

STEM Society Meeting, April 9, 2013

James Emery

Last Edit: 4/12/2013

Contents

1	About the STEM Society and the STEM Society Website	1
2	The April Meeting Announcement	2
3	Bill Price: An Earthship House in Kansas	3
4	Jim Emery: Complex Variables in Electrical Engineering	4
5	Steve Cummins, A Cylindrical Aluminum Quadrupole, from a Mass Spectrometer	4
6	Steve Cummins Question, Found On The Trail: An Old Fly-back Transformer With an Attached Vacuum Tube, What Is It?	5
7	Kent Smith Question: What is the difference between Ordinary Light and Laser Light?	5
8	Steve Cummins: A Tesla Coil For Detecting Gas Leaks	6

1 About the STEM Society and the STEM Society Website

STEM is an abbreviation for Science, Technology, Engineering and Mathematics. The acronym STEM is commonly associated with K-12 education,

but our use of the term is only slightly bound to this meaning. There are over one hundred people on the mailing list, although a much smaller group attends any one meeting. We meet on the second Tuesday of each month at the Trailside Center at 99th and Holmes in Kansas City, Missouri. The meetings are open to all. The start time is 6PM. We make presentations, have discussions, and have demonstration experiments. These relate to Science, the History of Science, Mathematics, Engineering, Philosophy and Technology at all levels. The topics have ranged from a technical discussion of the mathematics of General Relativity to scientific experiments for young students.

The set of meeting notes may be viewed by going down the list of notes appearing on the front page of the site. These notes contains links to documents, which may be viewed or downloaded by clicking the link. Other documents can be reached by clicking the heading "Documents and Downloads" that appears on the left side of the front page. Then click on "documents." The meeting notes may also be viewed in an archive file in the list of documents. Most of the documents are PDF files. They may be viewed or downloaded to the computer by clicking, provided Adobe Reader is present, or another program capable of reading PDF files. There are usually more documents available at the site than are listed under "Documents" because they are not in the documents.htm file.

The web site is:

<http://www.stem2.org/>

Direct to the documents list:

<http://www.stem2.org/je/documents.htm>

Direct to the archive file:

<http://www.stem2.org/je/archive.pdf>

2 The April Meeting Announcement

The April meeting of the STEM Society will take place on the second Tuesday of the month, April 9, 2013, at the Trailside Center at 99th and Holmes in Kansas City, Missouri. The starting time is 6PM.

A List of Possible Topics are

(1) Bill Price will present his design for an Earthship - an energy conservative home - that will use a solar chimney system to draw ventilation air through a buried duct to cool air in the home. He would like to consult with us on the air flow, heat transfer, proper size, ductwork, and efficiency of his system.

(2) The use of complex numbers and complex analysis in electrical engineering and electronics.

(3) As always, impromptu topics, projects, show and tell, book reports, problems and solutions in mathematics, physics, engineering, biology, scientific biographies, et cetera, are welcome.

Backup and Future Topics:

(1) Optimization Theory, Lagrange Multipliers, and the Golden Section Search.

(2) Electronics and Circuits.

(3) Machine building.

(4) The calculation of energy levels in semiconductors.

The STEM Society Website:

<http://www.stem2.org/>

3 Bill Price: An Earthship House in Kansas

Bill is building an Earthship passive solar house based on the model pioneered by Michael Reynolds of Taos, New Mexico. This house will be located in Leavenworth county Kansas where the building codes are such as to allow such construction. Earth-filled tires form the walls of the house. These are rows of tires filled with earth and compacted with a sledge hammer.

An Earthship is a type of passive solar house made of natural and recycled materials. Designed and marketed by Earthship Biotecture of Taos,

New Mexico, the homes are primarily constructed to work as autonomous buildings and are generally made of earth-filled tires, using thermal mass construction to naturally regulate indoor temperature. They are usually passively ventilated by cross ventilation assisted by thermal draught (Stack effect). Earthships are generally off-the-grid homes, minimizing their reliance on public utilities and fossil fuels. Earthships are built to utilize the available local resources, especially energy from the sun. For example, windows on sun-facing walls admit lighting and heating, and the buildings are often horseshoe-shaped to maximize natural light and solar-gain during winter months. The thick, dense inner walls provide thermal mass that naturally regulates the interior temperature during both cold and hot outside temperatures.

Bill wanted to primarily talk about ventilating the house using a buried duct, which would draw air into the house and out a tall stack, by convection.

This property is located at 23727 Springdale Road near highway 92 in Leavenworth County, Kansas.

4 Jim Emery: Complex Variables in Electrical Engineering

Derivation of the impedance concept, solving steady state AC networks, series and parallel resonance, application to tuning a simple AM radio, measuring inductance example. See topics in **Electrical Circuits** by Jim Emery:

<http://www.stem2.org/je/ee.pdf>

and **Basic Electricity**

<http://www.stem2.org/je/basicelectricity.pdf>

5 Steve Cummins, A Cylindrical Aluminum Quadrupole, from a Mass Spectrometer

Steve was an analytical chemist at MRI and used mass spectrometers.

6 Steve Cummins Question, Found On The Trail: An Old Flyback Transformer With an Attached Vacuum Tube, What Is It?

For A starting explanation, see the Wikipedia Article titled, **Flyback Transformer**. The vacuum tube in old television sets was called the horizontal output tube. This was a vacuum tube that frequently failed in 50's and early 60's era television sets. Because the generation of the high voltage to accelerate the electrons from the electron gun to the CRT screen was generated with this sawtooth horizontal voltage connected to a high voltage transformer, the absence of any image on the screen suggested a failure of the horizontal output tube. Later televisions of course no longer used a vacuum tube.

Last year Steve Siegle led a Make:KC project to build a "Miniature Tesla Coil" at the HMS Beagle store in Parkville MO. This used a flyback transformer, from a CRT monitor, or from a television set. The major part of the project was to build a sophisticated laboratory power supply.

7 Kent Smith Question: What is the difference between Ordinary Light and Laser Light?

A very simple explanation of the difference is that a laser produces coherent light (As Samuel Adams said in the revolutionary war, "We must all hang together, or we shall all hang separately). LASER is an acronym for Light Amplification by Stimulated Emission of Radiation. As radiation passes through atoms, photons from the atoms are stimulated to fly off in perfect step with the stimulation. Suppose soldiers march down a street of a small village in perfect step. The young men of the village are stimulated by this and fall into perfect step with the soldiers (Editorial comment: They probably march off and are eventually killed in a pointless war to increase the kings wealth).

So marching soldiers are like laser light. On the other hand suppose someone shouts fire in a large auditorium, the people run in a panic in multiple directions from diverse original locations in the auditorium. This is noncoherent random motion like the radiation and photons of ordinary light.

For a more "coherent" explanation refer to a general book on Optics,

such as **Introduction to Modern Optics** by Grant R. Fowles, 1968, Holt-Reinhart-Winston.

Also an interesting early book on the subject is **Introduction to Laser Physics** by Bela A. Lengyel, John Wiley, 1966. The first Ruby Laser was constructed by Maiman in 1960 at Hughes Research Laboratories. Lengyel was a colleague of Maiman at Hughes. There was an early working Helium-Neon laser manufactured by Hughes of 1960's era, laying around the Hammer Space. I have not checked, but there is probably a copy of this book by Lengyel at Linda Hall Library.

8 Steve Cummins: A Tesla Coil For Detecting Gas Leaks

Steve promises to bring this device to a future meeting.