



CubeSat Club Meeting

10/28/2010

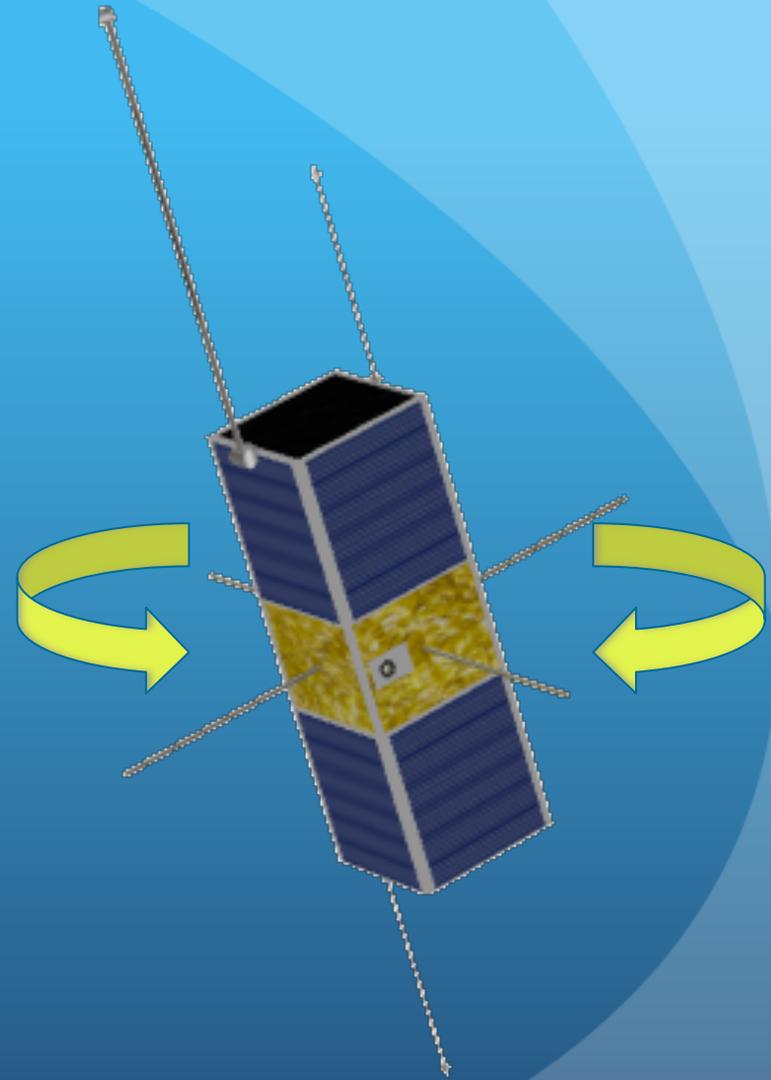
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10/28/10



Last Week

- Problem Solving
- Magnetic Torquer Design
- Building Torquers
- Electrical Measurements



Today

- Continue Building Magnetic Torquers
- Solar Panels



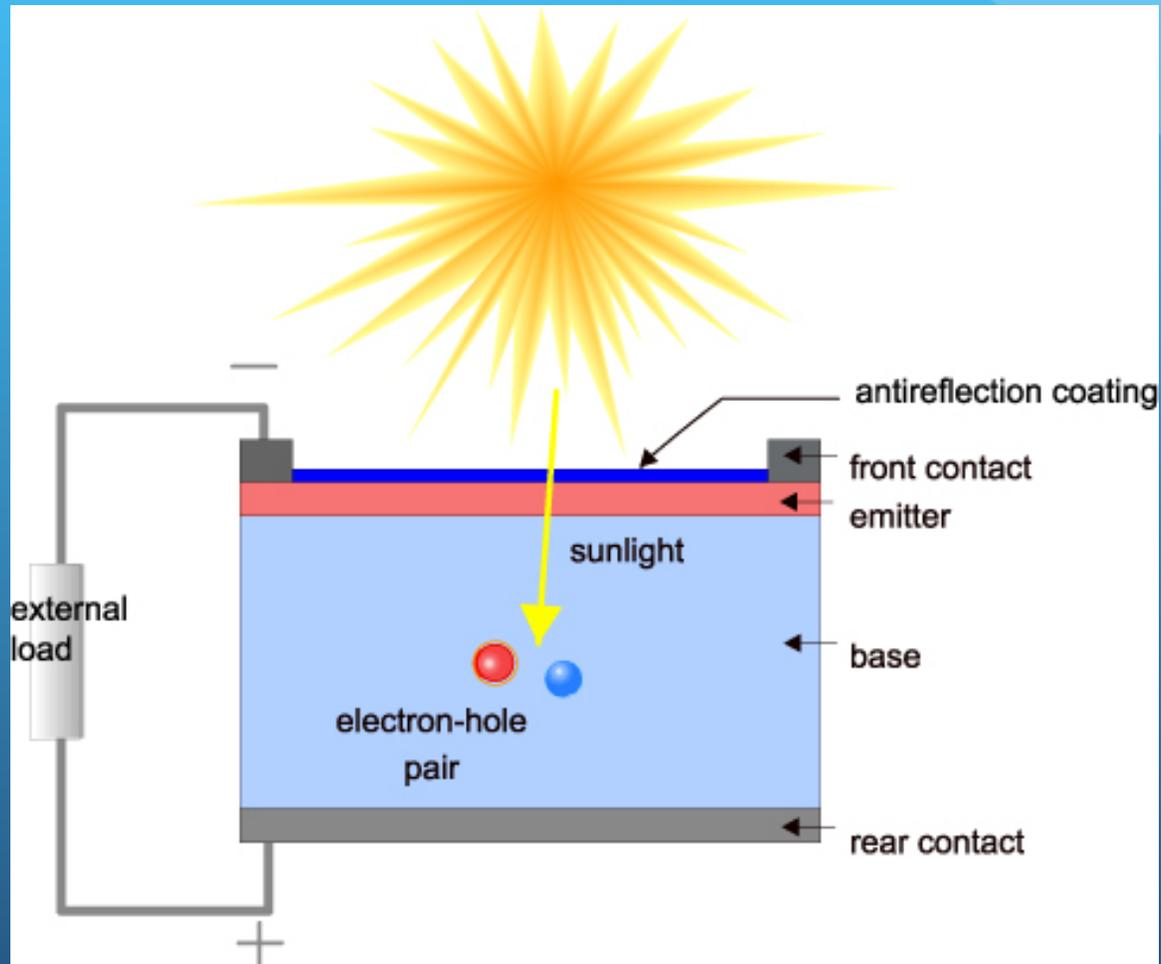
Solar Panels

- Devices that convert energy from the sun directly into electricity
- Composed of an assembly of SOLAR CELLS
- “Photovoltaics” = “light” + “electricity”

Energy Generation Process

- Light from the sun hits the solar panel and the photons heat up the solar cells.
- Electrons are energized and begin to move. These are called “free carriers.”
- Moving electrons create a current in conductors. The solar panels have a voltage, and the moving current produces power.
 - $P=IV$

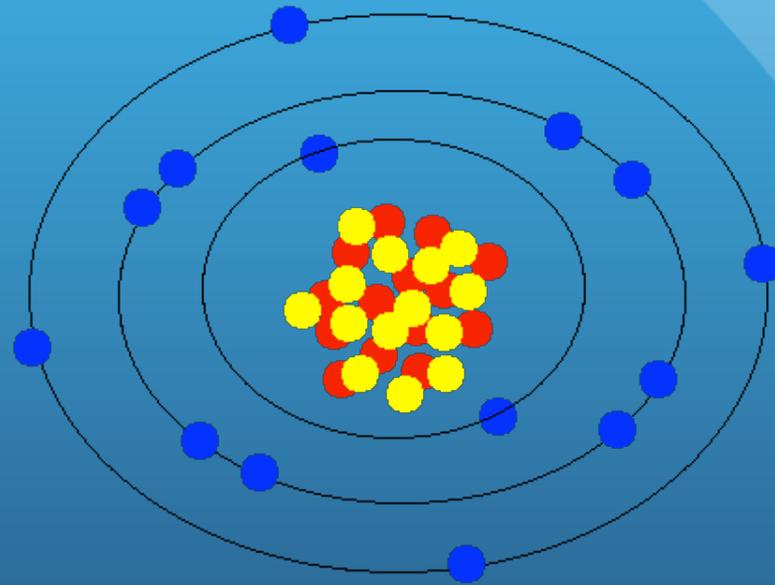
Energy Generation Process



<http://pvcdrum.pveducation.org/CELLOPER/IDEALCEL.HTM>

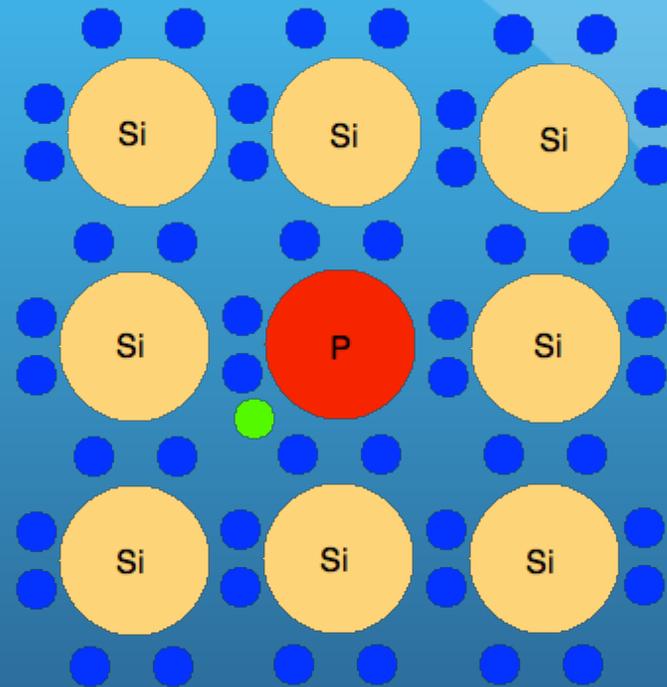
Silicon

- 14 protons, 14 electrons
- Wants 8 electrons in its valence shell
- Shares electrons with neighboring atoms to form the crystalline structure
- Pure crystalline silicon doesn't produce enough free carriers



Impurities

- Introducing impurities into semiconductor material is called “doping”
- Phosphorus atoms amidst silicon atoms
- Boron atoms amidst silicon atoms



Anti-reflection coating

- Silicon is very reflective!
- Energy cannot be used if it is not absorbed by the solar cell.
- Anti-reflective coating is needed to minimize losing photons and therefore improve efficiency
- Other objects that have anti-reflective coating include camera lenses and eyeglasses

Conductors

- Silicon is a semiconductor, so it doesn't carry a current as well as conductors
- Solar cells are lined on both sides with a conductor
- On the sun-facing side, this must be a grid so that light can get through



<http://www.solarenergyeasy.com/solar/>

Efficiency

- Solar panels do not capture all of the energy that hits them
- Photons that hit the panel have different energies, and the electrons require only a certain amount of energy to be freed
- Energy required to move these electrons out of its valence shell is called the BAND GAP ENERGY. This value also determines the voltage of our system.
- Band gap for c-Si silicon is ~ 1.1 electron volts [eV]

Solar Panel Experiment

- Cover the N-type surface of the solar panel
- Hook up solar panels to a voltmeter
- Uncover the emitter surface
- Take measurements
- What are the voltage, current and power?
- How much torque can our magnetic torquer produce with this power source?