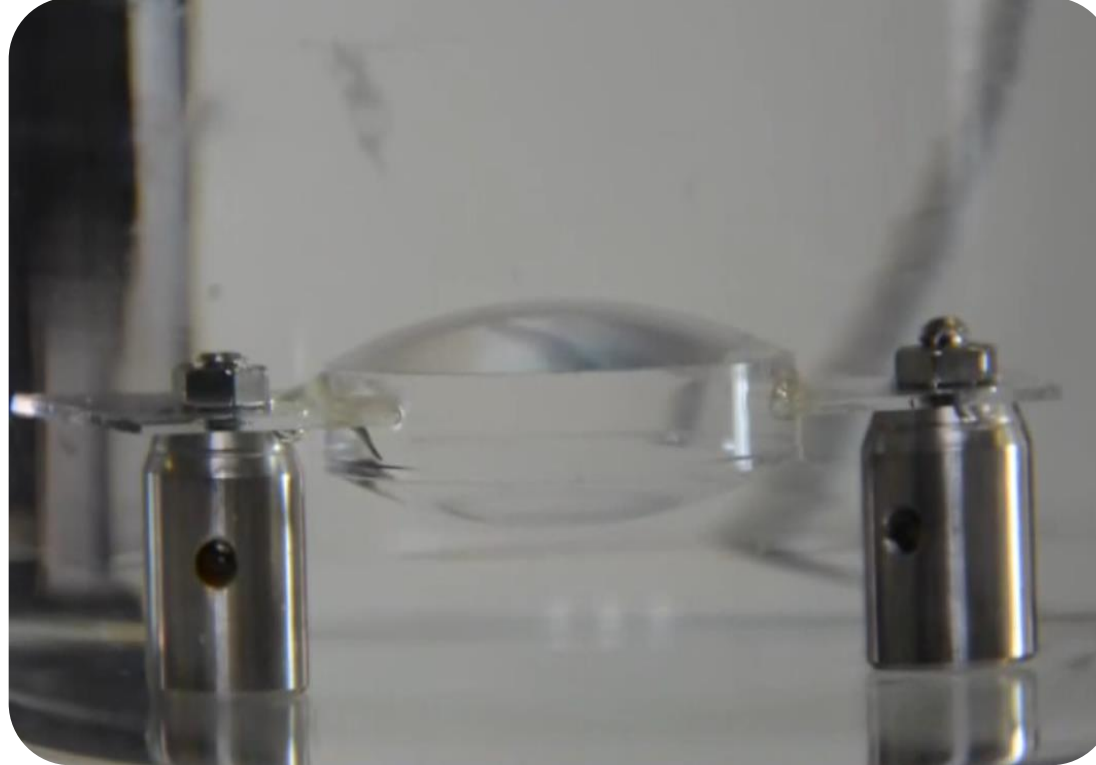


FLUTE

Fluidic Telescope: Enabling the Next Generation of Large Space Observatories

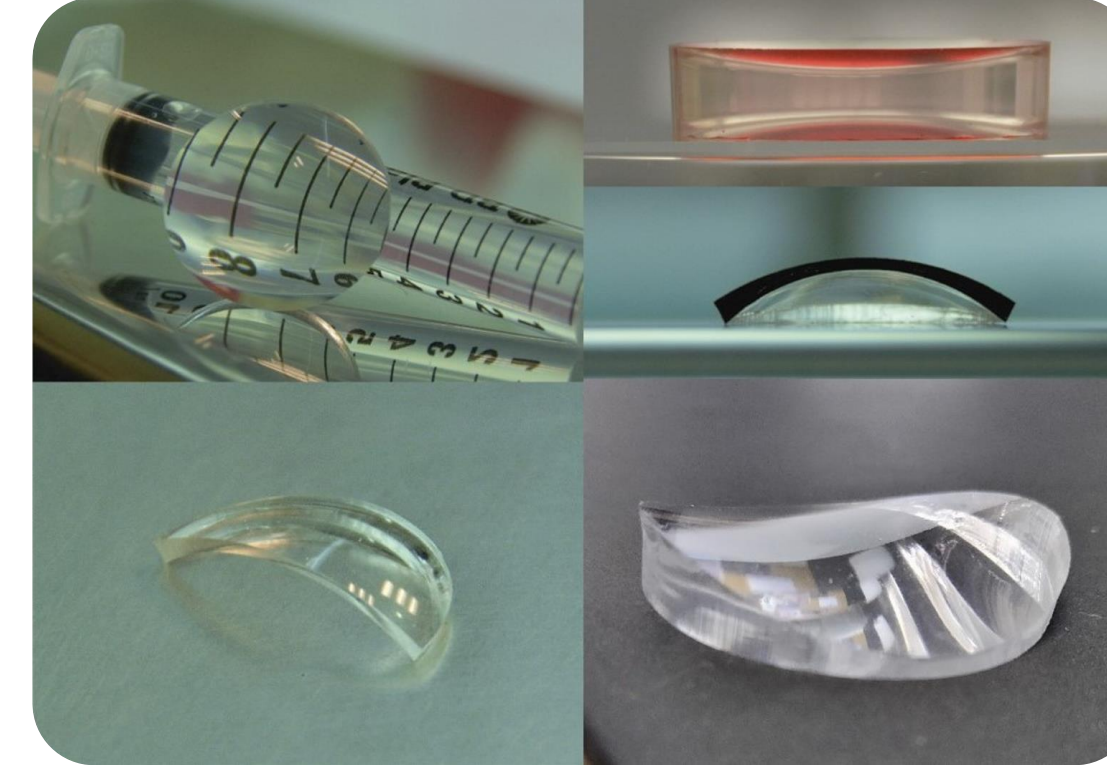
Innovation

- Optical components created in space via fluidic shaping.
- Very large, smooth-surface lenses or mirrors can be made.

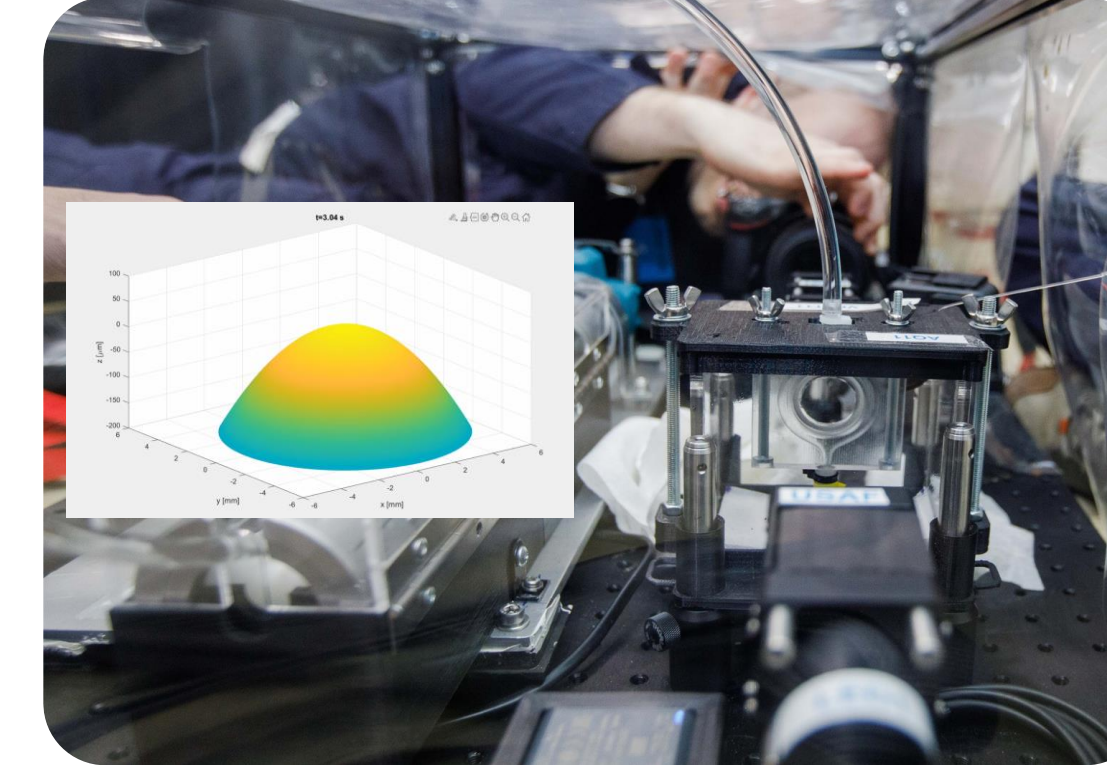


- Fluidic optics are not constrained by launch vehicle dimensions.
- In-space liquid optics are also resilient to micrometeorites.

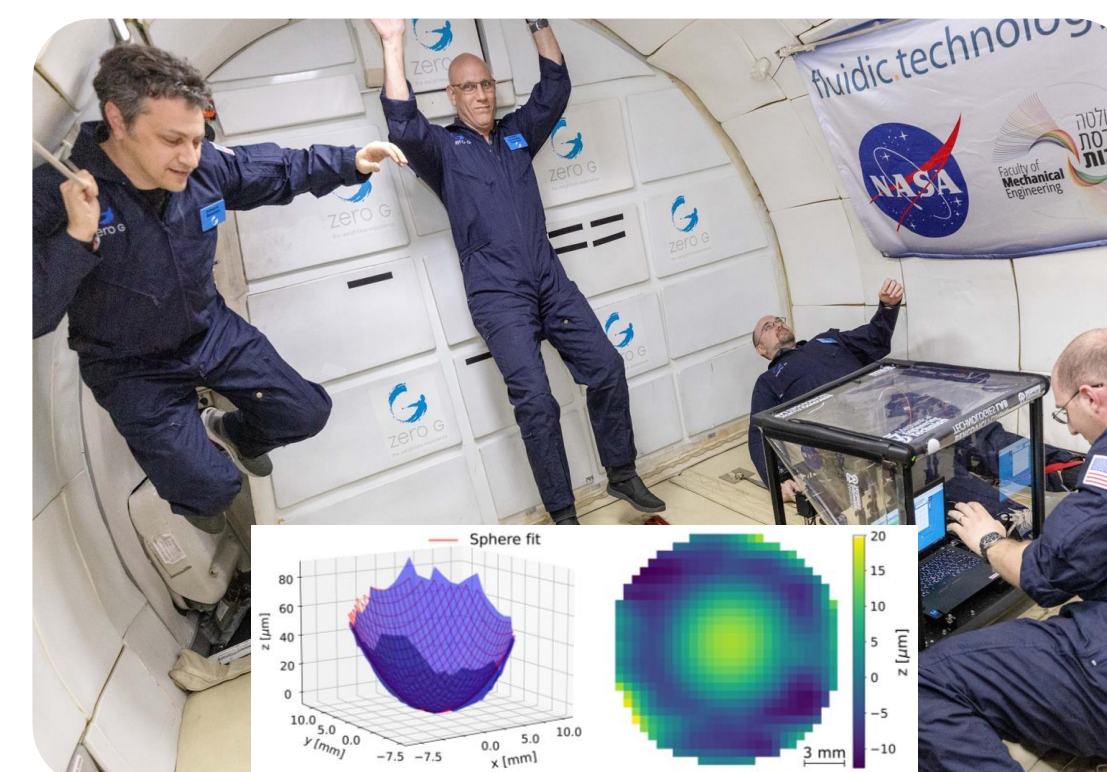
Foundational Work



Lab experiments



Zero-g flights: lenses

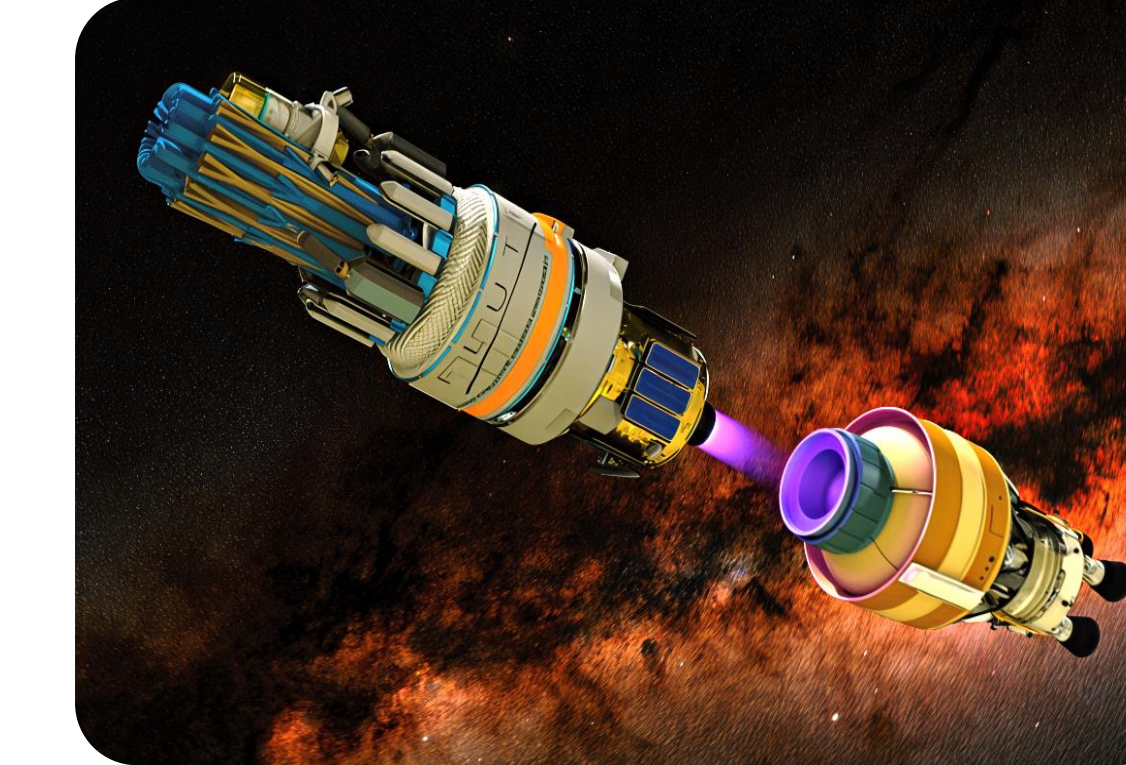


Zero-g flights: mirrors



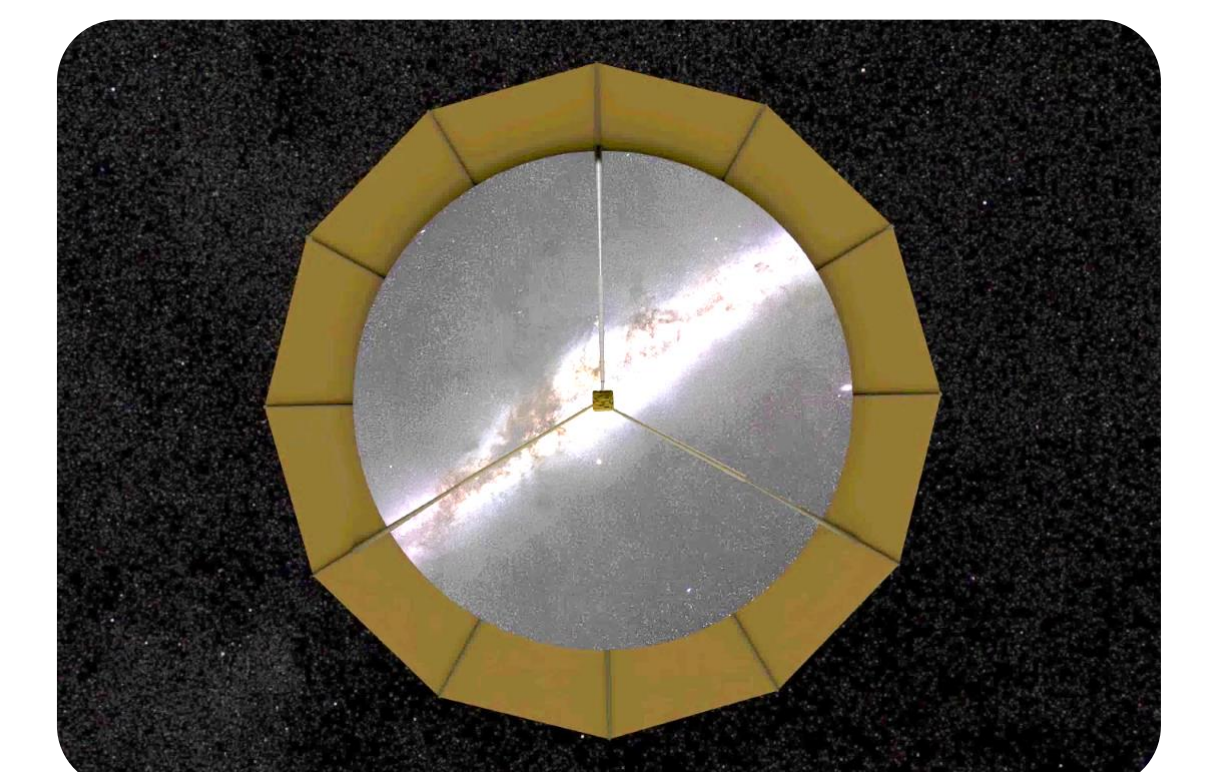
ISS Experiments

Mission Concept

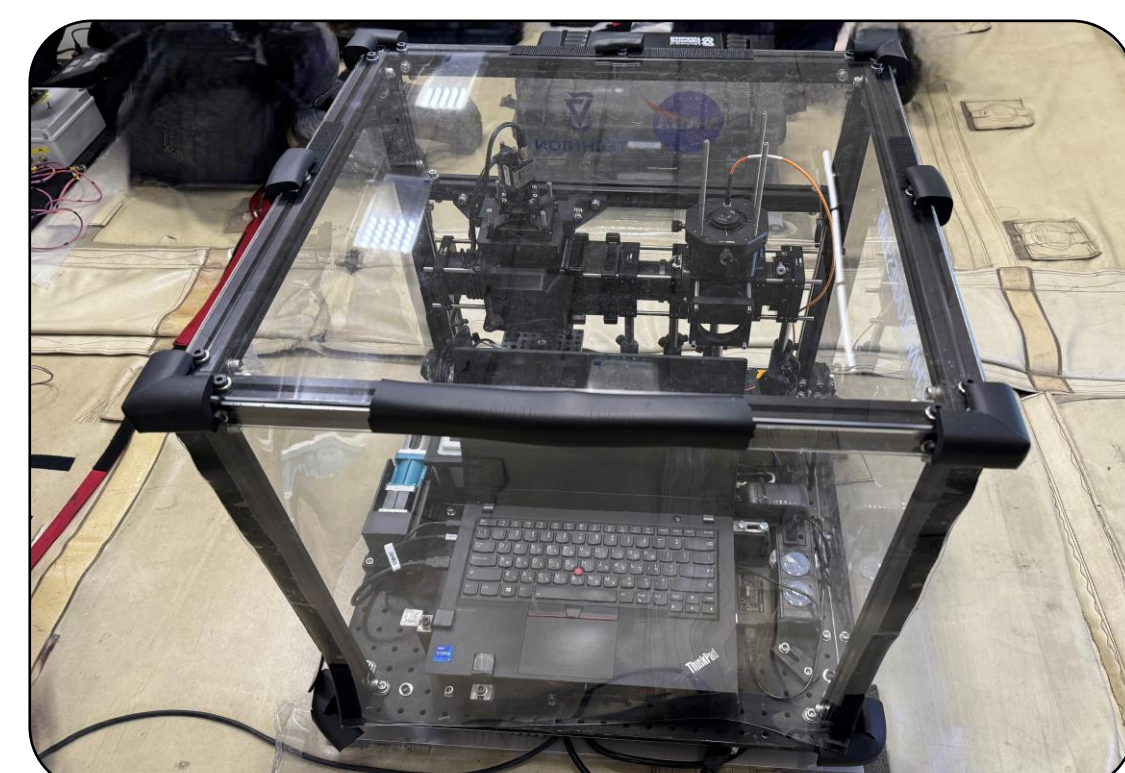


- A space telescope with a 50-m primary liquid mirror (FLUTE-50).
- The architecture is potentially scalable to much larger sizes.

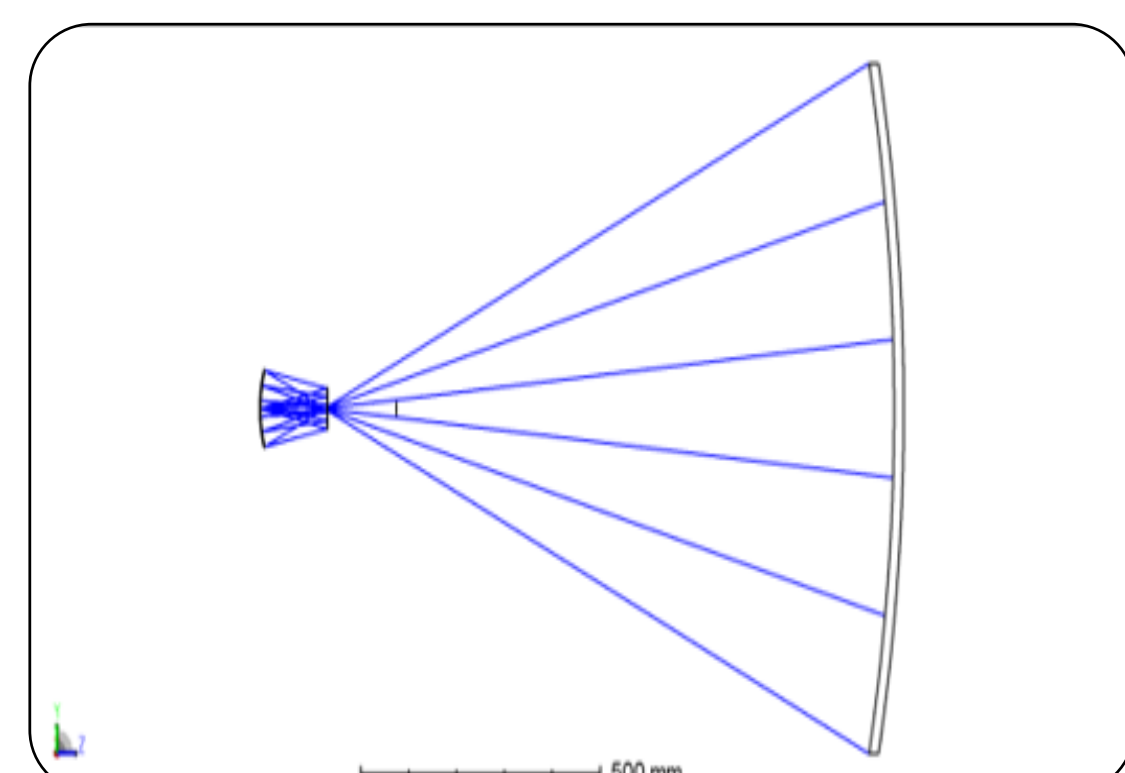
- The mirror is created using an ionic liquid with a reflective layer.
- Will observe high-priority faint objects, e.g., exo-planets.



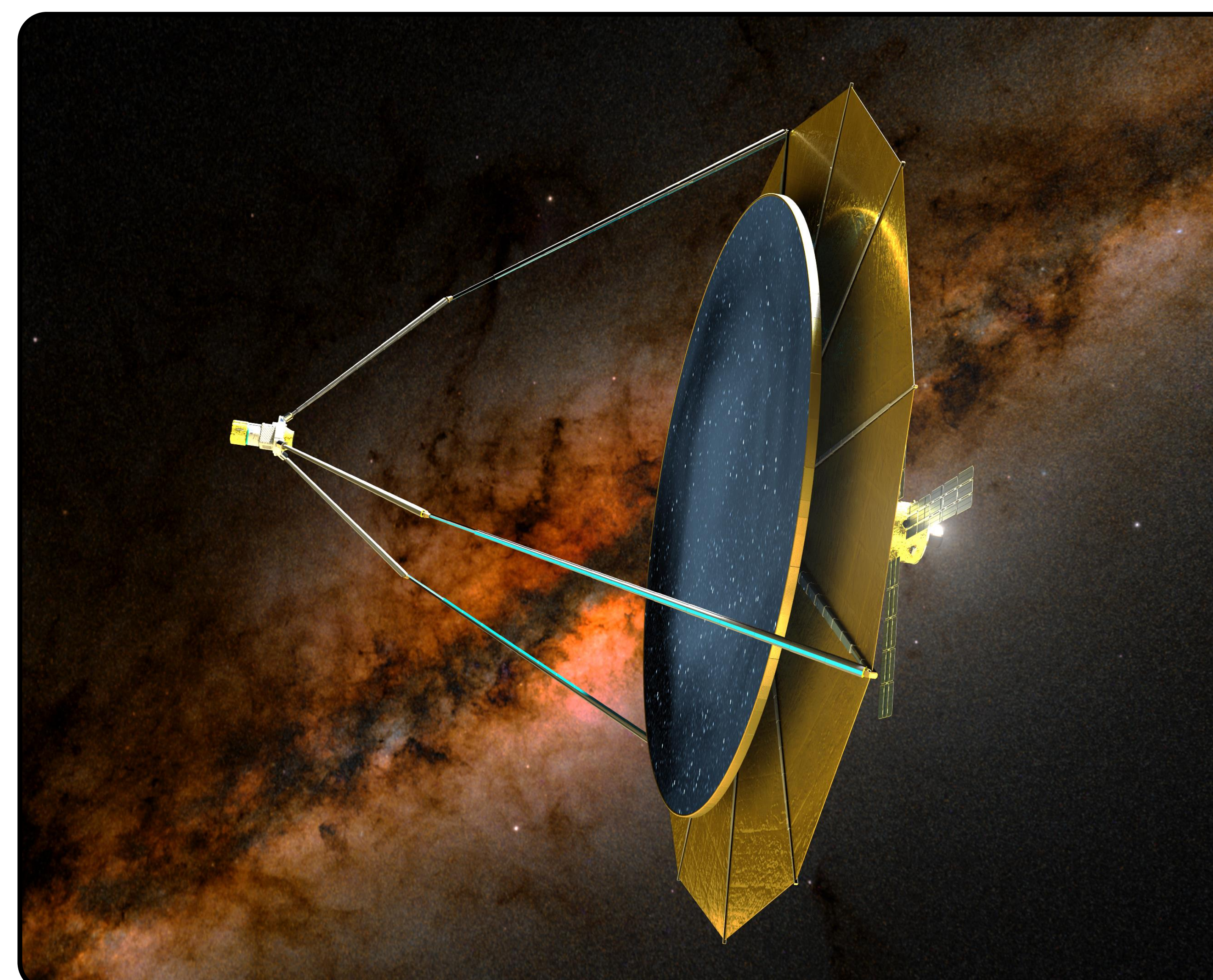
Mirror Dynamics and Optical Architecture Design



- Developed mirror dynamics models for in-space operations.
- Conducted initial tests of these models in microgravity flights.



- Performed a trade study of various optical architectures.
- Carried out a detailed analysis of leading architecture candidates.

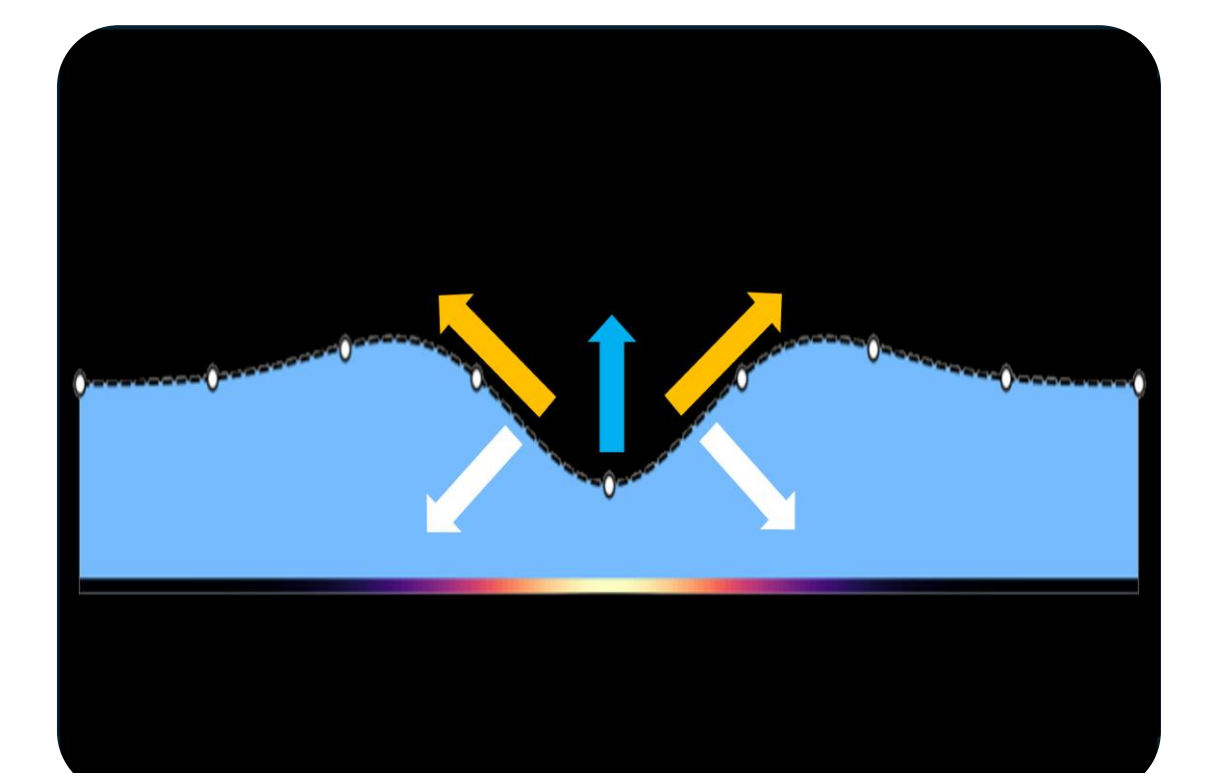


Mirror Liquid Composition and Shape Control

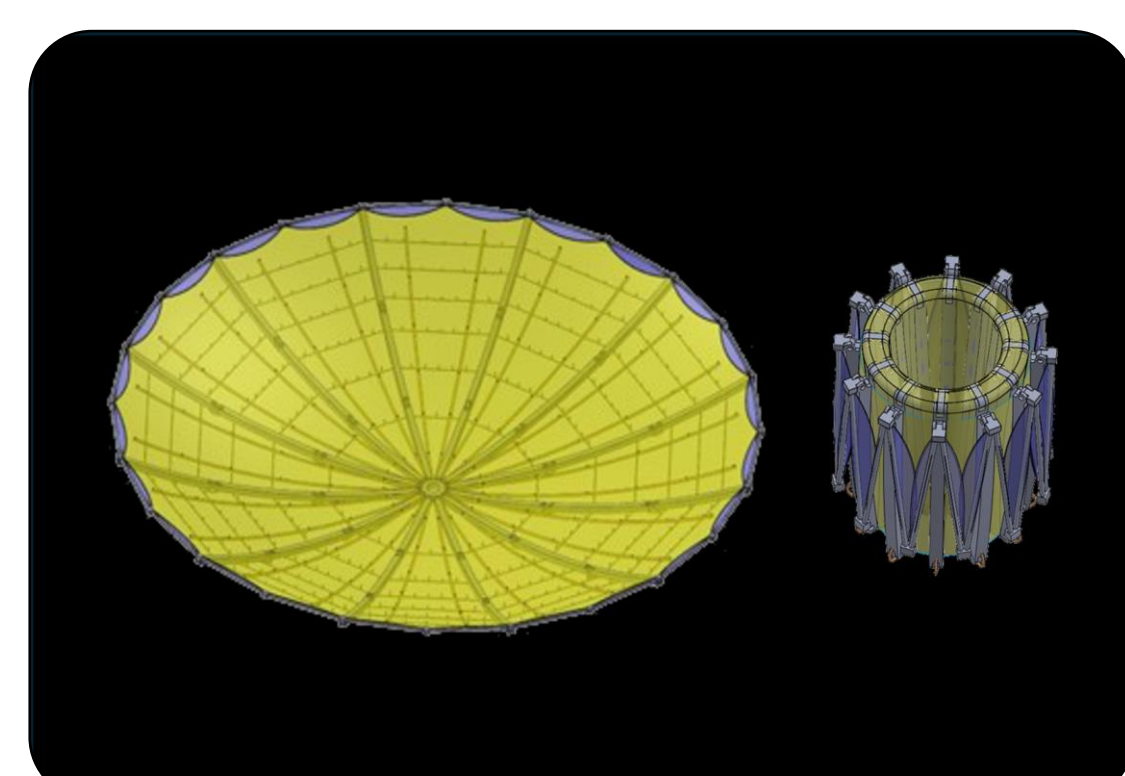
- Performing lab experiments with reflective ionic liquids.
- Doing computational modeling to guide the lab experiments.



- Developed a theory of thermocapillary control for liquid mirrors.
- It enables aspherical geometries and rapid disturbance damping.

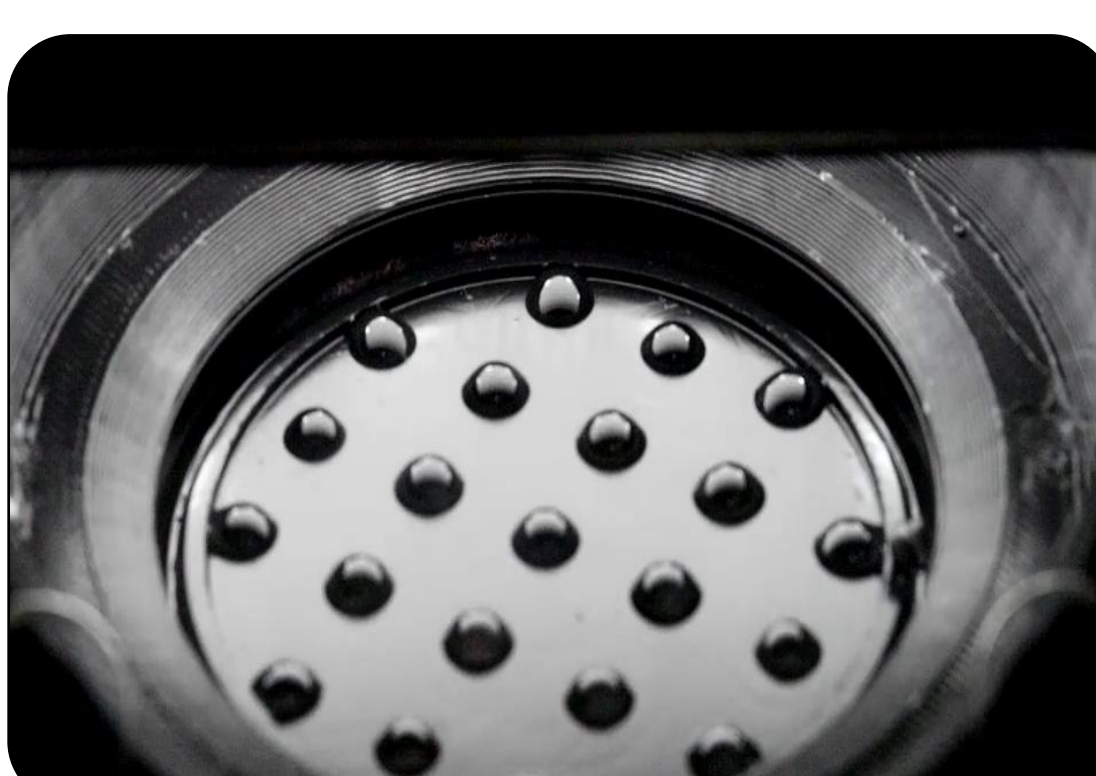


Mirror Frame Design, Modeling, and Experiments



- Evaluating several mirror frame design candidates.
- Assessing feasibility for integration of heaters, fluid lines, etc.

- Examining several potential liquid deployment methods.
- Performed initial tests of some of these methods in zero-g.



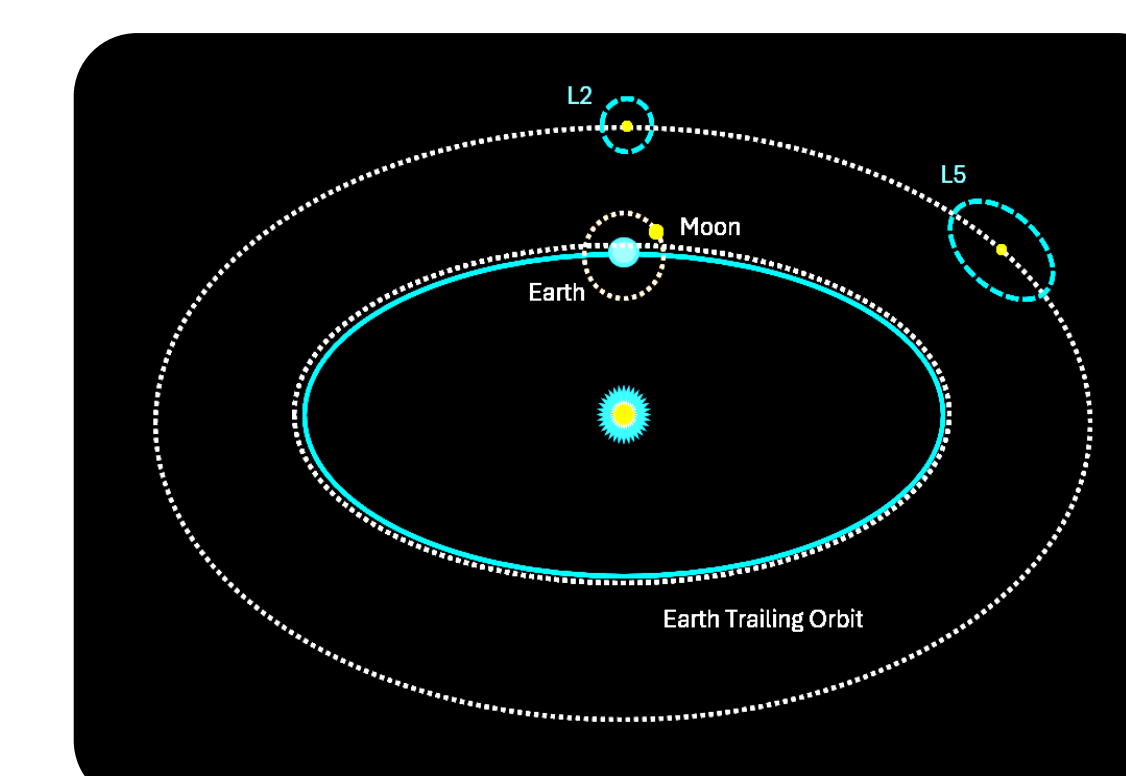
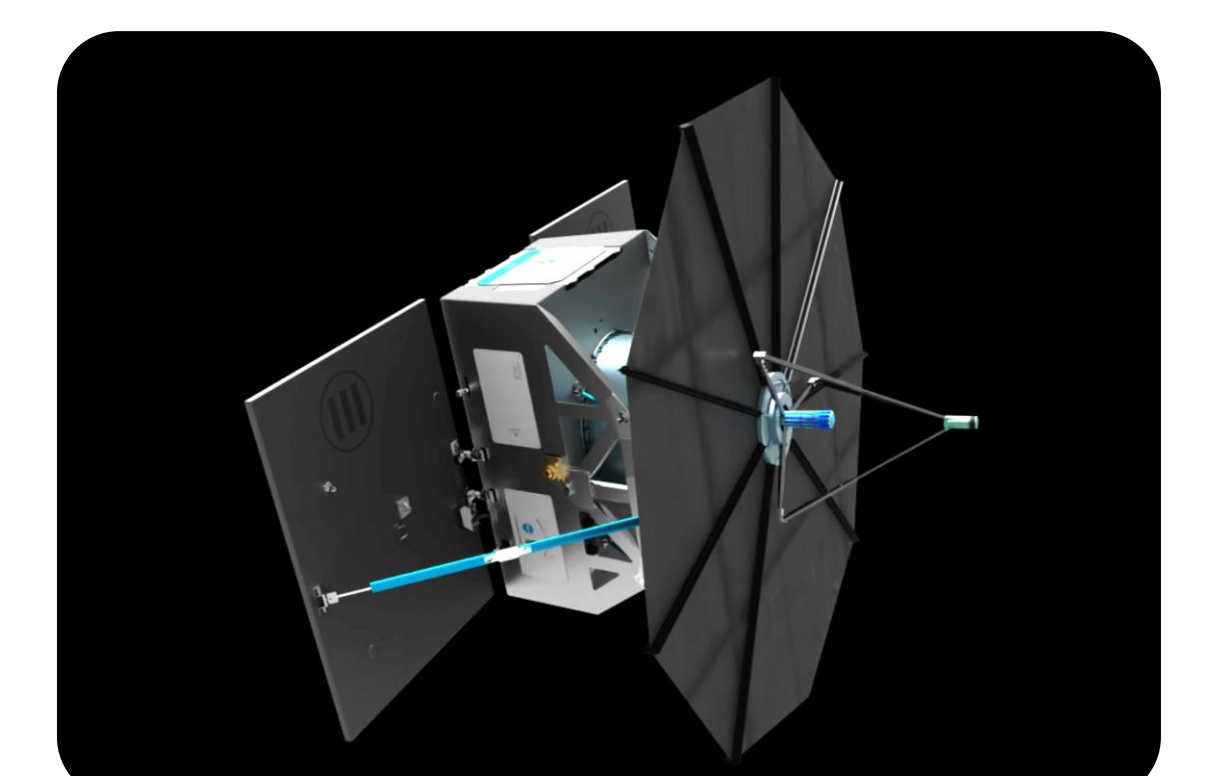
Team

Manan Arya (Stanford)
Edward Balaban (NASA)
Moran Bercovici (Technion)
Rus Belikov (NASA)
Eduardo Bendek (NASA)
Enrico Biancalani (UMD)
Jay Bookbinder (NASA)
Penny Boston (NASA)
Kev Carrico (AstroDigitronics)
Alan Cassell (NASA)
Anthony Colaprete (NASA)
Michael Dickey (NCSU)
Vivek Dwivedi (NASA)
Mor Elgarisi (Technion)

Jonathan Erickson (Technion)
George Fiedziuszko (NASA)
Valeri Frumkin (Boston U.)
Israel Gabay (Cornell)
Khaled Gommed (Technion)
Alexandra Harazsti (Stanford)
Christine Gregg (NASA)
Omer Luria (Technion)
Dylan Morrison-Fogel (NASA)
Collin Payne (NASA)
Titus Szobody (Rice)
Rachel Ticknor (NASA)
Sylvain Veilleux (UMD)
Daniel Widerker (Technion)

FLUTE-1 and FLUTE-50 Concepts Maturation

- Improved the design of FLUTE-1 tech. demo mission.
- Apex Aries is the leading spacecraft bus candidate.



- Developed detailed analysis of FLUTE-50 operating orbit options.
- Created system designs, risk tables & mitigation approaches.