



Deployable Solar Array Developments at Opterus

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Thomas Murphey

CEO and CTO
tmurphey@opterusrd.com
(505) 250-3006

Erik Pranckh

Director of Business Development
erik@opterusrd.com
(440)840-2490

Opterus Introduction

- Advanced structures company in Northern Colorado
- Focus on deployable structural systems and architectures
- Rapidly advancing several mid-TRL technologies
- Technical Contributors:
 - Levi Nicholson
 - Daniel Hunt
 - Michael Folkers
 - Patrick Rodriguez

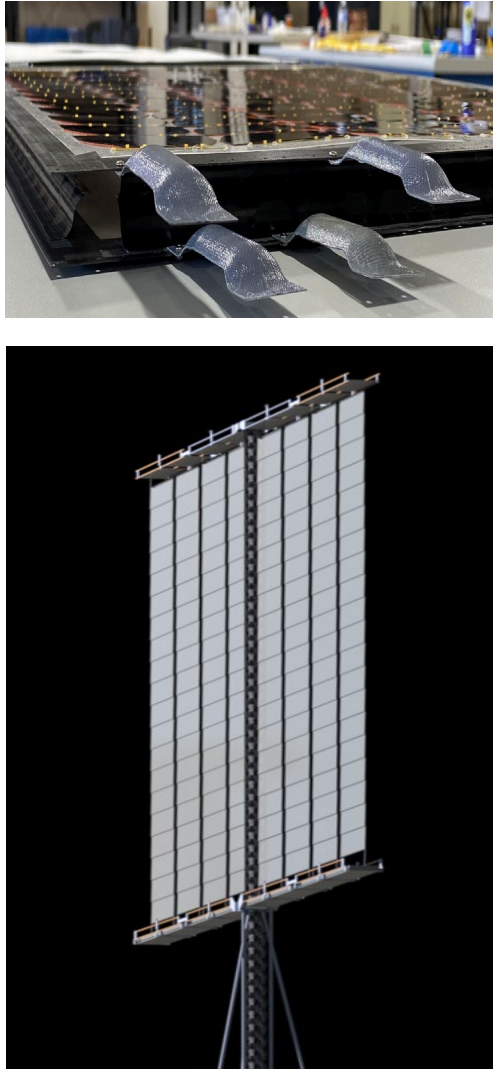


Product Area

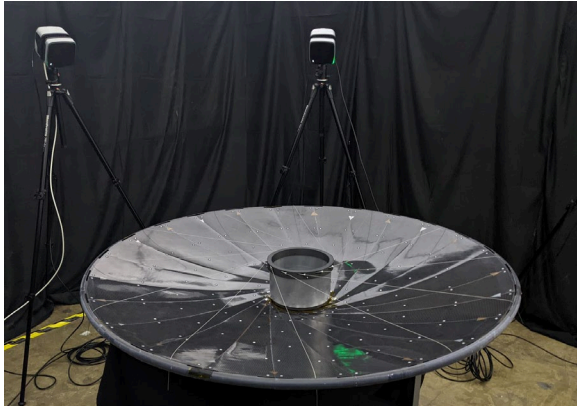
Booms & Hinges



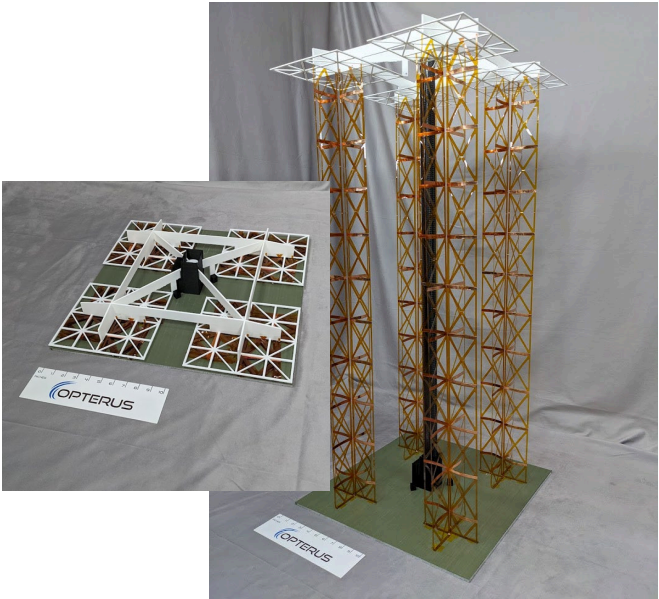
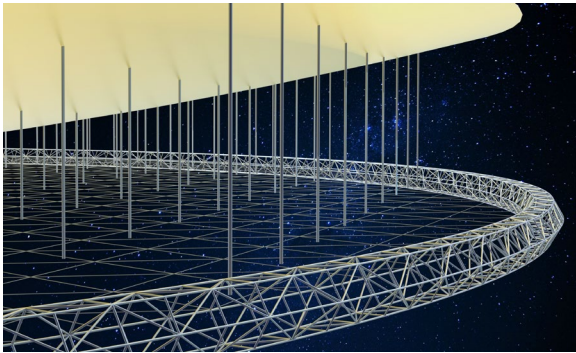
Solar Arrays



RF Systems



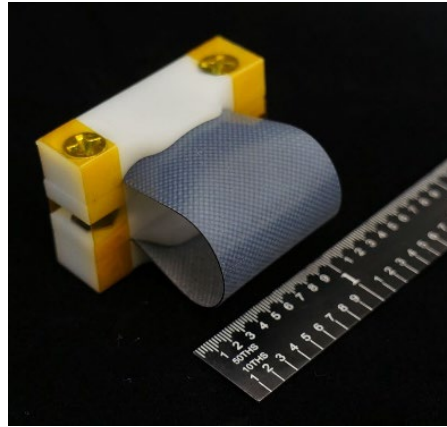
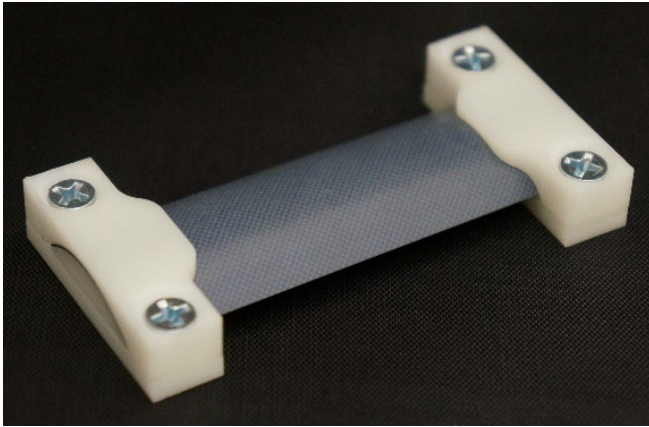
OSAM



Patented or Patent Pending

Core Material Technology: HSC (high strain composites)

Hinges



2x higher strain

8x stiffer in bending

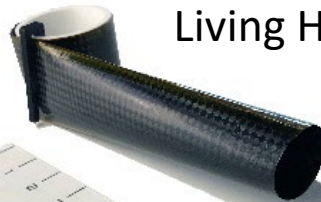
5x lighter weight

20x lower CTE

Slit Tube



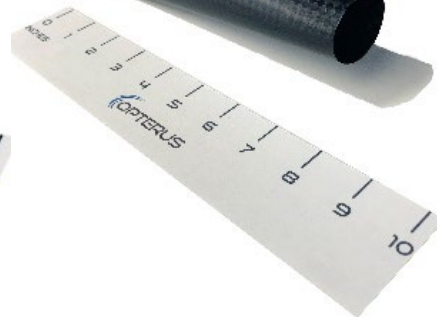
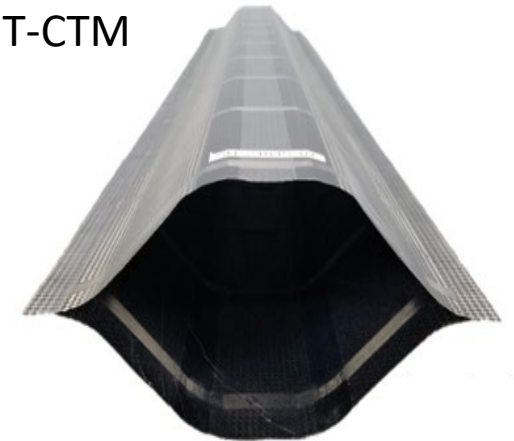
Living Hinge



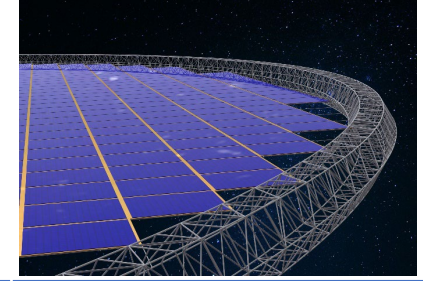
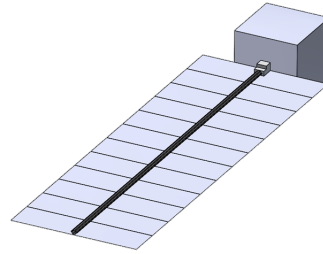
CTM



T-CTM



Solar Array Product Summary



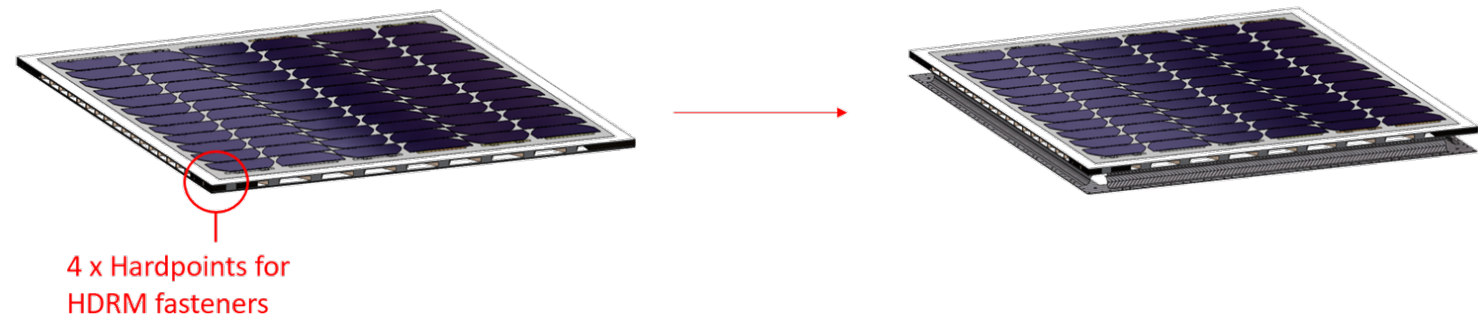
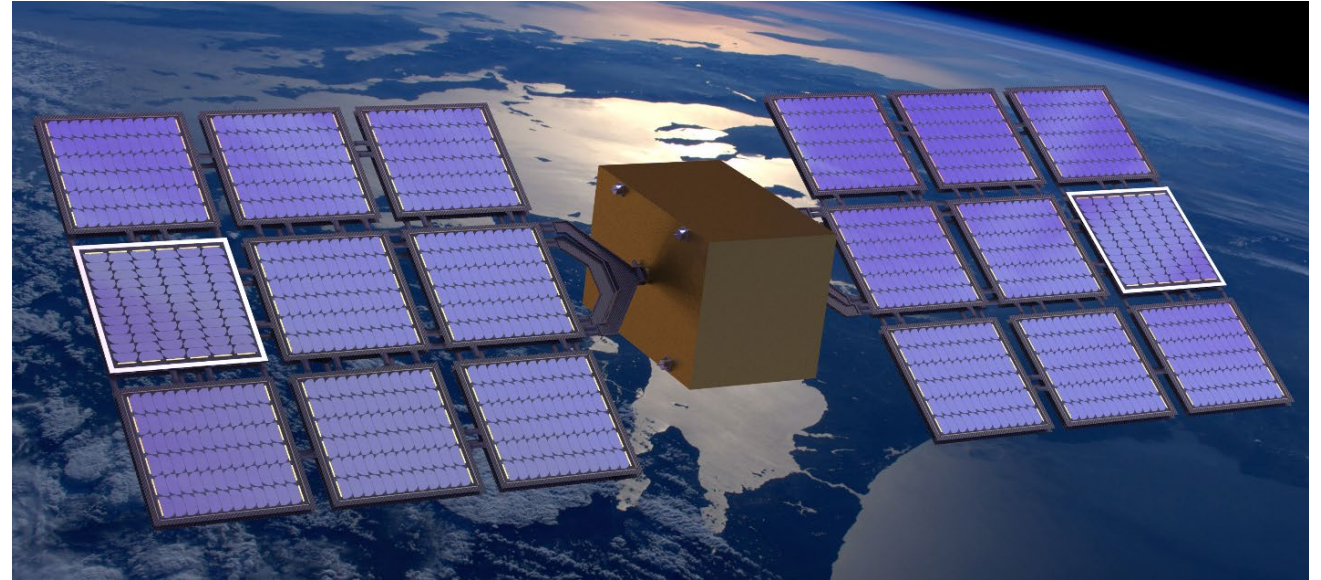
Feature	MOSSA	CCX	R-ROMA	TAD
Architecture	Folded Panel	Z-Folding H Blanket	Z-Folding H Blanket	Tension Aligned Disc
Packaged Form	Pizza Box	Rectangle Stacks	Parallel Stacks	NA (OSAM)
Deployed Size (up to)	3 x 3 m	10 m	10 x 30 m	200 m diameter
Stiffness	High	Low	Medium	Low
Cost / Watt	Medium	Low	Medium	Low
Power (up to)	3 kW/wing	5 kW/wing	100 kW/wing	5 MW
TRL	4	3	4	2
Target Application	Agile high power smallsats: AESA, SAR	Solar electric propulsion	Large solar electric propulsion, lunar surface power	Space solar power, power as a service
Retractable?	No	Yes	Yes	No

Modular Self Stiffening Array (MOSSA)

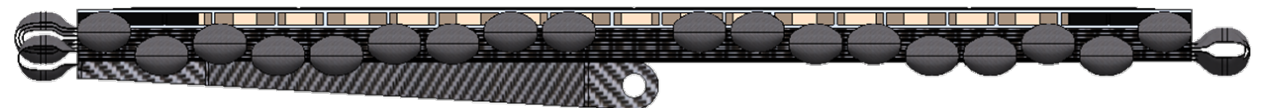
- High stiffness for precision pointing & rapid slewing
 - Expanding thickness in panel cross-section enables high stiffness
- Modular and Reconfigurable
 - Designed for ESPA scale spacecraft
 - 300W - 3 kW
 - Panel sizes between 0.34 - 1 m²
 - Larger if ESPA volume can be exceeded in 1-axis
 - Configurations from 3 - 9 panels
- 9-panel, 1kW ESPA-standard wing estimated performance:

Specific Power: 153 W/kg

Power Density: 158.17 kW/m³

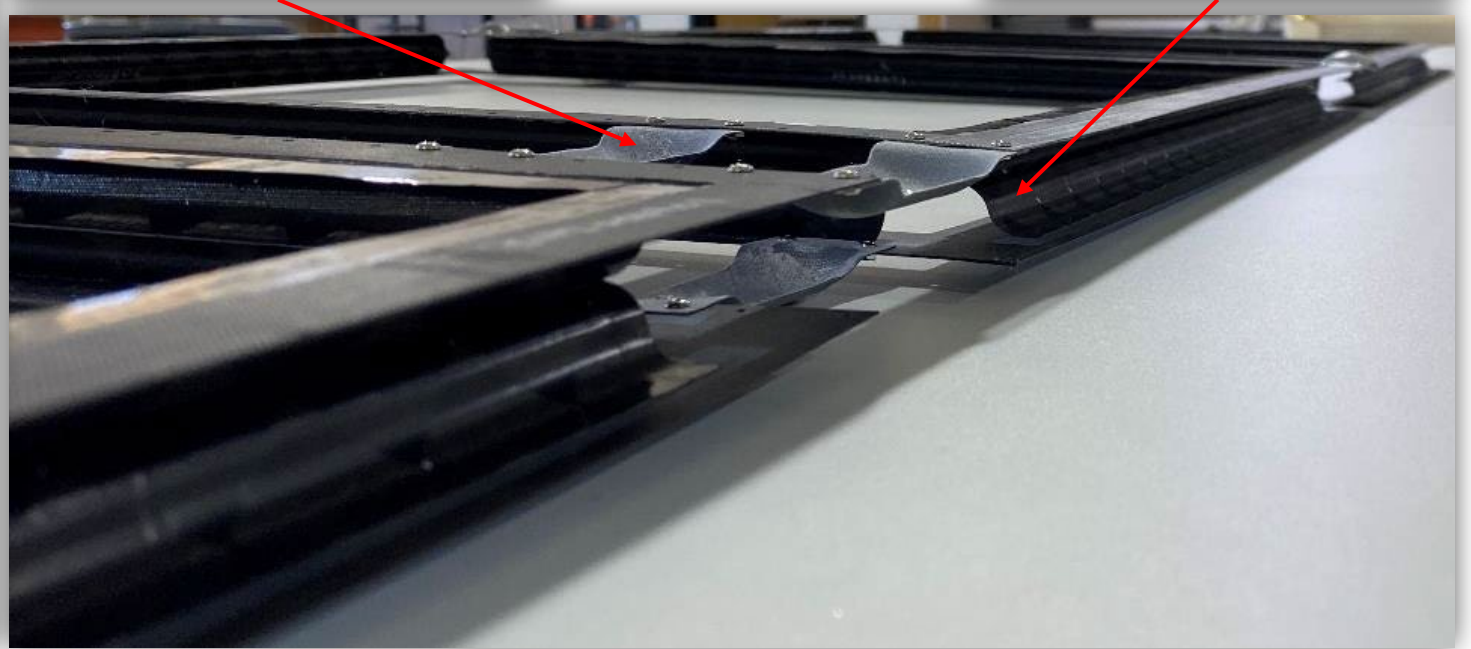
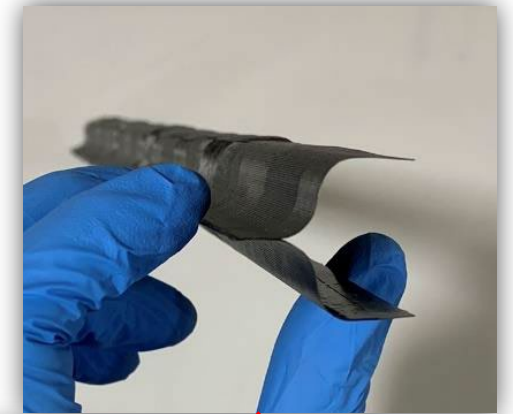


Patent Pending

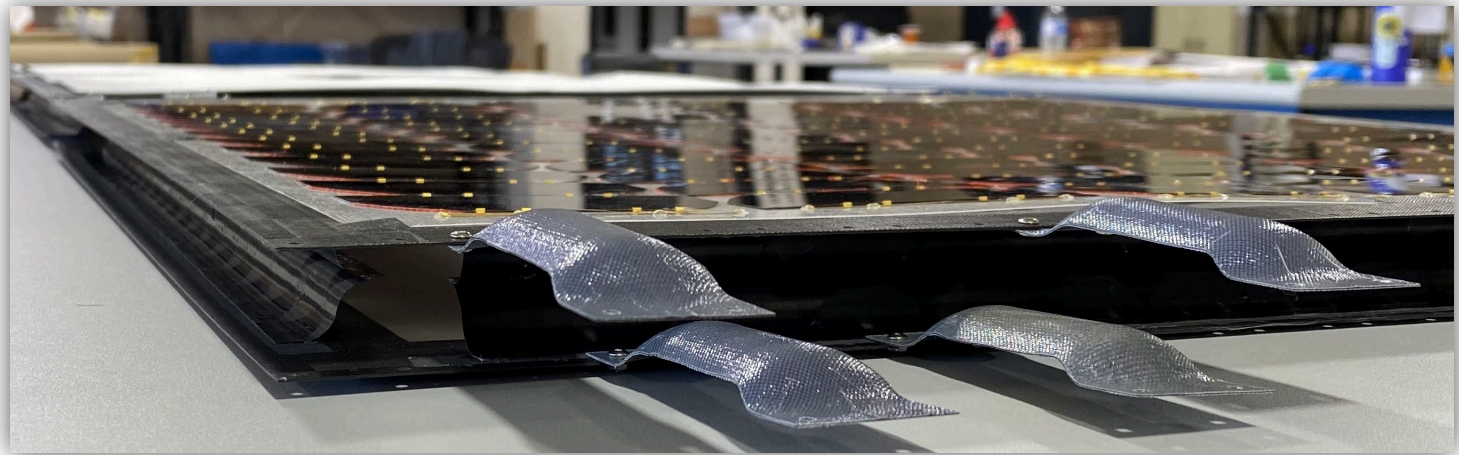




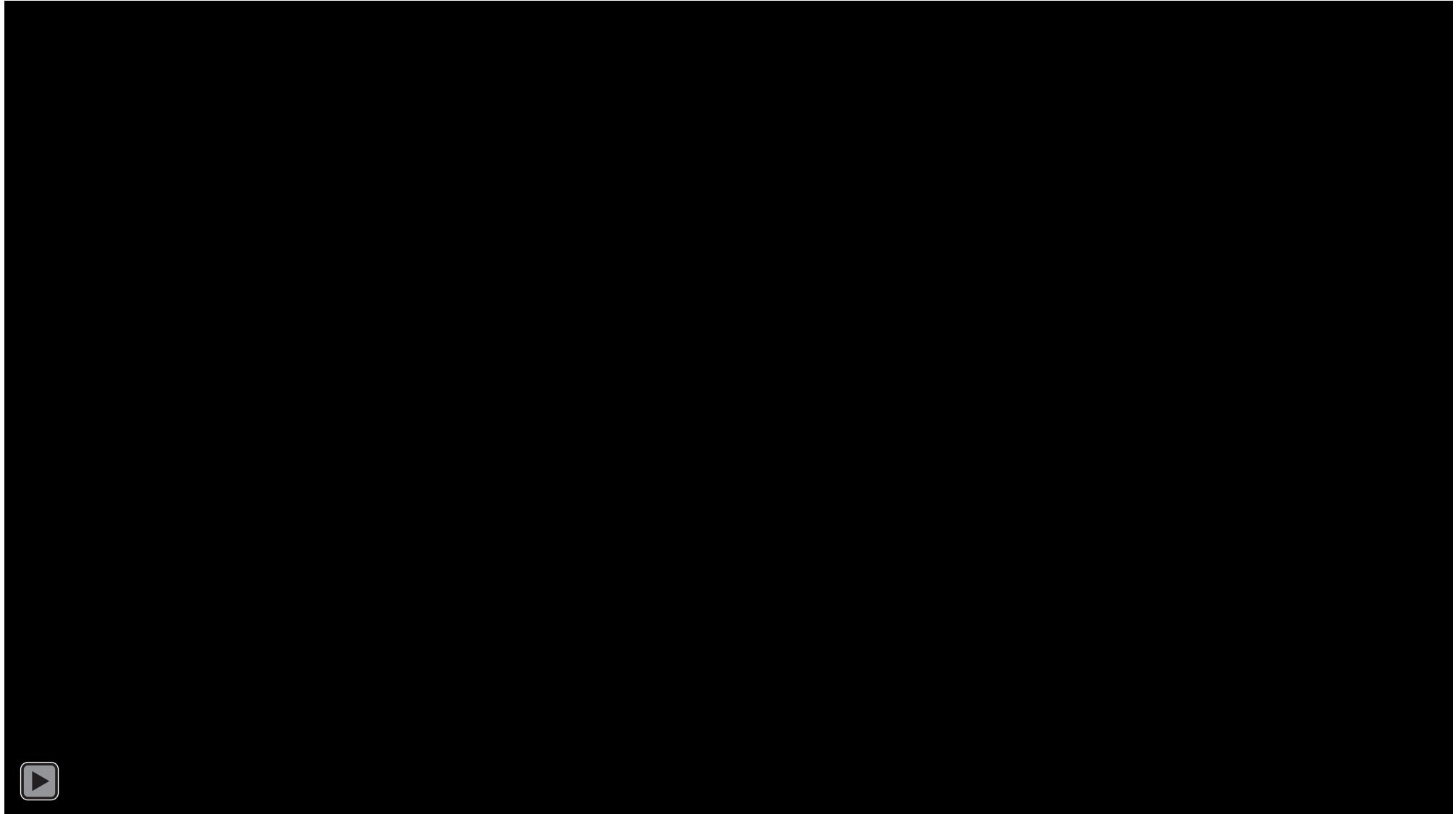
MOSSA Prototype



MOSSA Prototype



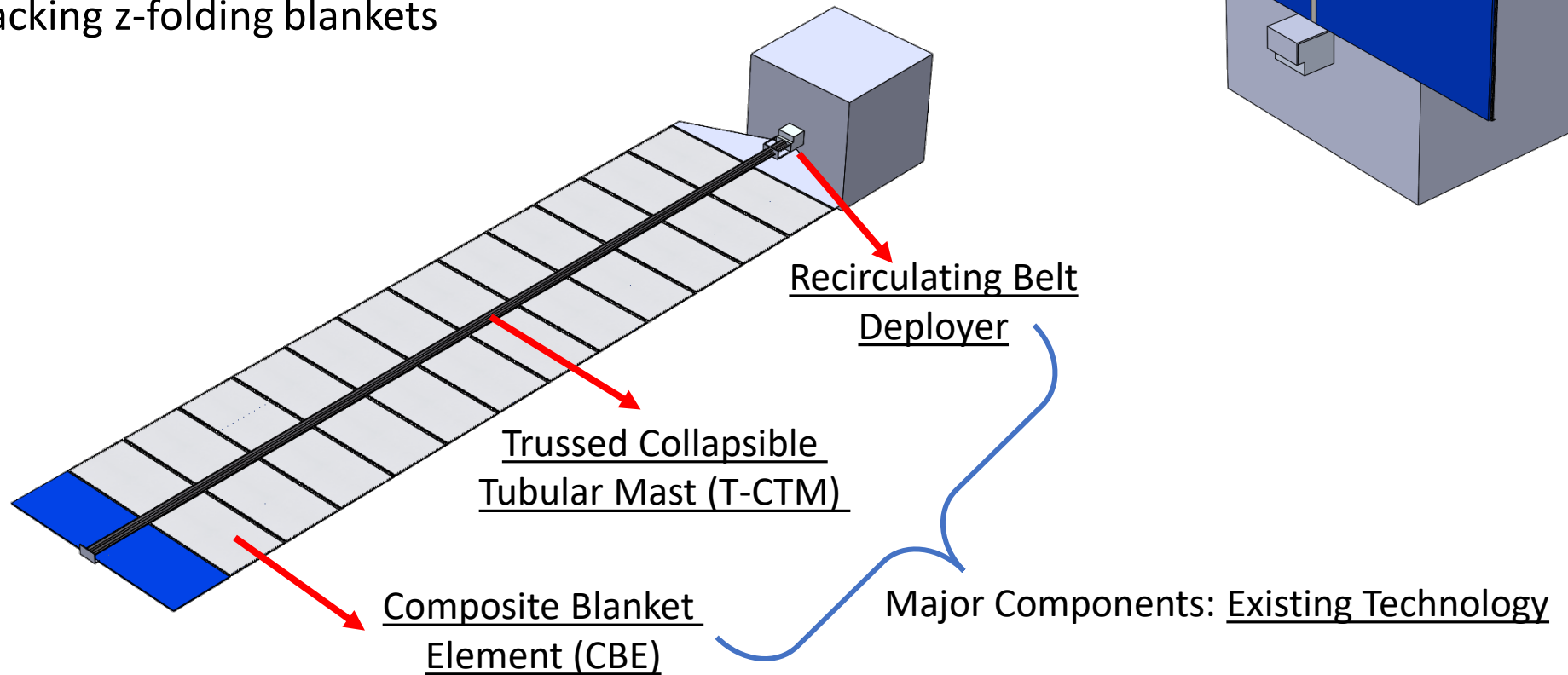
MOSSA Prototype Deployment



CCX Array Overview

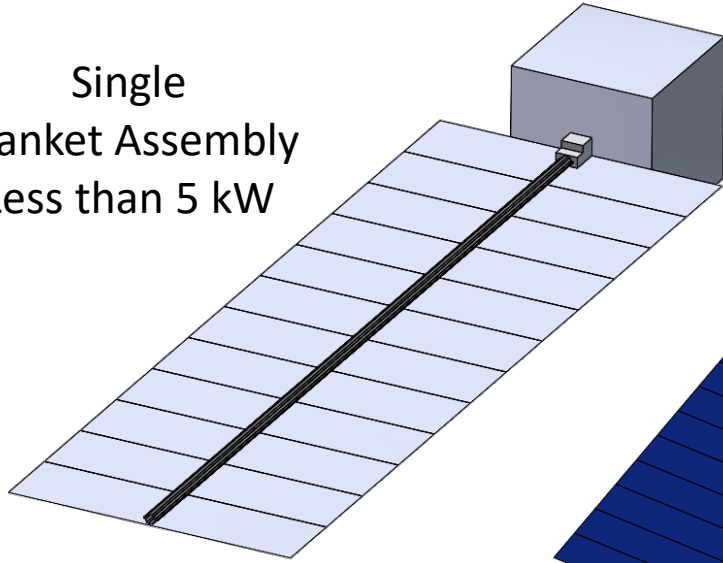
Closed Cross Section (CCX) Array

- Trussed CTM Backbone
 - Driven by Recirculating Belt Deployer
- Low cost / high volume manufacture
- Compact, thin stacking z-folding blankets

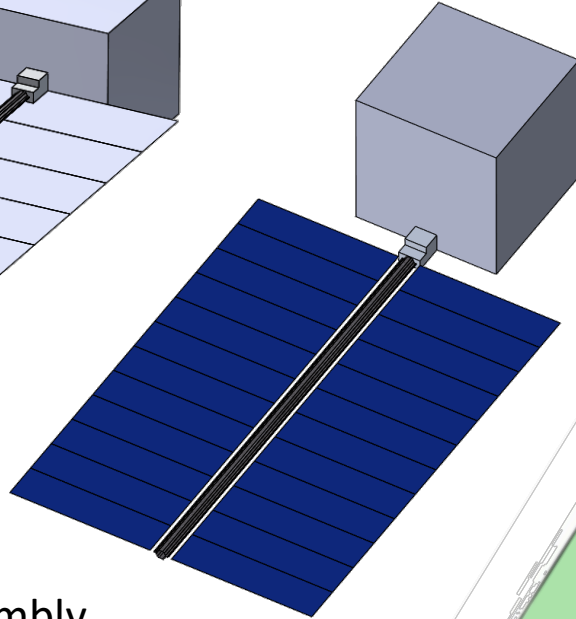


CCX Array Scaling to R-ROMA

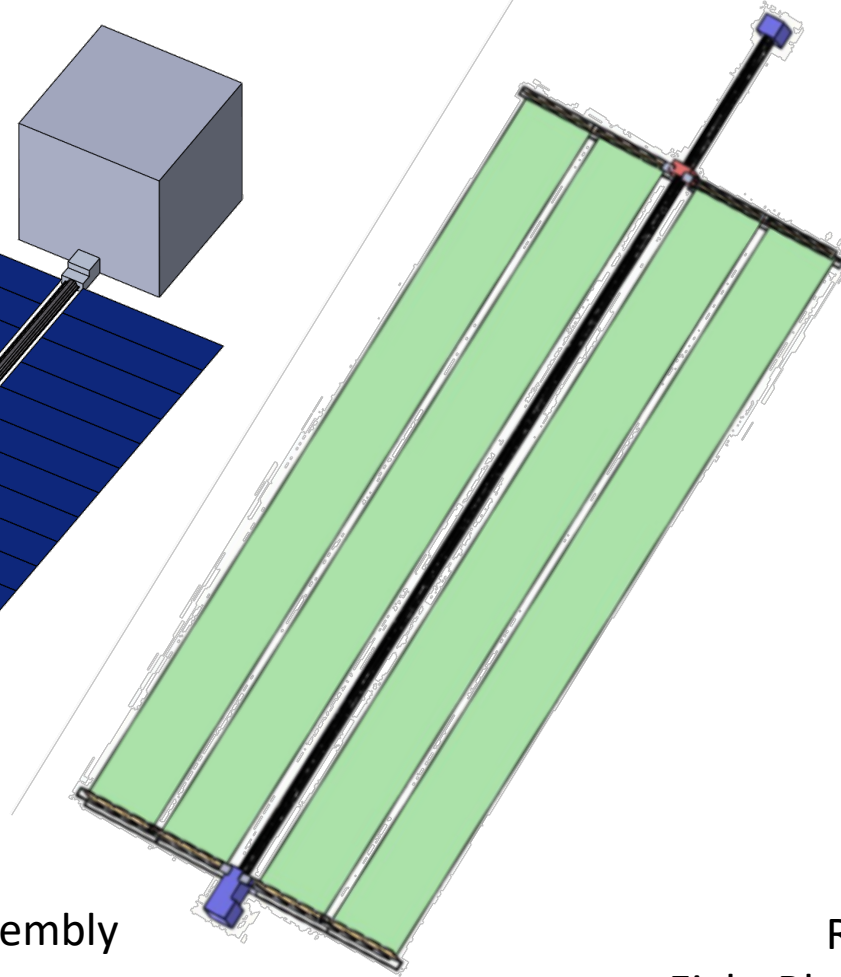
Single
Blanket Assembly
Less than 5 kW



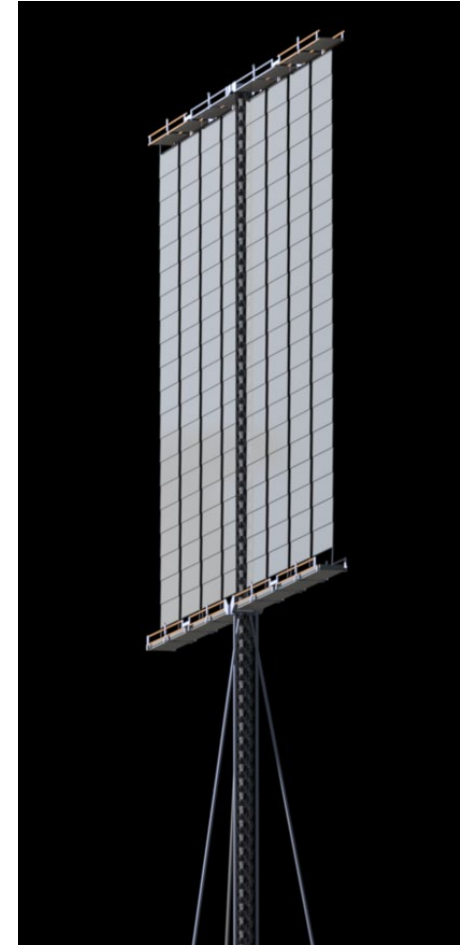
Double
Blanket Assembly
5-10 kW



R-ROMA
Quad Blanket Assembly
10-20 kW



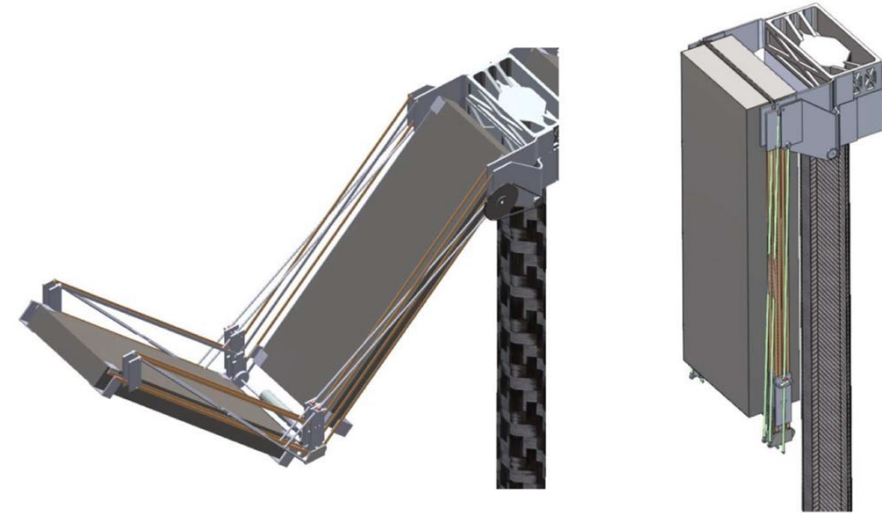
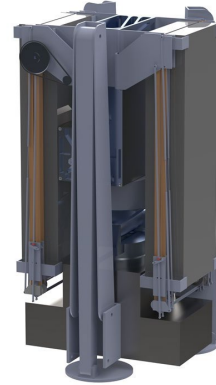
R-ROMA
Eight Blanket Assemblies
20-40 kW



R-ROMA

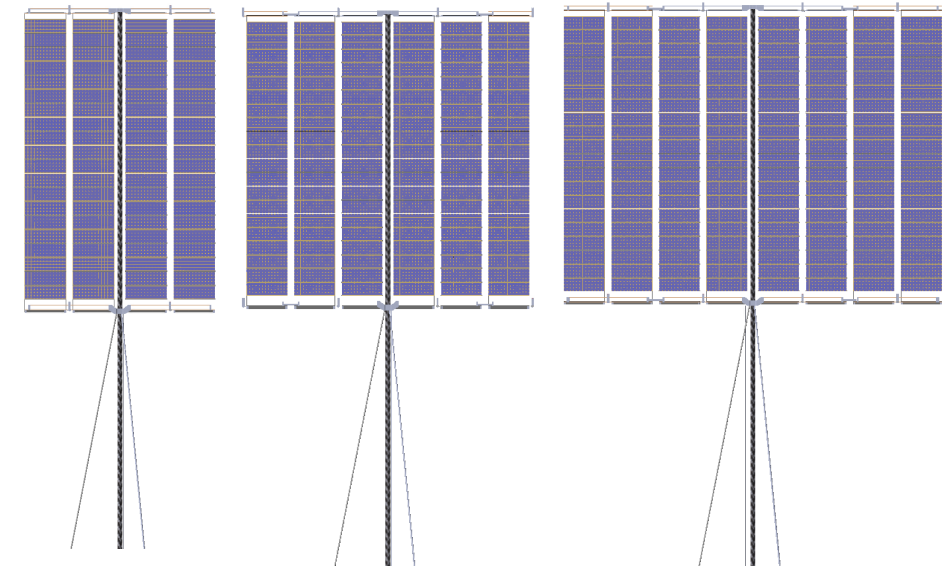
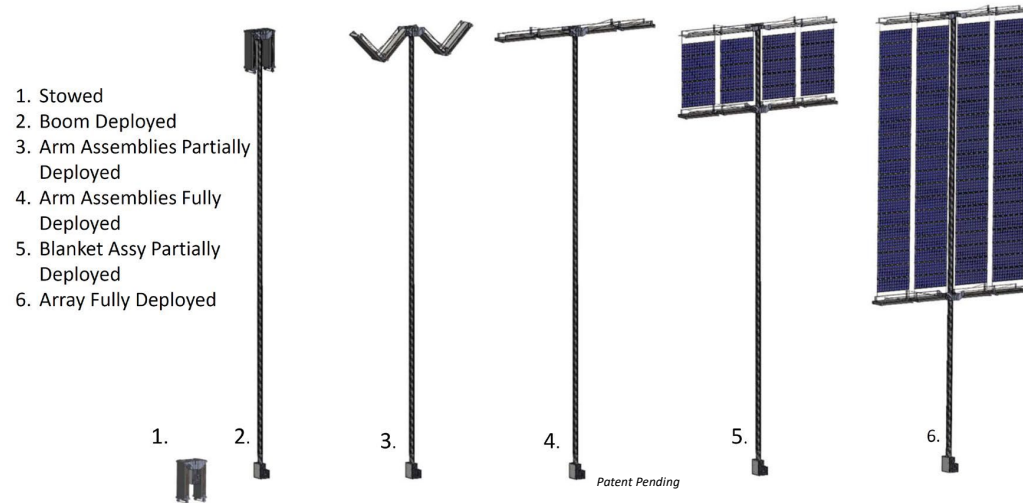
Retractable – Rollable Mast Array (R-ROMA)

- Very large, high-power missions
 - Greater than 10 kW
 - Up to 10 m x 30 m
- Double Z-Fold
 - Z-folded blanket
 - Z-folded arms
 - Arms form trusses
- Both deployments reversible for retraction



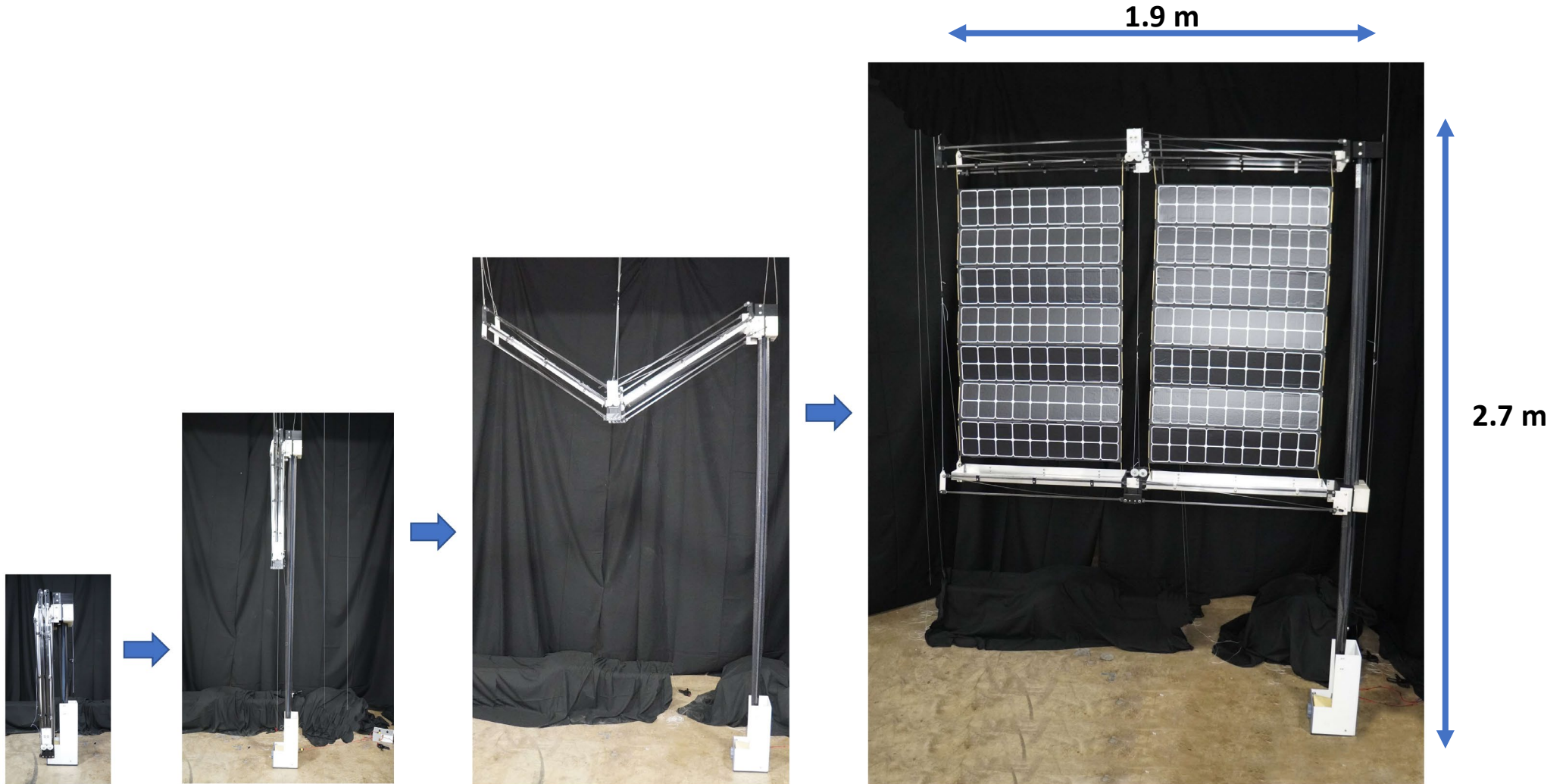
Partially Deployed

Stowed



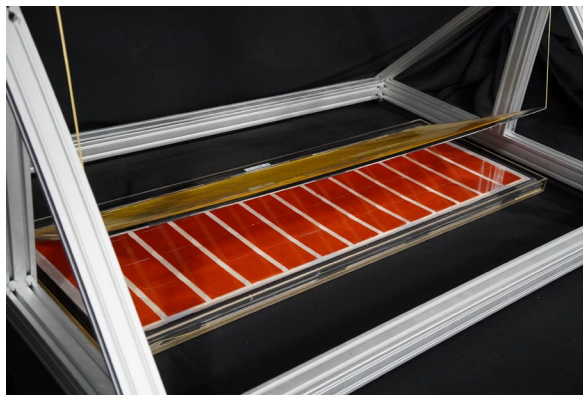
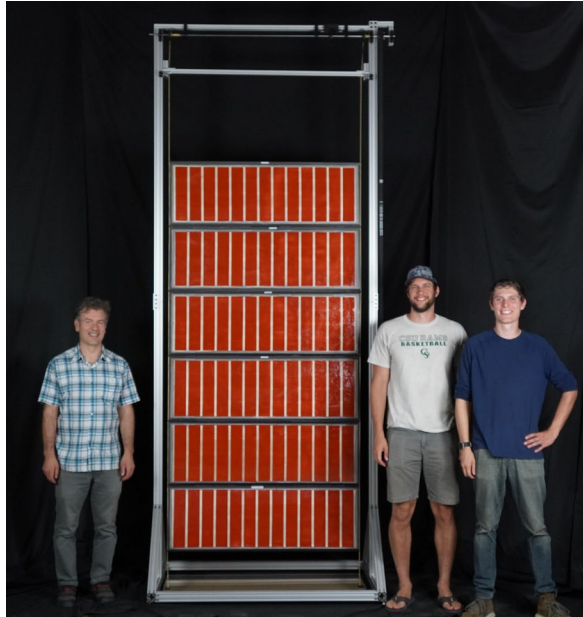
4, 6 & 8 blanket configurations

R-ROMA Prototype Assy – Deployment Sequence

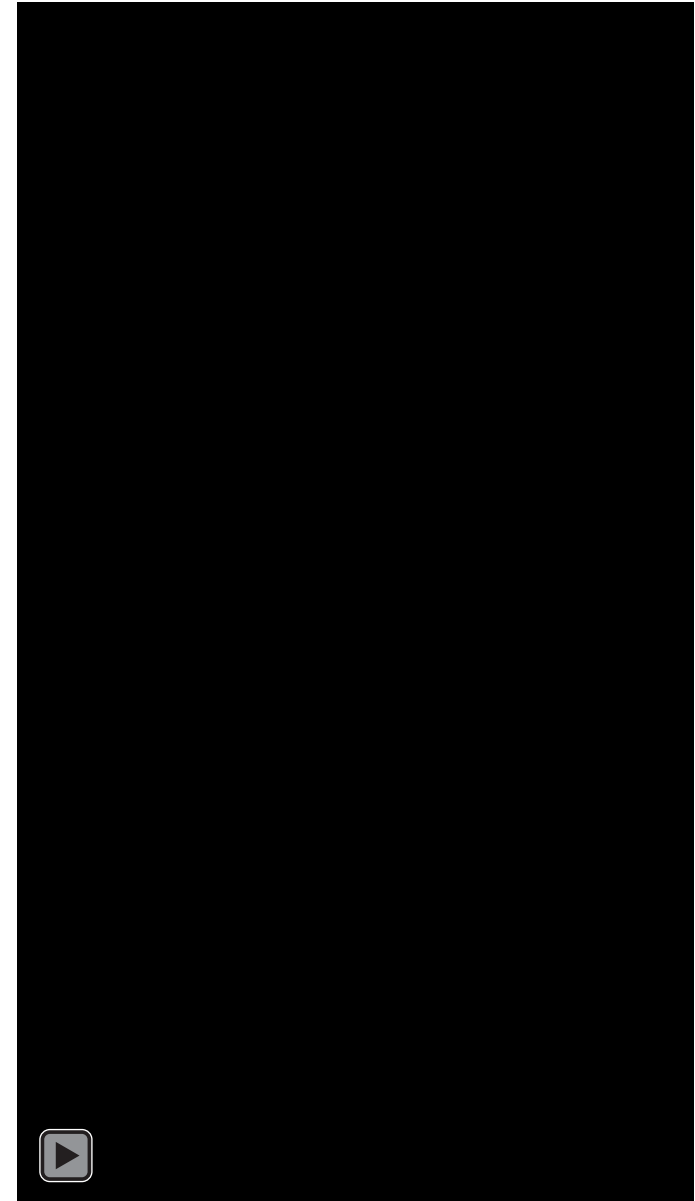


Composite Blanket Elements Deploy & Retract

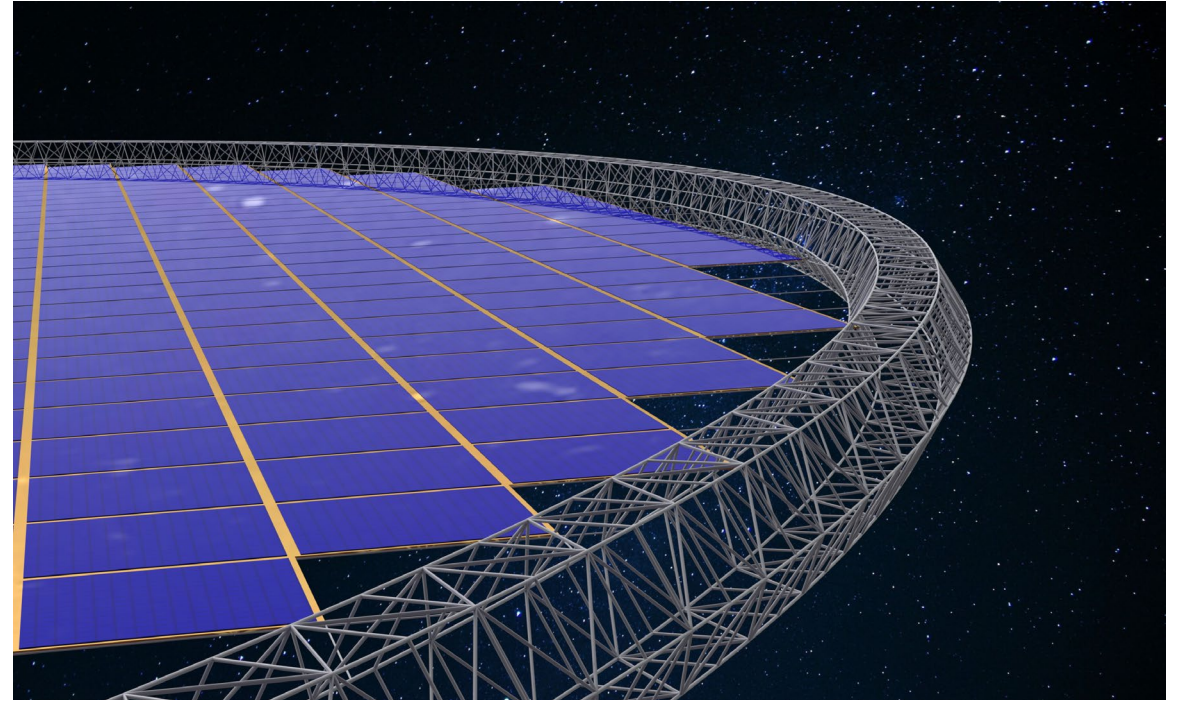
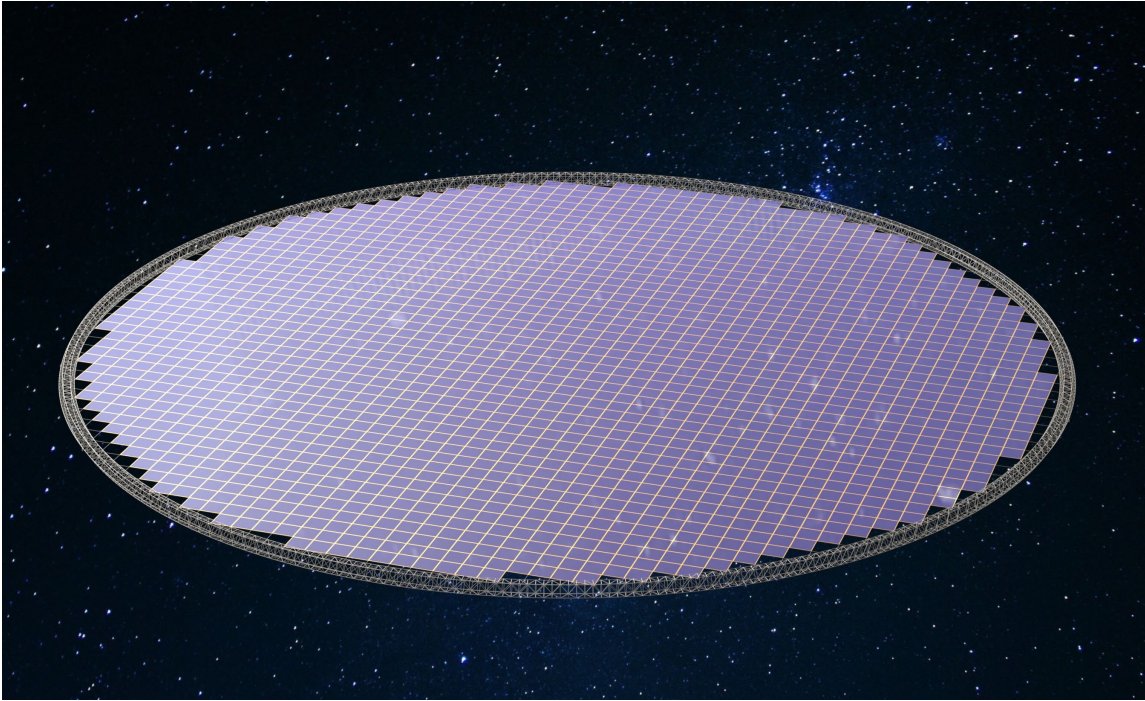
- Blanket Specific Power: **298 W/kg**
- Blanket Specific Volume: **150 kW/m³**



Patent Pending



Tension Aligned Disc Solar Array



- 200 m diameter
- In-space assembly and manufacturing technologies
- Ultra mass efficient architecture and high-performance tubular truss
- Less than 3% structural mass fraction



Questions?

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