Contribution to the photovoltaic part of the SOLSTICE program, specifically the organic photovoltaic (OPV) part.

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- **We have been investigating how to improve the efficiency of the OPV by the addition of a small molecular dopant (in our case, a liquid crystal). The liquid crystals have the ability to self-align. As a dopant, they are hole carriers.**

- **Dr. Salamanca-Riba and I have investigated possible hybrid photovoltaics, with a mixture of ZnO nanoparticles and a liquid crystal, and characterized them structurally (GIXS, and TEM) as well as electrically (an adapted two point probe).**

- **More recently, Dr. Borunda and I have been studying how to convert the liquid crystals into nanowires by physical means through the roughness of the interface between the two principal constituents that participate in the charge separation in the photovoltaic (see Figure 1 and 2 at the right)**
- **Using the knowledge of how the surfaces can be prepared, Dr. Borunda investigates theoretically how the arrangements are such that his theory can choose the two preferred arrangements.**
- **This allows us to observe if the transfer inside the nanowire can arise from the overlap of the p-orbitals in the liquid crystal which can add to the efficiency of the percolating structure due to the polymers in the structure.**
- **Dr. Salamanca-Riba and Dr. Martinez-Miranda will use the techniques mentioned in the last slide, and Dr. Borunda will contribute current-voltage measurements in addition to his work on theory.**
- **The results of this research will serve as the "surface of the earth" results that can be used in Dr. Al-Sheikhly's research.**

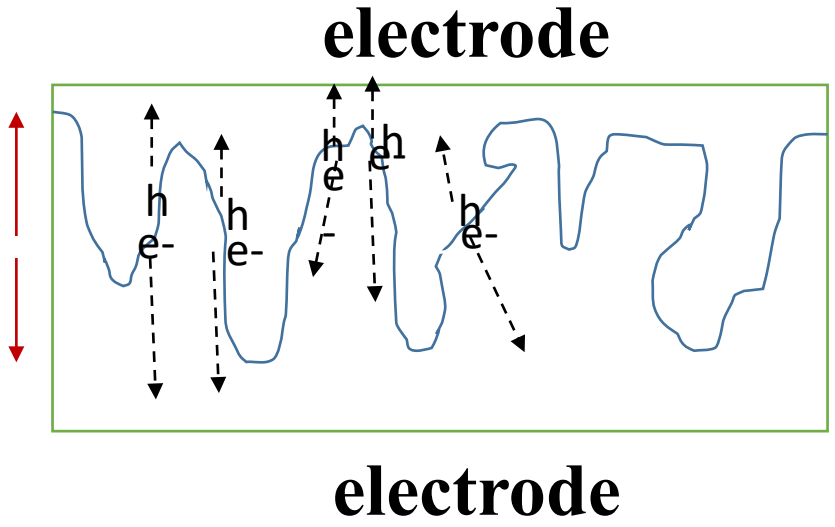

Figure 1. Rough interface (original drawing)

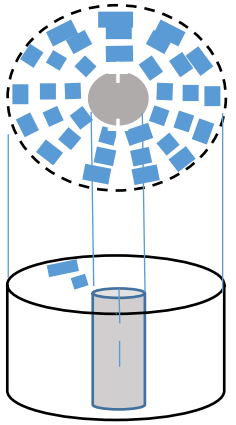

Figure 2. Resulting nanowire (one type) (original drawing)

Space Radiation Environments and Primary Effect

- **Dr. Al-Sheikhly studies what happens to polymer materials in the Van Allen belt or situations that are similar to the Van Allen Belt: is a zone of energetic charged particles, and originated from our sun. These charged particles are captured by the Earth's magnetic field. There are two Van Allen belts with altitude 640 to 5899 km above the surface. The belts are in the inner region of the Earth's magnetosphere. The belts trap electrons, protons, and small contribution of alpha particles and gamma particles (see the regions in Figure 3, and the primary device effect in Table I)**
- **In his studies, he will use polymeric materials which contain phenyl groups to enhance their resistance to ionizing radiation. Also, we will avoid any polymeric materials which contain glycosidic bonds and fluorine atoms on the backbone of their chains. Polymers with glycosidic bonds and fluorine atoms on their backbone undergo scission reactions upon irradiation.**
- **These can help us to choose the appropriate material for the earth experiments.**

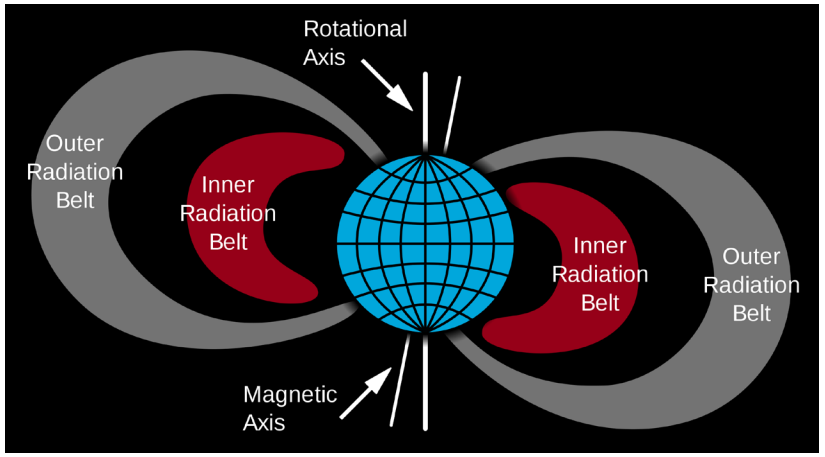

Figure 3. The different regions shown (from NASA)

Table I. Primary device effect of the radiation type

Radiation type	Primary Device Effect
Electrons (Van Allen Belts)	Ionization
Ions: Protons (Solar Flares)	Displacement
Cosmic Rays	Displacement

If we succeed, we will have a method for combining the surface studies and those in space and will have good data that can be combined with theory.

We estimate that this project will take about 4.5 – 5 years, at approximately $190-200K/[(researcher plus Graduate students or postdocs plus materials and equipment maintenance)-year]

The midterm results will consist on looking at the results of Irradiation and comparing it to results in the earth's surface. The final result will consist in looking at a second run and observing if we get consistent results.