# Eye Safe IR Power Beaming to GaSb CPV Modules

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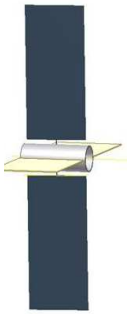
## Dream Concept for Space Power Satellite with IR Power Beaming

Solar Power Satellite
Scale up design with 20 kW laser and 40 kW solar array.
PV array span 34m
Cooling radiator span 24m
Laser Tube 3m diameter by 8m long



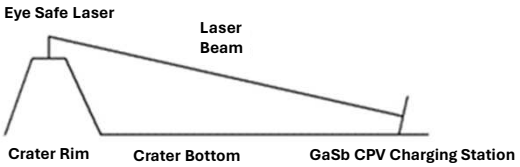
Imagine a center body with two 20 kW CPV wings with gimbals.

A 20 kW laser is inside the center body with cooling panel on the sides. The axis is NS.

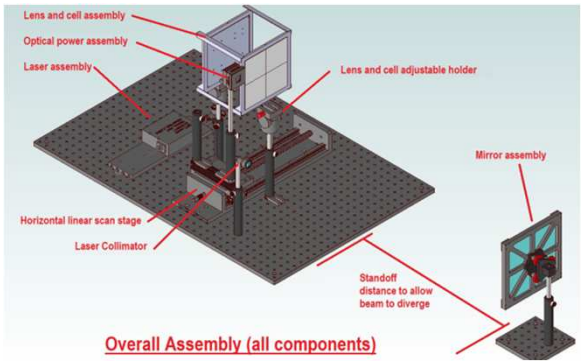
The Advantages of IR Power Beaming compared to microwave is a smaller ground site diameter and thence the ability to start with MWs or actually kWs and a much lower cost to develop.

| *Paul Jaffe at NRL | Microwave | Laser |
|---|---|---|
| Transmit frequency (Wavelength) | 5.8 GHz (5.2 cm) | 1.5 microns **(eye safe)** |
| Transmit Aperture Diameter in GEO | 1 km | 2.5 m |
| Receiving Aperture Diameter on the ground | 3 km | 40 m |

## Laser Power Beaming to Permanently Shadow Regions on the Moon



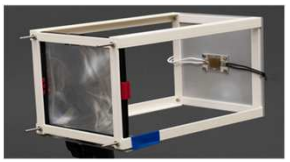

## Laser Power Beaming Test Setup




Overall Assembly (all components)

4 Acrylic Lens GaSb Laser Converter Module

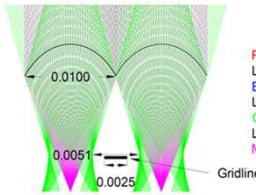
| Summary of Array of Four 8cm x 8cm Acrylic Lenses CPV Module Performance | |
|---|---|
| Laser Power at Lens Plane | 38 Watts |
| Laser power Intercepted by Lenses | 36 Watts |
| Laser Power at Lens Focus | 29 Watts |
| Electrical Power Out | 9 Watts |
| | |
| Lens Optical Efficiency | 80.6% |
| Cell Efficiency | 31.0% |
| CPV Module Efficiency | 25.0% |
| | |
| Cell Quantum Efficiency | 71.9% |
| Cell Fill Factor | 70.0% |

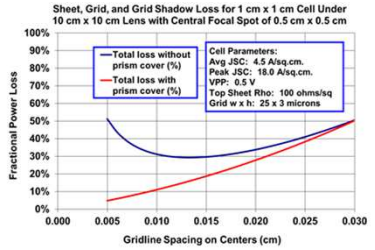


1 Silicone Lens GaSb Laser Converter Module

| Summary of 10cm x 10cm Silicone Lens CPV Module Performance | |
|---|---|
| Laser Power At lens Plane | 9 Watts |
| Laser Power Intercepted by Lens | 6.5 Watts |
| Laser Power at Lens Focus | 6 Watts |
| Electrical Power Generated by Cell 5-13 | 1.8 Watts |
| | |
| Lens Optical Efficiency | 92.3% |
| Cell Efficiency | 29.8% |
| CPV Module Efficiency | 27.5% |
| | |
| Cell Quantum Efficiency | 71.9% |
| Cell Fill Factor | 69.2% |

## Performance Improvements from Present Silicone Lens Test to Future Flight System



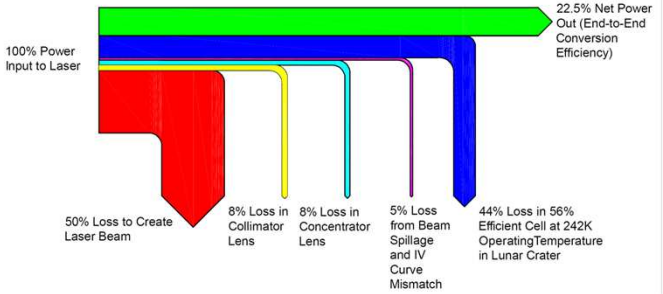




Prismatic cover slides will offer improvements to the cell's efficiency.

- The cover slides will minimize grid shading by concentrating the laser light onto the active area, improving external quantum efficiency.
- The cells will have more and closer grid lines which will reduce series resistance, improving fill factor.

| | Test | Improvements |
|---|---|---|
| **External Quantum Efficiency** | 72% | 95% |
| **Fill Factor** | 69% | 80% |
| **Room Temp Efficiency** | 30% | 46% |

## Sankey Diagram for One Laser per One Lens per One Cell System with 100 Elements (**22.5% End-to-End**)

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