**Name(s)**

Eric Casavant; Alex Marshall

**Project Number**

# S1602

**Project Title**

## On the Direct Detection of Dark Matter with LENS: A New Directionally Sensitive Low Energy WIMP Detector

**Abstract**

**Objectives/Goals**

Astronomical observations suggest that there is an immense amount of matter in the universe that is invisible and seemingly undetectable. This invisible matter is known as dark matter, and it has been theorized to exist for nearly a century. The WIMP (Weakly Interacting Massive Particle, also referred to as the Neutralino) is the leading candidate for the particle that constitutes the majority of dark matter density in the universe. However the WIMP has never been directly detected. This project proposes a new WIMP detector called LENS, the Low Energy Neutralino Search

**Methods/Materials**

The LENS detector will detect WIMPs by observing recoil and photon emission caused by WIMP-mercury nucleon collisions. This is accomplished by using a thin solid state mercury target medium sheet placed inside a highly evacuated and cooled chamber. Above the target medium is a TPC (Time Projection Chamber), and surrounding the target medium are PMTs (PhotoMultiplier Tubes). In the event of a WIMP interaction, a single mercury atom will spontaneously ionize and leave the medium. Because it is ionized, its trajectory can be tracked through the TPC. Also, due to the WIMP interaction, the recoiling ion will also emit photons, which can be observed by the PMTs.

**Results**

According to theoretically calculated events, LENS has the ability to bring many new limits unachievable by other methods of detecting dark matter. It has the most efficiently used target mass (the most amount of interactions per kg/day), and the lowest observable recoil energy threshold. Also, superior methods of discrimination against non WIMP recoil events have been found specifically for this detector. LENS also has the ability to view recoils with the highest resolution, and can view the energy distribution of a WIMP interaction with the highest accuracy.

**Conclusions/Discussion**

Dark matter has never been directly detected. This project proposes a new method to detect dark matter that uses Mercury recoils and scintillation to detect WIMP interactions and their corresponding direction. hypothetical WIMP interactions have shown promising results, with several new contributions that LENS could bring to the study of detecting dark matter.

**Summary Statement**

This project is on the design of a new dark matter detector.

**Help Received**

Graduate students attending Berkeley helped educate us on very abstract dark matter concepts (we conducted all major research at home). Physics and Math teacher verified some of our physics problems and solutions