



# FLOW SPACE

## Colorado School of Mines

June 2019

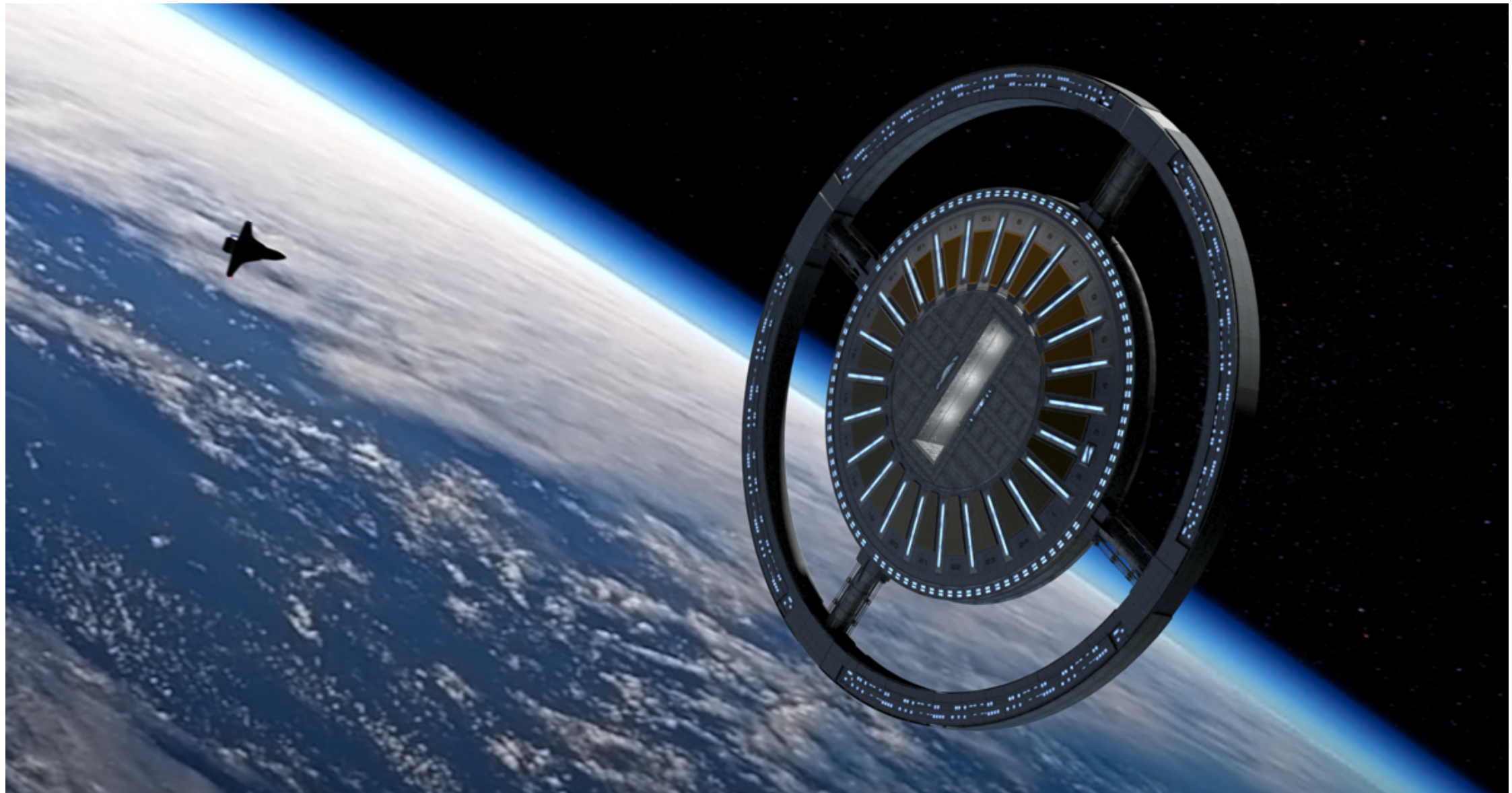
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Founder and CEO  
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Founder and Chief Scientist  
[bruce@flowspaceinc.com](mailto:bruce@flowspaceinc.com)



## THE FUTURE WE DREAM OF BUILDING

FLOW  
SPACE



The logo for FlowSpace is located on the left side of the slide, featuring the word "FLOW" in a large, bold, sans-serif font above the word "SPACE" in a smaller, all-caps, sans-serif font. The background of the slide is a vertical strip of vibrant, colorful nebulae in shades of blue, red, orange, and yellow, resembling a cosmic scene.

## 01 Our Mission

FlowSpace is committed to developing technologies aimed at unlocking the infrastructure required to enable sustainable human presence in space.

## 02 Our Core Value Proposition

A safe contactless encapsulation, handling and mobilization of objects in space using an Autonomous Pneumatic Handling System.

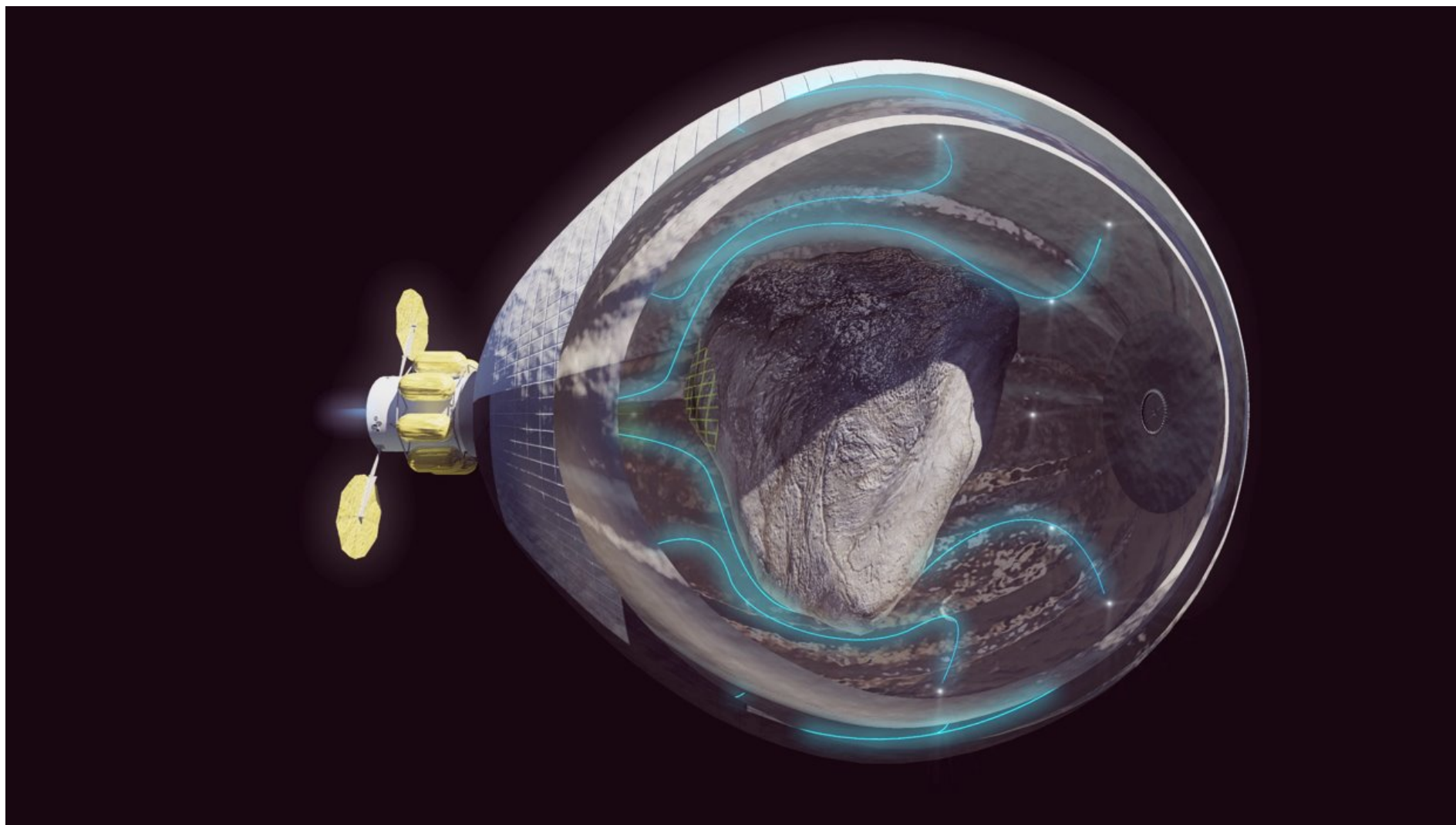
## 03 Our North Star

Creating a sustainable business model aimed at the generation of cashflow to enable the further development of our technologies.



## Our Technology

### Autonomous Pneumatic Handling System





## MILESTONES

IP: Patent Portfolio = derisking mechanism for Private Funding

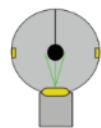
Commercial Services = Cash Flow Generation

Transportation Services = Cash Flow Generation



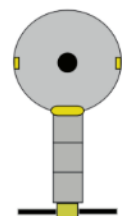
Simulation

2019



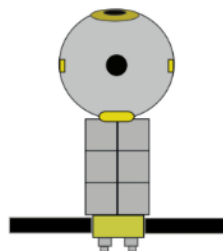
Autonomous Handling Experiments

2020



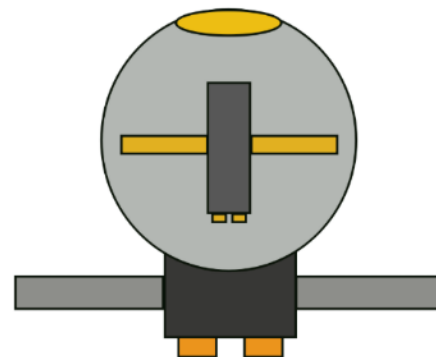
CubeSat Mark -1

2021



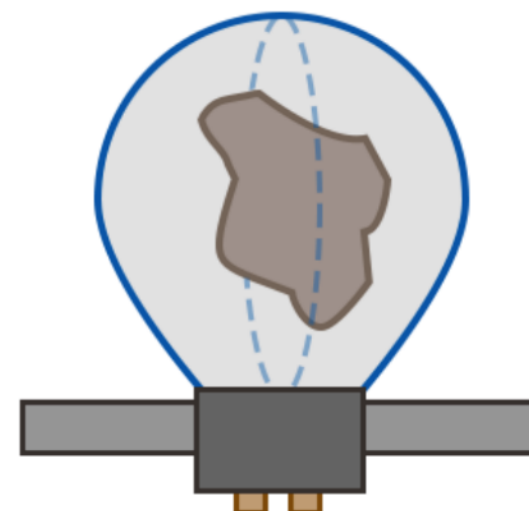
CubeSat Mark -2

2022



Commercial Vehicle 1

2025

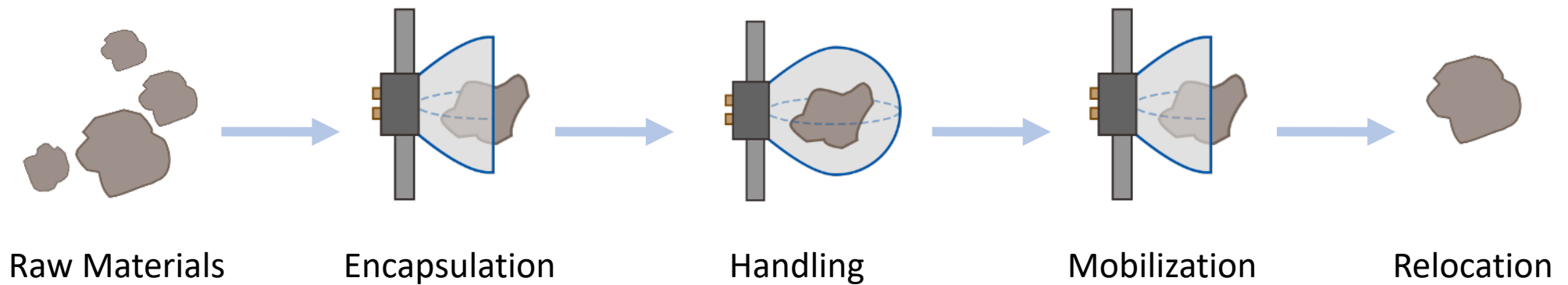


NEO Capture Mission 1

2030

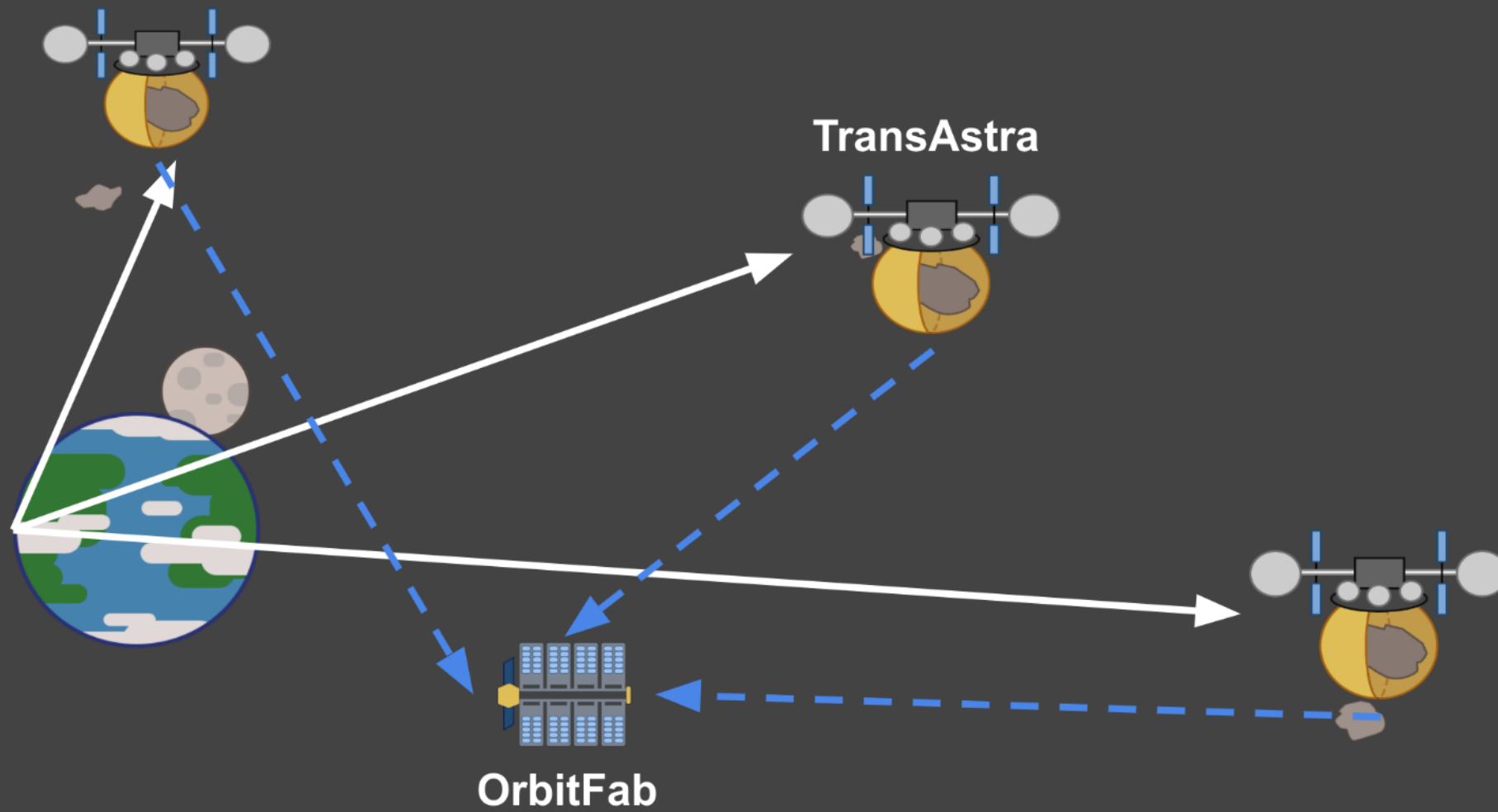
## TRANSPORTATION OF RAW MATERIALS

Using the SHEPHERD technology to safely encapsulate, handle and mobilize raw materials in space with Autonomous Pneumatic Handling Systems

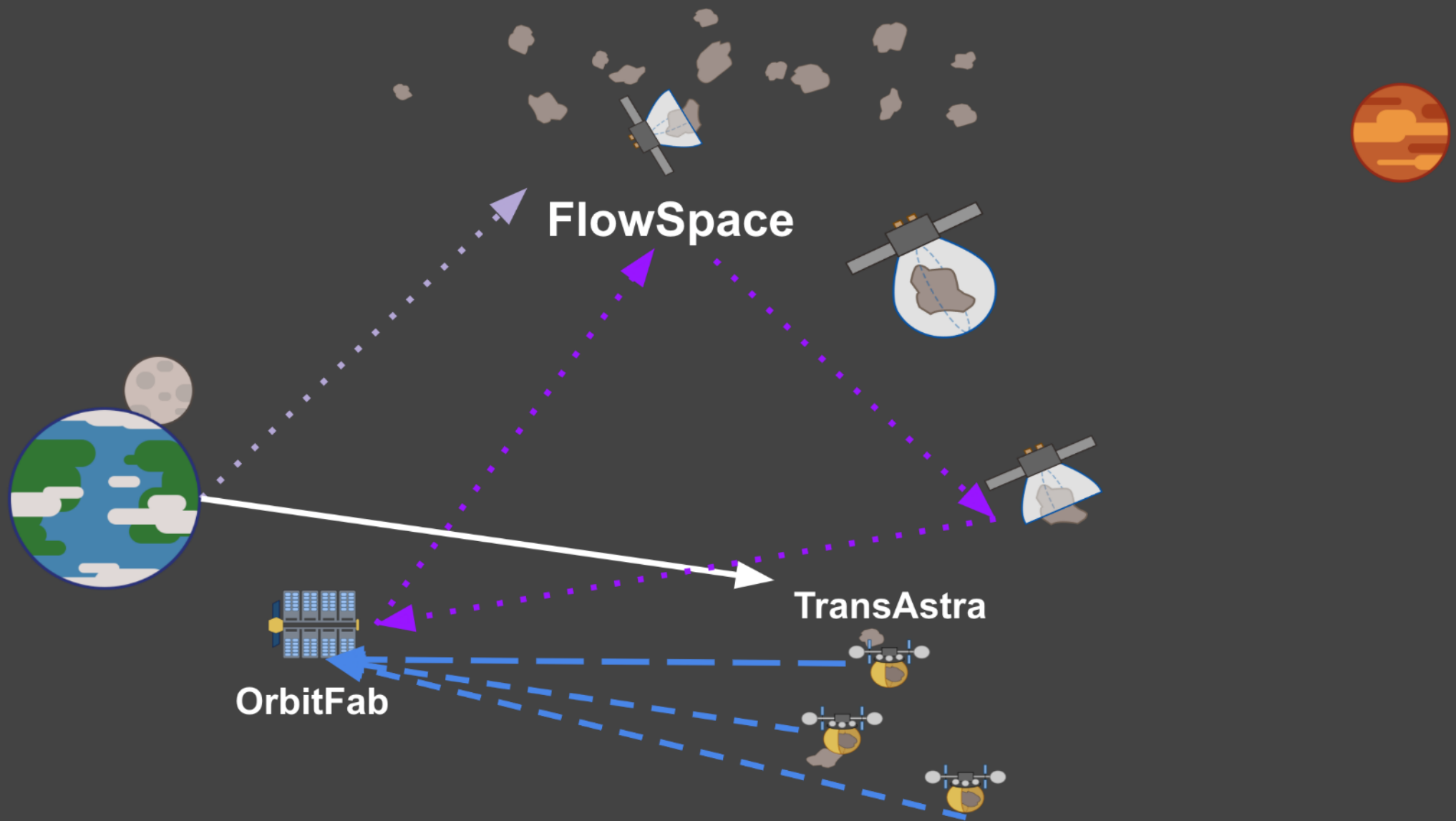




## NON-SUSTAINABLE SUPPLY CHAIN INFRASTRUCTURES

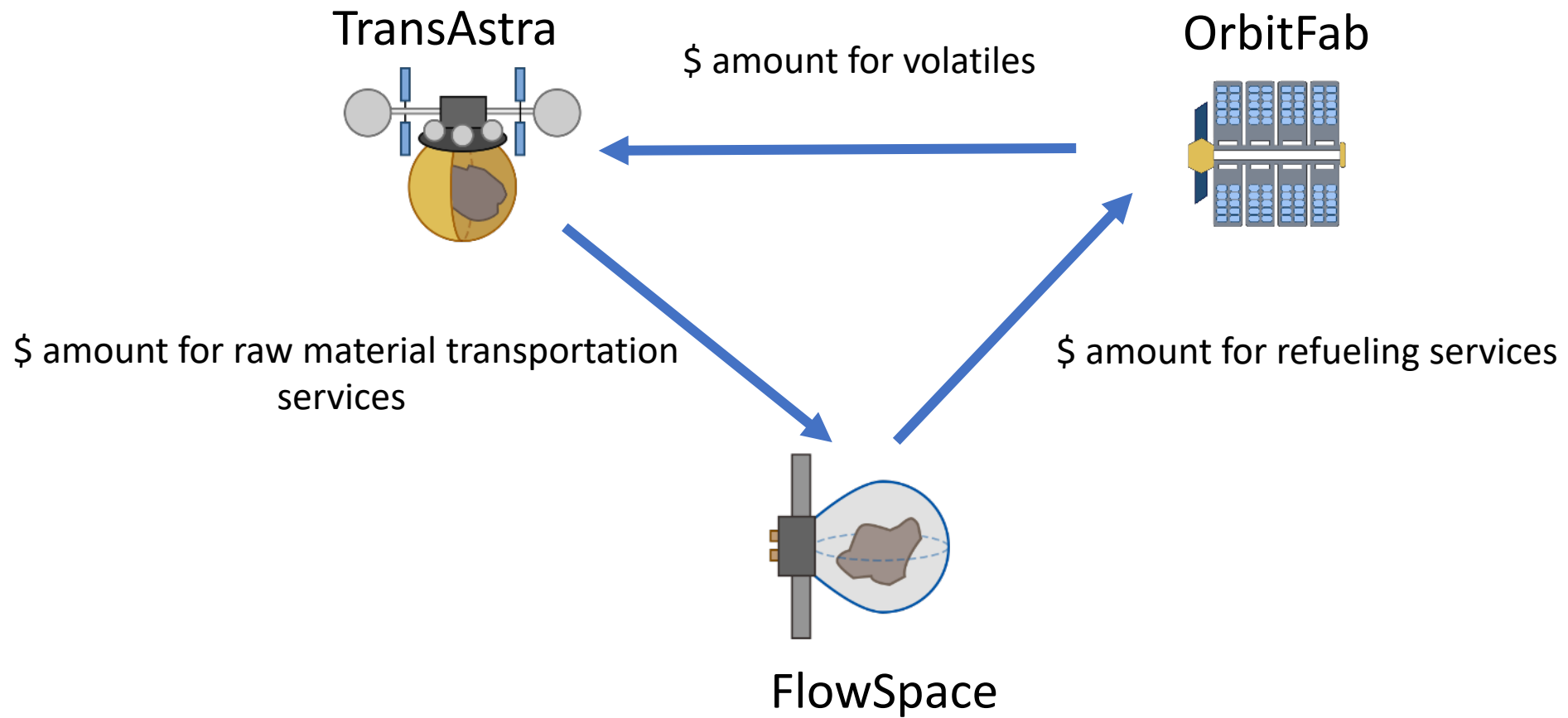


# SUSTAINABLE SUPPLY CHAIN INFRASTRUCTURES





## CREATING A SUSTAINABLE SPACE ECONOMY THROUGH COLLABORATION



# SHEPHERD Secure Handling through Encapsulation of Planetesimals Heading to Earth-moon Retrograde Delivery

Proposal: ARRM BAA/NASA (2014), Publication: NewSpace (2015)

## SHEPHERD: A Concept for Gentle Asteroid Retrieval with a Gas-Filled Enclosure

Peter Jenniskens,<sup>1</sup> Bruce Damer,<sup>2</sup> Ryan Norkus,<sup>2</sup> Stuart Pilorz,<sup>1</sup>  
Julian Nott,<sup>3</sup> Bryant Grigsby,<sup>4</sup> Constance Adams,<sup>5</sup>  
and Brad R. Blair<sup>6</sup>

<sup>1</sup>SETI Institute, Mountain View, California.

<sup>2</sup>DigitalSpace Research, Boulder Creek, California.

<sup>3</sup>Nott Technologies LLC, Santa Barbara, California.

<sup>4</sup>Accel Biotech, Inc., Los Gatos, California.

<sup>5</sup>Synthetics Intl. LLC, Houston, Texas.

<sup>6</sup>New Space Analytics LLC, Idaho Springs, Colorado.

### ABSTRACT

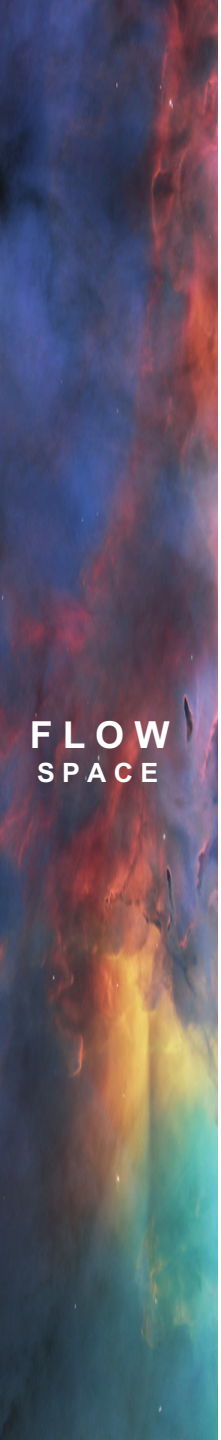
*Sealing a small asteroid within an enclosure enables innovative approaches to the Asteroid Redirect Mission concept that pave the way for future in situ asteroid resource utilization. A sealed enclosure would make it possible to use an introduced atmosphere of xenon gas to*

However, the most interesting materials for retrieval and study are primitive and fragile, especially those too frail to be represented in our meteorite collections. Loose agglomerations of rocks and regolith may be common materials in space. Understanding the internal strength of small asteroids may be the single most important parameter affecting planetary defense operations and future mining or volatiles resource utilization operations. Indeed, ARM mission candidate asteroid 2011 MD is thought to be a weakly consolidated rubble pile.<sup>3-4</sup>

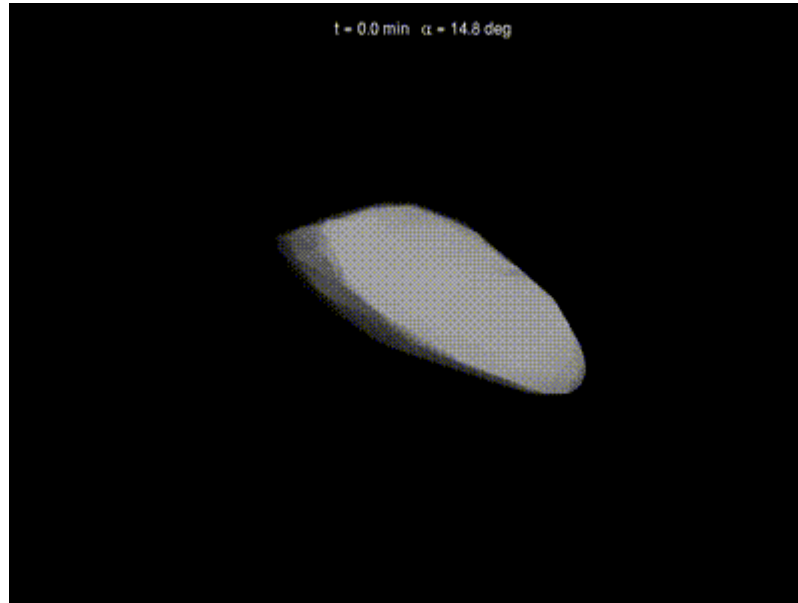
Ideally, ARM would deliver the fragile asteroid in much the same condition as it was found in space, and so human space flight missions will visit an asteroid, not a bag of rocks. By interacting with a free-floating weakly consolidated asteroid, astronauts would face many of the same challenges as when interacting with a larger asteroid in heliocentric orbits in a longer mission. This would make the ARM mission a suitable stepping stone to the longer-duration mission of visiting asteroids in solar orbit, and ultimately Mars.<sup>1</sup>







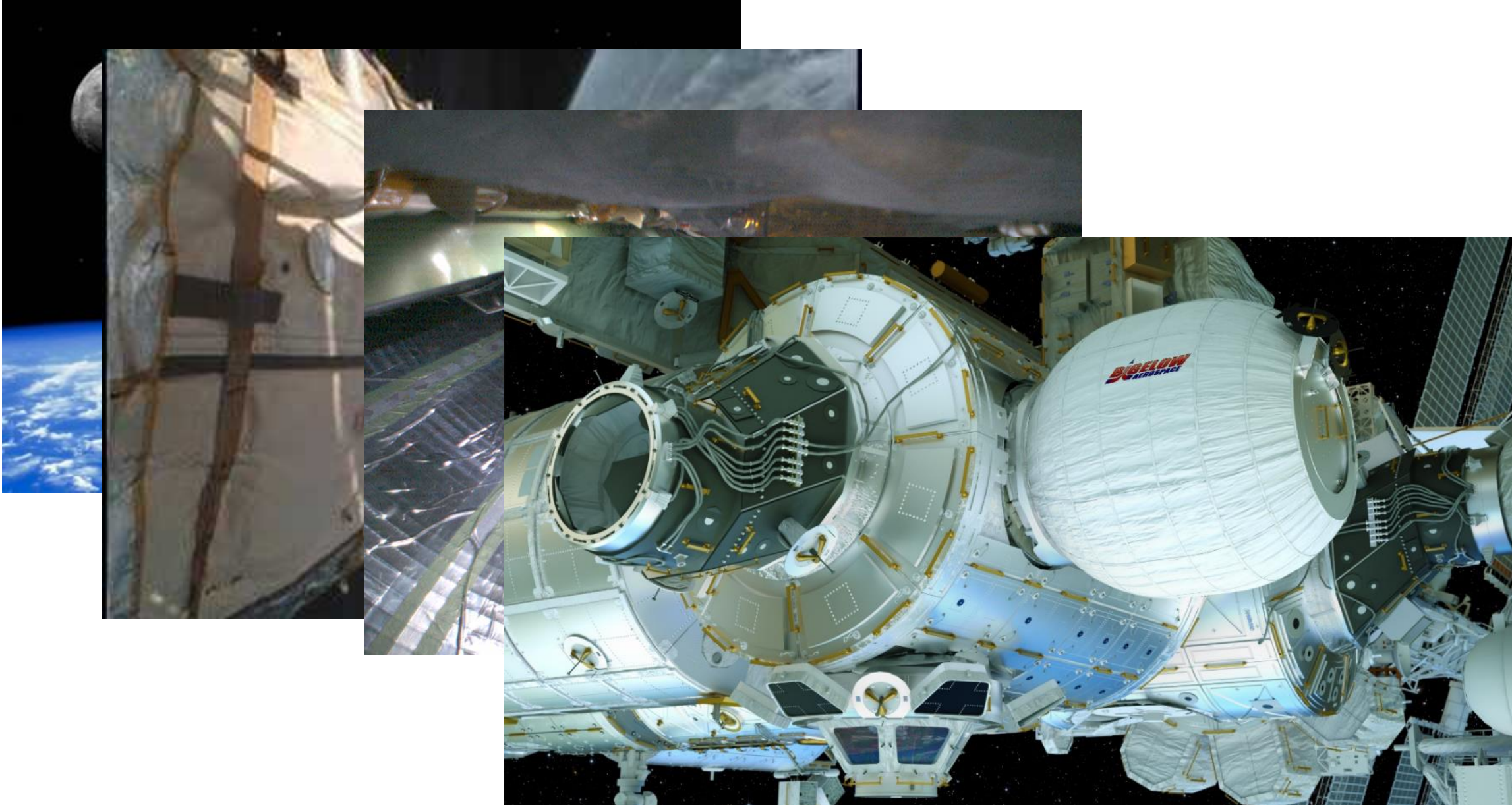
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Pneumatic handling simulation @ SETI Institute  
(Jenniskens-Pilorz)  
2008 TC<sub>3</sub> (3m diameter)  
de-tumble/de-spin  
in .1atm < 24 hours

# Strong Heritage Bigelow Genesis/BEAM)

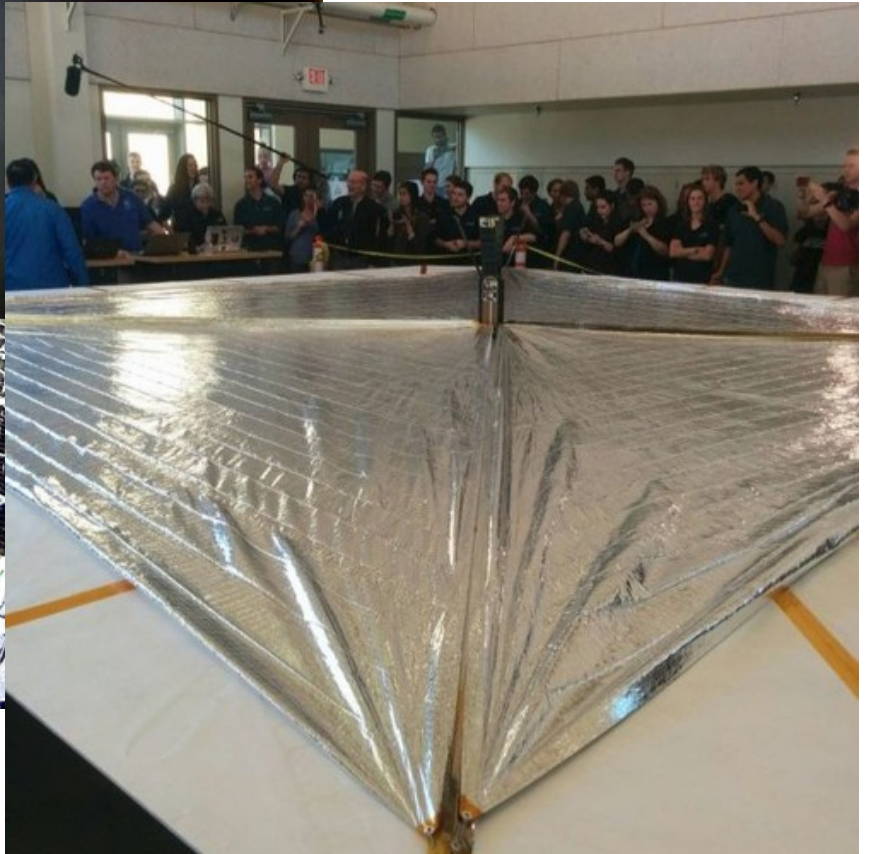
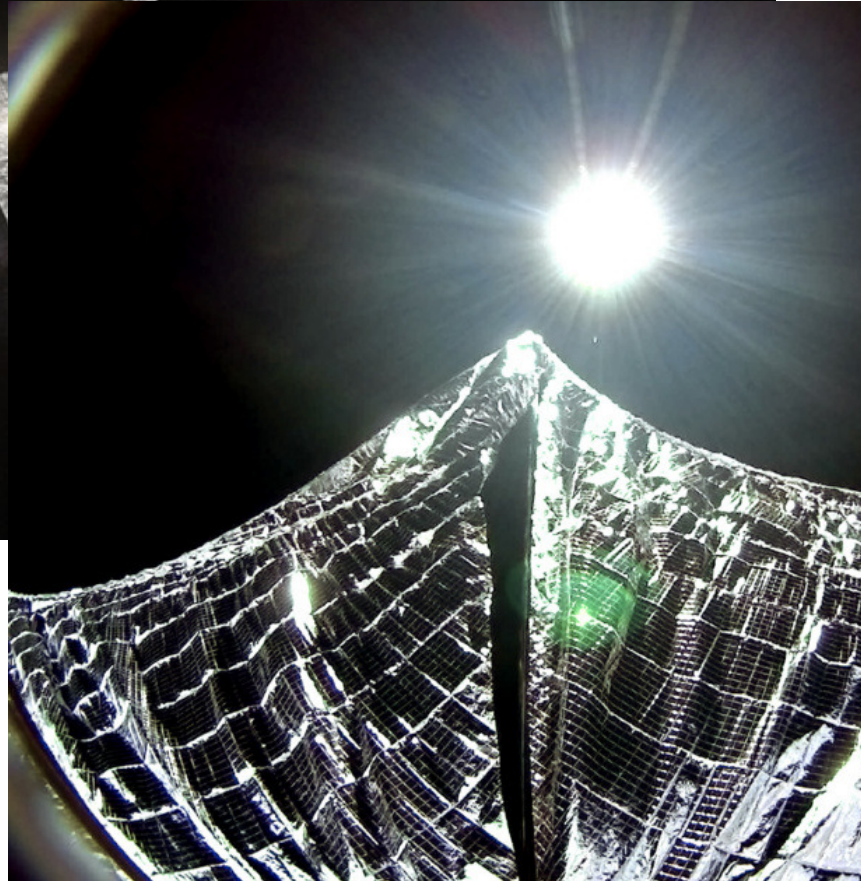
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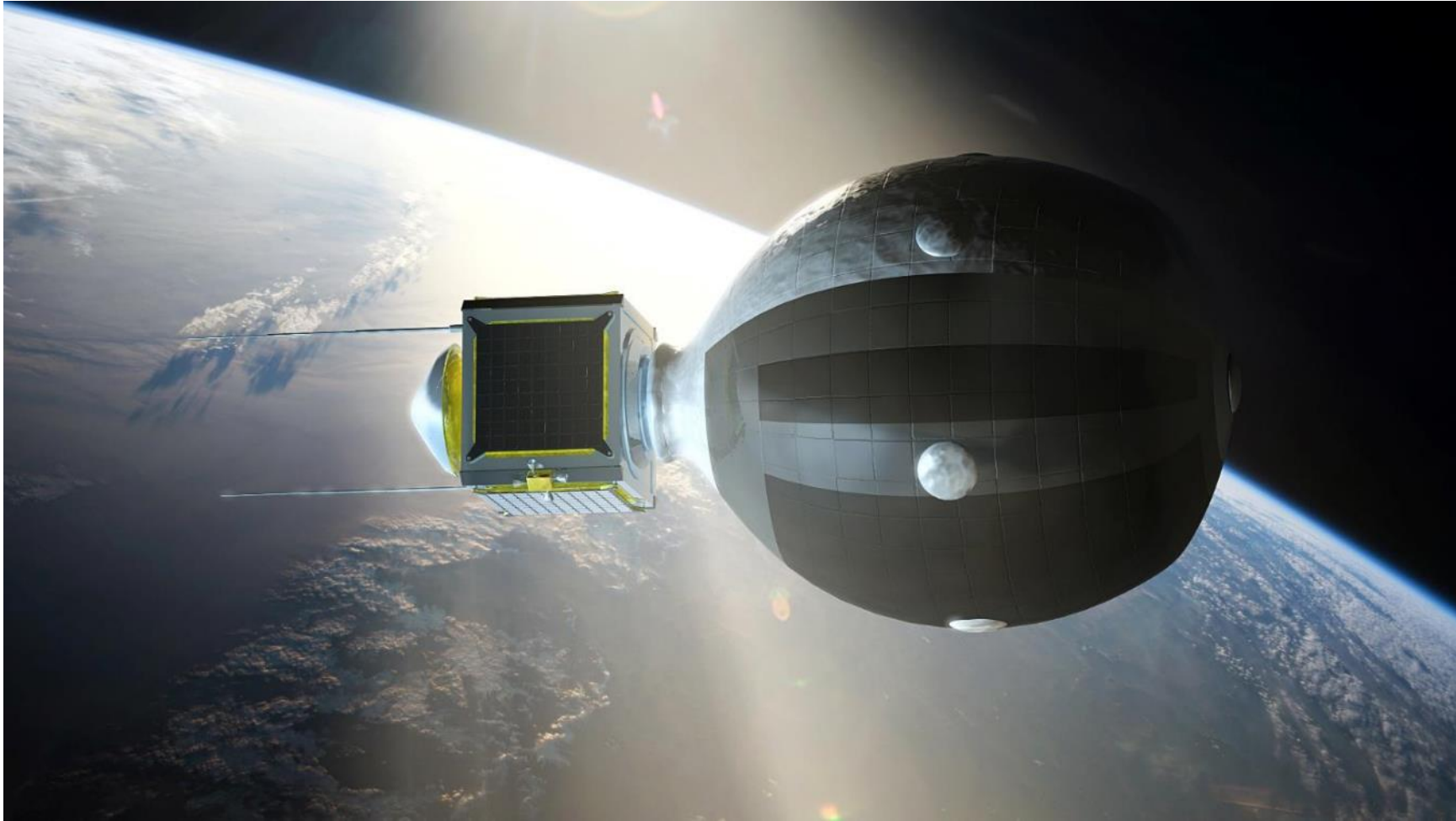
FlowSpace Inc, 2019



# Strong Heritage Planetary Society Lightsail 1



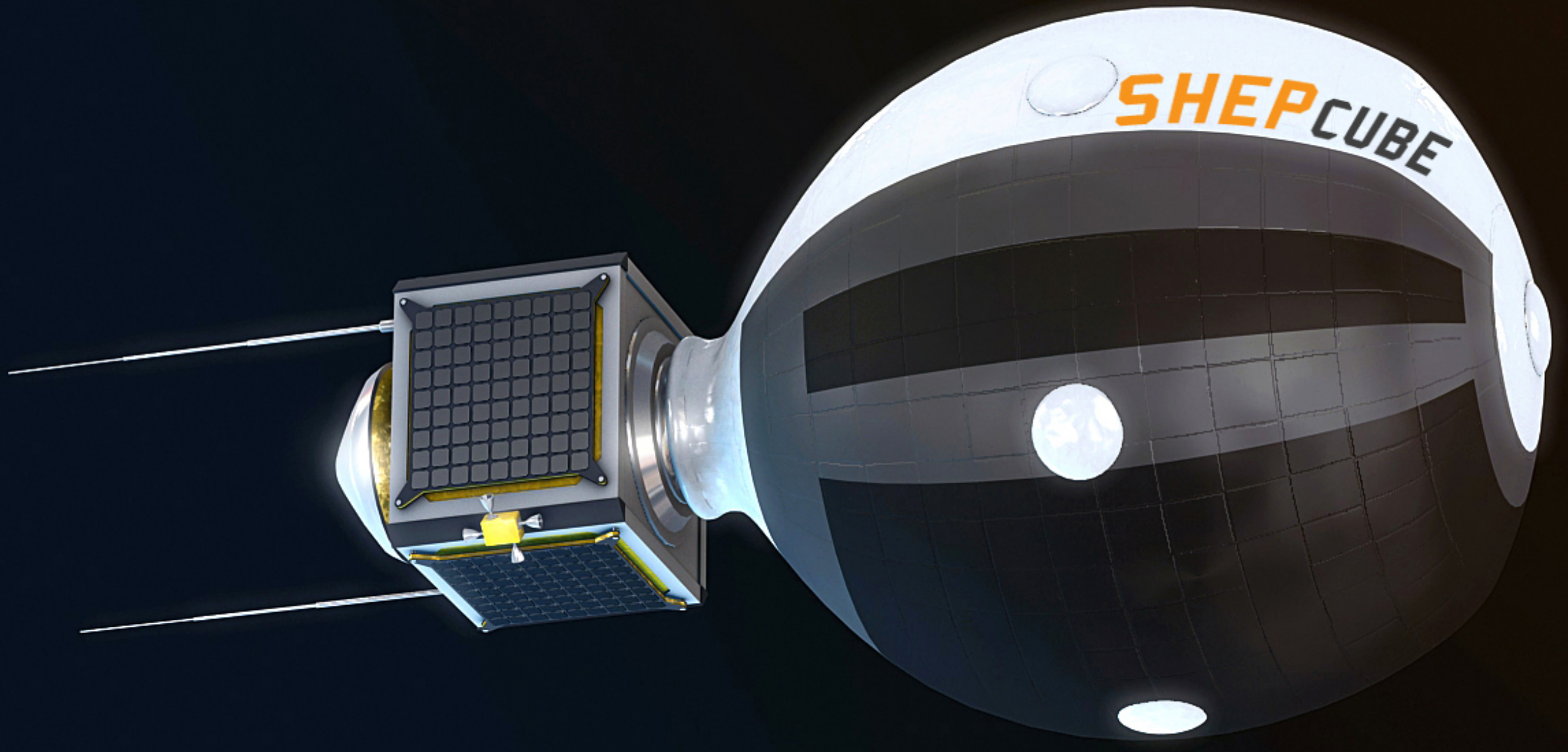
# CubeSat Demonstration



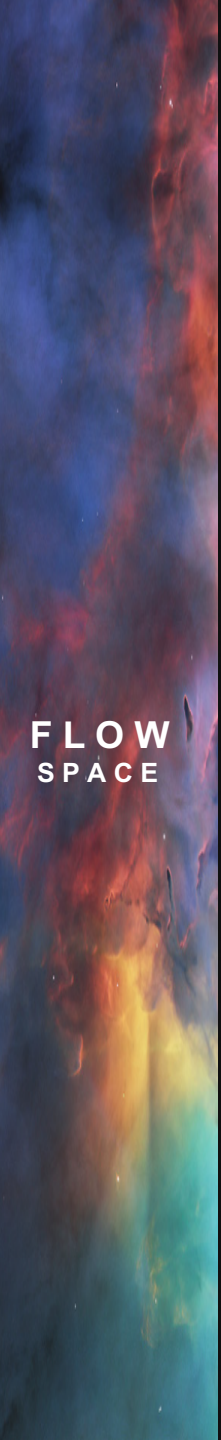
**Proof of concept for secure handling of objects**



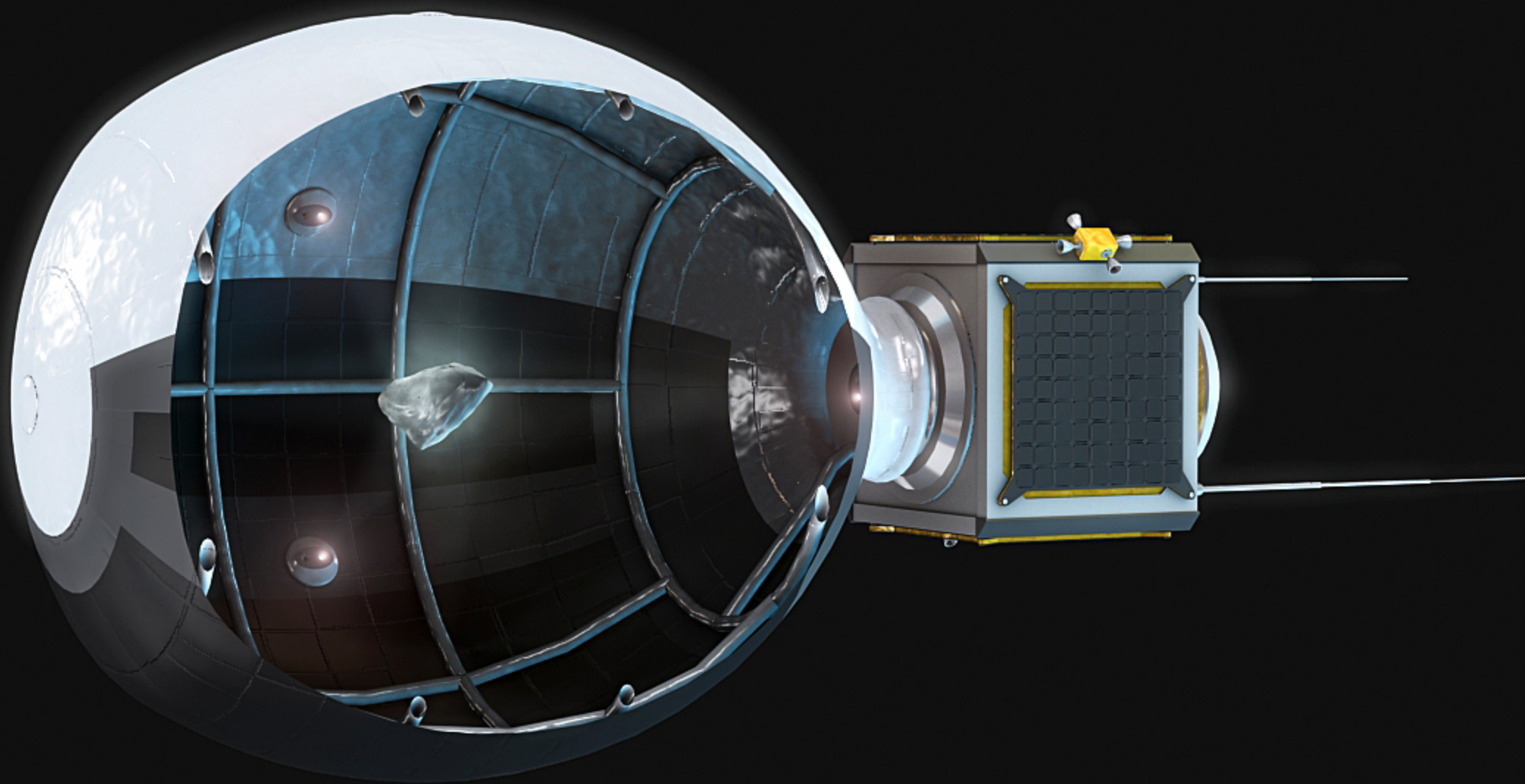
# Views of SHEPHERD-CubeSat



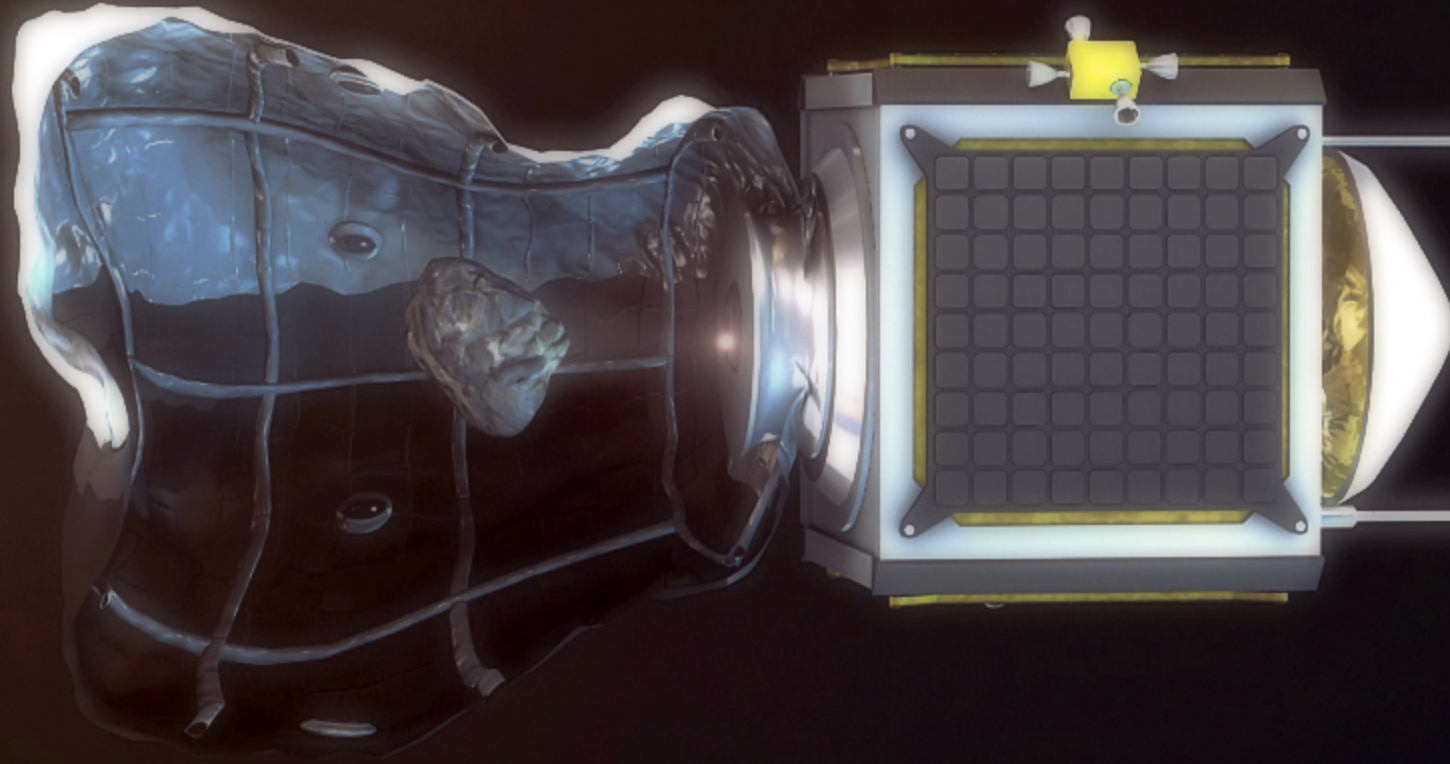




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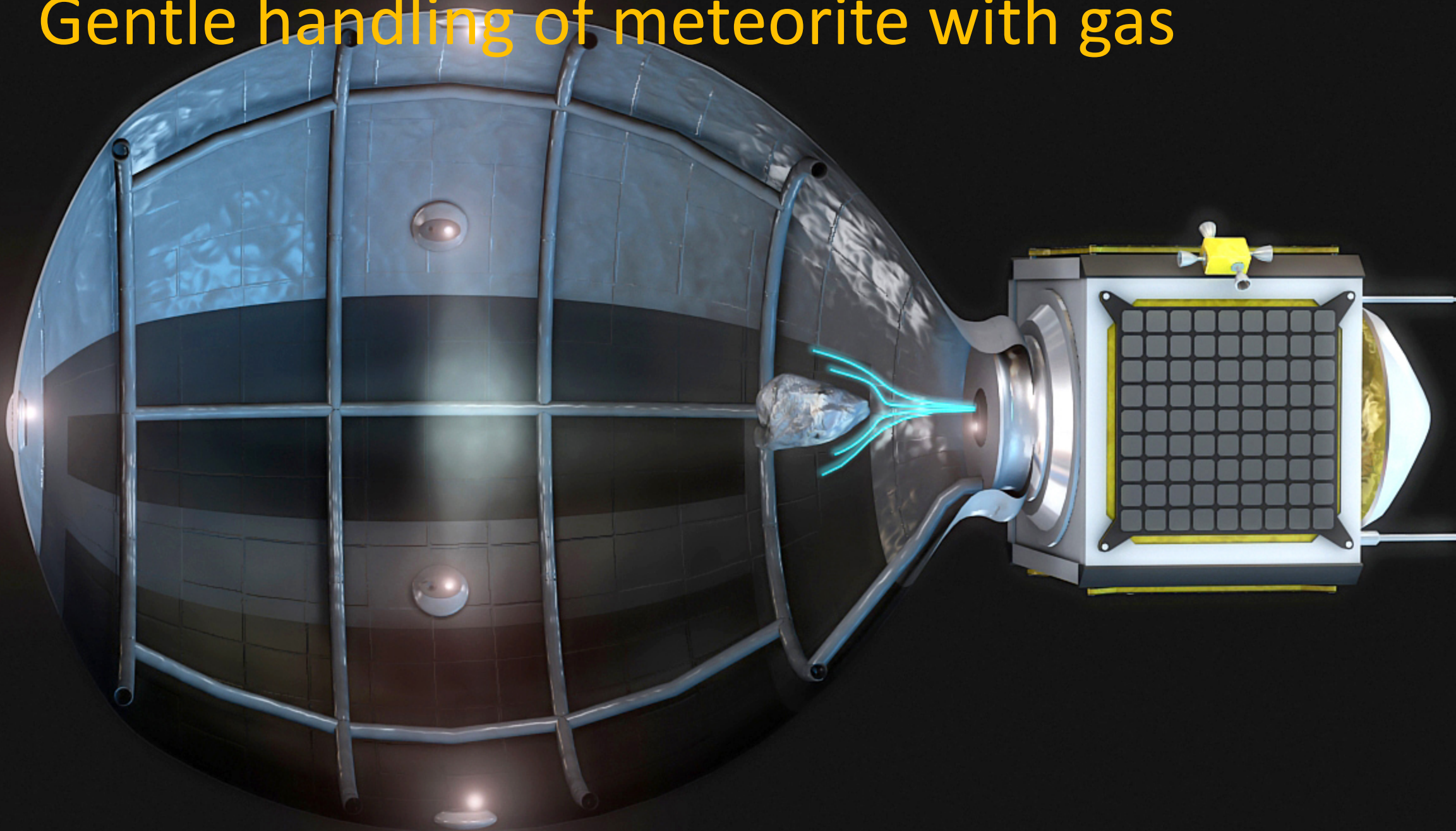
# Deployment of bag with meteorite target



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# Gentle handling of meteorite with gas

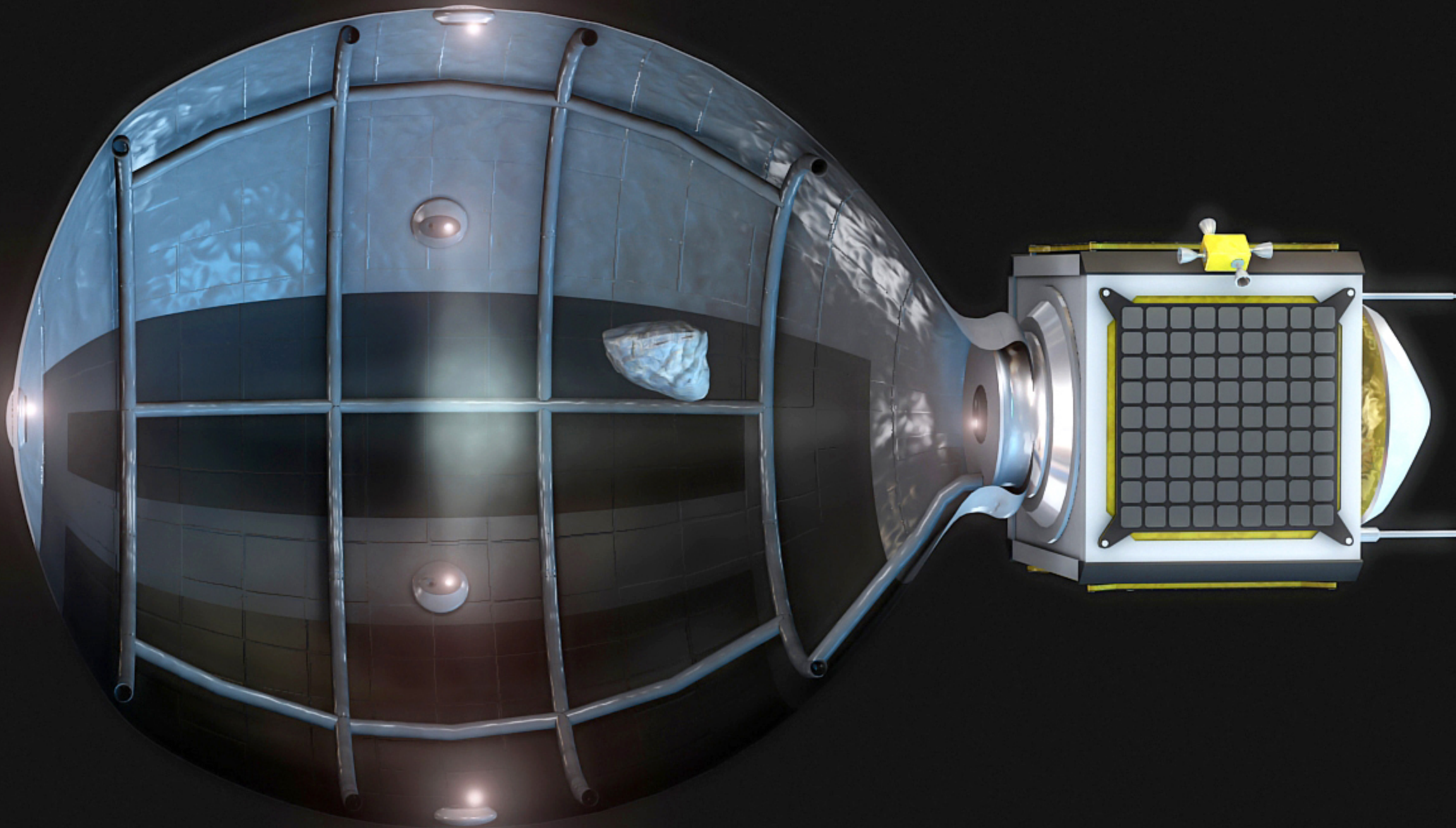


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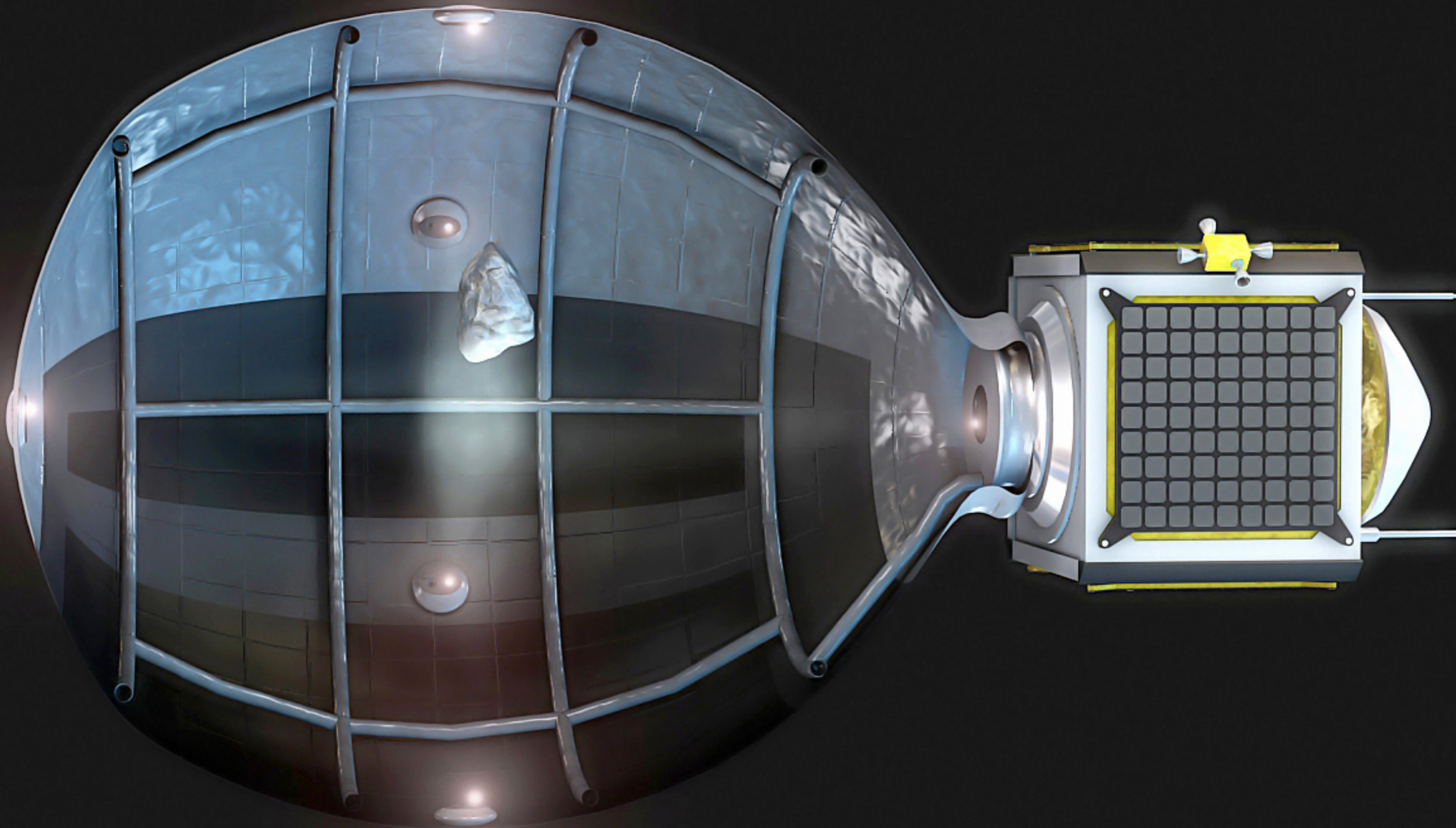
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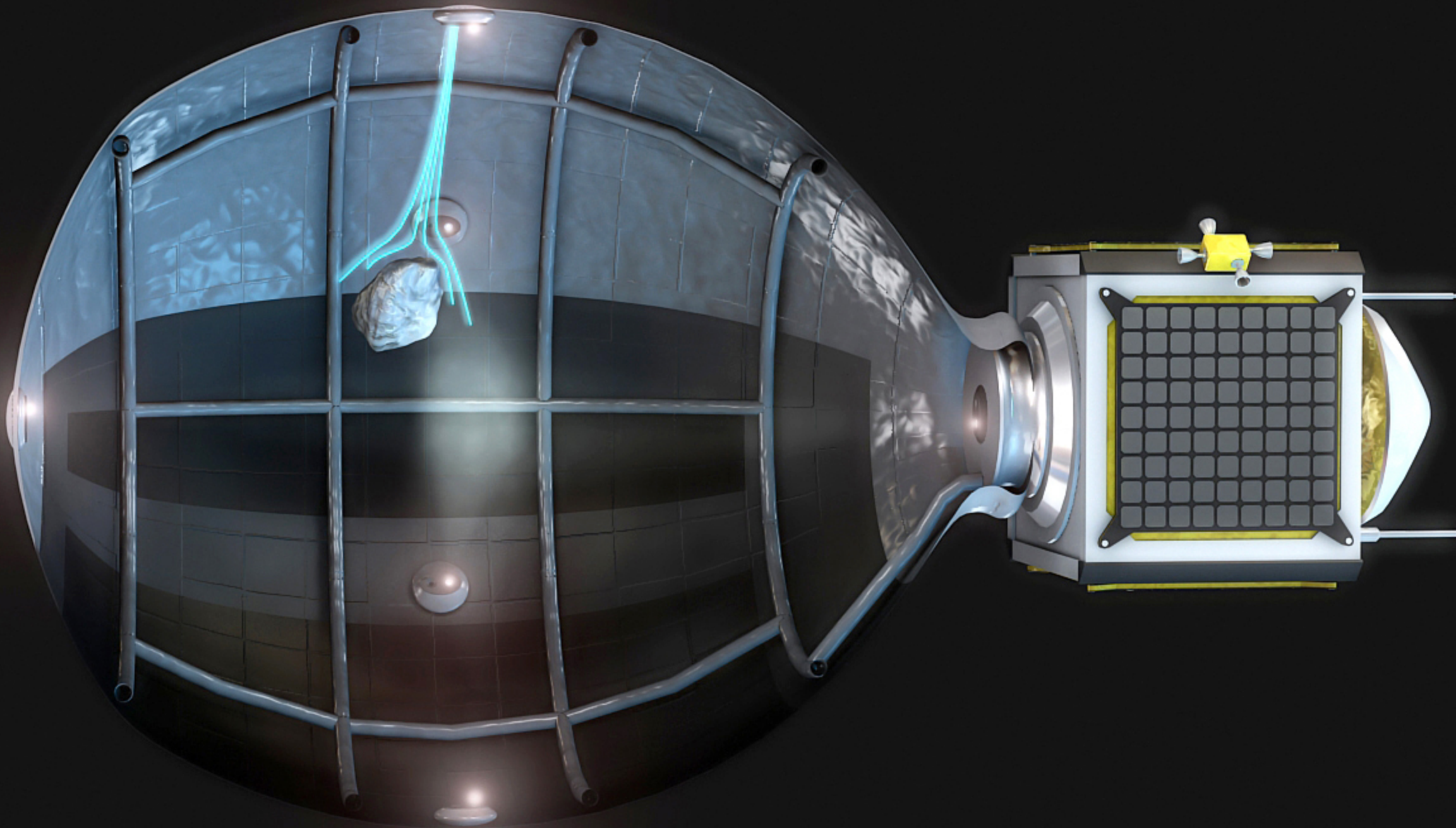
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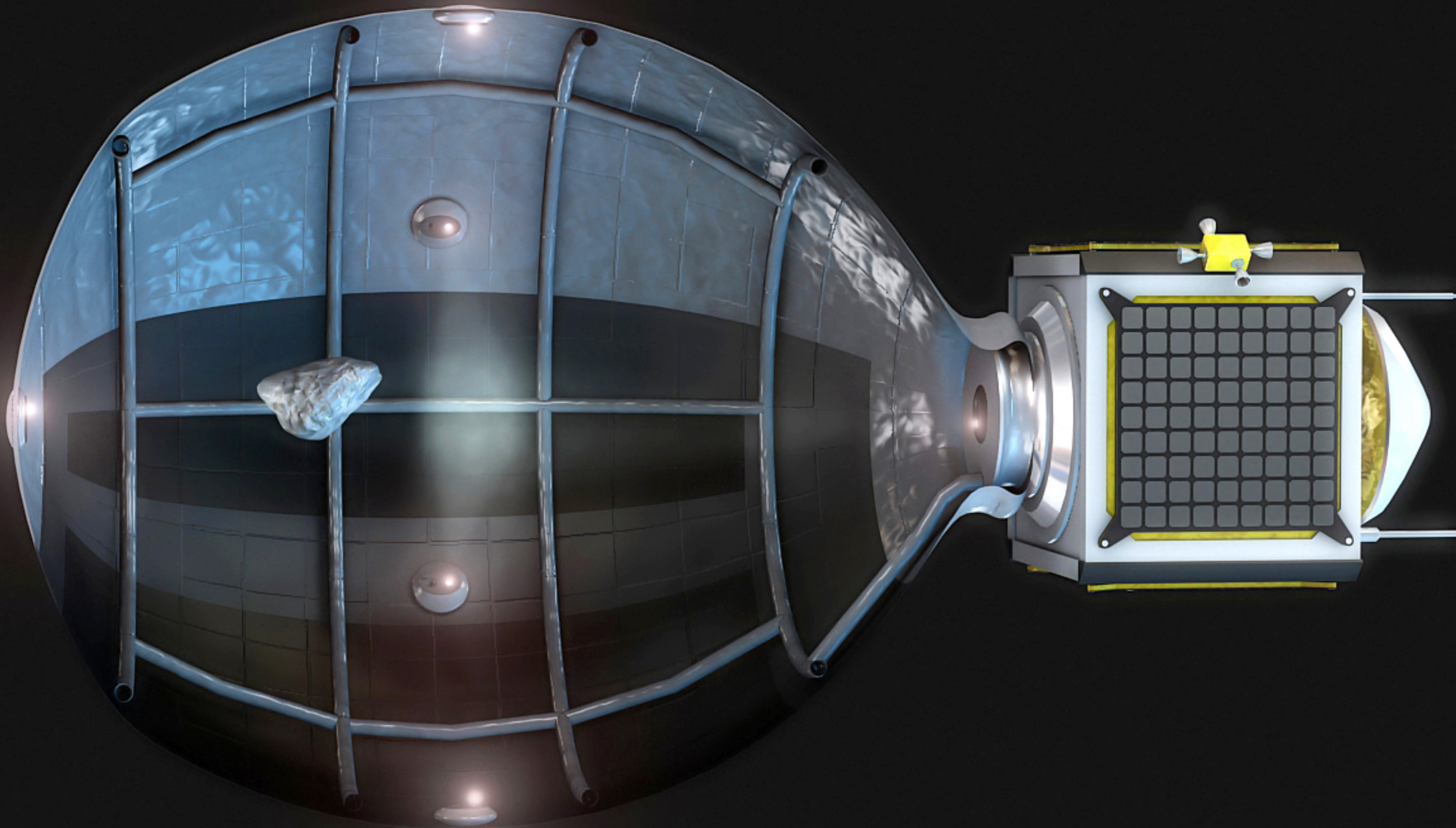
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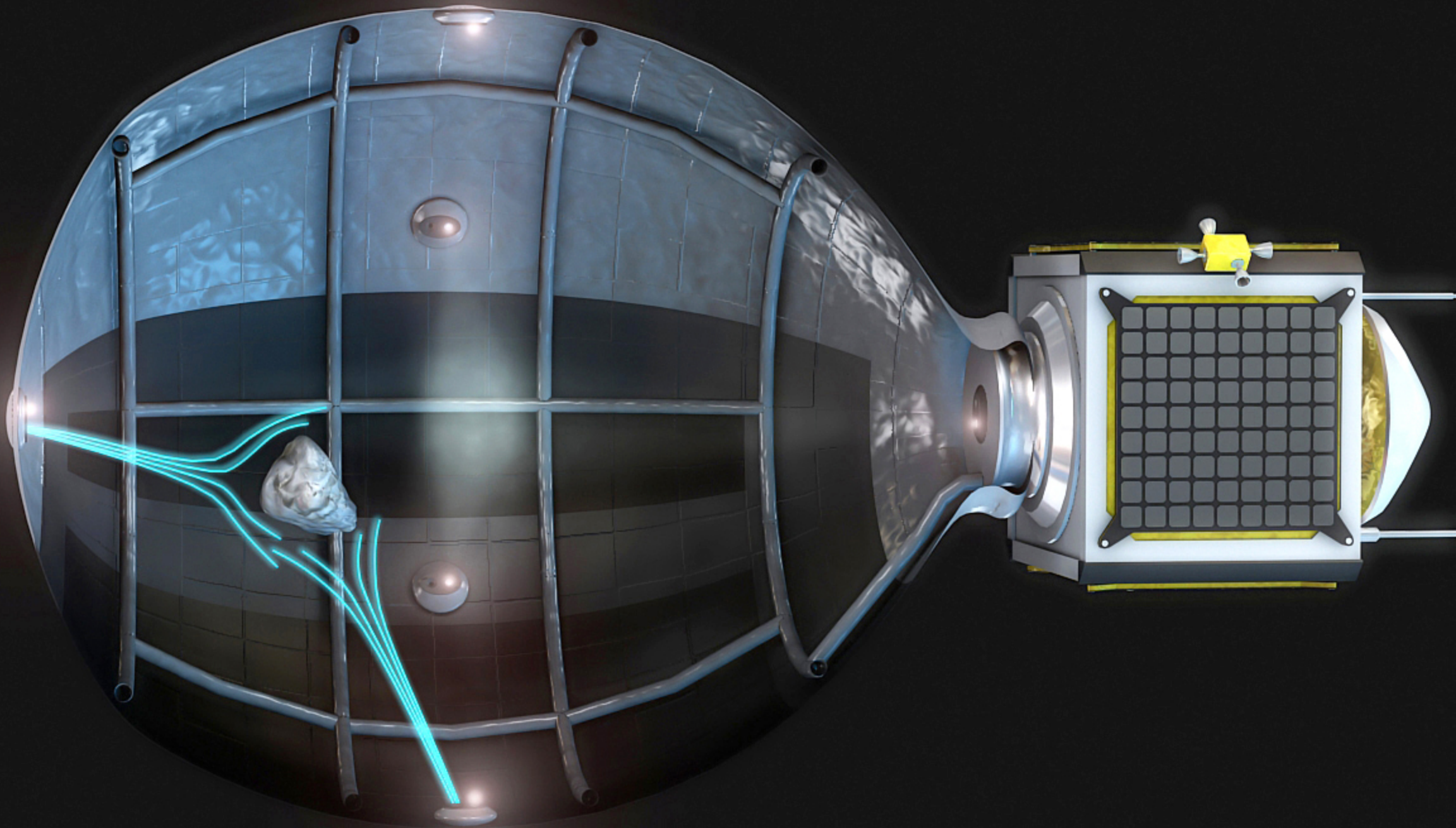
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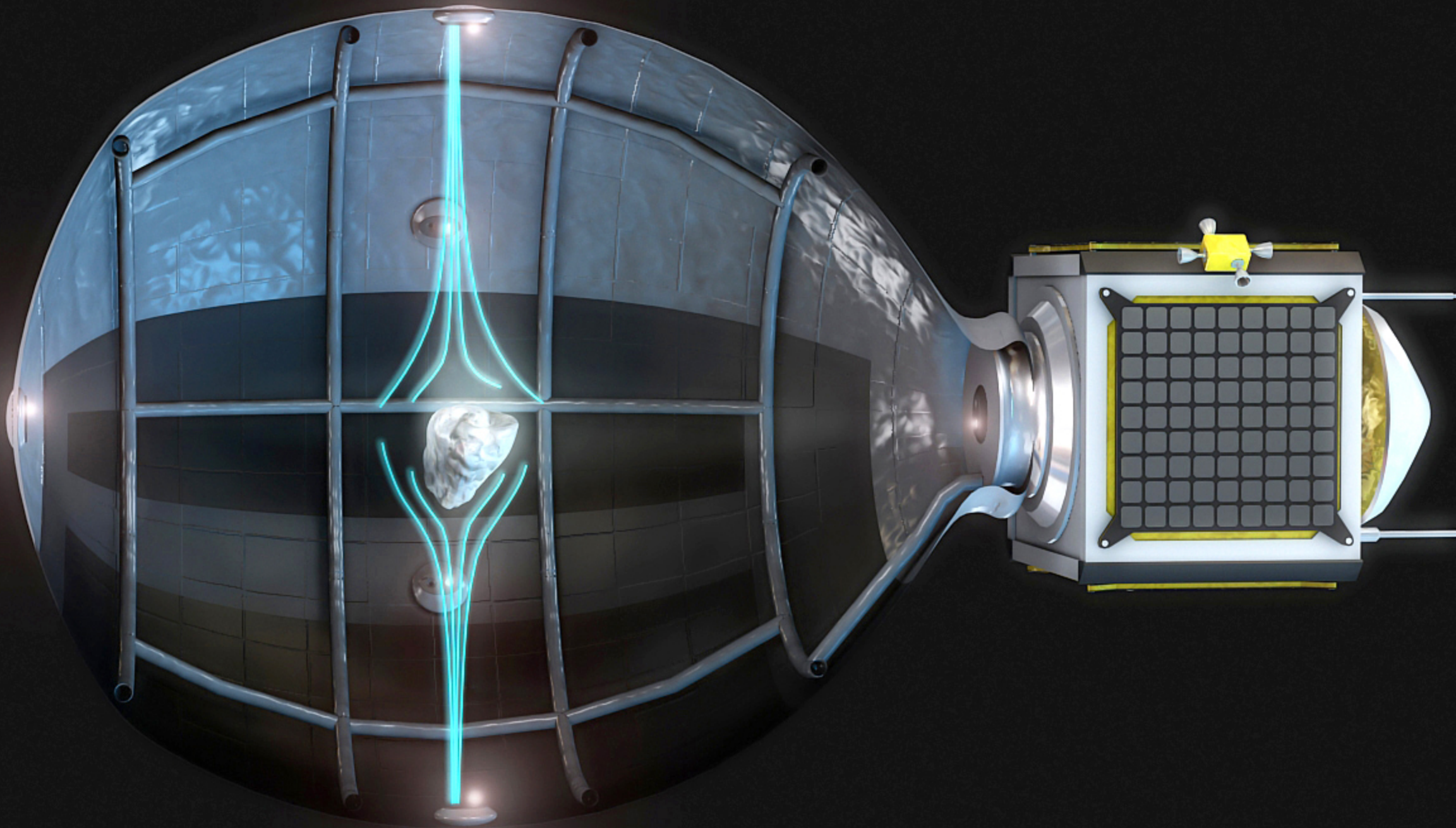
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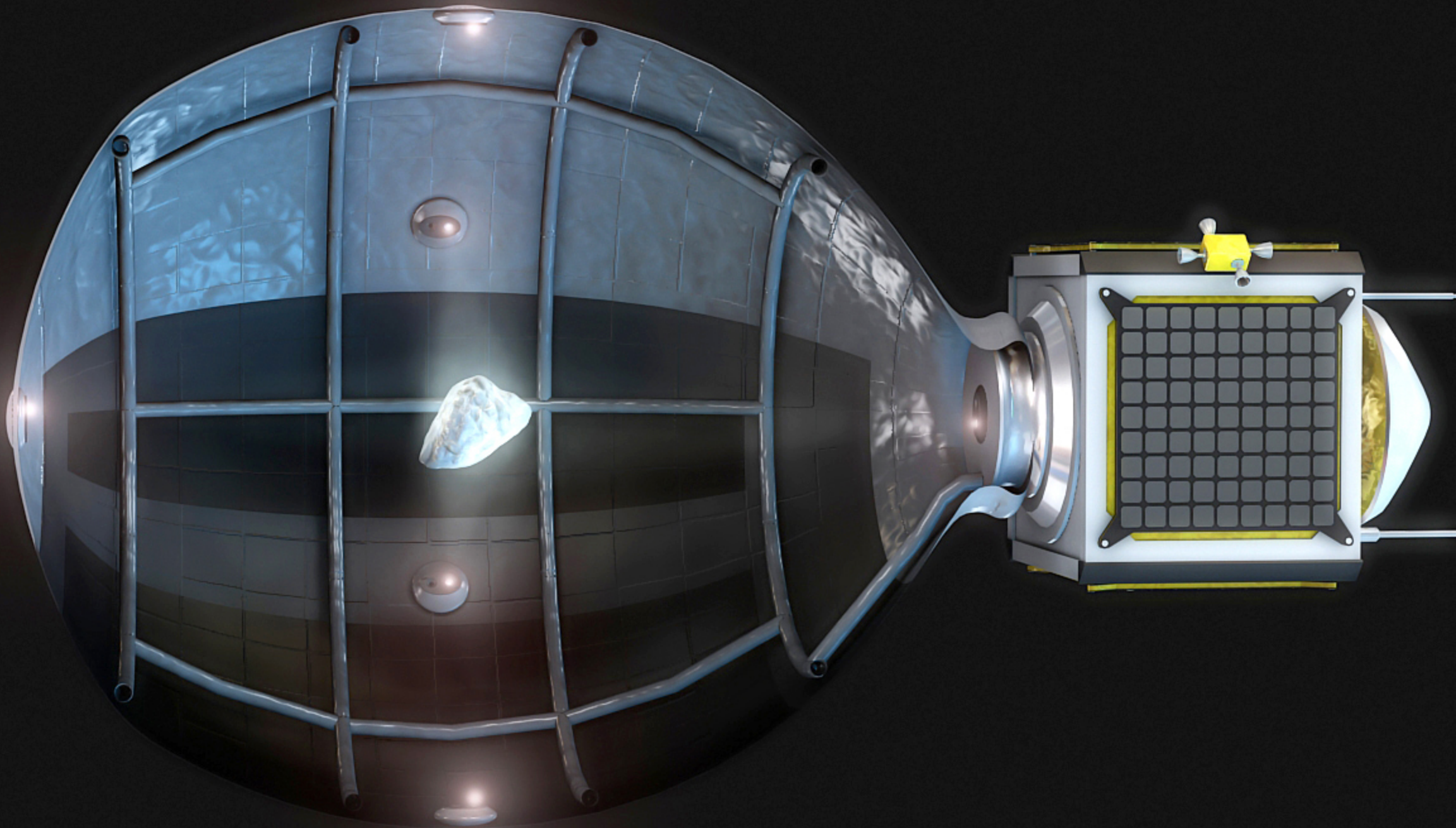
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FLOW  
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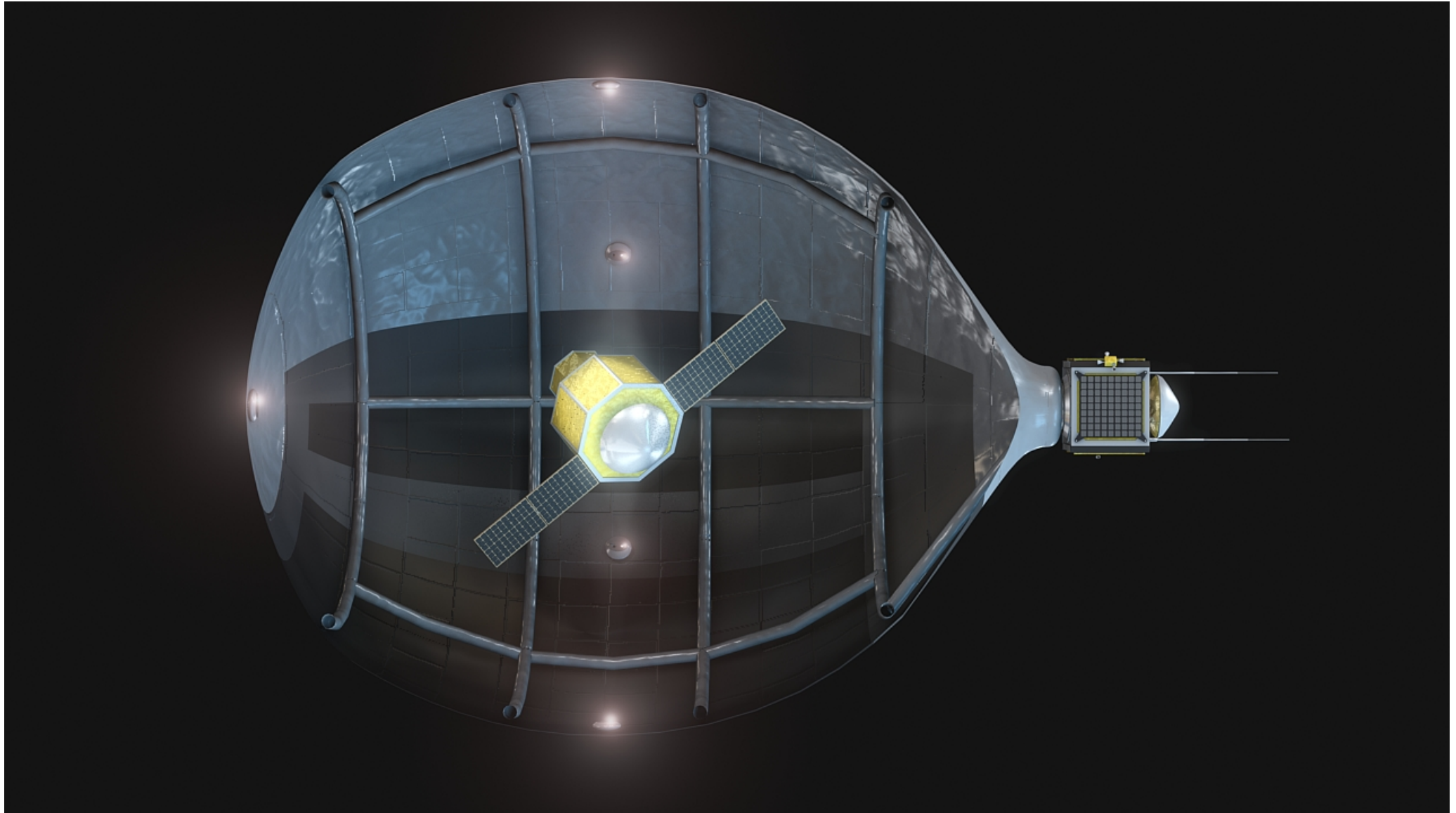
# Interior views of meteorite within enclosure



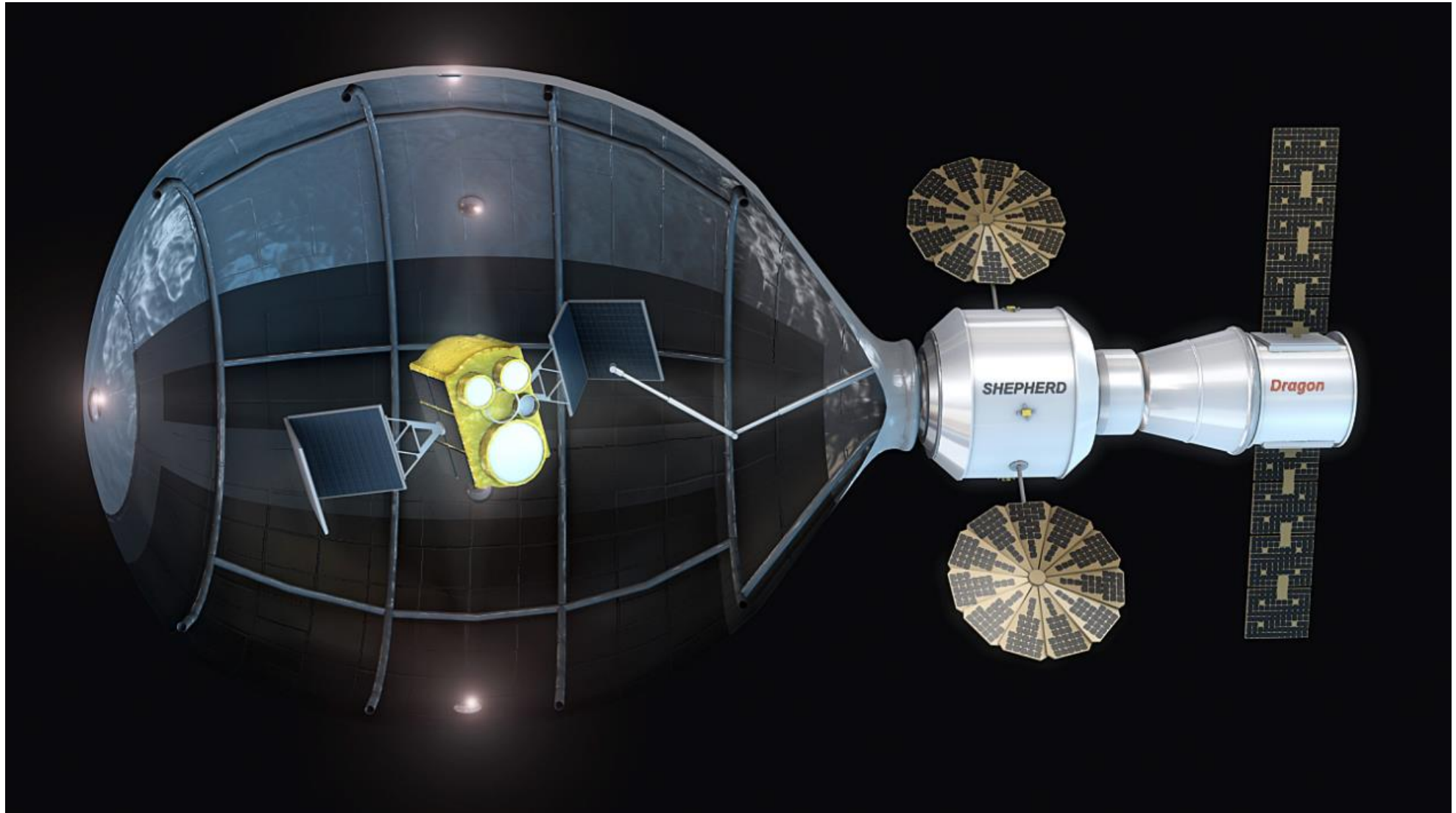
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# Debris encapsulation/mobilization test



# Larger Satellite Servicing





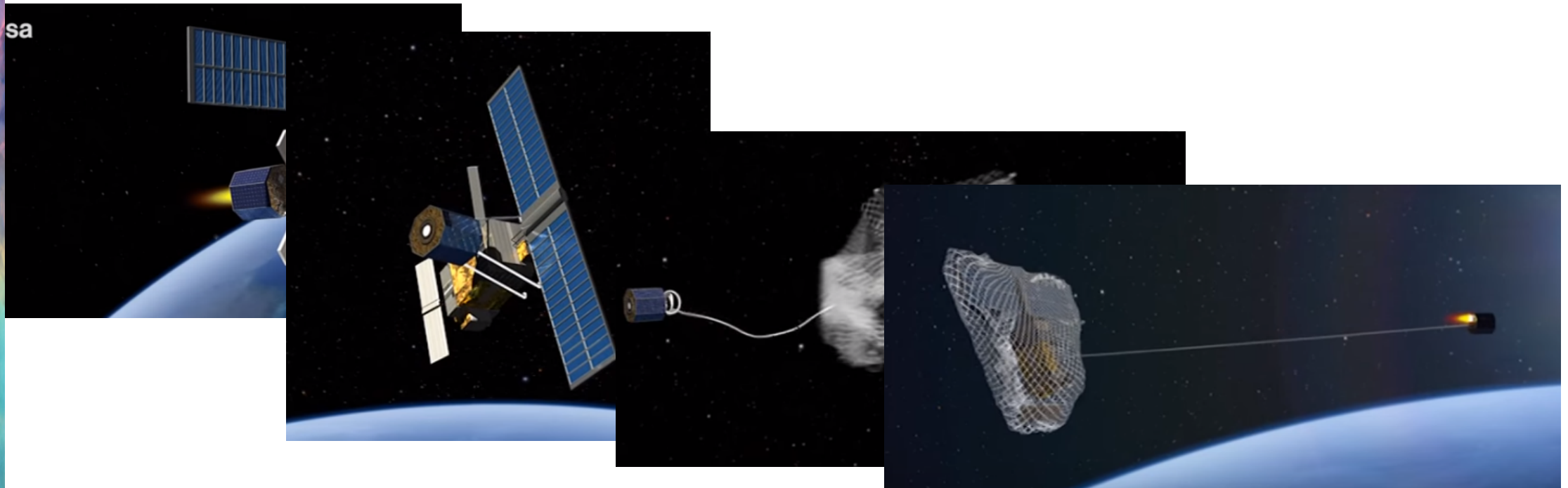
# EoL - collision prevention, de-orbiting

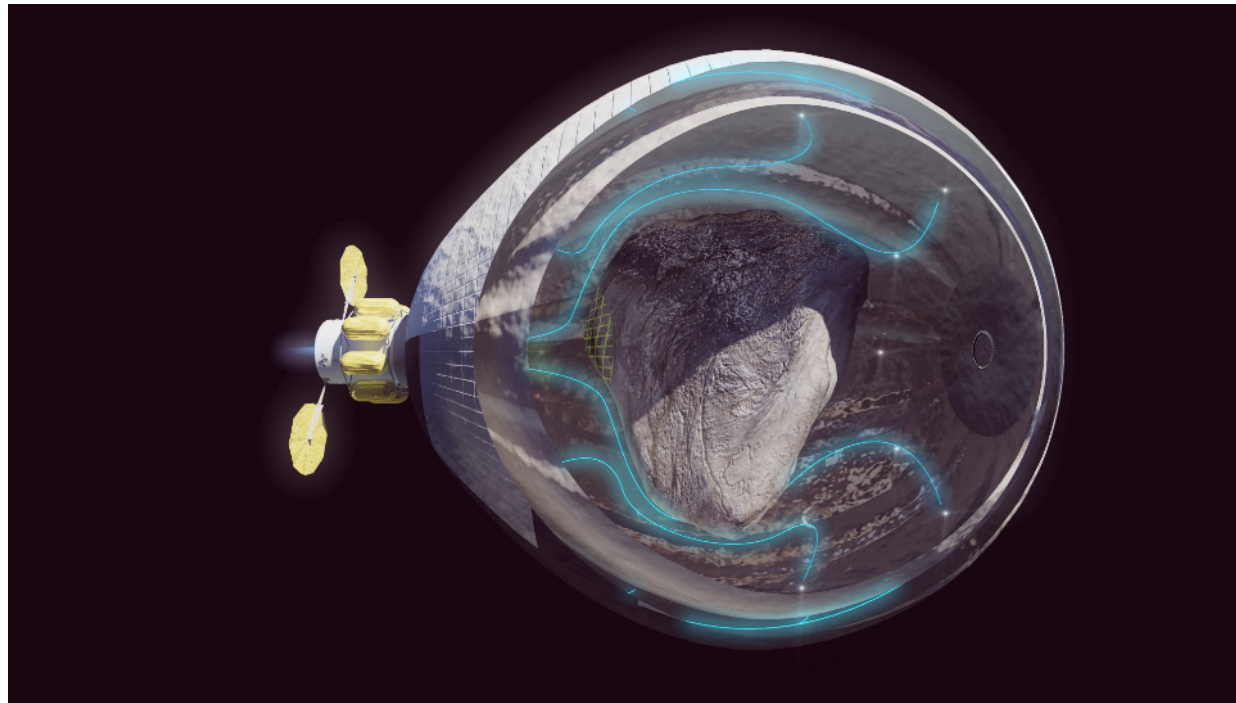
CleanSpace Initiative-> legal requirement for active removal

Collision mitigation by moving to graveyard orbits/EoL

SHEPHERD provides *contactless solutions and can securely handle rotating objects, relocation, controlling debris*

Current proposals are more complex/risky than SHEPHERD...





# COMMUNITY **FEEDBACK**