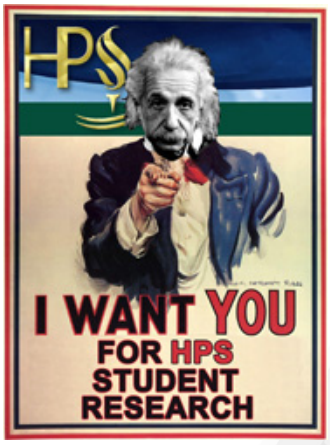
PROGRAM IN HISTORY AND PHILOSOPHY OF SCIENCE

CSUS History and Philosophy of Science Program

A Joint Program of CPNS and the Department of History

HPS STUDENT RESEARCH INITIATIVE
SPRING, 2015



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As part of Sacramento State's History and Philosophy of Science Initiative, CPNS Undergraduate Student Research Fellows develop and implement interdisciplinary research projects bridging empirical inquiry within the fields of the natural sciences and mathematics (NSM) into cross-connection with the field of history and philosophy of science (HPS). These faculty supervised student research projects give undergraduates crucial experience in the synthesis of new ideas and their proper investigation via both empirical study and analysis of scholarly literature in the natural sciences, philosophy of science, and history of science. Beyond these goals, the CPNS Student Research Initiative provides students with the unique opportunity to network and collaborate with both CPNS Graduate Research Fellows and CPNS Faculty Research Fellows across multiple institutions, both nationally and internationally. **Student Research Coordinators earn 3 units as a College of Arts and Letters Internship (ALS 195).**

SRI Student Coordinators:

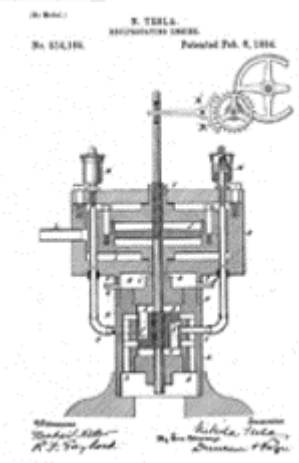
Christopher Keys, Physics Major
Elizabeth Keys, Physics Major

SRI Faculty Advisor:

Michael Epperson, CPNS

2015 CPNS Student Research Initiative Group Project: Tesla's Oscillator

Background:



The influence of modern science upon popular culture, from the early modern period to the present day, has demonstrated a persistent grounding in an underlying tension: Despite science's emblematic emphasis of formal and rigorous methodology—and the precise manner in which its successful theories are exemplified by viable technology—the *popular cultural* embrace of scientific knowledge seems driven more by the most exotic implications of this knowledge than by the merely practical applications. One need look no further than the typical science programming that has proliferated on cable television in recent years for a crude metric exhibiting this thesis. It is arguably no coincidence that during this same period of proliferation of science 'educational entertainment,' popular fascination with Nikola Tesla has soared, even to the heights of cult status for many. While Tesla's significance within the history of modern science is unquestionable—particularly within the field of electrical engineering—his recent resurgent popularity clearly has less to do with his technologically validated (and industry-changing) theories than with his more exotic ideas. Today's Tesla enthusiasts often argue that because of his notorious eccentricity, his most revolutionary and potentially earth-shattering ideas have been improperly summarily dismissed by the scientific community.

Project Description:

The goal of this project is the building and testing of a natural frequency electro-mechanical oscillator, commonly called "Tesla's Oscillator." Tesla claimed that by matching the "natural frequency" of buildings he had the capability to cause

earthquake like tremors with just a few pounds of force. Shrouded in myth and speculation in popular culture, the claim has not been scientifically tested. It is the goal of this project to build and analyze the capabilities of such a device with respect to period and modern construction and to explore the specific claims made about Tesla's Oscillator.

In the Fall semester, significant preliminary work began on the construction of a Tesla Oscillator. The primary motivation of the project is to evaluate the legitimacy of the claims made by Nikola Tesla that he was able to match the natural frequency of a material and amplify this frequency enough to shake whatever structure the device was attached to. **During the Fall semester, some simple experiments were carried out to show proof of concept for this idea. A report from NIST titled "Fire Induced Fibration Monitoring for Building Collapse" states the pressure waves caused by flames does lead to building collapse and might be related to this frequency amplifying event. This phenomenon is of real concern in the everyday life of firefighters.**

Work in the Spring semester would progress to building a frequency reading device, possibly similar to what was used in the report, to detect at which frequency different objects vibrate. A device would also need to be built to oscillate a small mass using a very finely adjustable motor. The work would entail the actual building of the frequency reader, a fairly simple task, and would include the building of the oscillator itself which is more complicated. In discussing this issue with other members of the Society of Physics Students, there is debate on how the mass should oscillate, whether linearly in one direction, or if a fly-wheel design might provide better results. **Theoretical modeling with both designs would be done to answer this question before work would begin on construction with the input of Jérôme Bürki, Department of Physics**. With these two devices, measuring the natural frequency of an object and the ability to match that frequency would allow us to run experiments and evaluate the claims made.

The scientific value of the project itself is immense. Should this device be able to match the natural frequency of these materials or objects, the device can be set 180 degrees out of phase with that frequency hypothetically meaning that when a building begins on oscillation, this device could break up that wave giving firefighters more time to get out of a building or possibly prevent the collapse of the building all together.

Student Coordinator Responsibilities

- **Christopher Keys, Senior, Dept. of Physics** **ALS 195 Internship Credit: 3 units**
- **Elizabeth Keys, Senior, Dept. of Physics** **ALS 195 Internship Credit: 3 units**

Our plan is to attempt to construct this device using any modern materials and methods at our disposal to try to show whether his device could have the effects claimed or not. There have only been a couple of attempts to replicate this device and among those only one was even semi-scientific. The attempt done by the show "Mythbusters" produced some results, however that was a quickly performed experiment and lacked theoretical understanding of the physics behind it.

Creating a mythical item is not a trivial task, and as such we are not working alone on this project. We have over twelve physics majors signed up to help so this project can, we believe, be done with the thoroughness that is required of it. Our task will involve coordinating the whole project and will be assisting in every aspect of the project. This will include theoretical modeling using computer simulations, constructing a resonance measuring sensor, and of course the oscillator itself. The project will also involve safely testing it on a small structure constructed by our group.

While we believe that this device has great potential, if it fails to produce sufficiently impressive results it will still be a success in the sense that it will finally be scientifically disproven. In order for it to be disproved however, this project needs proper time dedicated to it. While there are more than a dozen who have volunteered for this, only two or three of us can be considered invested enough in this to reliably work on it and complete it during the spring semester. Regardless of how much assistance we receive, we each anticipate working a minimum of 10 hours per week on this project.

Additionally, if time permits, we would like to put together and reenact related scientific debates. Many times in history a new scientific idea has been proposed and immediately scrutinized. We propose to assemble these old controversies in the form of a series of debates. This will give training scientists the opportunity to experience being at the heart of a scientific debate, coupled with knowledge of which side was the correct one. This is intended to give them greater insight into the scientific process, and hopefully gain them some wisdom for when they, too, are testing a new scientific idea.

Debate is part of the soul of science, but we often only remember the results in the form of accepted scientific principles. We do not properly go back to reexamine the mechanics of these debates even though it could be argued that they are just as important as the accepted principles that came out of them. The subject of each debate will be an accepted scientific theory or principle that was hotly debated at the time. With our historical insight we will know which side was proven to be more correct, but will only use the knowledge of the time.