Abstract Submitted
for the DFD15 Meeting of
The American Physical Society

The Hybrid Sterling Engine: boosting photovoltaic efficiency and deriving mechanical work from fluid expansion and heat capture

NATHAN BEETS, Wake Forest University, WAKE FOREST CENTER FOR NANOTECHNOLOGY AND MOLECULAR MATERIALS TEAM, FRAUNHOFER INSTITUTE COLLABORATION — Two major problems with many third generation photovoltaics is their complex structure and greater expense for increased efficiency. Spectral splitting devices have been used by many with varying degrees of success to collect more and more of the spectrum, but simple, efficient, and cost-effective setups that employ spectral splitting remain elusive. This study explores this problem, presenting a solar engine that employs stokes shifting via laser dyes to convert incident light to the wavelength bandgap of the solar cell and collects the resultant infrared radiation unused by the photovoltaic cell as heat in ethylene glycol or glycerin. When used in conjunction with micro turbines, fluid expansion creates mechanical work, and the temperature difference between the cell and the environment is made available for use. The effect of focusing is also observed as a means to boost efficiency via concentration. Experimental results from spectral scans, vibrational voltage analysis of the PV itself and temperature measurements from a thermocouple are all compared to theoretical results using a program in Mathematica written to model refraction and lensing in the devices used, a quantum efficiency test of the cells, the absorption and emission curves of the dues used to determine the spectrum shift, and the various equations for fill factor, efficiency, and current in different setups. An efficiency increase well over 50% from the control devices is observed, and a new solar engine proposed.

Nathan Beets
Wake Forest University

Date submitted: 26 Jul 2015 Electronic form version 1.4