. Cryogenic coolant
2. Cryogenic system housing
3. Lattice material
4. AC power supply
5. Location sensor
6. Programmable controller
7. DC power supply
8. Electromagnetic coil array
9. DC motor
10. External object
11. Conductors (contact or contactless)
12. DC voltage controller
13. Force lines

The core of the system is a lattice material (3), such as the superconductor YBCO. Superconductivity is preferred to maximize energy transfer, so the lattice material is contained within a cryogenic housing unit (2) where it can be cooled by a coolant (1) to maintain superconductivity. Within such housing is a motor (9) to spin the disk at a programmable rotation, and an array of electromagnetic coils (8) that may be individually programmed (6) to create different magnetic fields for each coil. This is managed by voltage controllers (12), supplied by a DC power supply (7), which may be housed external to the cryogenic housing unit. An AC power supply (4) is connected to the lattice material with contact brushes or contactless magnetic field (11) to create a current in the lattice material. This creates a force on a external object (10). By programming and controlling the rotation of the lattice material, its AC current and the magnetic field from the coils, the external object can be controlled. A location sensor (5) provides real-time location feedback to the programmable control to position the object. This is illustrated in the next two figures.

Side View

Not all electromagnetic coils shown

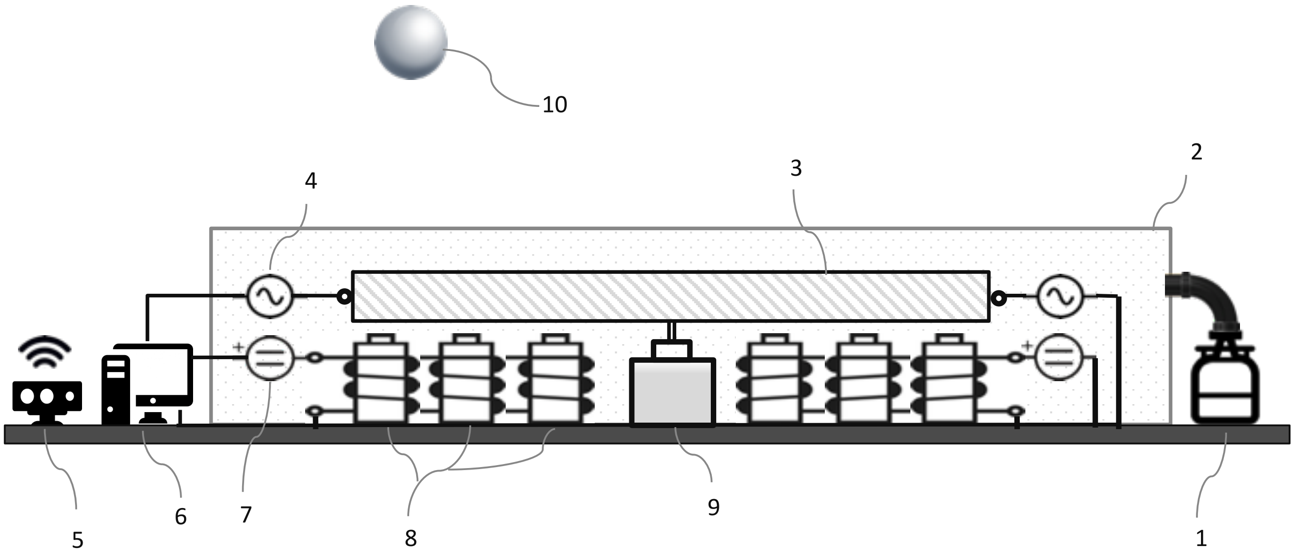


Fig 5.1.1 – Side View of Motion Control System (*not all electromagnetic coils (8) shown*)

Top View

Electromagnetic coils and test subject not shown

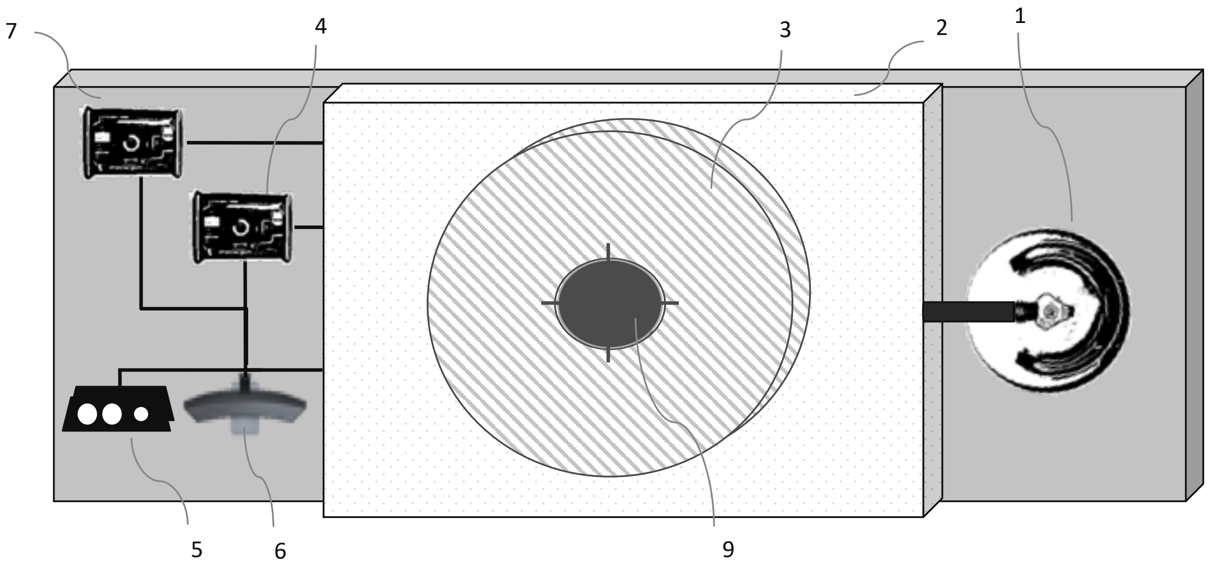


Fig 5.1.2 – Top View of Motion Control System (*electromagnetic coils and generator not shown*)

Four subsystems are described in further detail. The power generated in the motion control system follows the conservation of energy, and when under superconductivity conditions, the energy can be transferred efficiently to proton vibration without waste. These mechanisms are described with equations and how to optimize the subsystems for maximum energy transfer.

In the equations, the following constants and variables are used. A unit cell refers to the repeating structure within the lattice material.

- c – speed of light
- g – surface gravity of Earth
- m_e – electron mass
- m_p – proton mass
- m_u – unit cell mass
- d_a – distance of the unit cell in the a-axis
- n_c – number of unit cells aligned in the c-axis
- n_e – number of valence electrons per unit cell
- f – frequency of AC current
- f_c – effective frequency of proton vibration in the c-axis
- h – displacement height of lattice material
- q – single electron charge (elementary charge)
- B – magnetic field measured at a unit cell
- v – linear velocity of a unit cell in a rotating lattice material
- a – linear acceleration of a unit cell in a rotating lattice material
- a_z – acceleration of external object in a fixed z-axis (perpendicular to Earth's surface)
- P_z – power generated in the fixed z-axis (perpendicular to Earth's surface)

AC Circuit - E_c

The AC circuit generates the flow of electrons in the lattice material, causing proton vibration. It is important to reduce resistance and energy waste and so superconductivity is preferred. It is also important to achieve the resonant frequency, otherwise energy is wasted. The resonant frequency is dependent on voltage/current and superconductor material, so it needs to be calculated.

The programmable controller manages the voltage and frequency of the AC circuit to maintain resonant frequency. The higher the resonant frequency, the more energy is created. Thus, a high-voltage power supply is recommended.

The electrical energy of this system for a single electron-proton interaction is described in the equations as E_c.

AC Circuit Subsystem

AC power supply and lattice material

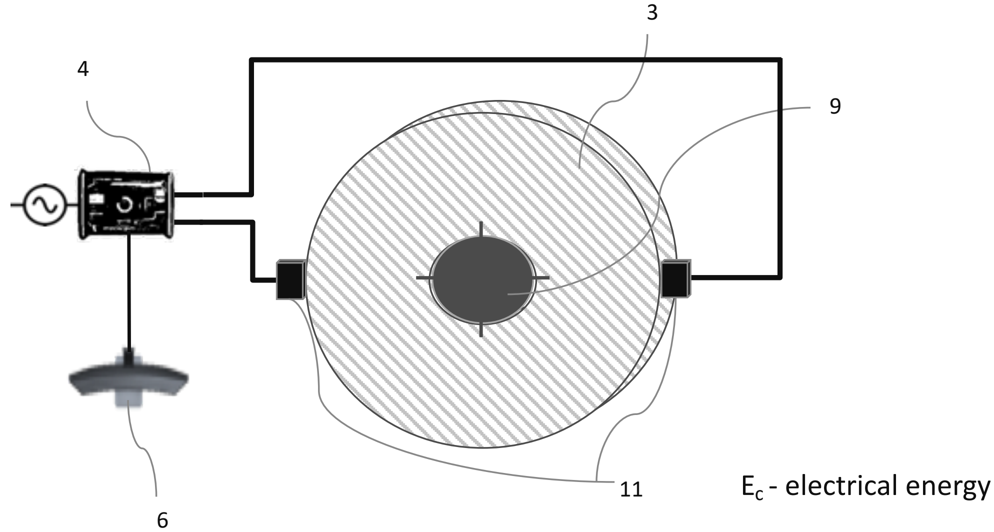


Fig 5.1.3 – AC Circuit Subsystem

The equation for the electrical energy of an electron in this subsystem is described by the following, where f is the input AC frequency. The impact of the resonant frequency will be described later in the final equation.

$$E_c = 32m_e(fd_a)^2 \tag{5.1.1}$$

DC Circuit – E_m

The DC circuit manages the magnetic field experienced by the lattice material, generated by electromagnetic coils. For granular control of the external object, multiple electromagnetic coils are used and individually controlled by managing the voltage through each coil. This affects the magnetic field experienced by electrons in each unit cell, increasing or decreasing energy.

Fig. 5.1.4 illustrates a potential array of electromagnetic coils. Any number of coils may be placed into configuration, with additional coils allowing more granular control of an external object. However, each additional coil increases cost and complexity. For purpose of illustration, not all coils are shown connected to a voltage controller and power supply, but is assumed that they are connected in the prototype.

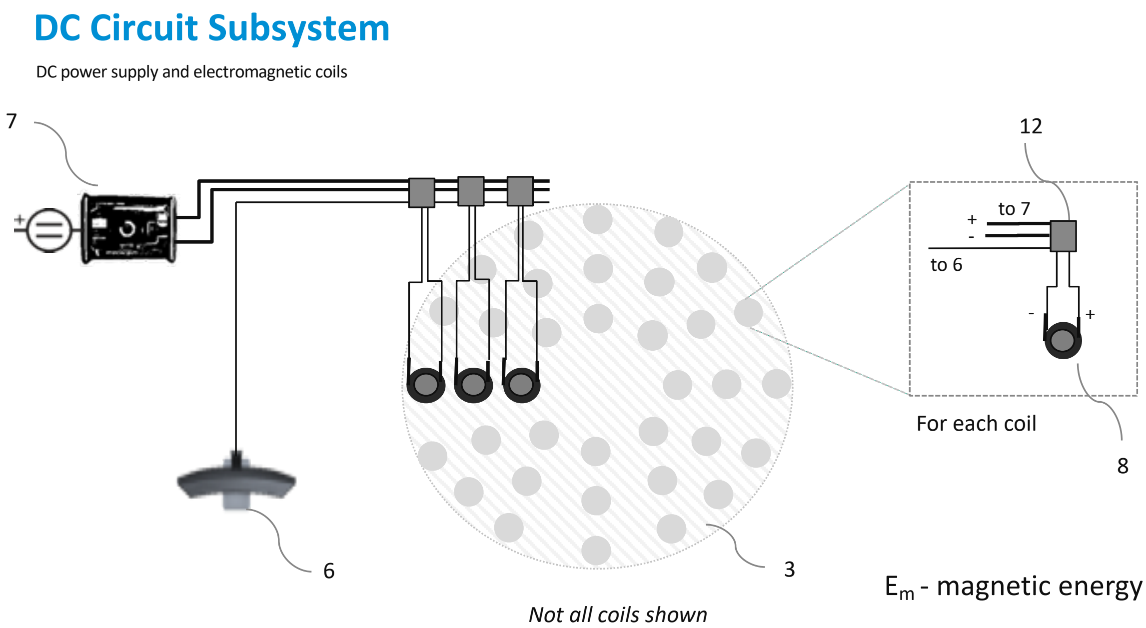


Fig 5.1.4 – DC Circuit Subsystem

The equation for the magnetic energy of an electron in this subsystem is described by the following.

$$E_m = \frac{1}{2} q v B d_a \tag{5.1.2}$$

If the lattice material rises from its natural position due to the magnetic field, there is a balance between the gravitational force and the magnetic force. The gravitational force needs to be considered based on the height (h) that the superconductor is displaced from its natural position. In these equations, g is negative ($-9.807\ m/s^2$).

$$E_g = m_p g h \tag{5.1.3}$$

DC Motor – E_p

The DC motor controls the rotation of the lattice material, providing additional energy to unit cells due to the acceleration of a mass. The equations model linear velocity and acceleration, which means that a faster rotation increases energy, but unit cell distance from the center of rotation also affects energy. A larger radius therefore increases energy if the external object is measured at the radius/edge.

A lattice material in a magnetic field is typically forced away from the field source, and in some cases, may start spinning as a natural reaction of particles to balance forces. The DC motor provides a secondary benefit by "holding" the lattice material closer to the magnetic field and not allowing it to rise to balance forces. This allows more magnetic field energy to penetrate unit cells.

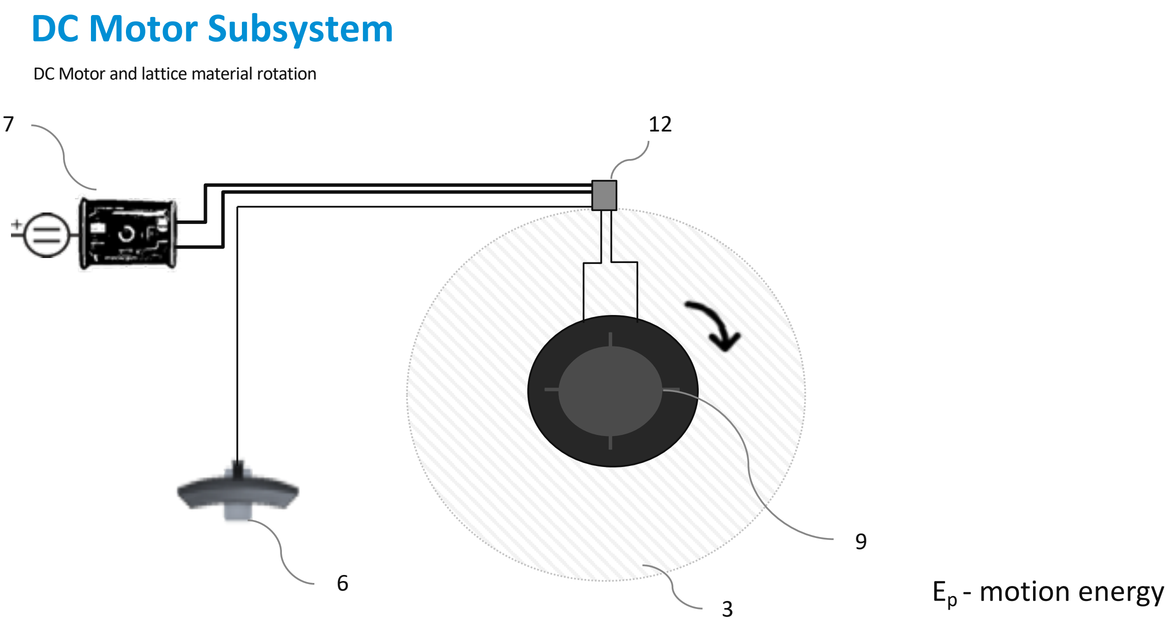


Fig 5.1.5 – DC Motor Subsystem

The equation for motion energy for each unit cell is the mass of the unit cell, linear acceleration and the distance of the unit cell in the direction of travel.

$$E_p = m_u a d_a \tag{5.1.4}$$

Location Control

The location sensor is used to monitor the location of the external object and relay its x-y-z coordinates to the programmable controller. Initially, it requires calibration based on the placement of all components in the system. The sensor provides real-time feedback as the test subject moves such that the programmable controller can manage the AC Circuit, DC Circuit and DC Motor subsystems to control the motion of the test subject. This subsystem is based on software algorithms, applying equations from the other subsystems.

Location Sensor Subsystem

Location Sensor and Programmable Controller

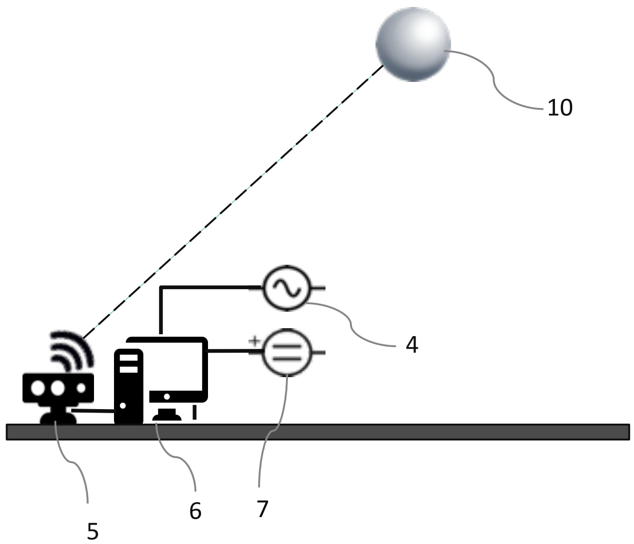


Fig 5.1.6 – Location Control Subsystem

Lattice Material Properties

A material with a lattice structure allows electrons to travel freely, but this structure is also known to allow the vibration of protons. A Cooper pair of electrons causes an attraction of protons, which then return to their original position. In a lattice material unit cell, a greater number of valence electrons will cause a greater number of protons to vibrate, or a single proton vibrates more frequently. Thus, a higher number of valence electrons per unit cell is preferred in a material.

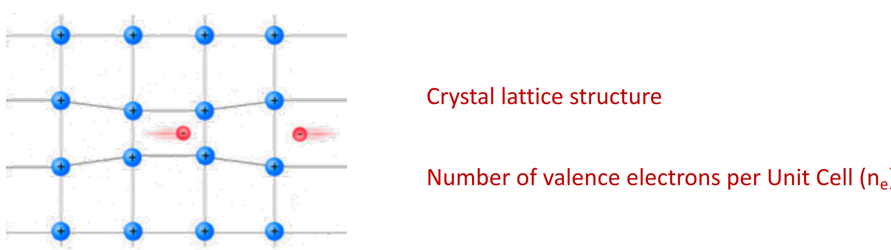


Fig 5.1.7 – Electron Cooper Pair and Proton Vibration in Lattice[17]

A material at superconductivity temperatures is important to achieve the greatest energy transfer. At low temperatures, superconducting materials have zero to little resistance. Electrons are not colliding with other particles in their path and are free to travel. If electrons flow through the a-axis or b-axis plane of a unit cell (using lattice parameters), then it may cause the motion of protons in the c-axis of the unit cell. A unit cell is shown in Fig. 5.1.8.

In a lattice structure, protons may align in the c-axis. Therefore, a lattice material with a greater thickness (c-axis direction) is preferred because it will generate more energy in the direction of force.

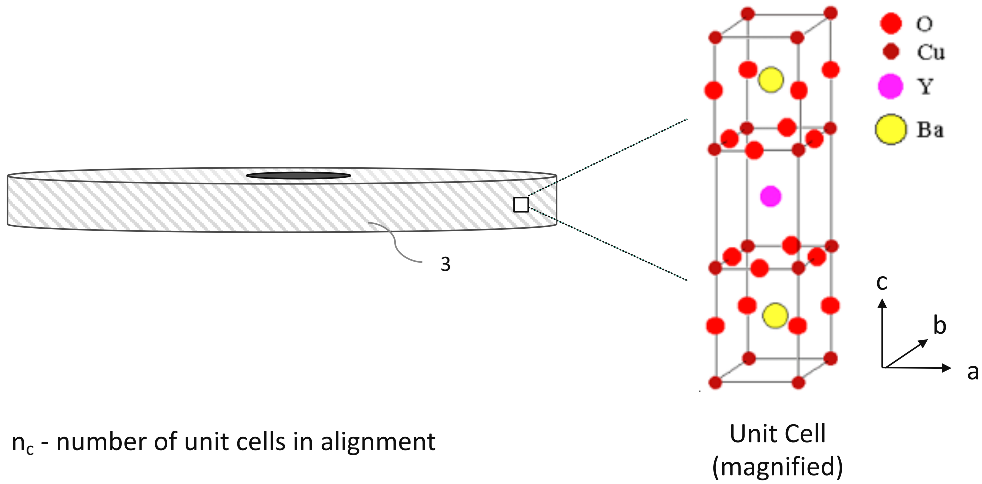


Fig 5.1.8 – Lattice Material and Unit Cell (YBCO example)

Many experiments do not recognize that a resonant frequency is required for the optimal energy transfer. An electron that stops short of the next unit cell distance (a-axis) or too far beyond, is wasting energy. The ideal distance achieved before returning in an alternating frequency is the unit cell distance – d_a. This is illustrated in Fig. 5.1.9.

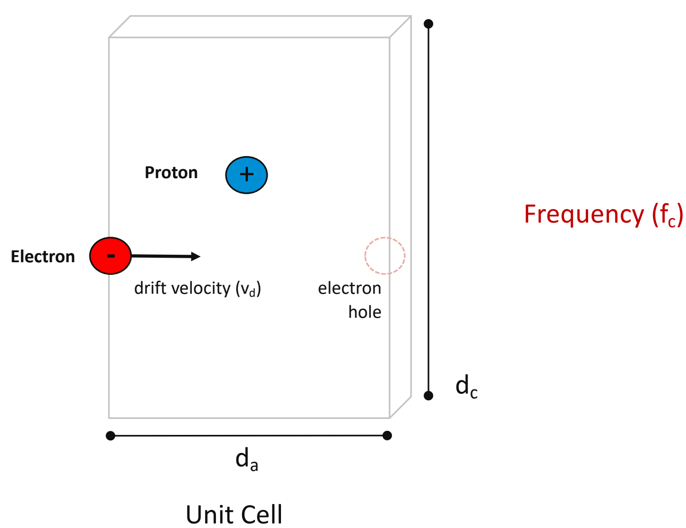


Fig 5.1.9 – Electron Frequency in Unit Cell

The resonant frequency is required to understand the proton's effective frequency of vibration. It will cycle two times for every cycle of the electron (it goes up-down each time the electron crosses the unit cell as it is attracted and then repelled). The resonant frequency (f_0) is based on the electron drift velocity (v_d) and distance of the unit cell (d_a). The voltage affects current, so the velocity needs to be calculated based on the voltage and known material properties of the unit cell before resonant frequency can be calculated. This is expressed in Eq. 5.1.5.

When the resonant frequency is known, and the AC input frequency (f) is known, the effective frequency of the proton's vibration (f_c) can be calculated. This is expressed in Eq. 5.1.6.

$$f_0 = \frac{v_d}{2d_a} \tag{5.1.5}$$

$$f_c = \frac{2f_0^5}{f^4 - f^2 f_0^2 + f_0^4} \tag{5.1.6}$$

The final equation for the power generated in the fixed z-axis (perpendicular to Earth's surface) considers gravitational effects. Therefore, the angle of the lattice material's c-axis needs to be considered relative to the z-axis. This angle is illustrated in Fig. 5.1.10. For optimal power generation, these axes should be aligned.

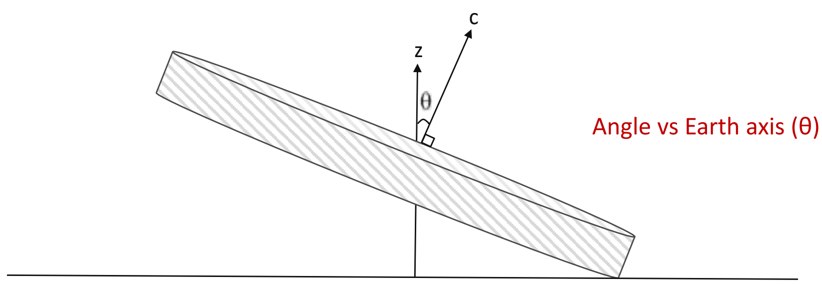


Fig 5.1.10 – Lattice Material c-axis Angle vs Earth's z-axis

The final power equation is shown in Eq. 5.1.7. Maximizing the energy (E) of each subsystem is important, but equally important is the selection of the lattice material for its valence electron properties and thickness (n_e and n_c). Finally, the angle and frequency (determined by input frequency and resonant frequency) may diminish power, so it is recommended to operate at the calculated resonant frequency and align the lattice material with the z-axis.

$$P_z = n_c n_e \left(E_c + E_m \left(\frac{E_c}{E_c - E_g} \right) + E_p \right) f_c \cos(\theta) \tag{5.1.7}$$

The experiment measures a force, based on acceleration. Thus, the final calculation is based on the net acceleration above the unit cell in which distance is calculated, in Eq. 5.1.8. The expected acceleration when conducted at Earth's surface, where surface gravity is -9.807 m/s^2, is expressed as a_z, where a negative value accelerates towards Earth and a positive value accelerates away from Earth.

$$a_z = g + \frac{P_z}{10 m_p c} \tag{5.1.8}$$

A summary of prototype component selection, experiment design and placement of the external object for greatest energy output:

1. Lattice material thickness in c-axis direction should be largest possible.
2. Lattice material material with the greatest number of valence electrons possible per unit cell.
3. Largest possible voltage for AC power supply to lattice material. Frequency will be optimized based on voltage.
4. Largest possible voltage for the DC power supply to electromagnet coils.
5. Lattice material as close to electromagnet coils as possible without being allowed to rise.
6. Lattice material allowed to rotate as fast as possible.
7. Measurements of external object placed above the edge (radius) of the lattice material, but within its influence in the c-axis.

5.2. Prototype Construction Steps

To efficiently build and test the prototype, it can be done in steps, minimizing the funding requirements until a previous step has been validated.

Test #1

In the first test, a lattice material (preferably superconductor) can be exposed to an alternating current and a magnetic field with household products to generate the current and field. The power generated will be minimal, so it is proposed to validate the influence of a vapor, such as smoke. It should rise when the test is conducted. All other conditions that could cause the smoke to rise should be ruled out first.

The lattice material should have the maximum thickness possible for a commercially available product. YBCO should be used so that liquid nitrogen can be the coolant.

The highest voltage should be used and the electron drift velocity calculated. Then, resonant frequency can be calculated. The test should operate at the calculated resonant frequency, but allow for adjustments to find the actual material resonant frequency.

Success criteria: Smoke is proven to rise only under the influence of the test (all other factors excluded).

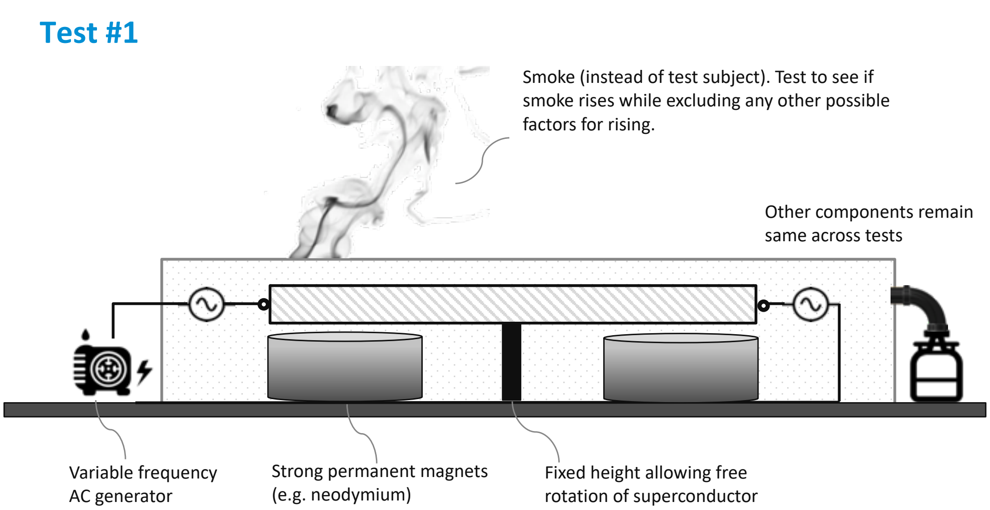


Fig 5.2.1 – Test #1 – Smoke Test

Test #2

If the first test meets the success criteria, then smoke is replaced with an actual external object. A small, non-magnetic object with mass (less than 100 grams) should be placed in an apparatus that allows accurate measurement, by suspending it with a material that is non-magnetic (e.g. cotton thread). The external object should be placed near the edge of the lattice material.

The test is run again, testing various frequencies to ensure that it is operating at or near the resonance frequency. The external object should be measured for weight loss.

Success criteria: External object is proven to show weight loss (e.g. greater than 0.1% weight loss).

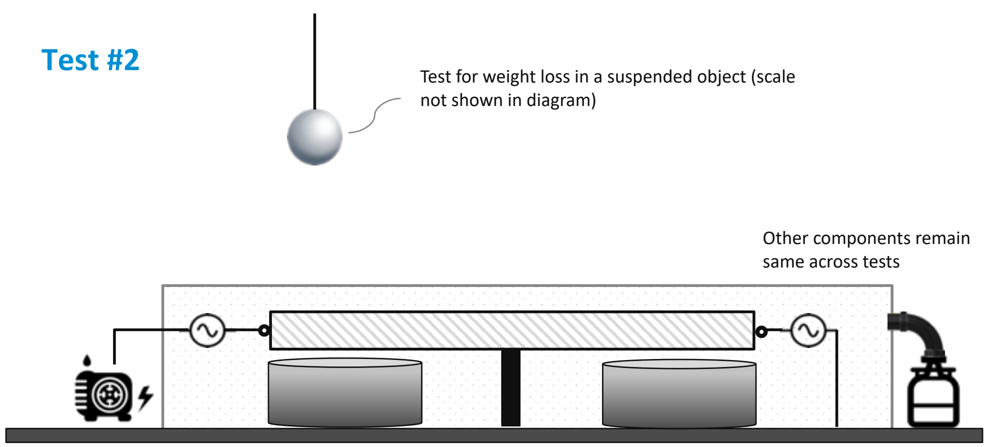


Fig 5.2.2 – Test #2 – Weight loss test

Test #3

If test #2 is successful, the components of each subsystem will be upgraded to generate a larger force. A DC motor is added to control the spin of the lattice material. Electromagnetic coils are added to control the magnetic field. The AC and DC power supplies are upgraded to high-voltage products. If necessary, a new lattice material may be added, especially a thicker, superconducting lattice material built to specification. The latter may be initially avoided to reduce costs if the other subsystems show substantial improvement in weight loss.

The test should use the test subject from Test #2 and check for an increase in weight loss at the maximum possible energy for each subsystem (AC voltage, magnetic field and rotation). Once the maximum weight loss is achieved in an external object, a lighter object may replace it until the force creates a levitation effect on the external object.

At this point, the first motion control test can be performed by manually reducing the voltage on one of the subsystems (e.g. reduce the magnetic field). The object should experience a gravitational force again (weight loss), instead of suspension.

Success criteria: A lightweight external object is proven to levitate (zero net acceleration).

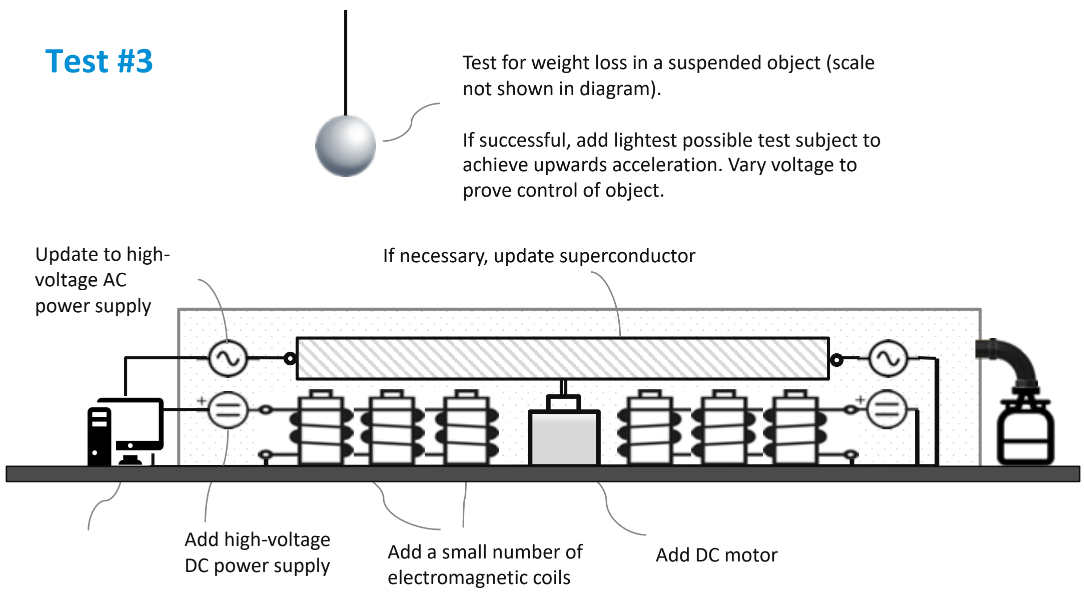


Fig 5.2.3 – Test #3 – Levitation Test

Test #4

Once levitation is proven (test #3), the location sensor can be added to the system. The code algorithm for determining location and managing the voltage of the subsystems is also added. The first test of programmatic motion control can be executed by giving instructions to cause the test subject to move vertically, up or down, based on the location information provided by the sensor and the voltage modified by the controller.

Success criteria: An external object is proven to move to a precise location based on programmatic voltage control of the subsystems.

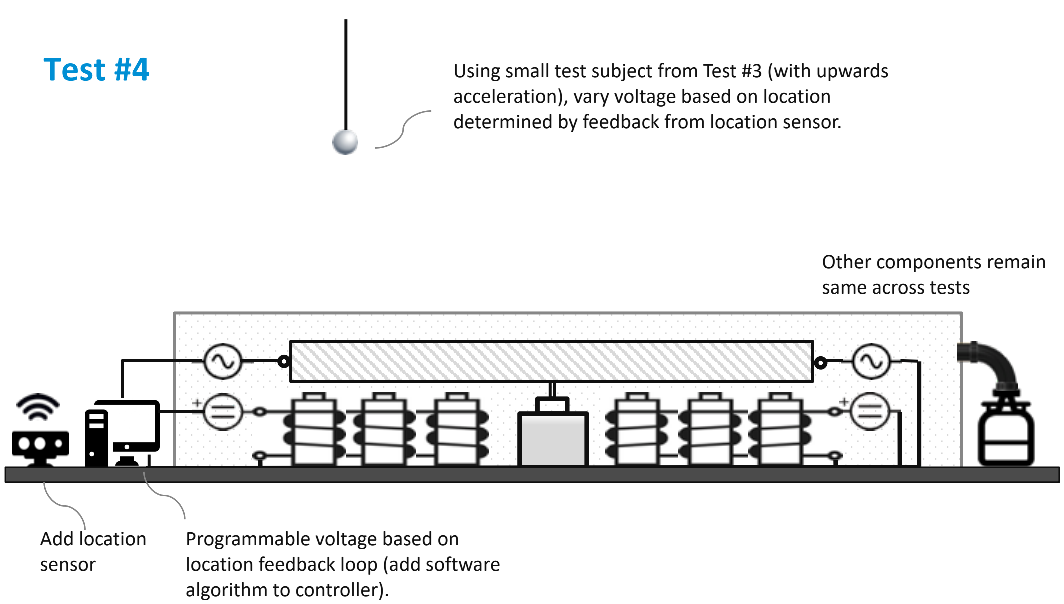


Fig 5.2.2 – Test #4 – Programmable Motion Control Test

That's it. If test #4 is successful, it's time to go celebrate because a method to control gravity has been proven!

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