Overview of the Capabilities and Technology Thrusts

of the Photovoltaic and Power Technologies Branch

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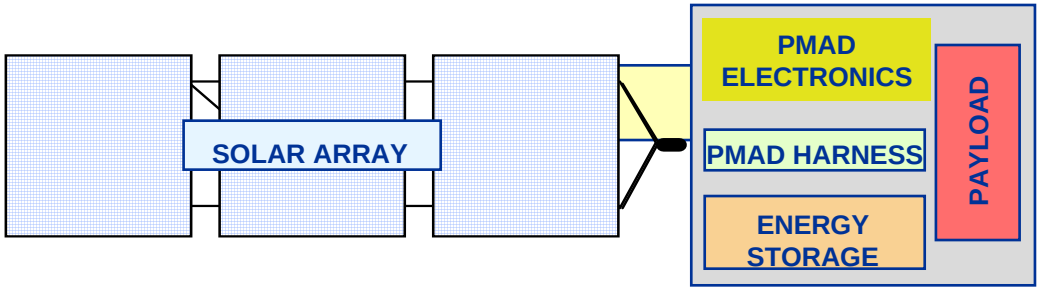
Why do we need advanced photovoltaic technology?

- **In present Earth-orbiting satellites ~ 20 - 35% of total mass and cost is the Electric Power System, the payload is ~ 23%**
- **Advanced PV technology can yield a 50% increase in payload, reduced costs, area, volume, launch cost, launch vehicle, or increased power**



⇧ **Efficiency:** Drives area (A), mass (M), stowage volume (V), and cost

⇩ **Size:** Drives launch vehicle, aerodynamic drag, radar cross-section, attitude control, and cost

⇩ **Mass:** Drives payload fraction, launch vehicle, and cost

⇧ **Lifetime:** Drives mission availability, mission lifetime, and life cycle cost

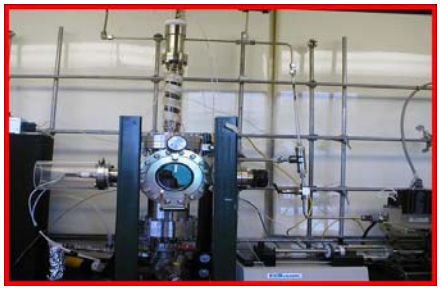
Facilities and Capabilities

Expert physicists, chemists, and engineers with years of cumulative experience. World experts in materials growth, device fabrication, measurement, and characterization at cell and array level, and modeling/measurement of plasma interactions with high voltage arrays. Partners range from Universities, non-profit organizations, small/large businesses, NASA, and the Department of Defense.

Lear 25 Calibration

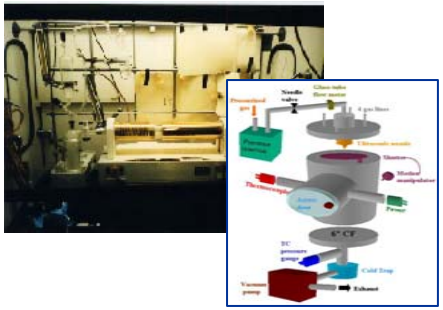
X25 Solar Simulator

OMVPE Reactors



National Plasma Interactions Facility

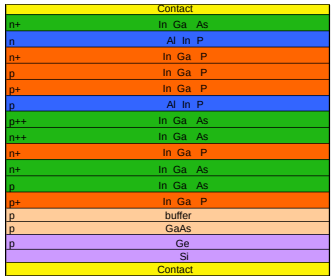
Spray CVD Reactors



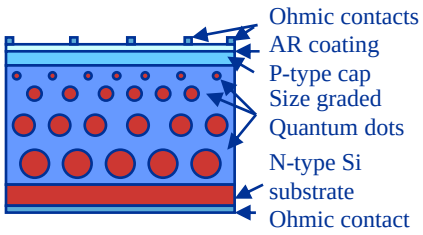
Nano-Structured Materials Characterization

Technology Thrusts

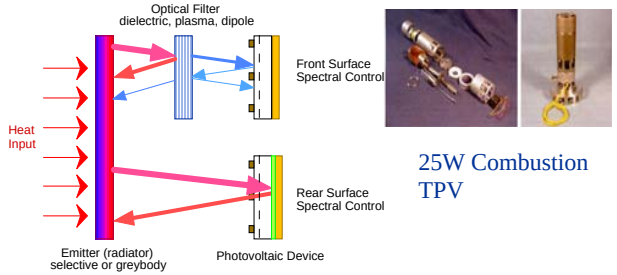
High Efficiency III-V Photovoltaic Development



Nanomaterials and Nanostructures for Space Photovoltaics



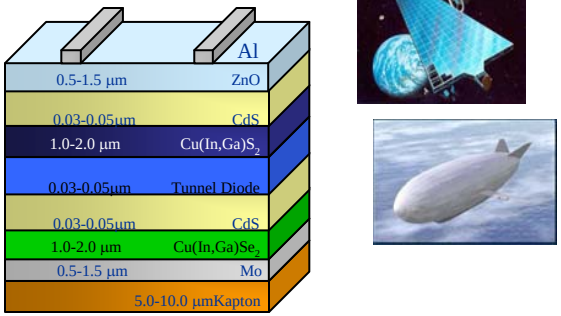
Thermophotovoltaic Technology



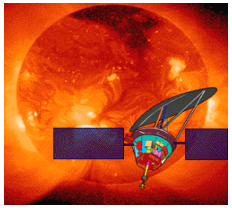
25W Combustion TPV

Solar Cell Measurement and Calibration

Advanced Thin Film Technologies



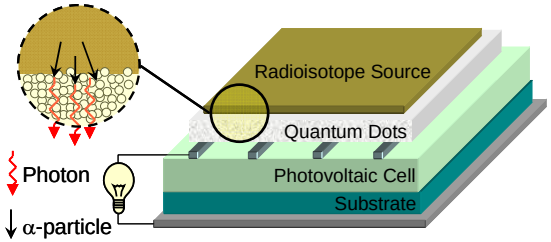
Extended Temperature Solar Cells



Space Power Arcing, Radiation, and Charging

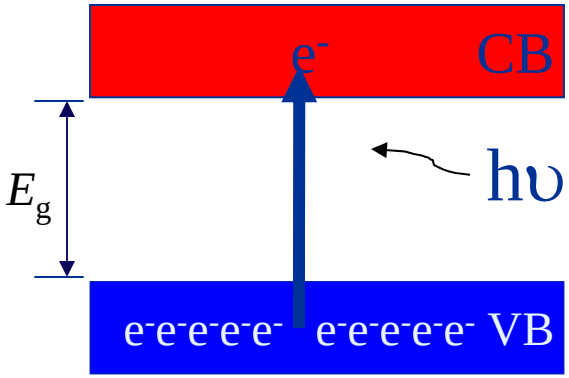
Advanced Blanket and Array Technologies

Alpha- and Beta-Photovoltaics

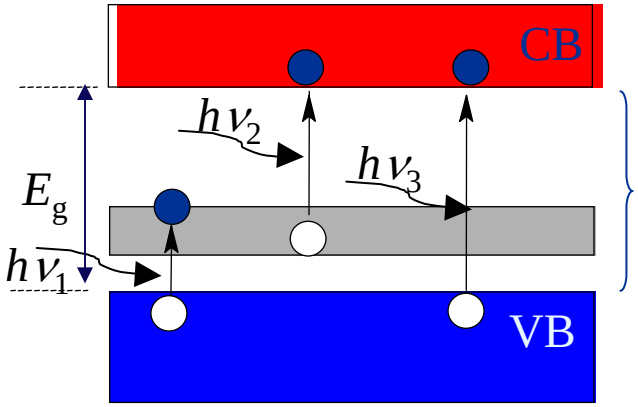


Quantum Dot/Intermediate Band Solar Cells

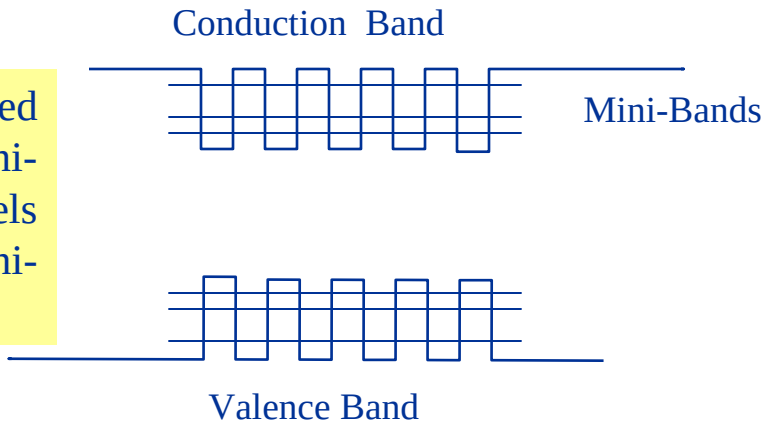
Single Junction Solar Cell
Theoretical 1 sun efficiency = 31%



Intermediate Band Solar Cell
Theoretical 1 sun efficiency = 63%

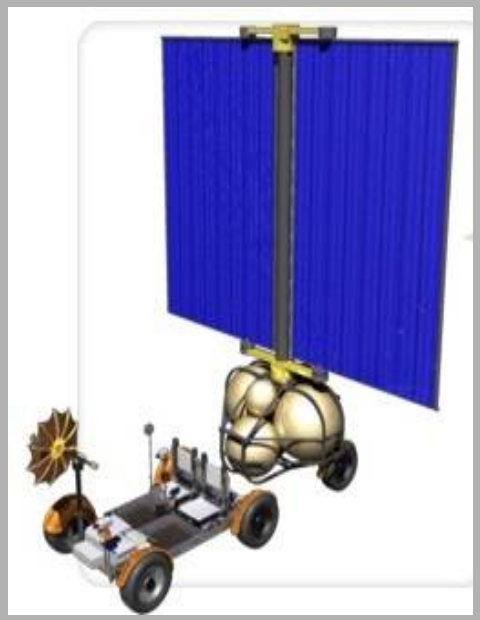


Quantized electronic states within a coupled QD array form new energy bands or "mini-bands". These discrete-like energy levels form within the QD bandgap. The mini-band levels depend on the size of the QD.



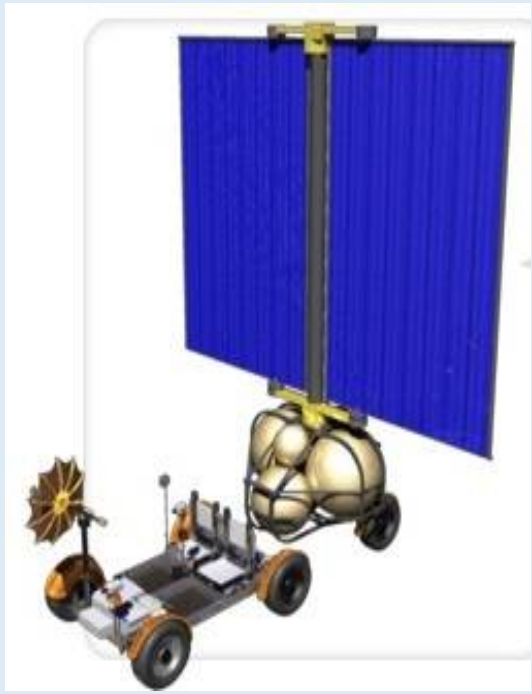
- Superlattice leads to formation of IB within bandgap of host material. Three-level absorption improves efficiency.

Polycrystalline III-V Thin Films for Lunar Surface Power



222 kg Solar Array
3 x 19.6m
6.5 kW daytime power

SPU (std power unit) from LAT study



188 kg Solar Array
3 x 31.4m
6.5 kW daytime power

SPU with 20% efficient poly III-V MJ
- 15% mass savings for same power
- Taller array for potentially shorter shadow periods
- Roll up array for eased stow/deploy cycling