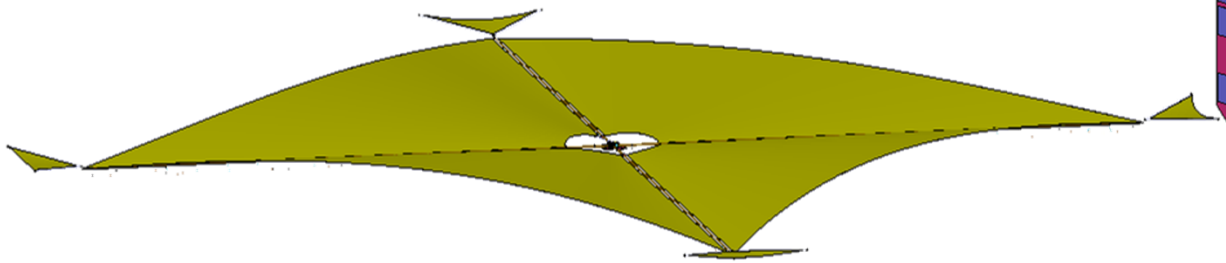
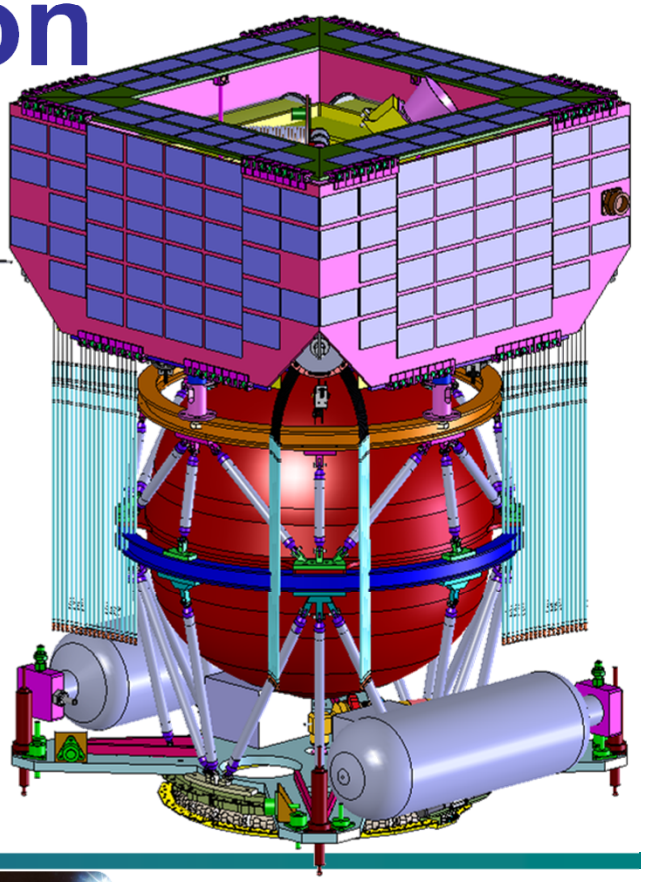
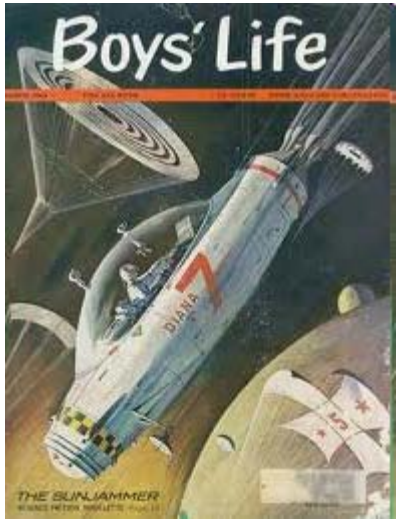
Sunjammer
Solar Sail
Demonstration





June 7, 2012
L'Garde Inc
Tustin CA

Sunjammer Name



Sunjammer is a story by the late Sir Arthur C. Clarke that detailed a race of solar sail yachts.

The coining of the term “solar sailing” is attributed to this story.

Sir Clarke’s estate has granted permission for L’Garde/NASA to use the name for this mission.

Dear Mr Barnes

Georgia is away at the moment, but on her behalf I am pleased to be able to let you know that we may grant you non-exclusive permission to use 'Sunjammer' as the name of your NASA mission.

Please would you keep Georgia informed of what happens next? I would also be grateful if you could send updates to the Arthur C Clarke Foundation in the US informed, especially its Vice Chair, Professor Joseph Pelton, who has worked on space transport systems for decades. His address is joepelton@verizon.net

Thanks and best wishes

Marigold

Marigold Atkey
Assistant to Anthony Goff and Andrew Gordon

David Higham Associates
[Literary, Film & TV Agents]

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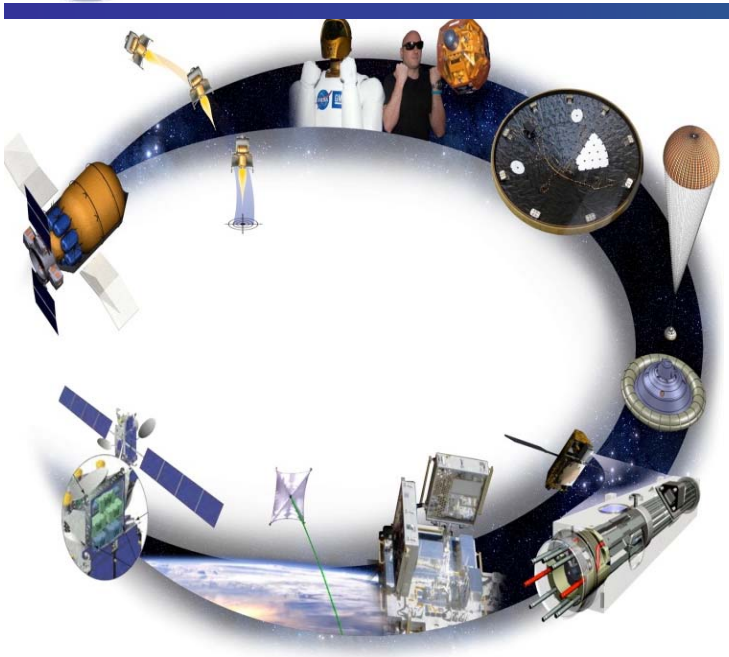
NASA Office of Chief Technologist (OCT) Space Technology - Technology Demonstration Mission (TDM)



10 OCT Space Technology Programs

1. Space Technology Research Grants (GRC)
2. NIAC (HQ)
3. SBIR/STTR (ARC)
4. Centennial Challenges (MSFC)
5. Center Innovation Fund (HQ)
6. Game Changing Development (LaRC)
7. Franklin Small Satellite Subsystem Technology (ARC)
8. Edison Small Satellite Missions (ARC)
9. Flight Opportunities (DFRC)
10. **Technology Demonstration Missions [TDM] (MSFC)**

Initial Nine TDM Technologies

CPST/GRC	MISSE-X/LaRC	LDSD/JPL	LCRD/GSFC	MEDLI/LaRC	TR/ARC	ALHAT/JSC	DSAC/JPL	SSD/L'Garde
Sue Motil	**Stuart Cooke**	**Mark Adler**	**Mike Weiss**	**Alan Little**	**Terry Fong**	**Chirold Epp**	**Todd Ely**	**Nathan Barnes**

One of the great challenges NASA faces incorporating advanced technologies into future missions is bridging the gap between technology development and initial mission infusion.

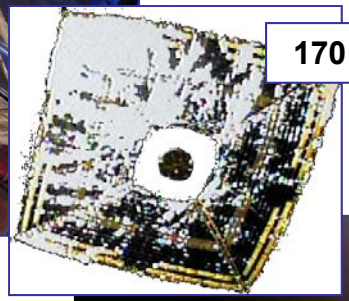
Demonstration is Critical Component!!

L'Garde Solar Sail Heritage

Key In-Space Propulsion (ISP) Sail Personnel Involved in TDM Project

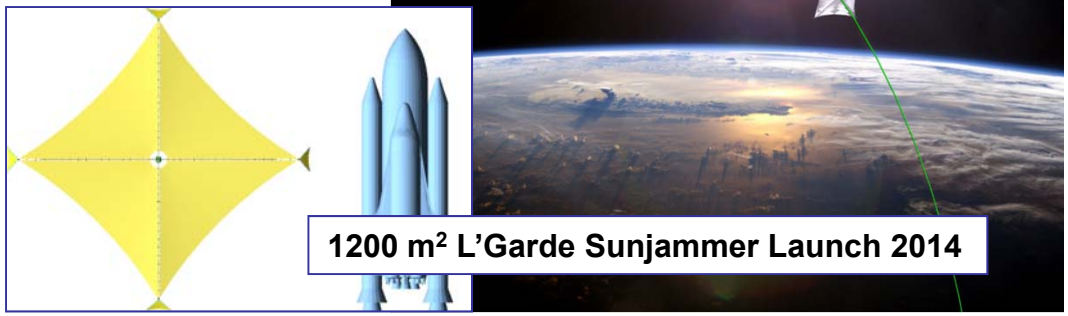
Design Heritage

- Cold Rigidization Boom Technology
- Distributed Load Design
- Aluminized Sun Side
- High Emissivity Eclipse Surface
- Beam Tip Vane Control
- Spreader System Design

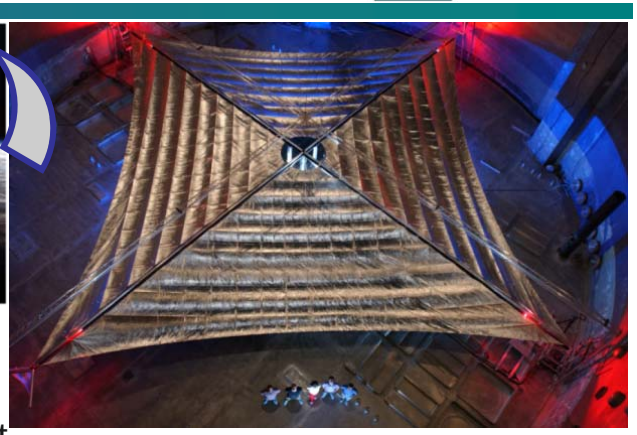


Design Features

- High Density Packagability
- Controlled Linear Deployment
- Structural Scalability
- Propellantless Operation
- Meets Current Needs
- Meets Future Desires



Sunjammer



Description: Small Sat Sailcraft extending a 1200m^2 Solar Sail on a 1 year mission

Technology Readiness Level (TRL)

TRL 5 to TRL 9

Launch Mass:112 kg / **Spacecraft Volume**: 1m^3

Benefits:

The end goal is the deployment, flight, and navigation of a mission capable solar sail to demonstrably prove the efficacy of solar sails. With this mission, L'Garde will advance the technology of solar photon propulsion.

Key FY12CR Activities:

- Finalize Contract
- Project Formulation
- Restart of the solar sail fabrication capability
- Establish mission requirements
- Develop preliminary design

Life Cycle Cost (LCC)

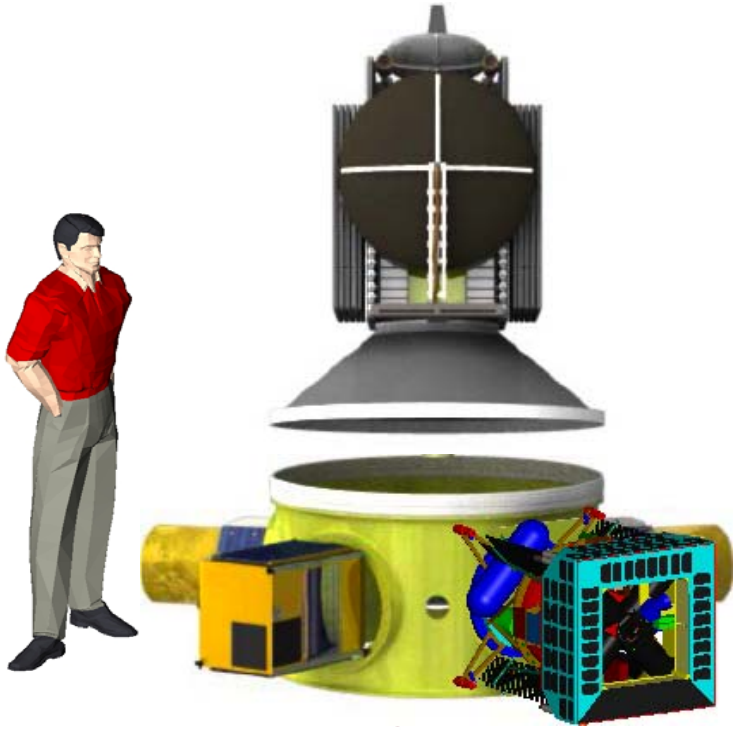
Updated LCC Requirement (2011.1.26)						
	FY12	FY13	FY14	FY15	FY16	Total
Mission Costs	2.9	3.5	3.3	1.7	0.2	11.6
Launch Costs	-	3.2	3.2	1.6	-	8
Project Estimated LCC in $M						19.6

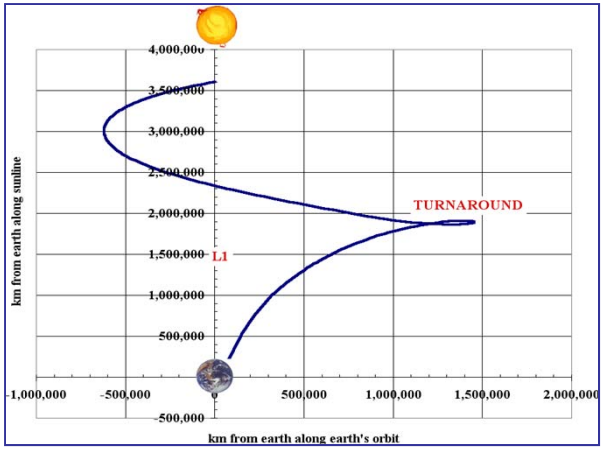
Key Milestones:

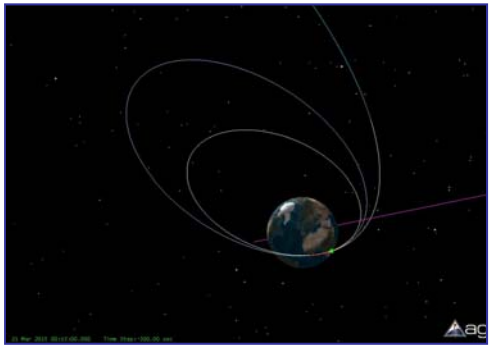
Tests ØB
- Test Short Tubes – 1/2012
- Test Sail Coupons – 1/2012
- Test Vane Mechanism – 4/2012

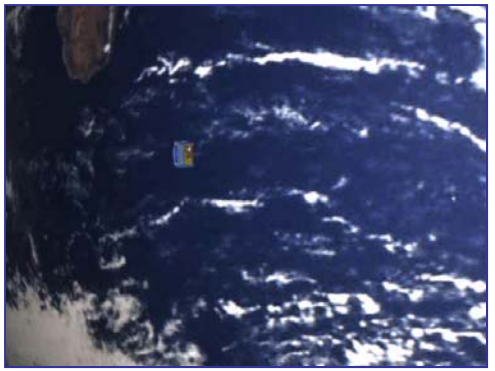
Reviews
- SRR – 1/2012
- PDR – 9/2012
- CDR - 9/2013
- FRR - 9/2014
- Launch- as early as 10/2014

Mission Overview





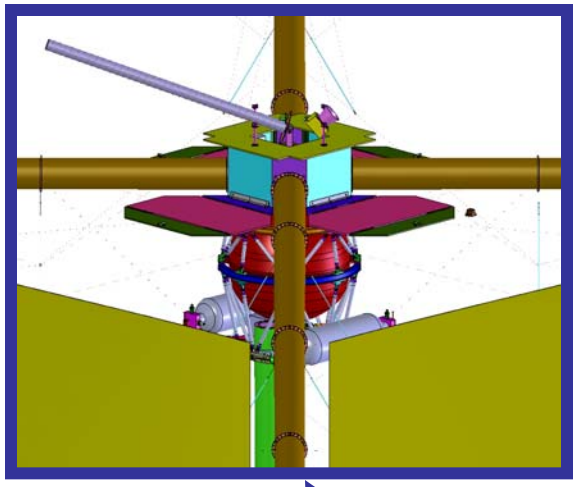




Demonstrated Objectives

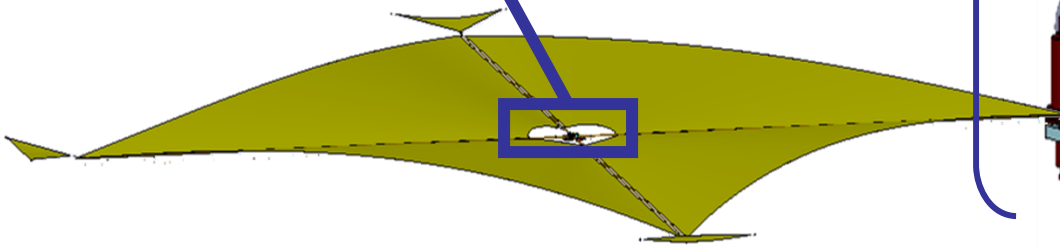
1. Demonstrate segmented deployment of a solar sail
2. Demonstrate attitude control plus passive stability and trim using beam-tip vanes.
3. Execute a navigation sequence with mission-capable accuracy.
4. Fly to and Possibly Maintain Position at L1 and/or Pole Sitter Positions

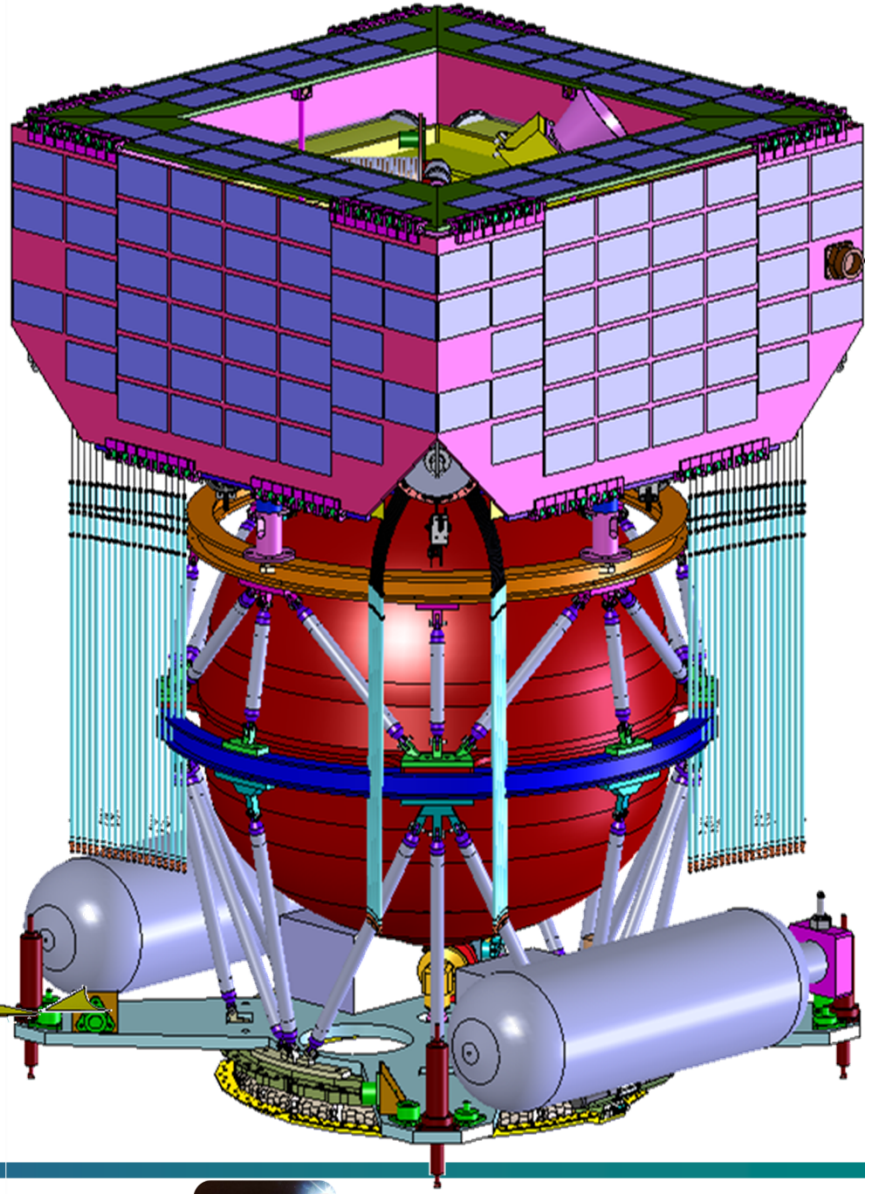
Conceptual Design (1/3)



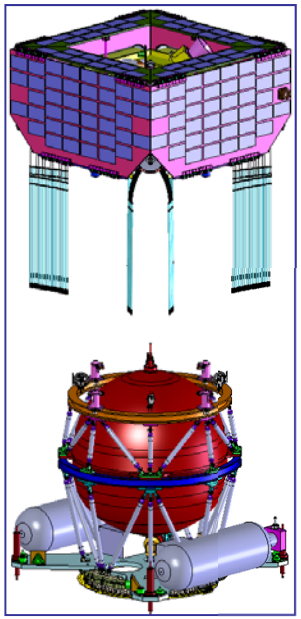
Sailcraft

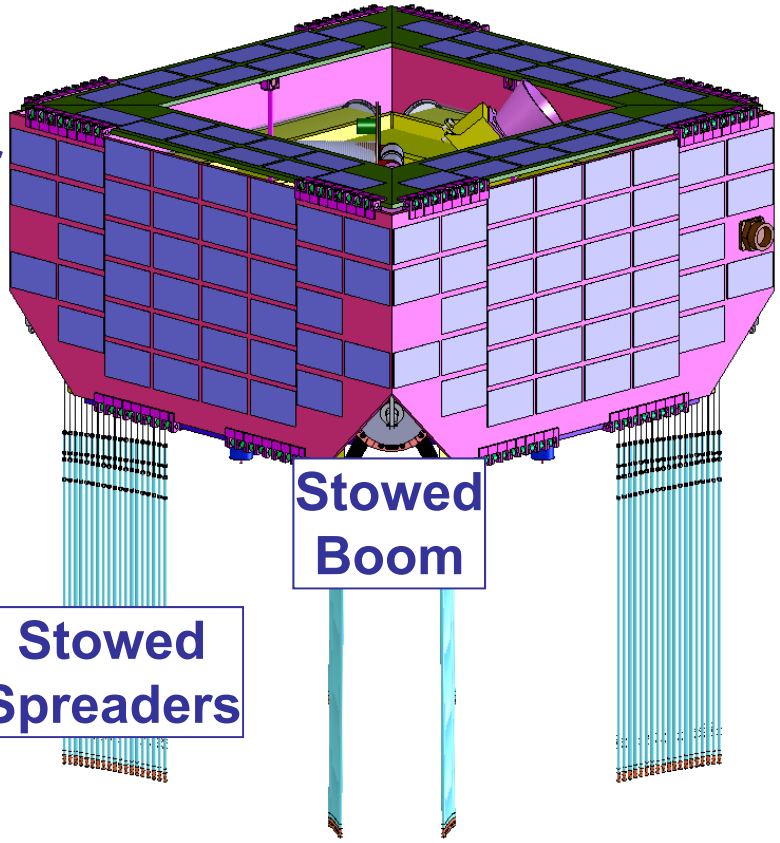
Carrier





Conceptual Design (2/3)





Canister Doors

Hydrazine Tank

Stowed Boom

Stowed Spreaders

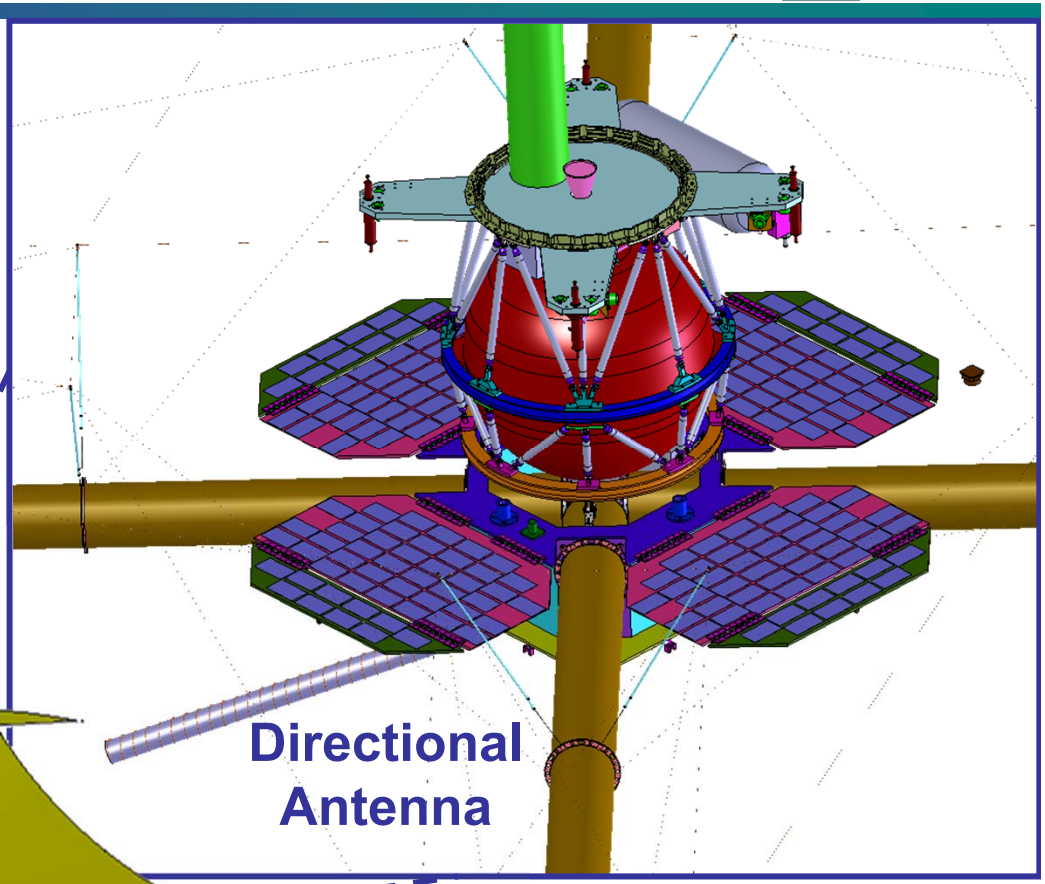
N2 Tanks

Separation Band

RCS Thrusters

Conceptual Design (3/3)

Sunjammer Before Carrier Jettison



Directional Antenna

Camera Boom

Control Vanes

~1200m² Sail Area

Importance of Infusion

Demonstration is Not Enough – TDM Programs Need Infusion Into Other Agencies and Commercial Entities

To NASA

- ✓ Without a credible path to infusion, the TDM program might be another unfulfilled research program.
- ✓ Successful infusion of the technology will demonstrate the technology development capabilities of the TDM, OCT, and NASA as a whole.

To L'Garde

- ✓ As a commercial entity L'Garde is committed to infusing technology.
- ✓ ***Our business model is committed to successful infusion.***
- ✓ L'Garde is an ideal partner to help demonstrate the infusion ideals promoted by TDM.

To Partners

- ✓ With a successful infusion effort all participants benefit. There are applications ready to incorporate these technologies but, demonstration and infusion are needed.

To Country

- ✓ For taxpayers, successful infusion will mean a significant ROI on tax dollars already invested.

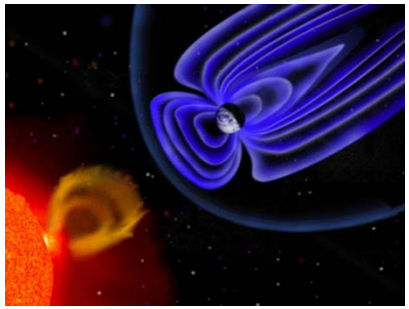
Infusion Opportunities

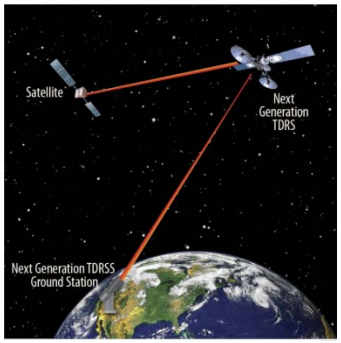
NASA	
Heliophysics	Near Term
Communication	Mid Term
ADR/ODR	Long Term

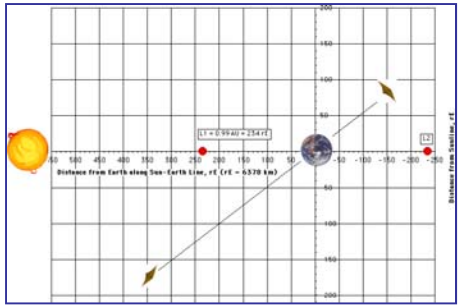
NOAA	
Storm Warning	Near Term
Communication	Mid Term

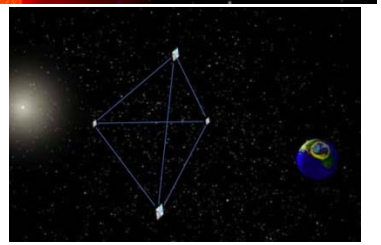
DOD	
STP	Near Term
Communication	Mid Term
ADR/ODR	Long Term

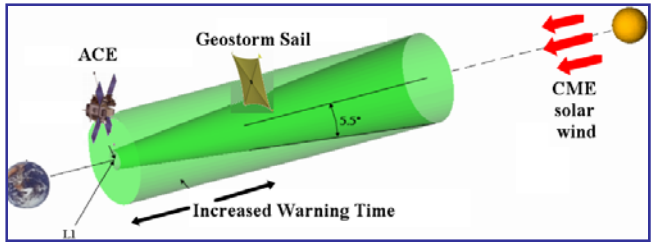
SSHI	
Celestis Payloads	Near Term
Advertising Rights	Mid Term

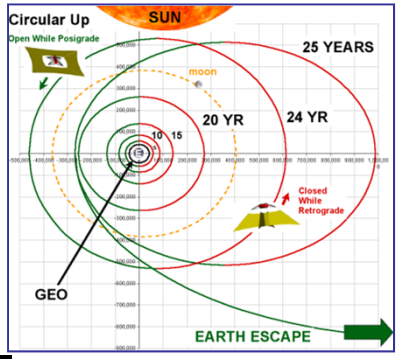


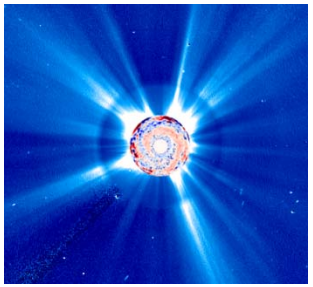


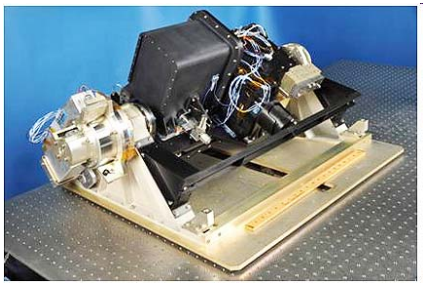


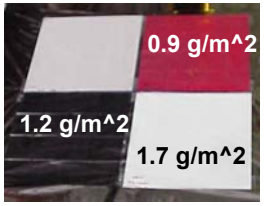












LOGO

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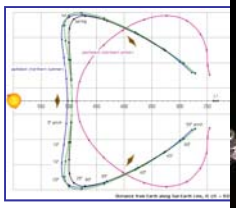
100% pixels



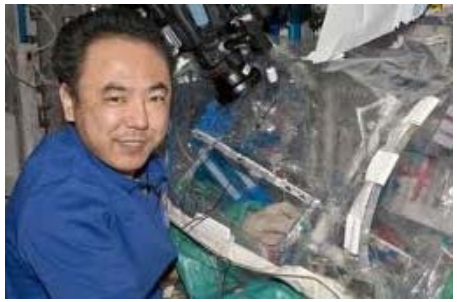
Cost Sharing Partners Private Sector Space Services Holdings Inc (SSHI)

SSHI Solar Sail Heritage

- SSHI – 30 years in commercial space
- Solar Sail Missions
  - Team Encounter: >$6m invested, NASA Space Act Agreement (SAA), NOAA data purchase = significant solar sail technology advance
  - NOAA: 5 studies to date; Sentinel Satellite commercial space weather missions; >$2m
- Other commercial missions: South Pole communications: Lunar communications; entertainment missions

Mission Benefits

- Opportunity to fund costs, extended mission ops, even an insurance policy for a second mission
- Augment public outreach and education, and support
- Validate commercial business model for future missions



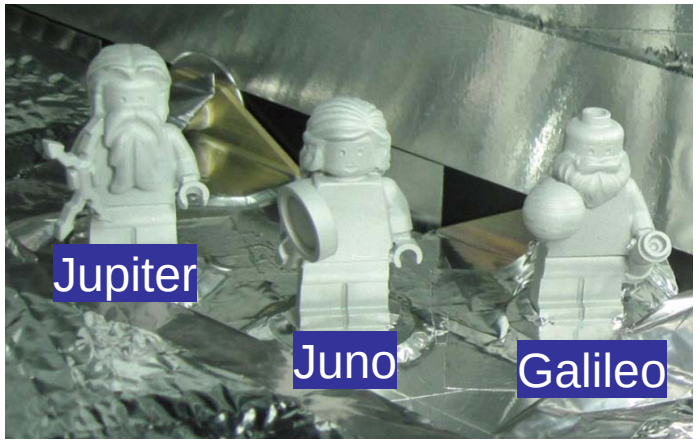
Astronaut Furukawa Building ISS Model Aboard ISS

NASA TDM Mission

- SSHI selected for secondary payloads (Celestis, Inc.) and public outreach augmentation via commercial rights (sponsorship, internet)
- SSHI commitment: $250k - $1m cash and $100k website development
- Currently considering augmenting commitment – seeking to expand cash contribution

Implementation

- Seeking SAA. NASA must approve: Requires non interference with primary mission objectives; Must be appropriate sponsor partners
- Ample precedents: Most notable - Lego to Jupiter

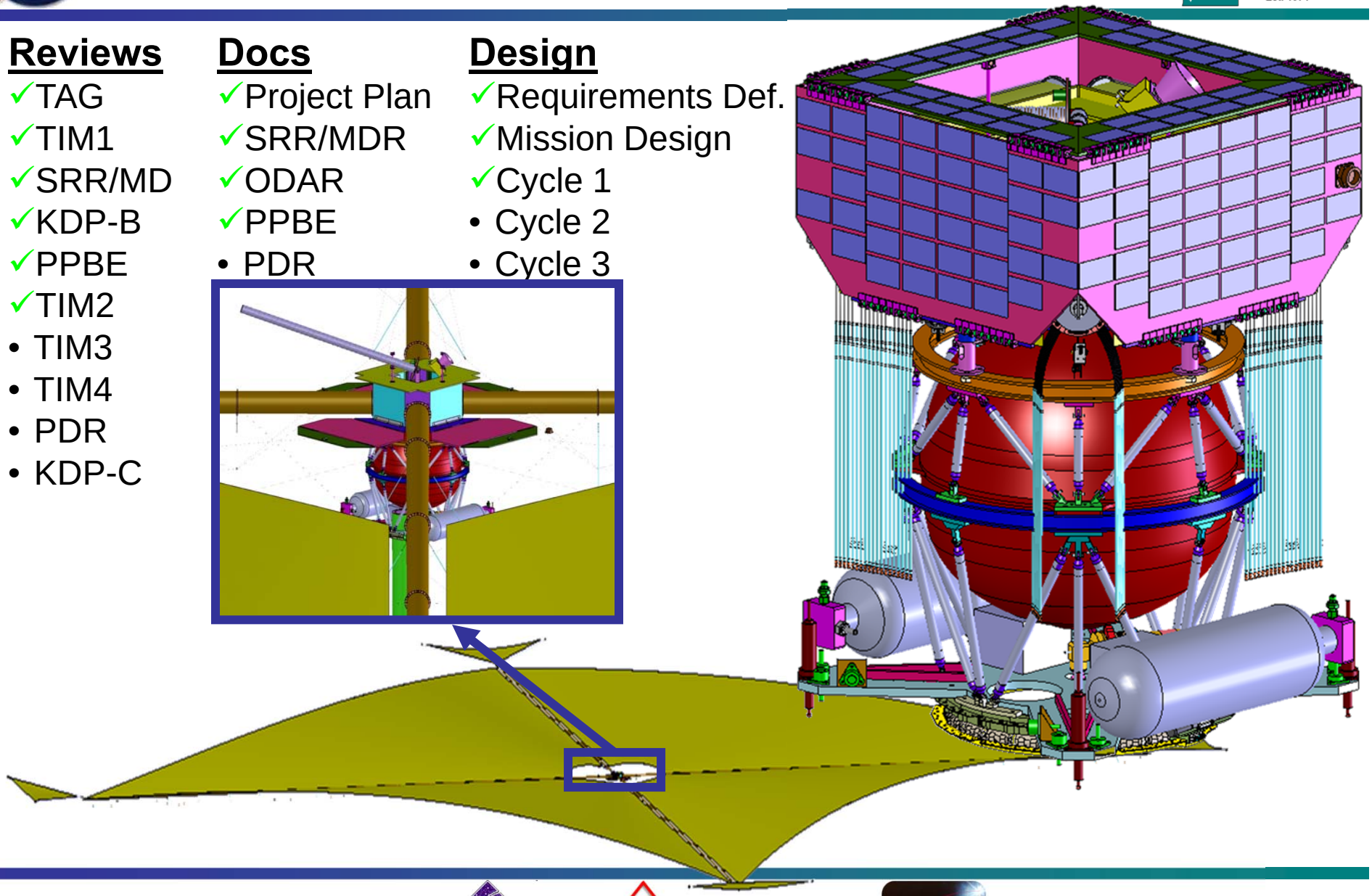


Program Status

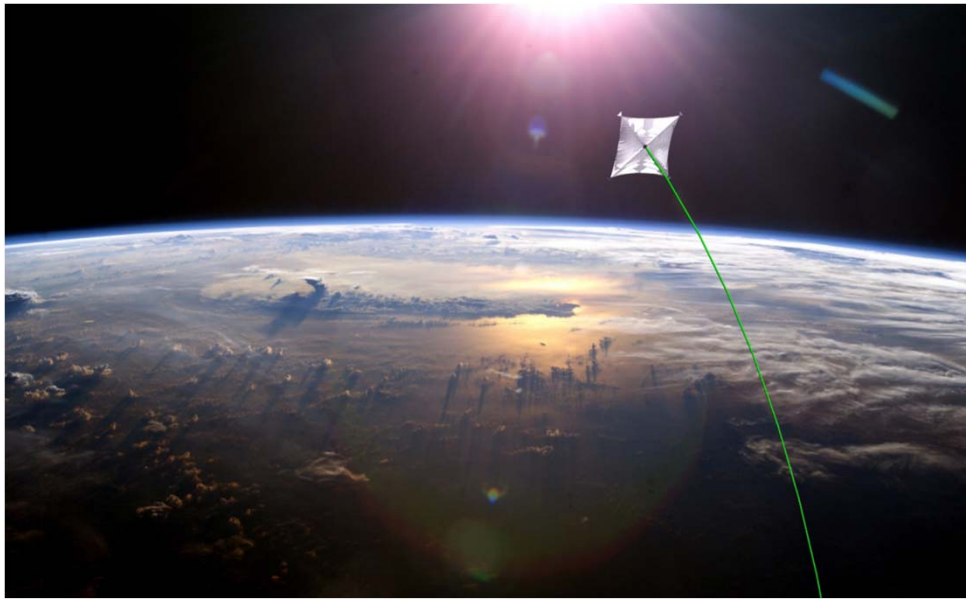
Reviews
- ✓TAG
- ✓TIM1
- ✓SRR/MD
- ✓KDP-B
- ✓PPBE
- ✓TIM2
- • TIM3
- • TIM4
- • PDR
- • KDP-C

Docs
- ✓Project Plan
- ✓SRR/MDR
- ✓ODAR
- ✓PPBE
- • PDR

Design
- ✓Requirements Def.
- ✓Mission Design
- ✓Cycle 1
- • Cycle 2
- • Cycle 3



Sunjammer



Demonstration Objectives:
- Fly a Mission Capable Sail
- Minimize Mission Cost
- Draw From Heritage
- Demonstrate Risk Tolerance

Rapid Demonstration:
Flight Ready in Three Years

- ✓ **Sunjammer Has a Tremendous Legacy Foundation**
- ✓ **Sunjammer Will Enable Critical Science Missions**
- ✓ **Sunjammer Will Help Commercialize NASA Technology**

-Final Demonstration-