

Tesla Wireless Energy Transfer at CCC

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Abstract

Tesla's Long Distance High-Power and High-Efficiency Wireless Energy Transfer System is still a mystery to our technology. To better understand claims that power can be transmitted to any distance on Earth with insignificant losses, and what challenges does this pose to the current technology, two simple prototypes of Tesla Magnifiers have been built.

Measurements of electrical properties have shown some unexpected electrical conditions. Computer simulations using SPICE (electronic circuit simulation) and NEC2 (antenna simulation and electromagnetic field visualization) have verified measurement results, showing waveforms and electromagnetic fields.

Revealed geometry of the field around the Magnifier differs from the field around ordinary radio antenna (which radiates transversal electromagnetic wave) and could lead us towards explanation of faster-than-light energy transfer on planetary scale which Tesla claims.

Computer models could be of practical use to engineer efficient devices for energy and information transfer.

1 Introduction

Tesla's Wireless Energy Transfer (WET) system consists of at least two units:

- Transmitter - resonant antenna driven by grounded AC generator
- Receiver - grounded resonant antenna directly powering the load

No wiring is required between them. Both units have to be grounded. Despite of up-to-date technology, properties of this system are still not very well known (it works better than expected).

In article [1] from 1919 Tesla makes a summary of his WET system. Few other articles are good at explaining the phenomena, like [2] on solar influence which notes the frequency range for efficient transmission and the article about magnifiers in autobiography [3] which explains mode of oscillations inside of the magnifier as a standing wave in transmission line and not a simple LC circuit.

Also a manual of a working prototype from dr. Konstantin Meyl [4] contains handful of practical information in order to get started.

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2 Magnifying Transmitter and Receiver

The magnifying transmitter consists of the resonant antenna called the Magnifier and power source (high frequency alternating current generator) connected between the ground (the Earth) and bottom terminal of the antenna. Magnifier is not a transformer, as it has only one winding, directly driven by the generator. Simplicity of its structure hides complex electromagnetic and geometric phenomena between the fields in space and the Earth.

The magnifying receiver consists of second Magnifier, grounded at remote location.

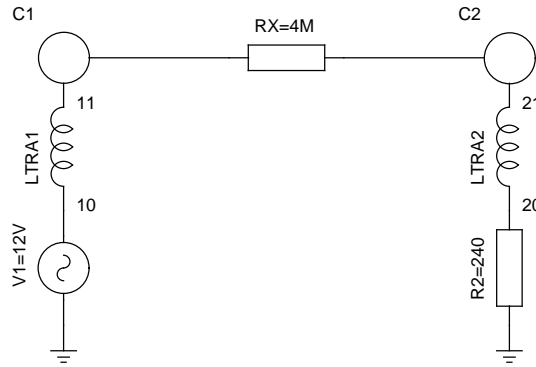


Figure 1: Equivalent Circuit for WET

When WET is in operation, it seems as if the air is conductive and of ohmic nature (represented by the resistance between toploads) and currents of the transmitter and receiver are in phase and in the same direction with respect to the ground. But in reality air doesn't conduct. It is a virtual conductivity in the circuit appearing as the reflection of Earth's conductivity and capacitance combined with the interactions of oscillating electric fields between transmitter and receiver.

Energy can be extracted in several ways:

- directly at ground connection (incandescent lamp or rectifier bridge in series)
- utilizing its magnetic field with a secondary winding (load impedance matching)
- utilizing its electric field to light gas discharge lamp - the field is so strong that it can drive electrodeless tubes.

Direct driving of electrodeless tubes allows for wide choice of discharge gases including those that would corrode tungsten filaments like sulphur, which is interesting because it can give white continuous spectrum. Such lamp may last forever because it doesn't have fluorescent coating nor any metal parts, so there's nothing to wear out.

2.1 Field around Magnifier

The magnifier is basically a resonant antenna capable of producing oscillating electric field E much larger than accompanying magnetic field H around the magnifier in case of transverse electromagnetic wave. Ordinary dipole antenna produces electromagnetic wave which basically follows the geometry of the antenna, We call it transversal electromagnetic wave with electric and magnetic fields perpendicular to each other and to the direction of wave propagation and ratio of absolute values $|E|/|H|$ fields of the wave is equal to the free space impedance [5]:

$$Z_0 = 377 \Omega \quad (1)$$

However, $|E|/|H|$ ratio in the near-field of the Magnifier is much larger than the free space impedance (1):

$$\frac{|E|}{|H|} > Z_0 \quad (2)$$

As the Earth is included in the antenna geometry, the near-field can reach far distances at planetary scale.

Intention of the design is to create spherically symmetric electric field in space. Ideally, all electric field vectors should originate from a single point and extend out to 3D space, like an electric field around charged sphere or the gravity field around a planet.

Magnetic field lines have to be closed curves perpendicular to the electric field lines. As we used all 3 space dimensions symmetrically for the electric field there's no dimension left in space for the perpendicular magnetic field to be created.

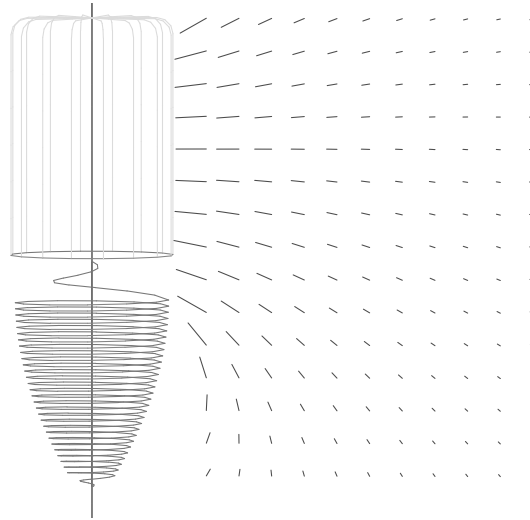


Figure 2: Electric field near the Magnifier

The real device has some leakages of magnetic field and slightly departs from the pure spherical symmetry but still there remains a dominant component of oscillating electric field coming from a single point in space. So the Poynting vector is almost zero in all directions and the Magnifier should not radiate but reflect almost all power back to the source, but at resonance energy is transmitted over significant distance with unexpectedly high efficiency.

2.2 Prototype

Amateur hobby version of the Magnifier was made of plastic bottle mounted upside-down. Topload is made of aluminium foil forming a conductive cylinder with hemispherical cap as topload capacitor. At the bottom is the coil made of insulated copper wire wound around the bottleneck.

From generator output of 10 V, the magnifier produces over 2 kV on topload and that is enough to light up neon and fluorescent lamps at 10 – 20 cm from the Magnifier,

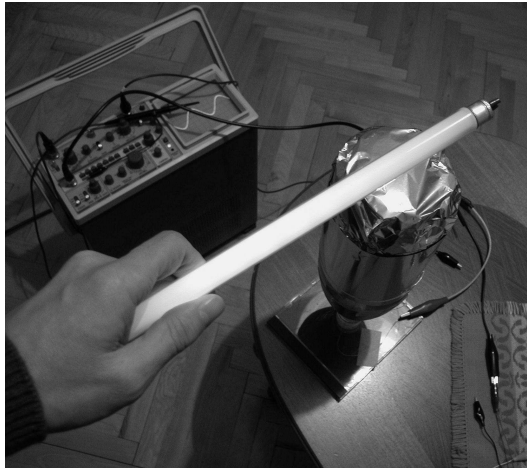


Figure 3: Magnifying Transmitter lights up Fluorescent Lamp in Hand. No Sparks.

3 Wireless Energy Transmission

Second Magnifier receives energy and lights up LED diodes connected in series to the ground.

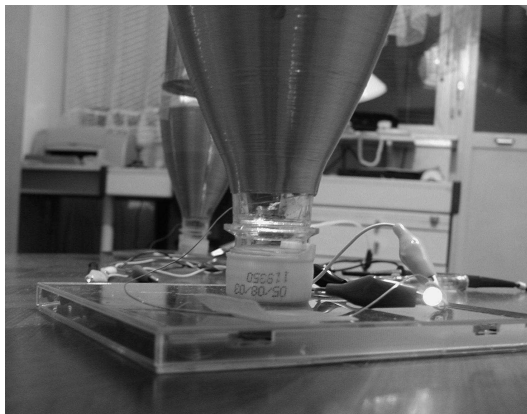


Figure 4: Receiver lights up LED

Received power slightly diminishes as distance increases, but LED can still be lit in the other room 10 m from the transmitter and with two walls inbetween.

4 Is Tesla Wave Faster then Light?

Together with WET, Tesla mentions speeds much larger than speed of the light (800000 km/s in [1] and 471240 km/s in [6]).

The speed of the light in the medium is slower than in vacuum by the factor equal to refractive index. It relates to relative dielectric constant as:

$$n = \sqrt{\epsilon_r \mu_r} \quad (3)$$

$\mu_r \approx 1$ for most transparent media.

$$v = \frac{c}{\sqrt{\epsilon_r}} \quad (4)$$

wave impedance [7] in the medium relates to the dielectric constant:

$$\frac{|E|}{|H|} = Z = \frac{Z_0}{\sqrt{\epsilon_r}} \quad (5)$$

Therefore wave impedance relates to the speed of the light. As the Magnifier creates much larger E/H ratio (2) than impedance of the free space (1), we could at least use mathematical formalism to explain Tesla's claims of Magnifier waves traveling faster than the speed of light:

$$v_{super} = c \frac{|E|}{|H| Z_0} \quad (6)$$

Although Tesla reported measurements of superluminal transfers, it seems that additional experiments are still needed.

5 Is this a Free Energy Device

No but it's close to this. If wireless reception of electrical energy works, then we can search for some natural source of oscillating electric field and receive it's energy with the Magnifier.

References

- [1] Nikola Tesla. *The True Wireless*. Electrical Experimenter, May 1919.
- [2] Nikola Tesla. *The Disturbing Influence of Solar Radiation on the Wireless Transmission of Energy*. Electrical Review and Western Electrician, July 1912.
- [3] Nikola Tesla. *My Inventions: The Magnifying transmitter*. Electrical Experimenter, June 1919.
- [4] Konstantin Meyl. *Documentation for the Experimental-Kit to the transmission of electrical scalar waves*. INDEL-Verlag, Villingen-Schwenningen, 2003.
- [5] Impedance of free space. http://en.wikipedia.org/wiki/Impedance_of_free_space, July 2009.
- [6] Nikola Tesla. *Art of Transmitting Electrical Energy Through the Natural Mediums*. Canadian Patent No: 142,352, 1906.
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