Poster Session	
Presenter	**Robert Nitzky** nitzkyr4@students.rowan.edu
Topic of Poster	*Electromagnetic-Induced Hypothermia in Wires*

Hyperthermia, or the heating of tissue, can be used as a type of cancer therapy. This increased temperature can be attained using a variety of methods, including laser ablation, microwave exposure, and direct contact. One non-invasive way to generate hyperthermia is to induce a heating response in metallic particles upon exposure to an oscillating magnetic field. This effect can be applied to nanoparticles that are targeted to seek out different tumor biomarkers; the heat generated by the nanoparticles is translated to the tumor, which retains the heat due to its poor vasculature. When used in conjunction with traditional chemical or radiation therapies, hyperthermia can improve patient outcomes in cases of resistant cancer.

While targeted nanoparticles are a promising direction for hyperthermic therapy, there are many obstacles to overcome regarding delivery of the particles (hence, the heat) to the tumor location. One potential way to bridge this gap is through the insertion of small metallic wire segments directly into the tumor volume. This method is inspired by brachytherapy, where small radioactive 'seeds' are directly implanted into a tumor to produce continuous low-dose radiation therapy inside of the tumor. In our case, the metallic wire segments (or seeds) would be implanted into a tumor and exposed to the alternating magnetic field to produce a heating effect due to induction (where eddy currents moving through the conductor create joule heating). This type of therapy may be potentially attractive for recurring hyperthermia sessions, where the seeds are implanted once and then therapy can be performed on multiple occurrences over a given time period.

Our initial studies regarding this project aim to characterize metallic wire segments for their hyperthemic response during exposure to oscillating magnetic fields. Preliminary studies concentrate on Fe-, CuNi-, and CuMnNi-wires submerged in a phosphate-buffered saline solution; the type of wire, gauge, length, and mass of the wires were varied across experiments. Hyperthermia was induced using an alternating magnetic field across a range of magnetic field strengths and oscillation frequencies. Throughout this process, temperature changes of the sample were recorded to analyze the thermal response as a function of time for each of the varying parameters. As expected, the heating effect increased linearly with wire mass, and the elemental composition of the wire also affected the ability to generate heat. Somewhat surprisingly, an optimal wire length of 5 mm was found to generate the greatest heating effect; this parameter is the focus of ongoing studies. Future stages of this project will examine implantable hyperthermia seeds in vivo, with the use of various orthotopic cancer mice. Additional types of implantable material, ranging from gold microwire to carbon fiber, will also be explored.

Additional improvements to the hyperthermia experiment (for both macroscopic wires and nano-scale particles) include the construction of a modular and adjustable sample holder, as well as design of a new high frequency coil. The new sample holder was constructed from off-the-shelf high temperature plastic and allows a variety of sample geometries to be tested at different coil heights. Plans are underway for creation of a next generation 3-D printed sample holder. Furthermore, the current hyperthermia device is a commercially available unit that operates at ten distinct frequencies (100 kHz - 1 MHz). As some materials respond to even higher frequency field oscillations, a new coil setup is currently under design and construction (in-lab) that will allow hyperthermia at even higher (up to 27 MHz) frequencies; this will broaden the array of biocompatible materials that can be applied for hyperthermia.

Presenter	**Hsuan-Lillian Labowsky** *Ridgewood HS* hlabowsky@ridgewood.k12.nj.us
Topic of Poster	*Using an iPhone Accelerometer App, students evaluate the impact force of various sports helmets*

Using an iPhone Accelerometer App, students evaluate the impact force of various sports helmets. The "impact force" is created by dropping a helmet from a fixed height onto the floor. As opposed to standard helmet testing that measures external force, the iPhone is fastened inside the helmet to simulate the effect on the brain. The app records the acceleration components as a function of time. The data is transferred to and graphed in an Excel spreadsheet. Graphs show the "free fall" and the "impact" regions, although an app with a data collection rate greater than the available 30Hz is desirable. After testing an unmodified helmet, the students then add foam and/or crumple zones in attempts to improve cushioning. Students exercise the scientific method in data collection/interpretation and draw meaningful conclusions. The experiment is particularly timely/meaningful in light of the concern over sports-related concussions.

Presenter	**Rich Terwilliger** babyblueazurite@aol.com
Topic of Poster	*Terwilliger's Physics, a collection of over six-hundred Microsoft Word, Excel and PowerPoint documents that have been classroom tested and revised*

This presentation is a brief introduction to Terwilliger's Physics, a collection of over six-hundred Microsoft Word, Excel and PowerPoint documents that have been classroom tested and revised many times according to student suggestions. Terwilliger's Physics allows you to flip your classes and spend precious time developing more demonstrations, labs, and classroom activities. Why spend hours developing worksheets and class lesson plans or searching the web for mediocre material when you can have it all with just a couple clicks of the mouse?

Presenter	**Bart Horn, Peter Gilmartin** *Manhattan College* bhorn01@manhattan.edu
Topic of Poster	*Observable relics of the simple harmonic universe*

The current explosion of precision data for early universe cosmology is creating opportunities for cutting-edge student research, using and modifying existing software packages such as CLASS and MontePython in order to simulate the growth of primordial structure, and to compare predictions against publicly available data. We analyze possible observational signatures corresponding to the "simple harmonic universe", which consists of spherical spatial curvature, negative vacuum energy, and one or more exotic matter sources, which then quantum tunnels and/or evolves into our present observer patch.

Presenter	**Tyler Reese** *Manhattan College* treese01@manhattan.edu
Topic of Talk	*Higgs Physics at the LHC*

The Standard Model of Particle Physics is a comprehensive yet still incomplete model of three out of the four fundamental forces. It is built on local gauge symmetries corresponding to the fields of the Strong, Electromagnetic, and Weak forces. Save for a few precision measurements, the detection of the Higgs Boson by the ATLAS and CMS experiments at CERN [1,2] completed the search for Standard Model physics. New physics, as in heavier particles, requires collisions at energies much higher than the capabilities of the LHC. Until a new larger collider is built, evidence of new particles can only by utilizing Effective Field Theories. An example of the application of EFT's is the search for CP Violation in processes with Higgs bosons. The detection of CP Violation would not only indicate that heavier particles, namely a CP-Odd Higgs, do in fact lie higher up the energy scale but also could point to an explanation for the matter/antimatter asymmetry in the universe. The Higgs Basis EFT [3] is a good choice for modeling studies such as this because it includes CP-Violating terms parameterized in a convenient way. Monte Carlo simulations done using the Higgs Basis will be used to interpret detector results. Preliminary work for this research has been done validating the Higgs Basis generator, Hto4l and Madgraph5.