Science Mission Directorate

2018 Technology Demonstration Industry Day

Technology Demonstration MO

Technology Title: The Lightweight Integrated Solar Array and Transceiver (LISA-T)

Affiliation: NASA Space Technology Mission Directorate

Assumptions: Technology required to be at TRL 5 by 2021

Technology Description, Current Performance Metrics, and Performance Goals

LISA-T is a launch stowed - orbit deployed small-spacecraft array with embedded lightweight power and communication devices.

- **More power**, less **stowage volume**, and less **mass** than state of art
- **Scalable** from 50W to >500W
- **Versatile** configurations - pointed versus non-pointed, economic versus highest performance
- **Flexible communications** for multiple band, spherical coverage, phased arrays, or high gain design

Current TRL

6- LEO

5- Deep space

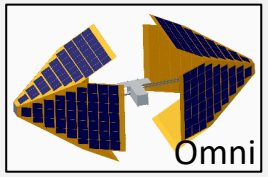
TRL By May 2021

7- LEO

5- Deep space

Industry State of the Art Technology Performance

Array Parameter	SOA	Demonstrated	Increase
Power generation	~80W (6U)	230.9W	288.6%
Stowage volume	~142kW/m^3	461.8kW/m^3	325.2%
Mass	~130W/kg	378.5W/kg	291.2%



Technology Development Challenges to Meet TRL Goal

- LISA-T currently validated to **TRL6 for a LEO environment** with thermal vacuum deployment, radiation, near UV, thermal cycling, etc. testing.
- Much of the LEO testing is applicable at the component level for **TRL5 in deep space.**
- Zero-g parabolic flight deployments and 1 year on orbit combined environmental exposure of solar cell and antenna assemblies (MISSE10) planned to begin push towards TRL7 for LEO.
- Exploring technology demonstration opportunities to reach TRL7 (LEO); funding is challenge.

Potential HPD Science Application (Optional)

- Highly capable small spacecraft swarms to measure space weather, radiation, etc. – LISA-T can provide high power with integrated comms.
- >1AU small spacecraft – as irradiance falls off at distance^2 from the sun, LISA-T can enable small spacecraft to go further from the sun.
- Reduced or completely removed solar array pointing requirements – Omnidirectional LISA-T can generate high power regardless of orientation to sun, enabling spacecraft to point elsewhere. E.g. do not need to slew during solar sail propulsion.

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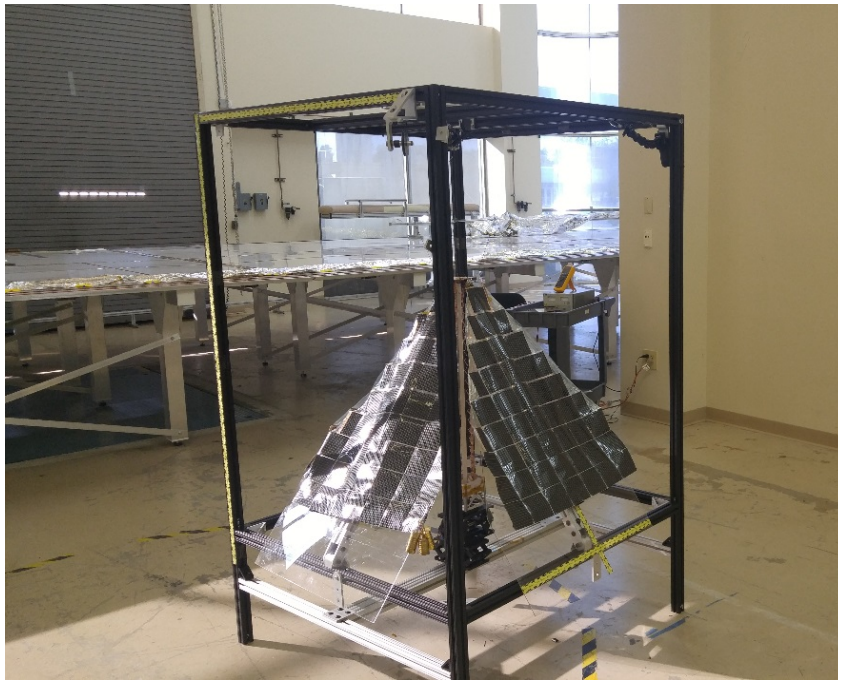
Additional Comments

Sample Cell Stack-up

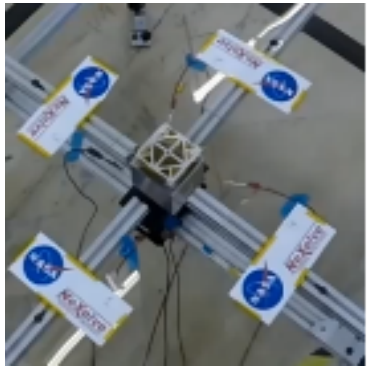
X-Band Helical Antenna

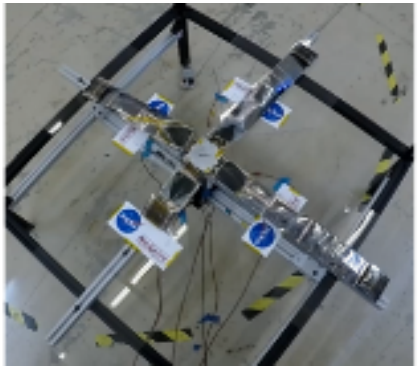
Omnidirectional

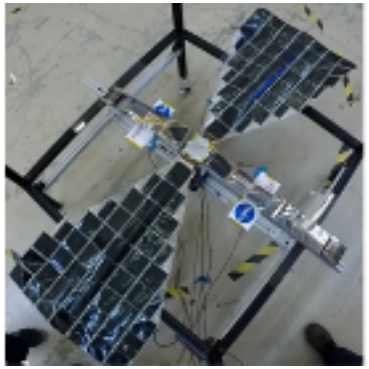


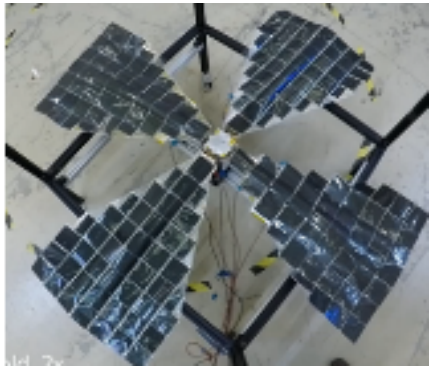
Planar

Planar Deployment









LISA-T: Solar Array Key Metrics

Planar

Parameter	SOA (best)	IMM Array	CIGS Array
Flat Point panel			
Array power generation	~80W (6U)	230.9W	134.0W
Array stowage volume	~142kW/m^3	461.8kW/m^3	340.0kW/m^3
Array mass	~130W/kg	378.5W/kg	250.9W/kg

Note: LISA-T power levels are scalable between ~50 and 500W.

Omnidirectional

Parameter	SOA (best)	IMM Array	CIGS Array
Omnidirectional			
Array power generation	7.3W (3U)	101.0W	60.0W
Array stowage volume	~33W/m^3	101.0kW/m^3	60.0kW/m^3
Array mass	~53W/kg	75.7W/kg	47.8W/kg
Generation axes	2-axis	3-axis	3-axis

LISA-T: Antenna Key Metrics

Parameter	**Endurosat Type -1**	**Ant Dev Microstrip Patch**	**Ant Dev Helix**	**Clyde Space CPUT**	**LISA-T Edge Feed Patch**	**LISA-T Direct Feed Patch**	**LISA-T Helix**
Antenna Gain	8.3 dBi	6 dBi	9dBi	8 dBi	6.7 dBi	7 dBi	10 dBi
Stowage Thickness	5.5 mm	3.8 mm	144.78 mm	3.8 mm	2 mm	2 mm	~0.7 mm
Volume	528.22 cm^3	29.8 cm^3	1173 cm^3	29.8 cm^3	11.5 cm3	11.5 cm^3	5 cm^3
Mass	64g	120g	110g	50g	~27g	~27g	10.5g
Beam Width	60°	70°	72°	60°	81°	78°	47°
Band	S-band	S-band	S-band	S-band	S or X-band	S or X-band	S or X-band
Type	Patch	Patch	Helix	Patch	Patch	Patch	Helix