



***A space solar power station enabled by HIVE  
architecture: A conceptual study***

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# Background

*Japan, China, Russia are actively pursuing a 1 GW system by 2050.*

- Space Solar Power History: The earliest known mention of wireless power transmission is accredited to Nikola Tesla, who discovered wireless radio. Tesla, speaking to the American Institute of Electrical Engineers in 1881, said,  
  
"Throughout space there is energy. If kinetic, it is a mere question of time when men will succeed in attaching their machinery to the very wheelwork of nature."  
  
• The concept of a large "solar power satellite" that would be placed in geostationary Earth orbit (GEO) to collect sunlight and generate an electromagnetic beam to transmit energy to Earth was invented by a Czech-American, P. E. Glaser, *Science*, 22 November, Vol. 162 (1968) pg. 857
- Other studies on space solar power station
  - "Concept Design", 1979 -GEO
  - "Sun Tower" 1995 – LEO
  - "Solar Disc" 1997 – GEO
  - "ISC" 1998 – GEO
  - "Sun Sail" – 1999 – GEO
  - "Tethered SSPS" – 2001 – GEO
  - "Alpha" – 2012 – GEO
  - "OMEGA" – 2016 - GEO

***All these concept studies require very large space systems with mass measured 2000 – 70,000 metric tons.***



# Background

*Design by modularizing and applications beyond use on Earth*

## Modular, Reconfigurable, High-Energy Technology Development

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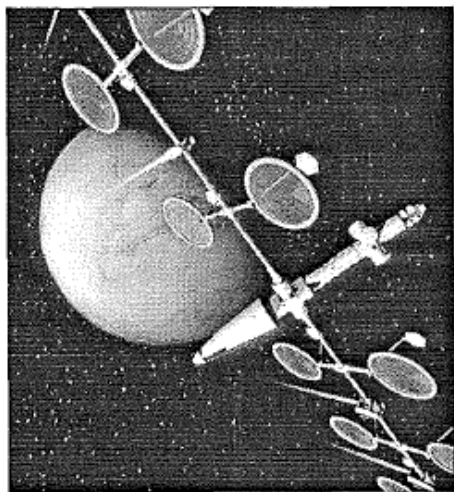


Fig. 1 Solar Clipper Transport Concept

C. Carrington and  
J. Howell IEEEAC  
paper # 1 1 18 ,  
Version 1,  
October 20, 2006.

- Application examples beyond use on Earth
  - In space depot for charging of space-service vehicles,
  - Provide wireless charging to “ailing” space systems,
  - Power to support in space “cloud” computation for orbiting satellite use,
  - In lunar orbit to provide power on the moon.



# ***HIVE: A modularized space construct based on a functional “unit cell”***

*What would spacecraft/systems look like if the space era started TODAY?*

- We have witnessed major advances in microelectronics, robotics, photonics, advanced materials and manufacturing, and AI/ML since Sputnik,
- HIVE:
  - *an Aerospace new space architecture concept*
  - *commenced 4 years ago to address the following needs, resiliency, adaptability, upgradeability.*
- HIVE encapsulates the technology advances and couples it with architecture borrowed from cellular biology
  - *to form a mass producible, self-functioning, satellite unit,*
  - *that can connect to other units to form, constructs large and small.*



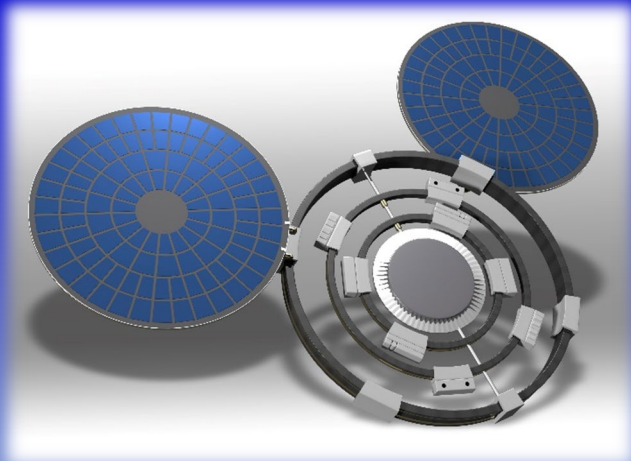
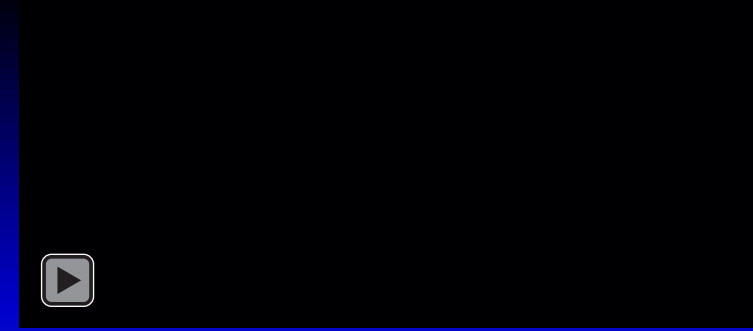
***The HIVE concept relies on developing a mass producible, self functioning module, the cellular unit.***



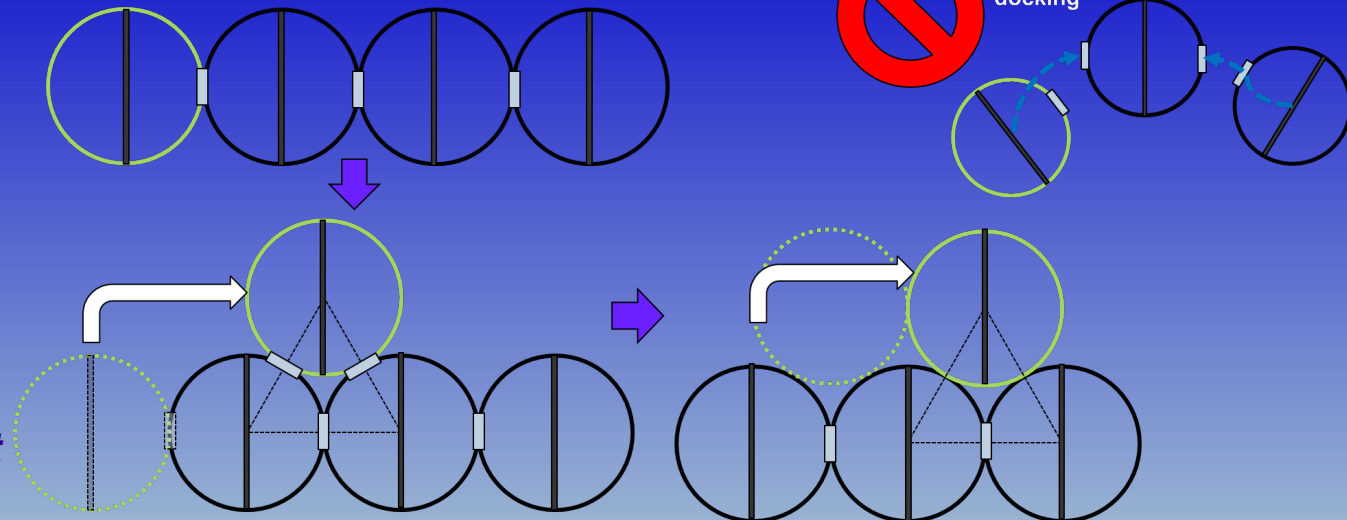
# **HIVE: A nested ring structure as the basis for a unit cell**

*A mass producible unit to increase reliability, open structure to minimize heat transfer*

- The rings are powered tracks for the mobile “trams”.
- Trams move sensors, make connections
  - *Outer-ring trams have graspers to connect to other ring units.*
  - *Inner-ring trams are payloads (e.g., sensors).*
- Standard spacecraft subsystems (e.g., computer, batteries, reaction wheels, ...) are housed in the center called the core.
- Outer ring can be 30 cm or 4 m.



The Satellite: A series of interconnected rings

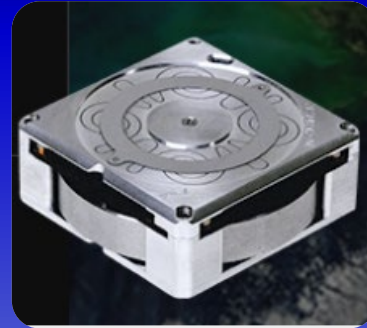


**HIVE units share power, data and in the future propellant**

# Full body 3D simulation of dynamics



Monitor reaction wheel torques, geometric constraints, maneuver times → Develop CONOPS



Based on Blue Canyon Reaction Wheels (RWP100)	
Volume	70x70x25 mm
Max Torque	0.007Nm
Momentum	0.1 Nms
Mass	0.35 kg

*All motion via angular momentum control*