Subtle influences on a single electron's spin

Thorsten Ludwig[1], Markus Fromm[1], Ronald Bryan[2]

[1] *Institute for Applied Conciousness Research (IACR), Ring 60, 15754 Kolberg, Germany*
[2] *Professor Emeritus, Texas A&M University, College Station, Texas, U. S. A.*

Abstract

In order to measure intentional influence on a single electron's spin, an ion trap and a sophisticated laser beam is being set up. The aim of this work is to hold a small number of magnesium ions in an ion trap and to see if subtle fields or mental intention can provide the 0.8 μeV needed to flip the spin of the single valence electron in the ground state. In this paper we report on the progress of the experimental setup and the scope of the experiment. The ion trap is built in the linear Paul-trap design. A tuned high frequency voltage is applied to four parallel stainless steel rods which are in 3 sections. The outer sections are used to create the ions. Magnesium atoms from an oven are crossed with an electron beam to produce ions by electron impact ionization. A tank circuit was built to apply up to 500 AC volts to the rods of the ion trap. The operation frequency is 6 MHz. In order to detect the spin flip and to cool the ions, a laser beam will be guided through the center of the trap parallel to the rods. The laser will be tuned to 279.6 nm to cause the magnesium ions to fluoresce. The ions will be excited by the laser photons from the $3s_{1/2}$ ground state to the $3p_{3/2}$ state. An external magnetic field of 5 to 10 mT is applied to the center of the ion trap by a pair of Helmholtz coils. The laser beam will have a bandwidth of 1 MHz at 279.6 nm. If the spin of the magnesium ion's valence electron is flipped, then the fluorescence will cease. The aim is to cause five magnesium ions to fluoresce for 12 hours. For this an ultra high vacuum is needed. The intent of the experiment is to then apply subtle fields and/or mental intention to the ions to probe if these effects will flip the spin of the electron. The build up of the experiment is well on its way. The ion trap and the tank circuit were completed. The vacuum chamber has been assembled and ultra high vacuum has been achieved. As soon as the setup is completed we will begin with the experiments where volunteers try to flip the spin. There will be many practical applications.

PACS: 41.20.Gz, 75.25.-j, 75.30, 75.80, 88.90.+t
Keywords: Electron spin, ion trap, linear Paul trap, magnesium, ion, magnetic moment, intention

---

1. Introduction

An electron has a magnetic moment which lines up in a magnetic field. Quantum mechanics also permits the electron's magnetic moment to line up in the opposite direction. No other states are allowed. In the experiment, a volunteer tries by conscious intent to reverse the direction in which the electron's magnetic moment is pointing, as sketched in fig. 1. (The M-field in the figure could represent Monroe’s M-field [1], Sheldrake’s morphic field [2], qi-gong, etc.) We can observe the spin direction by taking the electron to be the single valence electron of a once-ionized magnesium 24 ion immersed in a 5 to 10 mT magnetic field. A precisely tuned laser beam causes the ion to fluoresce in the ultra-violet (UV), indeed so brightly that if one could see in the UV, then one could see this single ion with the naked eye. Instead it is seen with a UV CCD camera. If a volunteer is able by mental intent or subtle energy to reverse the direction in which the magnetic moment is pointing, then the magnesium ion becomes dark. (This requires less than 1/5,000,000 the energy of a single blue photon, yet the electron's spin is extremely stable. Even a slammed door won't reverse the orientation of the spin.)

Mg is chosen because its ion can be held in a Paul ion trap, and its single valence electron has a simple spectrum of energy levels. A circularly polarized dye laser beam is directed to the ion and tuned to cause LIF (laser induced fluorescence) between the $3s_{1/2,\,-1/2}$ and $3p_{3/2,\,-3/2}$ levels, as illustrated in fig. 2. In this phenomenon, the valence electron absorbs a laser photon and jumps up to the upper level, then quickly emits a photon in an arbitrary direction and returns to the lower state. This can happen 10 million times per sec or more.

The electron’s intrinsic spin remains fixed in direction throughout. However if its spin is reversed (flipped) by some means, then resonance is lost and LIF ceases. If the electron’s spin is flipped once more, then LIF resumes.

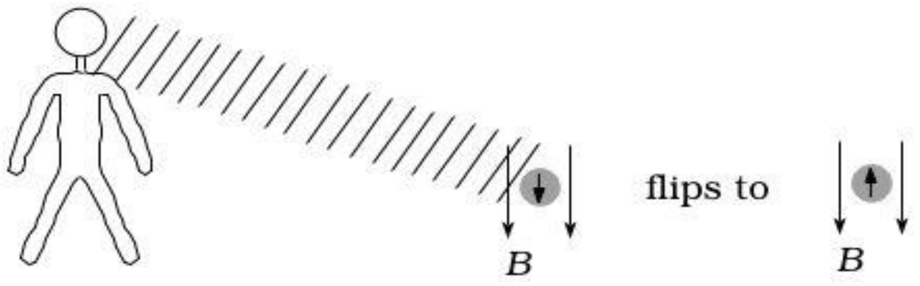

Figure 1. Human consciousness reversing the spin of an electron in a magnetic field B by means of a conjectured M-field.

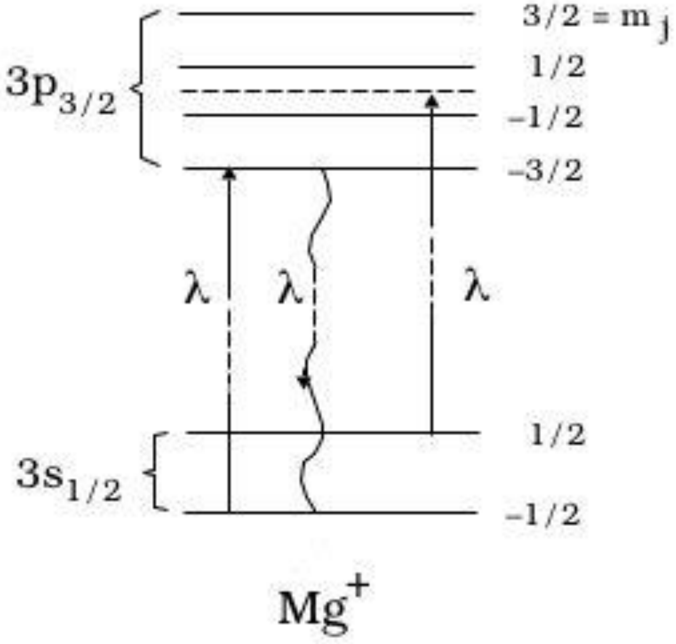

Figure 2. Relevant energy spectrum of the valence electron of Mg^+ immersed in a weak magnetic field. (The increase in energy from the $3s_{1/2}$ to the $3p_{3/2}$ levels is several orders of magnitude greater than it appears in the sketch.) A 279.6 nm laser photon excites the valence electron from the lower $3s_{1/2}$ state to the lowest $3p_{3/2}$ state. The electron de-excites (wavy line) with the emission of a photon of the same frequency. If electron is initially in the upper $3s_{1/2}$ state, then it cannot absorb the laser photon as this would put it at an energy (dashed line) where no state exists.

Nomenclature

Mg	Magnesium
UV	Ultra violet
CCD	Charged coupled device
LIF	Laser induced fluorescence
T	Transmission at the input coupler
R	cavity losses in the frequency doubling
I_a I_b	Intensity on the photo diodes
δ	Phase of the light coupled into the frequency doubling cavity

2. Building the ion trap

The ion trap was built in a linear Paul trap design. The trap consists of 3 sections of 4 stainless steel rods with 6 mm diameter and 30 mm length. Macor plates hold the rods in place. 6 mm threaded bars clamp the Macor plates and the rods together. The whole ion trap assembly is mounted with 8 mm threaded rods to a 150 mm CF flange. In order to make magnesium ions in the outer sections of the trap, 2 electron sources and 2 magnesium ovens are mounted to the 8 mm rods.

The magnesium ovens, as seen in figure 3 center left and right, are made out of tantalum pipe with a 1 mm bore. Inside the pipe is magnesium wire. The magnesium oxide layer is removed by 10 min treatment with citric acid. Macor plates and 4 mm stainless steel threaded rods hold the pipes in place. Tungsten wire with 0.2 mm diameter is wound around the pipes. Currents of 4 to 8 Amps heat up the magnesium oven and produce a magnesium atom beam. This beam is crossed with an electron beam in order to ionize the magnesium atoms by impact ionization.

The electron sources are mounted on top of the trap, as seen in figure 3, left and right top. One electron source was built in 2001 and is described in the Master's thesis of T. Ludwig. Both electron sources use Philips style AGRA filaments. The acceleration voltage is 300 V.

The tank circuit is very similar to the one described in [3]. The circuit consists of 5 coils made of silver coated copper wire wound on Teflon cores. The main capacitor is a vacuum capacitor to increase the quality of the circuit. The Paul trap requires some 300 AC volts on the rods. The resonance frequency is 6 megahertz. The tank circuit allows to apply a DC offset to the different sections of the trap and to inject a secondary radio frequency (rf) into the middle section. The secondary rf permits destabilization of specific ions in order to kick them out of the trap. This feature is used to scan the contents of the trap as well as to deliberately remove certain ion species in order to have only Mg_{24} in the trap.

The ion in the Paul trap has to be placed in a vacuum chamber that is evacuated to a ultra high vacuum. Four different stages of vacuum pumps are needed to provide a 10^{-12} mbar ultra high vacuum.

A scroll pump is used as a roughing pump, followed by a Pfeiffer TPU 330 turbo molecular pump. Vacuum valves permit isolating the scroll pump from the turbo pump as well as the main chamber from the first two vacuum pumps. The main chamber is equipped with the Duniway V60D Varian style ion pump and a Duniway TSP-275-003 titanium sublimation pump (TSP). The main chamber can be sealed off with the vacuum valve allowing us to pump the main chamber with only the ion and TSP pumps. The TSP is run with 38 Amps for 2 minutes every 8 hours.

The vacuum pressure can be measured with 3 different sensors that allow us to measure the pressure from atmospheric pressure down to 10^{-12} mbar. A MVC-3 BM vacuum gauge controller from VACOM is used to read out all sensors. To measure ultra high vacuum up to 10^{-10} mbar a Bayard-Alpert gauge BARION XHV is used. The other sensors are an active combination gauge PENNINGVAC PTR 90 and a THERMOVAC PTR 91, an active Pirani gauge.

To reach ultra high vacuum the whole vacuum chamber has to be baked out. After our first bake out of only 60 °C due to a delayed delivery of additional heaters, we still reached a vacuum of $2x10^{-10}$ mbar. Our next bake out temperature will be 150 °C. We plan to install an all-metal vacuum valve that will permit bake out temperatures of over 200°C. The temperature is ramped up slowly at not more 1 deg per hour. During the bake out time, the vacuum chamber is insulated with high temperature rock wool.

In order to detect ions that leave the trap, a secondary electron multiplier (SEM) from Hamamatsu is installed facing the middle section. The SEM voltage is 3 kV. The output is amplified and a SRS 410 dual photon counter is used to convert the signal into a count rate.

A LabView program displays the count rate and controls the frequency generators and the power supplies.

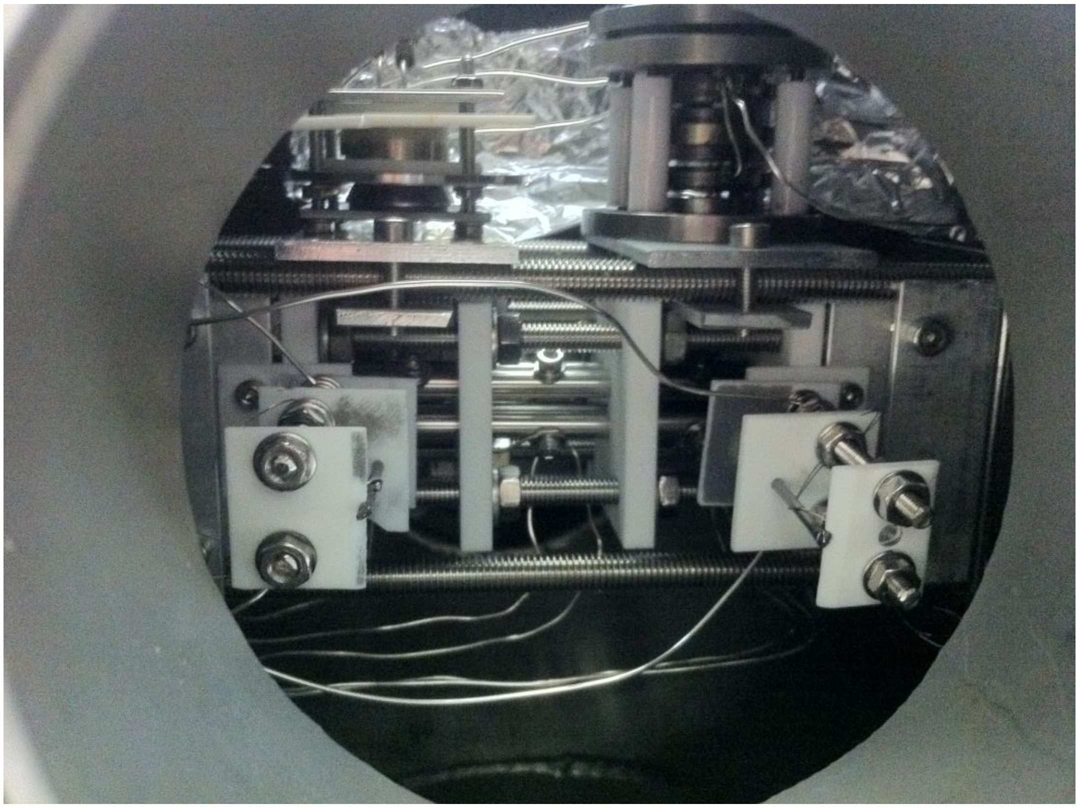

Figure 3. Ion trap in vacuum chamber

The external magnetic field is produced by a pair of Helmholtz coils mounted outside the vacuum chamber. The coils have each a resistance of 30 Ohms. Currently a 60 Volt power supply is used. With this power supply a maximum magnetic field of 6.5 mT can be reached.

3. The laser system

For the laser cooling and detection of the Mg^+-Ions we use the dipole-transition from $3s_{1/2}$ to $3p_{3/2}$ with a natural linewidth of 43 MHz [3]. To excite this transition, UV-photons with a wavelength of λ=279,635 nm are used.

Lenses guide the light from the shining ion to a charge-coupled device (CCD) camera that enables the computer to show individual ions on its monitor.

Our planned laser-setup is shown in fig. 4. An Argon-Ion-laser (Coherent Innova 200) with a power of 12 W @ λ=514 nm will be used for optical pumping of a cw dye laser (Coherent CR 699-21). The emitted light from the dye laser will be frequency doubled in an external cavity. We decided on a Bow-Tie-Resonator geometry with a 10 cm long non-linear crystal. As material for the crystal we choose Beta-Bariumborat (BBO), which works best at this particular wavelength.
To minimize cavity losses, all mirrors are highly reflecting, the input coupler is impedance matched and the transversal mode-matching is maximized.

To stabilize the resonator we choose a Hänsch-Couillaud-Lock (HC) [4]. The HC is basically a phase-detector. The sum-polarisation can be understood as the overlap of two perpendicular polarisations with different amplitudes, where only the part perpendicular to the optical table is used for frequency doubling. The polarisation parallel to the optical table is reflected at the input coupler. The reflected light passes through a $\lambda/4$-plate and afterwards through

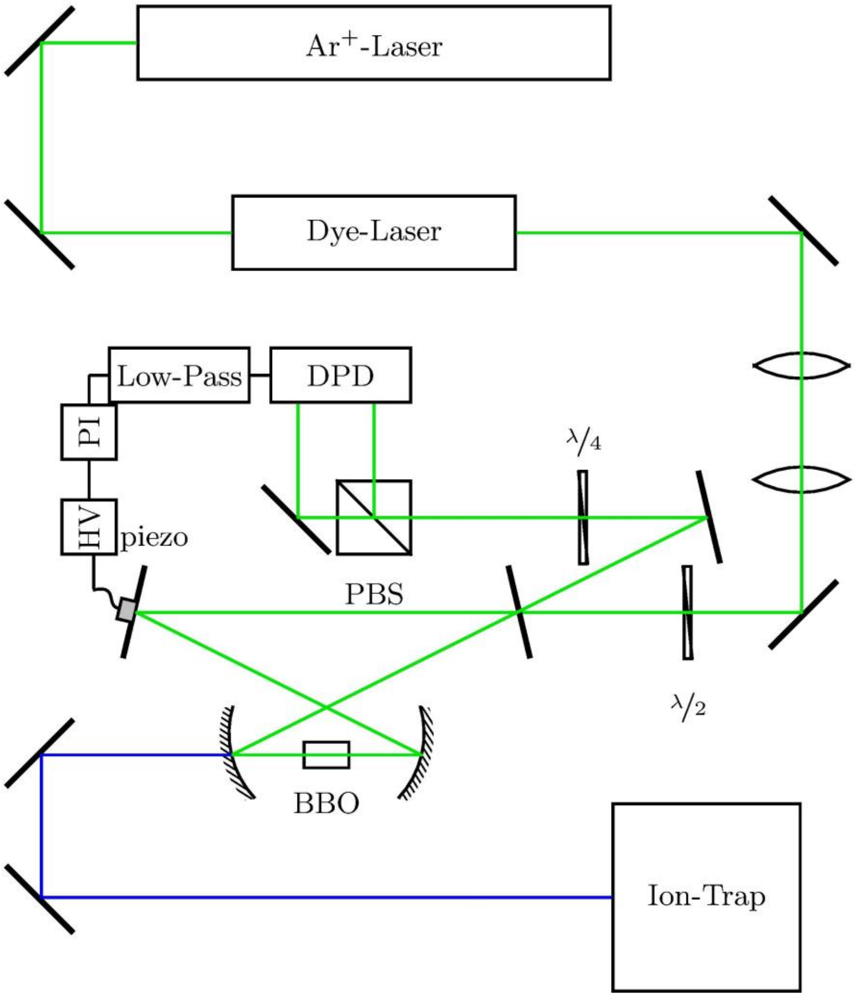

Figure 4. Optical set up for the Laser beam with frequency doubling and stabilization

a polarizing beam splitter cube. The light of the two beams is measured by two photo-diodes and the signal is subtracted from another. If the resonator is far off resonance, both polarisations are reflected and the photo-diodes measure the same intensity and therefore the overall signal is zero. At resonance the light leaves the cavity at the input coupler with a phase-change of $\delta=2m\pi$ and as a result the polarisation remains the same. But if the resonator is slightly off resonance, the light accumulates a little bit of a phase shift and the polarisation changes. This leads to different intensities measured by the photo-diodes and the equation for the difference signal reads:

$$I_a - I_b \propto \frac{T\,R\sin(\delta)}{(1-R)^2\,4R\sin^2(0.58)}$$

The zero-transmission of the signal corresponds to the maximum of transmission through the cavity. At this point the resonator is in resonance and the frequency doubling is maximized. So together with a fast PID-controller and a piezoelectric actuator, the difference signal can be used to stabilize the cavity.

4. The electron intention experiment

When all of this equipment has been made ready, the ion can be studied. It can float for hours, perhaps even days, in the chamber. Unlike another well known psychic experiment where a human acts on hundreds of thousands of 1s and 0s emanating from a random number generator in an attempt to alter their initially even distribution, or yet another experiment where persons try to alter the distribution of trillions of laser photons traversing a double slit in the space of a nanosecond each, here the human needs to act on only a single electron, and he or she can spend hours getting to know it and flip its spin. He or she can name the electron. This spin-flip experiment is the proverbial psychic switch.

In order to prove that a volunteer has flipped the valence electron's spin, we can ask him or her to let the ion's laser induced fluorescence (LIF) shine for suitably long and short periods in order to create a message in International Morse Code. The volunteer could spell out the Preamble to the United Nations Charter. We could program the computer to record the periods of LIF and print out the decoded Morse Code message in plain text. The letters could be directed through a projector to a large screen, showing a, b, c, d . . . . . The experimental set-up is sketched in fig. 5.

If a volunteer can successfully turn LIF off and on seated near the apparatus, then we will ask him or her to try from across the room, outside the lab, across town, across the country, etc., as distance doesn't seem to matter to psychic phenomena. The successful volunteer will have shown that this mental control of LIF utilizes a new physical phenomenon, not the strong, electroweak, or gravitational force.

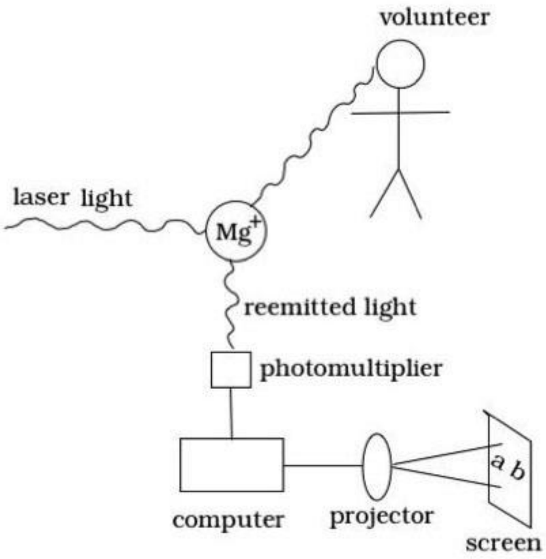

Figure 5. Sketch of experimental apparatus to demonstrate electron spin-flip.

5. Conclusions

The buildup of the experiment is well on its way. After one year of intensive work the ion trap and the tank circuit were completed. The vacuum chamber with all pumps and the vacuum measuring system have been assembled and a vacuum as low as $2\ 10^{-10}$ has been achieved. As soon as the setup is completed we will begin with the experiments were volunteers try to flip the spin.

There will be many practical applications: sending messages (probably easily through barriers, as psychic phenomena seem unfazed by obstructions), mentally controlling wheel chairs, page turners, etc., typing scientific papers using an extended Morse Code to include Greek letters and mathematical symbols, etc. See Bryan [5].

Acknowledgments

The authors thank the Integrity Research Institute and Frank Rees for support of this work. The authors also thank Hans Schuessler for helpful discussions.

References

[1] Monroe R. *Ultimate Journey*. DoubleDay, New York, 1994, p.185.
[2] Sheldrake R. *The presence of the past*, Random House, New York, 1988, p.175.
[3] Zhao X. *Laser and Mass Spectroscopy of Fullerene and Magnesium Ions in a linear RF Quadrupole Ion Trap*. PhD thesis, Texas A&M University, 2001.
[4] Hänsch T W and Couillaud B. Laser frequency stabilization by polarization spectroscopy of a reflecting reference cavity. *Optics Communications* **35**, 441-444 (1980).
[5] Bryan R A. Mental control of a single electron. *Physics Essays* **19**, 2006, pp.169-173.