A Study in Harvesting Solar Energy Using Bovine Blood - (Student Name)

Beginning in 2018, Dr. Erenso and his team studied the effects of laser trapping on cancer cells. Breast cancer cells were mixed with micron-sized polymer-coated magnetic beads in a 3:1 ratio. The purpose of the beads was to reduce the ionization period, making them ionize in a shorter time. The mixture was placed in a 16.5 mm wide and 0.78 mm deep depression slide. A 1064 nm infrared laser was directed by a series of mirrors and passed through 5 cm and 20 cm focal length lenses onto the cell mixture placed on a microscope stage. A steerable trap made from a mirror laser trap was placed to be within the microscope's focal plane. The released and absorbed power was recorded using a power meter placed below. The cells were directed towards the laser trap, and with the presence of a magnet in the trap, the bead-cell mixture was drawn into the laser trap, resulting in a new phenomenon. Their team witnessed a new phenomenon, that they call dark-bubble formation. This dark-bubble formation resulted in the emission of radiation energy similar to that of a star on a microscopic scale. This phenomenon had never been observed before (Erenso et al. 2024).

Like cancer cells, red blood cells can be used to trap energy produced from an infrared laser as well (Pasquerilla et al. 2018). In place of an infrared laser, the sun's power will be used and tested as an energy source. Using a larger lens, the sun's light energy will be focused onto a sample of bovine blood. The amount of energy absorbed and emitted by the bovine blood will be recorded using a power meter. Data recorded from the power meter will uploaded into a digital graphical analysis software, and the relationship between the power emitted by the sample compared to time will be recorded.

This research project will serve as a continuation of prior research done in Dr. Erenso's lab. What makes this project different from previous URECA projects is that this project will be testing the application trapping solar energy within blood cells, but previous projects used an infrared laser. Blood is capable of trapping electromagnetic waves from an infrared laser (Pasquerilla et al. 2018), and the sun is a prevalent source of electromagnetic waves. If blood could trap the electromagnetic waves from the sun like it could from an infrared laser, this could be a new potential method of solar energy harvesting. This experiment will lead to further development in biophysics and renewable energy research.

My mentor's role, Dr. Erenso, will be to teach me the methods and material necessary to complete this research, along with providing guidance and assistance when needed. My role in the project will be to learn the information and methods needed for the experiment, execute the experiments, and analyze the findings. Methods learned include how to use the infrared laser and other equipment, perform calculations, and use digital analysis tools. Once I learn the concepts and methods necessary for the experiment, I will construct the setup specifically used for sunlight trapping, which will be based on the infrared laser setup. I will use the setup to direct sunlight onto a sample of bovine blood and record the energy emitted by the sample. Once I have collected sufficient data, I will upload it into the digital graphing software, analyze the findings, and potentially draw conclusions from the data.

Sources Cited

Erenso, D., Tran, L., Abualrob, I., Bushra, M., Hengstenberg, J., Muhammed, E., Endale, I., Endale, N., Endale, E., Mayhut, S., Torres, N., Sheffield, P., Vazquez, C., Crogman, H., Nichols, C., Dang, T., & Hach, E. E. (2024). Observation of magnet-induced star-like radiation of a plasma created from cancer cells in a laser trap. *European Biophysics Journal*, *53*(3), 123–131. https://doi.org/10.1007/s00249-024-01701-3

Pasquerilla, M., Kelley, M., Mushi, R., Aguinaga, M. D., & Erenso, D. (2018). Laser trapping ionization of single human red blood cell. *Biomedical Physics & Engineering Express*, *4*(4), 045020. https://doi.org/10.1088/2057-1976/aac57d

Timeline

This project will take place from the start of June to the end of July, over 8 weeks. 50 hours will be spent working on the project, with around 6 hours spent working per week, on average. The project's timeline will be divided into three parts.

The first three weeks of the project will be spent reading and reviewing past research and learning the techniques to execute the project. It will be important to practice using the infrared laser that was used in earlier research. Understanding how to use the infrared laser and how it functions will allow for a better understanding of how the solar-powered setup will function. Along with practicing using the infrared laser, I will learn how to use the power meter and how to collect measurements. Once there is an understanding of the equipment's functions and how to collect measurements, the next part will begin.

The second three weeks will be spent constructing the setup to execute the experiment, along with its execution. The setup will use a large lens that will be compacted into a small beam directed into the blood sample. Once the setup is complete, sunlight will be directed into a sample of bovine blood, and measurements of how much energy is absorbed and released by the blood will be taken. The experiment will be repeated, and data will be recorded.

The third part of the project, or the final two weeks, will be dedicated to data analysis. Using Origin graphical data analysis software, power compared to time will be graphed and measured. How much energy was absorbed and radiation emitted by the blood sample will be calculated. This time will be used to draw connections and conclusions from measurements.