

Solar System Mini-Settlements 2060

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Exploration
requires ships.

Settlement
requires ports.



The Grand Challenges of Space Settlement: 2020 Dashboard

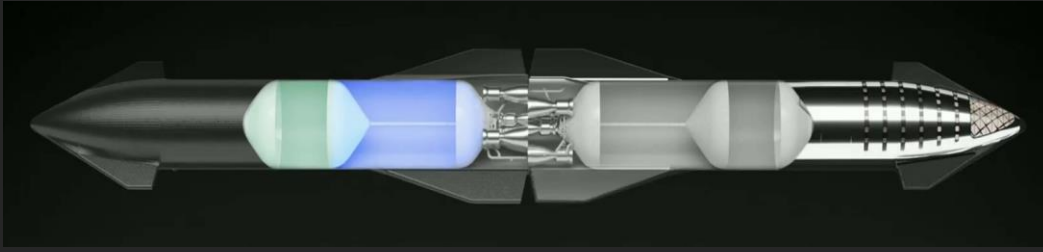
Launch/LEO	Deep Space	Moon/Mars	Settlement
Affordable Launch	Solar Flares	Moon Landing	Air/Water
Large Vehicle Launch	GCR: Cell Damage	Mars EDL	Power and Propellant
Orbital Refueling/ Mass Fraction beyond Earth Orbit	Medication/ Food Expiration	Spacesuit Lifespan	Base Construction
Space Junk	Life Support Closed Loop	Dust Issues	Food Growth
Microgravity (health issues)	Medical Entropy	Basic Power/ Propellant Production	Surface Mining and Extraction
	Psychology	Return Flight to Earth (speed, mass, etc.)	Hybrid Manufacturing
	Mechanical Entropy	Planetary Protection	Reproduction



The Grand Challenges of Space Settlement: Resolutions Here

Launch/LEO	Deep Space	Moon/Mars	Settlement
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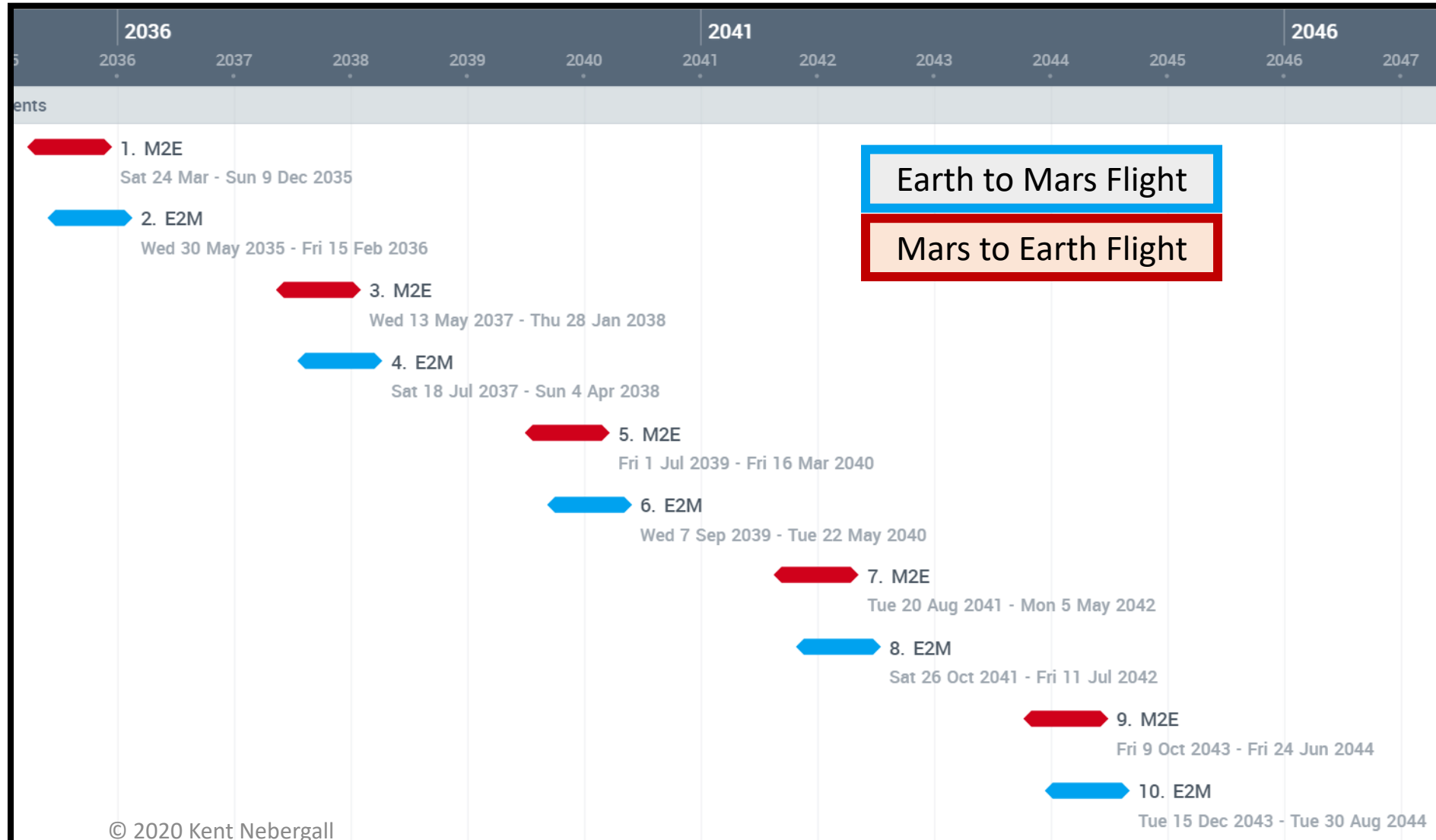




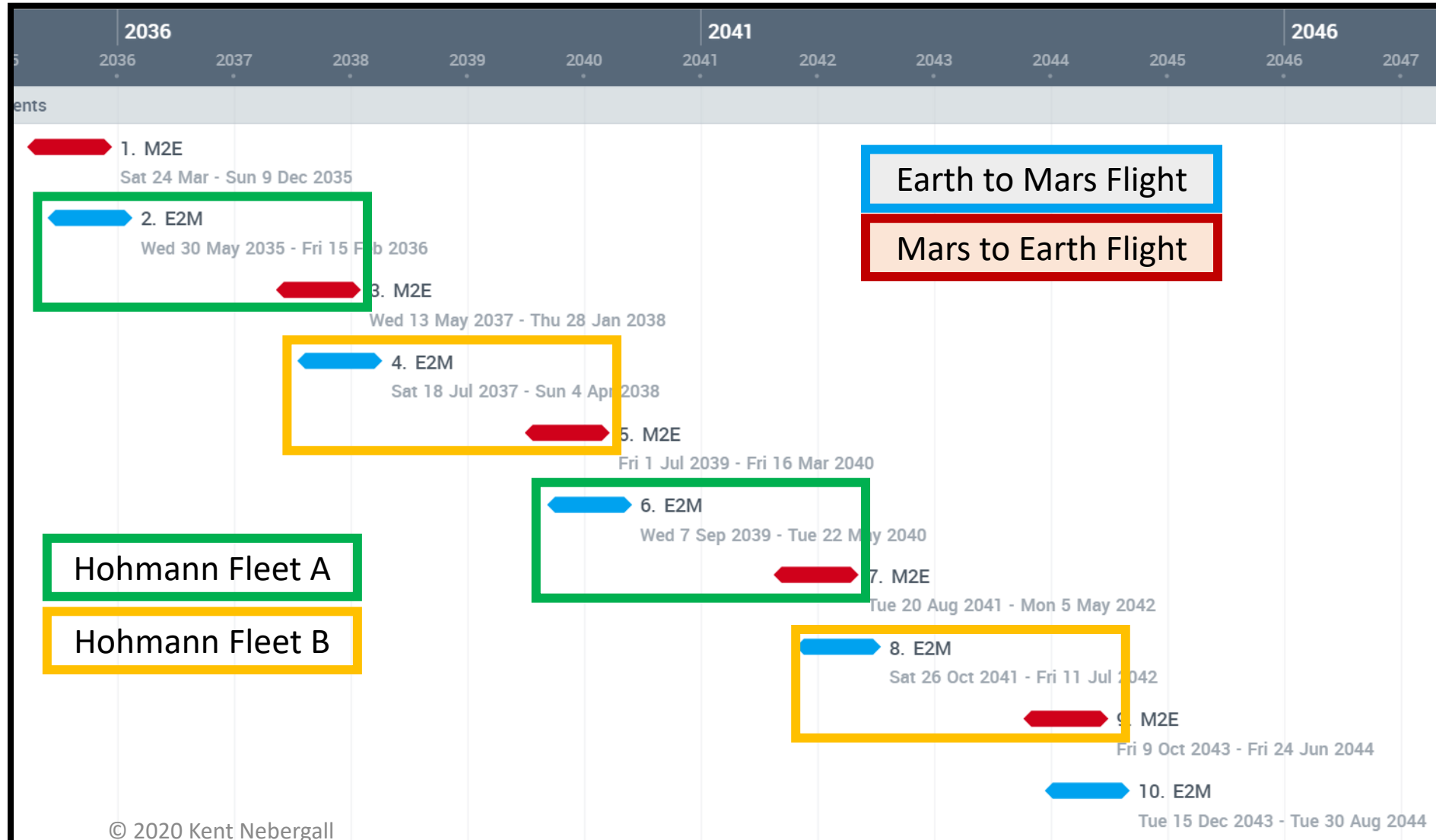
Issues with Starship Fleets

- Mars Launch window of 1 month every 26 months
- Refueling an entire fleet of 1000 Starships, meaning 5000 tanker flights without pad/vehicle damaging incidents
- Broad target for space debris during LEO refueling (Kessler Syndrome)

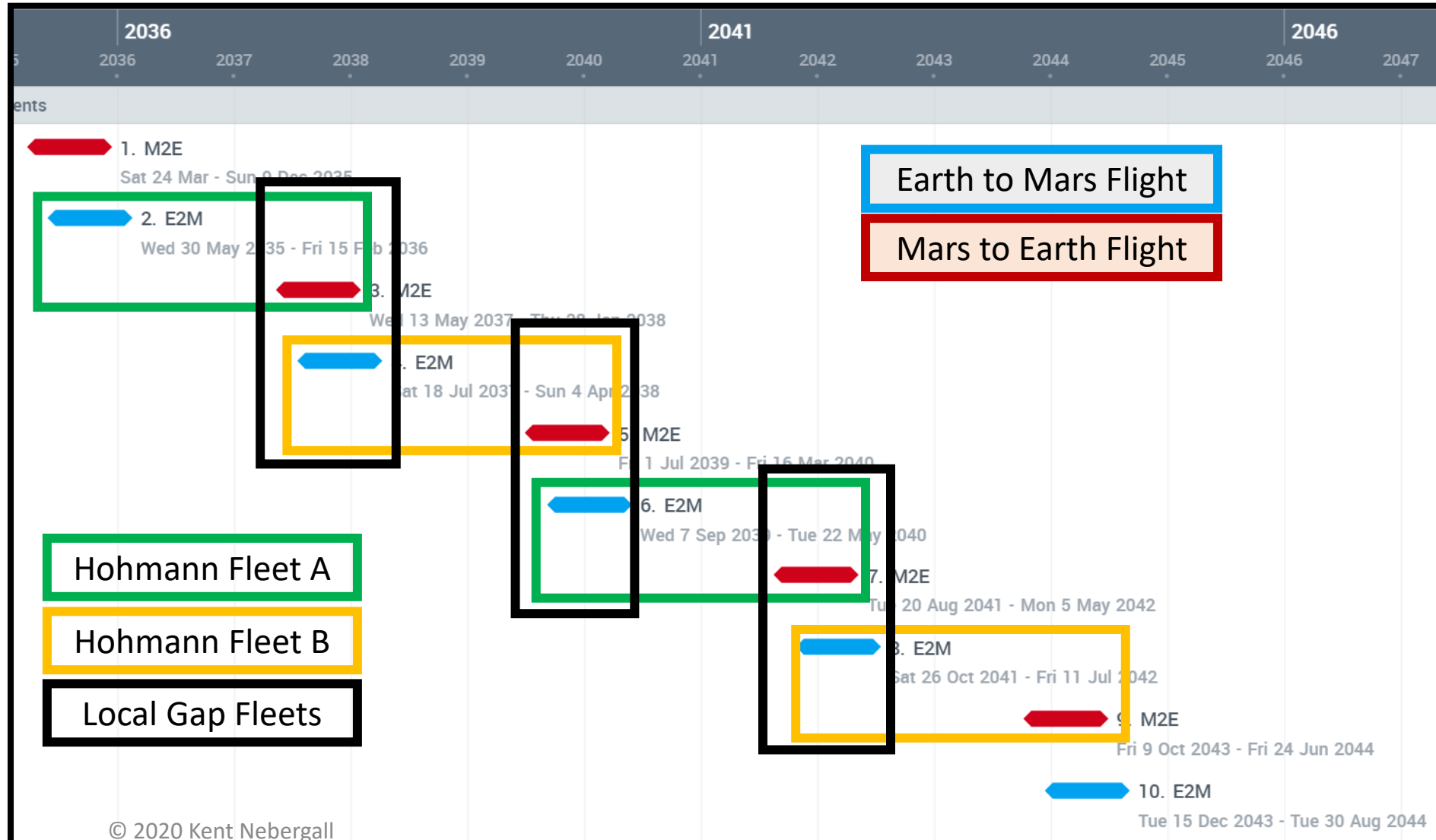
At Least Four Starship Fleets Required for Mars



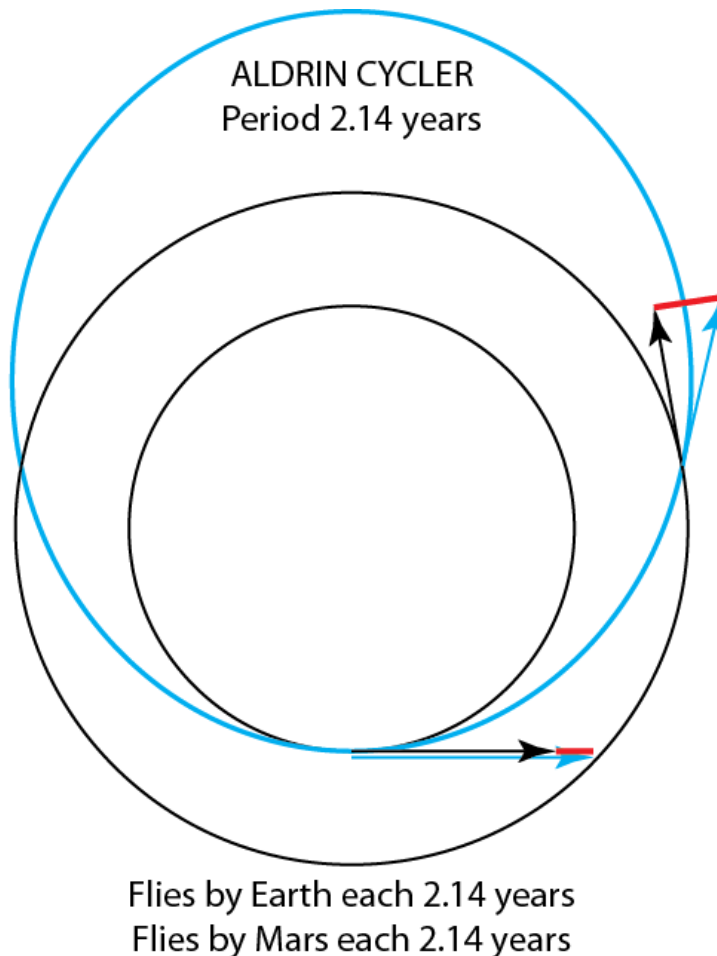
At Least Four Starship Fleets Required for Mars



At Least Four Starship Fleets Required for Mars



Plus Cycler Fleets



- Full trajectory out to asteroid belt.
- Could extend logistics to belt with single flight, or circularize solar orbit in belt and become mining colony vanguard.
- Could use industrial supplies or propellant for shielding en route, and then burrow into asteroid for shielding on site.

Problem:Solution Set

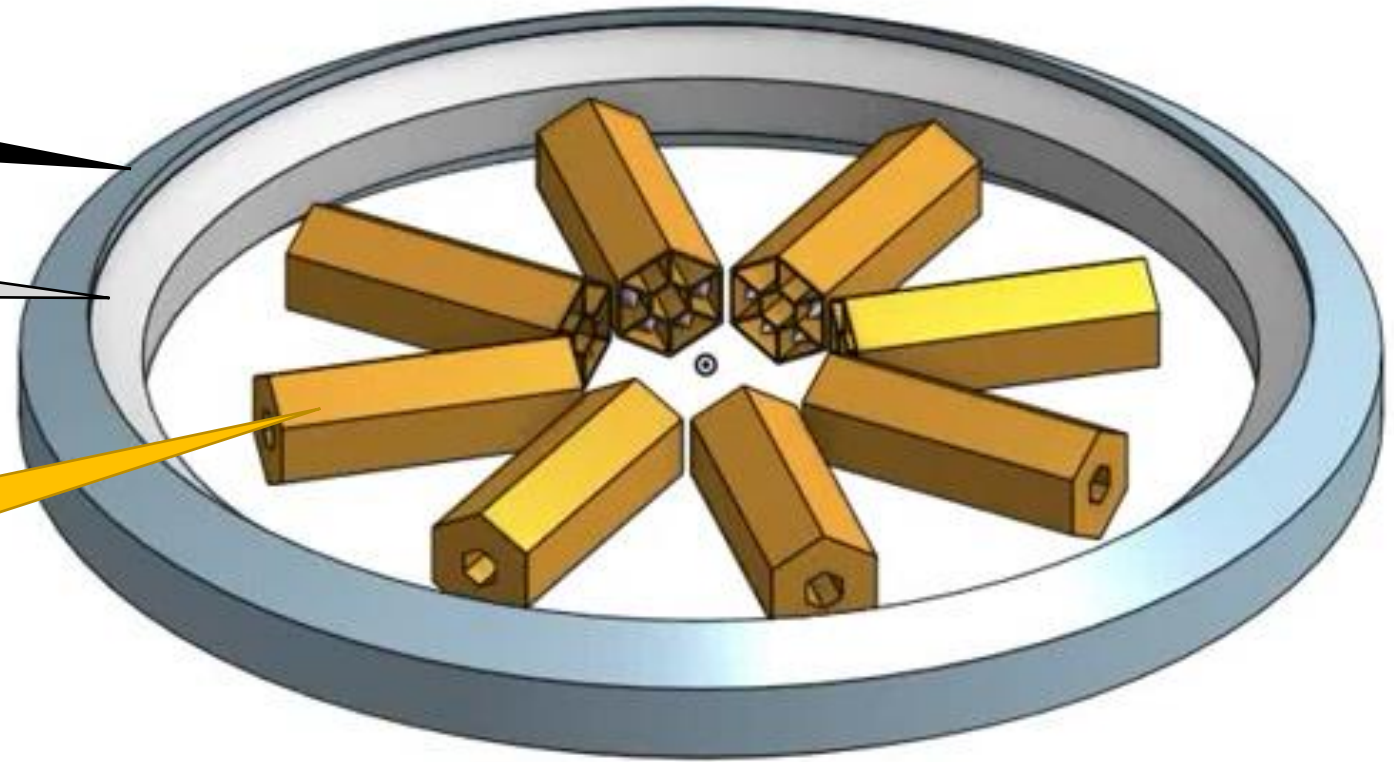
Issue	Resolution
4-5 tankers worth of fuel for every departing starship	Do Tanker-Tanker refueling on orbit to have full tankers (1-2 Starship refueling loads per tanker, rather than 4-5 tankers per starship)
Space debris	Have a slow-spinning ring (Pizza box) debris shield of pykrete and Whipple shield material surrounding the refilling facility.
Departure Starship Train risks	Refuel quickly at departure station Stage fleet at Lagrange Station
Psychological Adjustments to deep space voyage	Gather at L2 or L5 station for 1-2 months with cosmic ray shielding. If someone cannot adjust to this, they can be home in a few days.

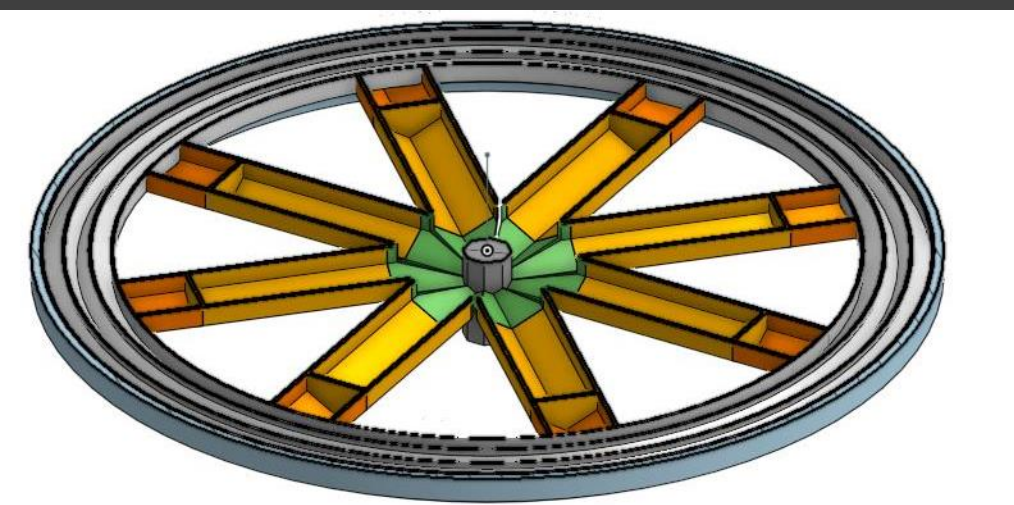
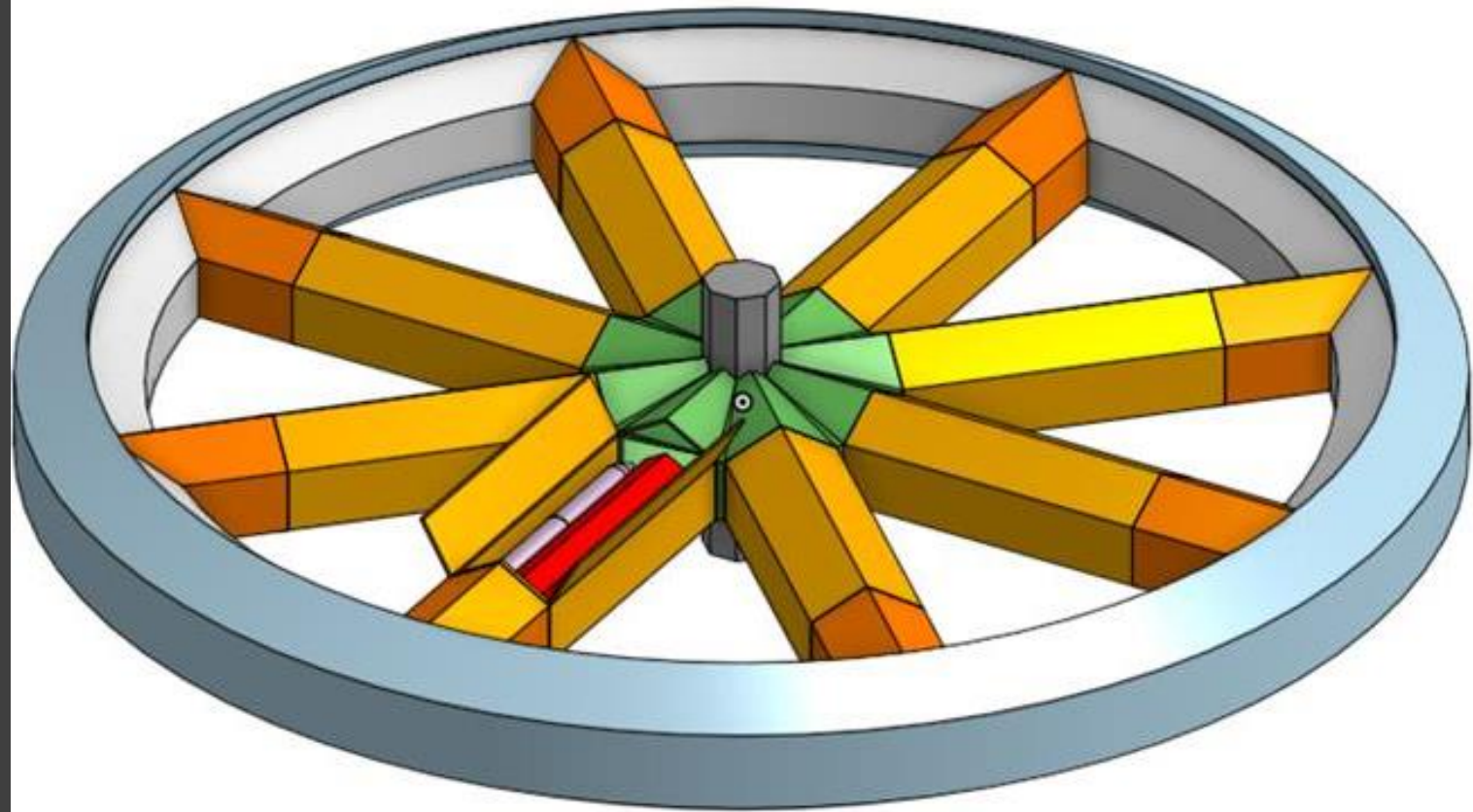
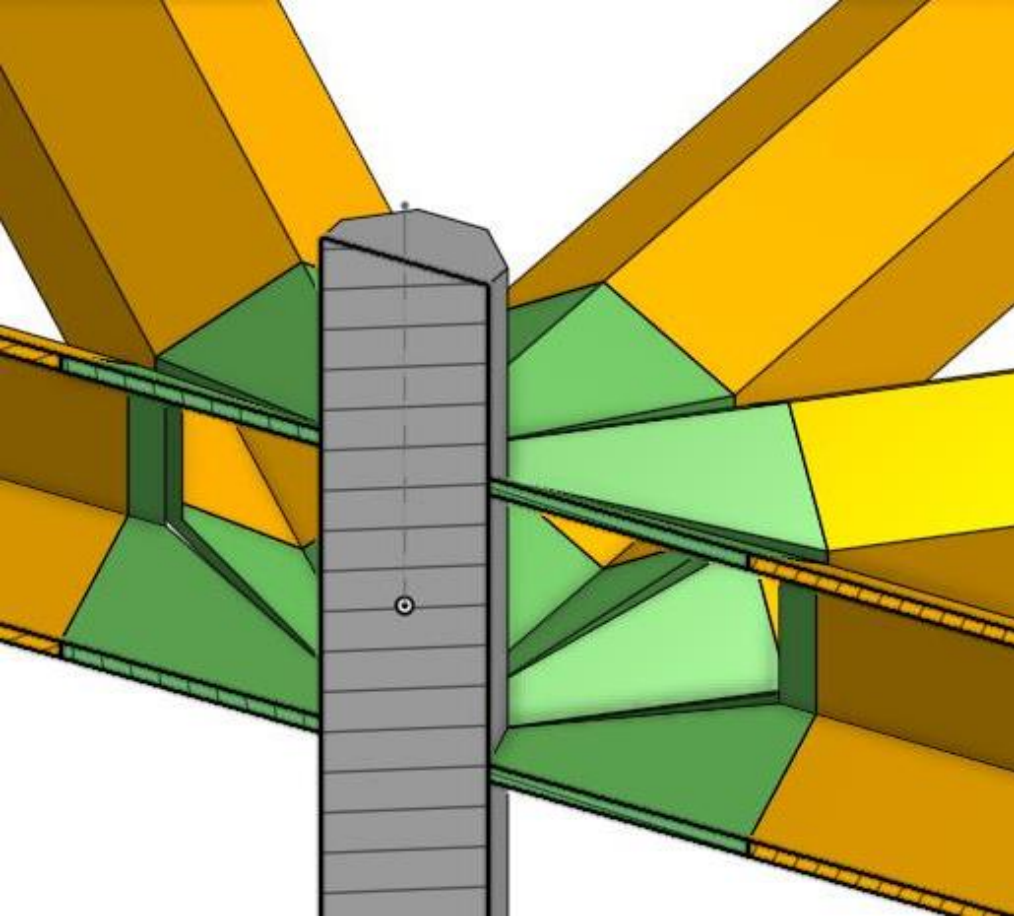
Concept: LEO Refueling/Staging Ring

Orbital Debris
Shield Ring

Centrifuge Ring
Habitats (Optional)

Starship Refueling
Hangars (96 slots)





StarPort: 3D Schematics

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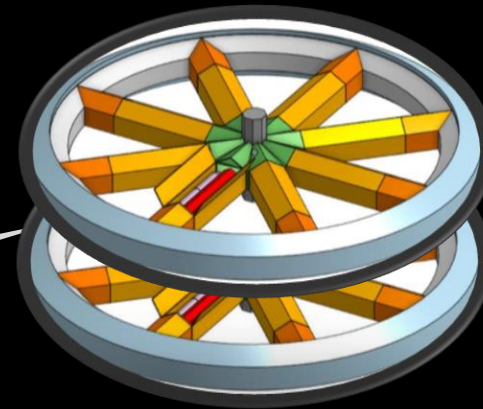
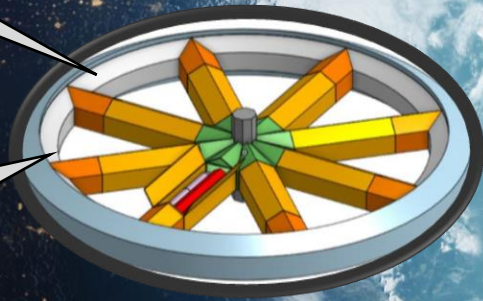
3D Illustration by Aarya Singh

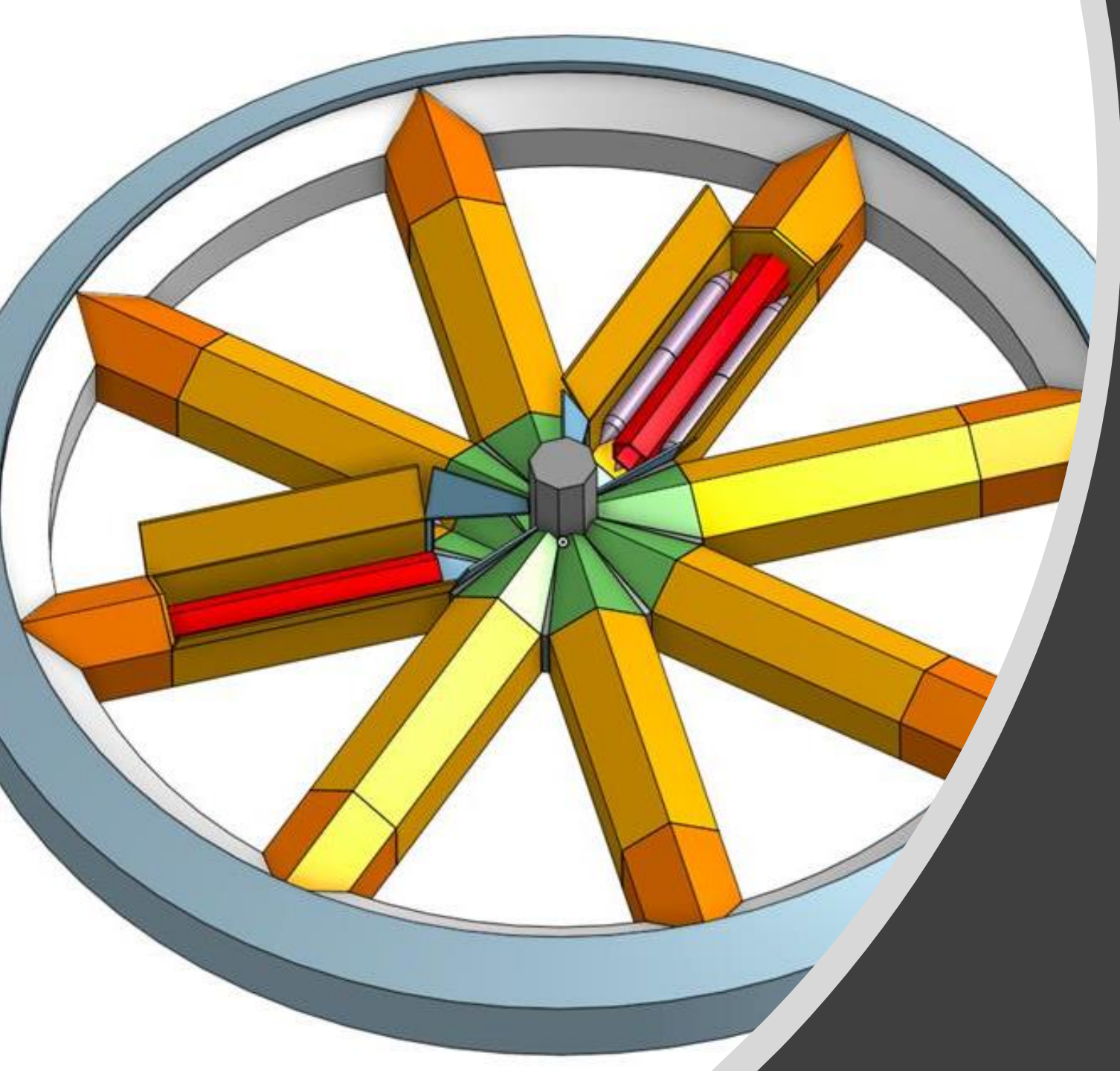
Logistics

1: Load Propellant
on Station in LEO

2: Launch up to 48
Starships to Station
for Rapid Refueling

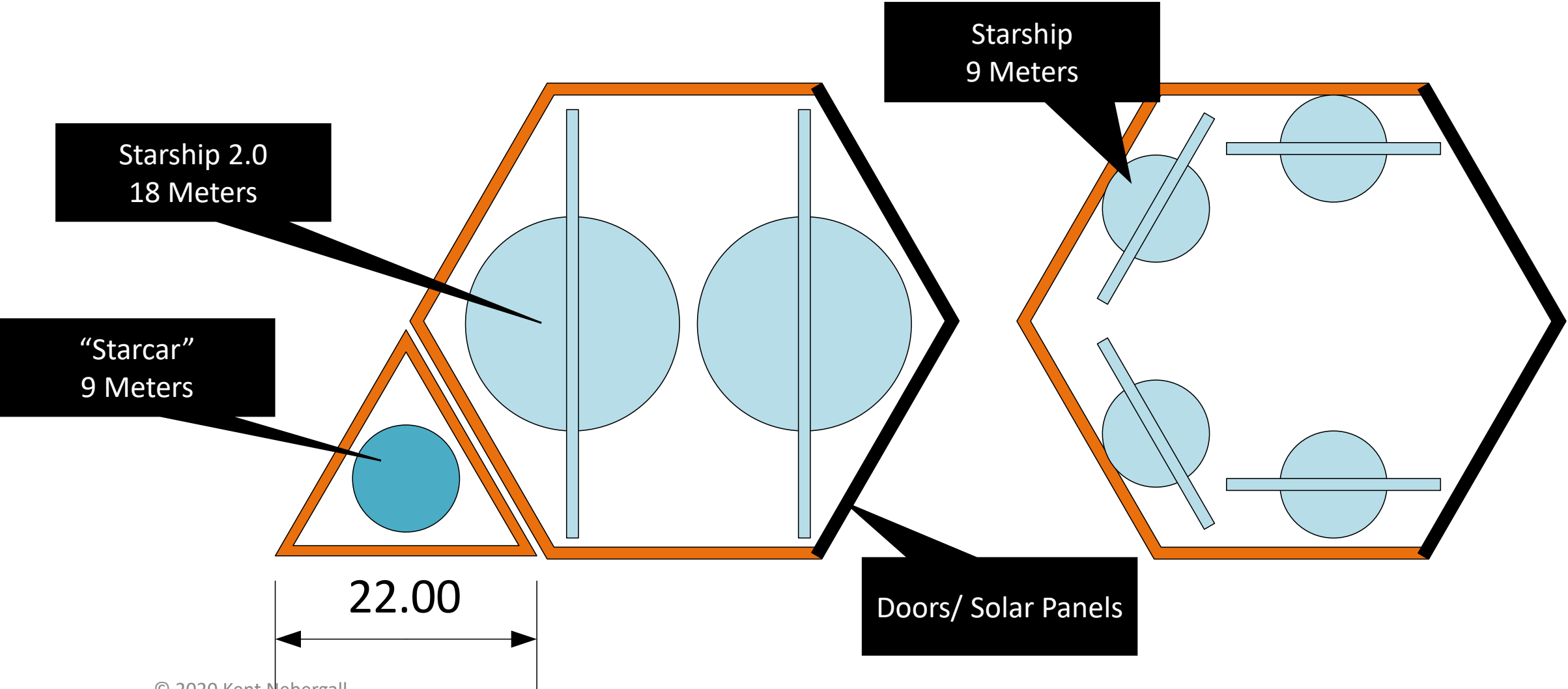
3: Send Mini-Fleet to
Lagrange Station Until Launch
Window Opens



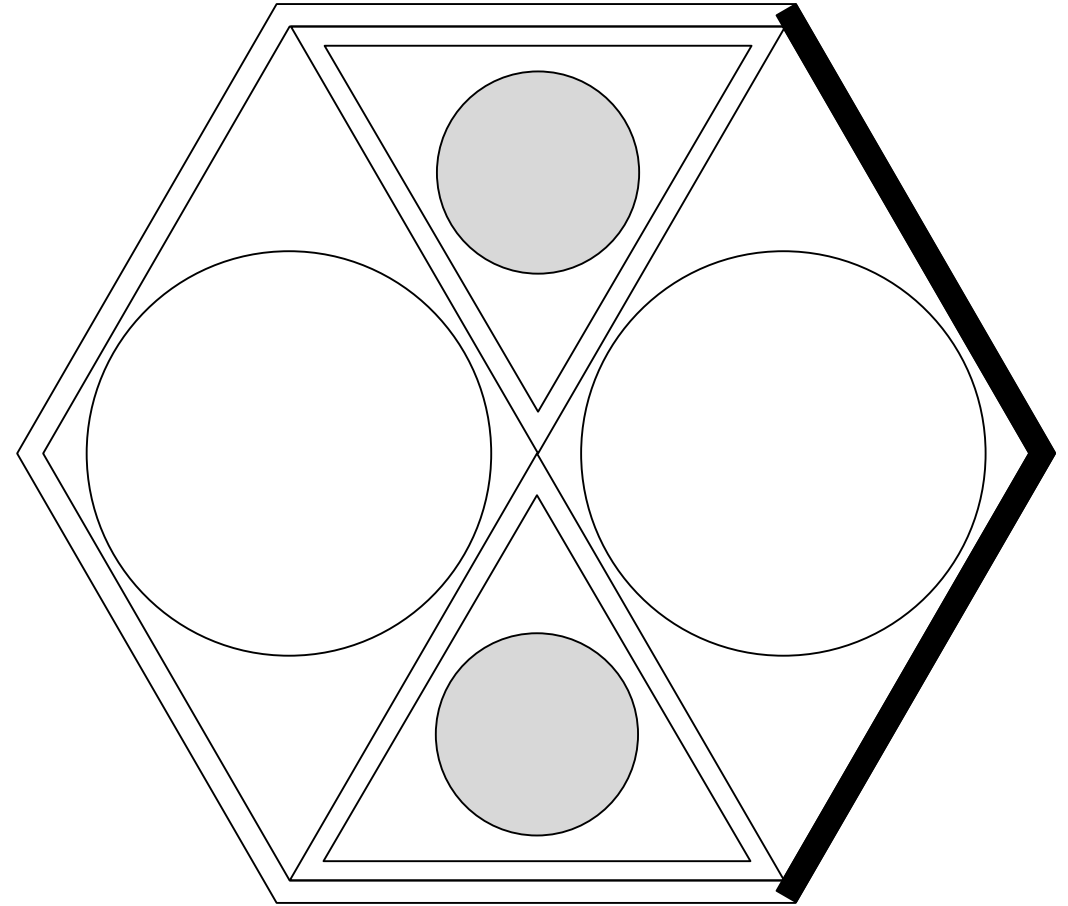
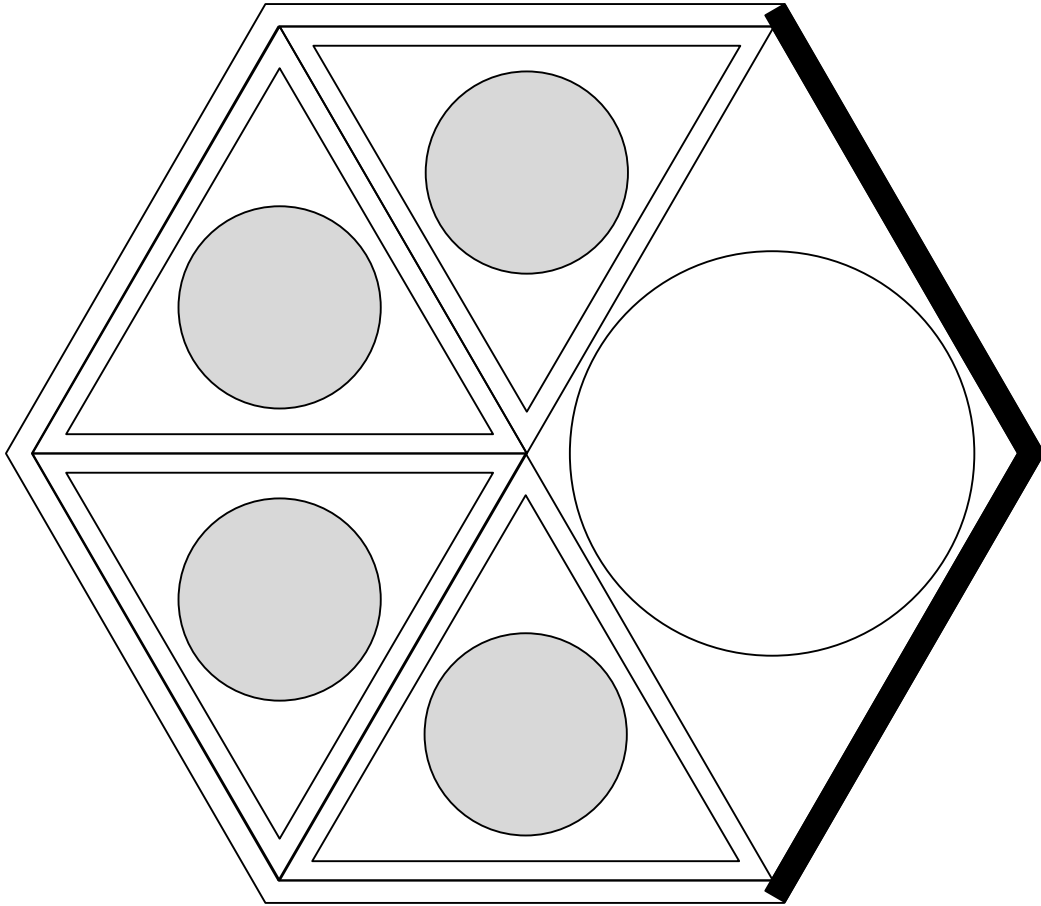


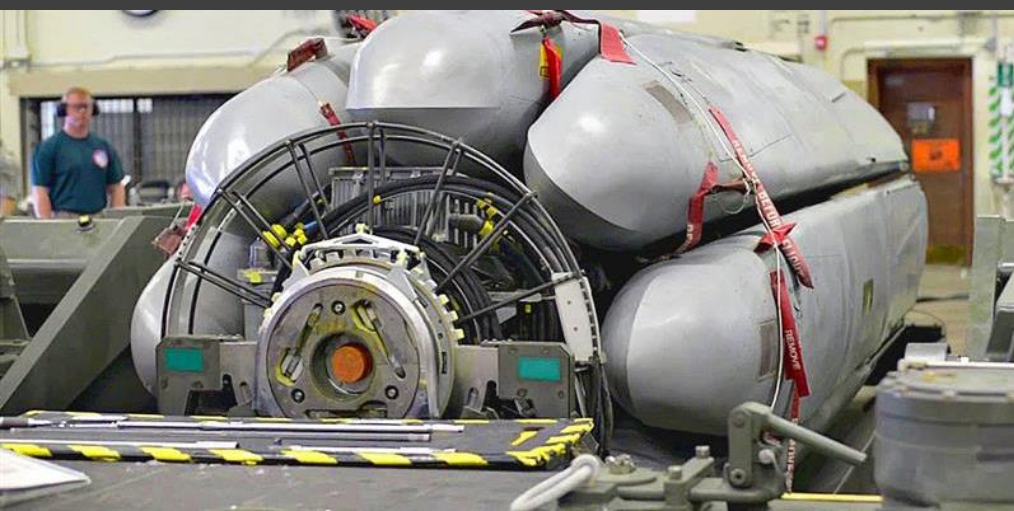
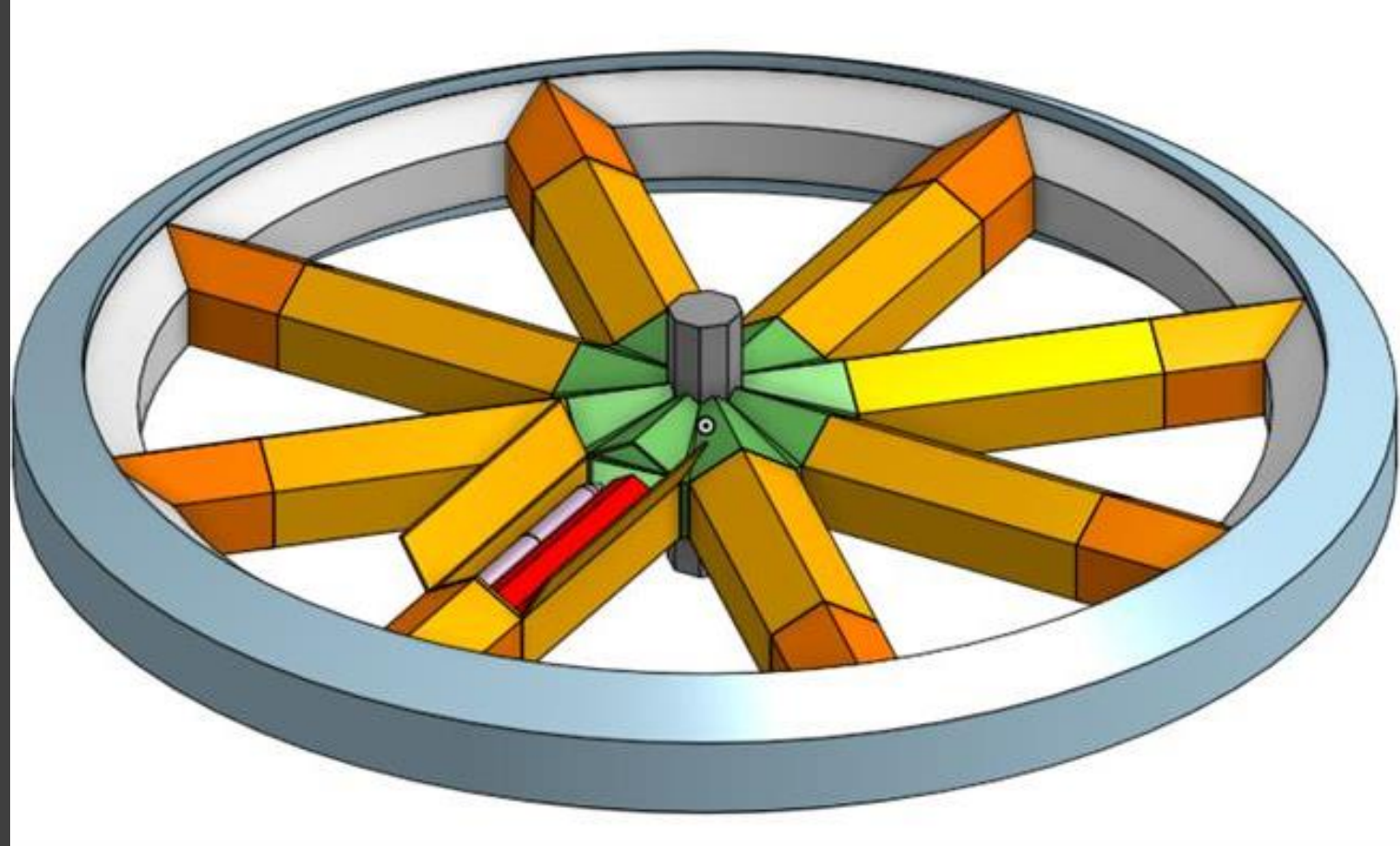
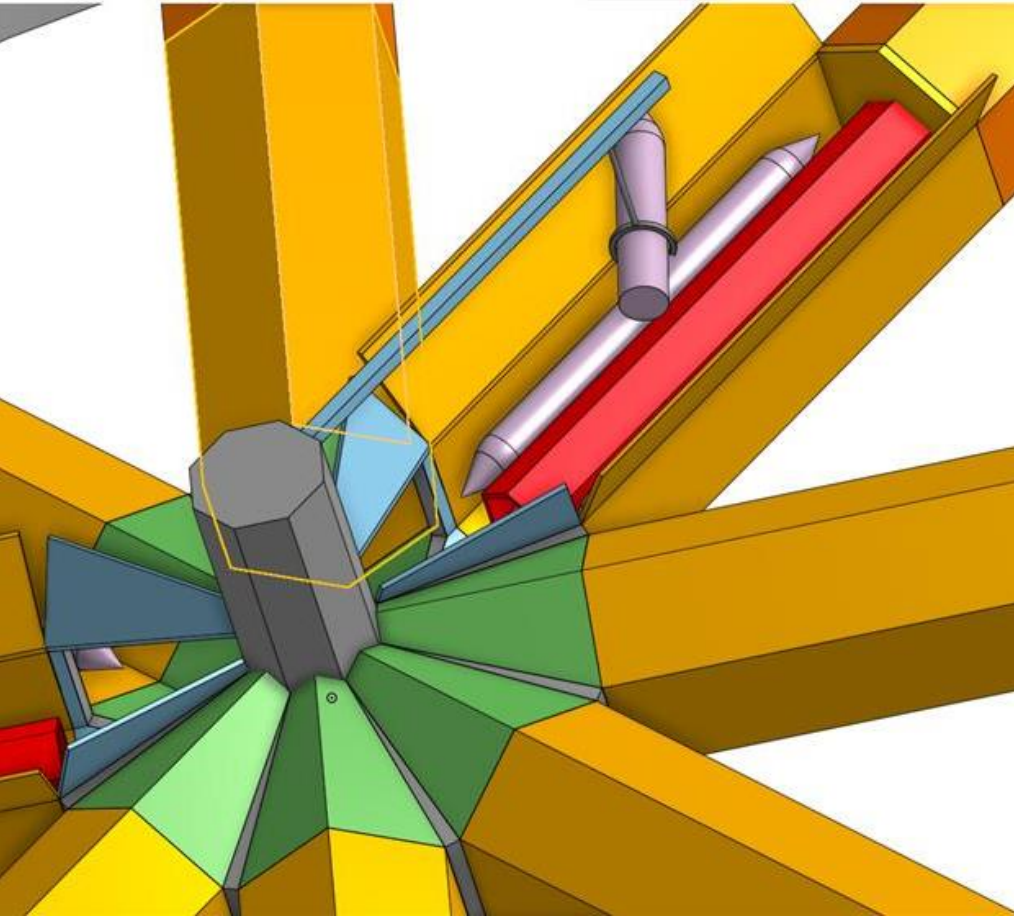
Hangar: Details

Hangar Scaling



Framing Options for Centrifuge Ring Cars





Docking in Hangars

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3D Illustration by Aarya Singh

Starcar: Modular “Wet Lab” Habitat

Front RCS/Tug Fairing
7.3 m base, 9 m tall, wraps around airlock.
RCS on sides, Tanks at top. Fairing

Starcar (~2000 M³)

Top Dock: 2 m tall by 5 m dia.

Front Taper: 6 m tall, taper 9 m to 7 m

Main Cylinder: 30 m tall by 9 m dia.

Rear Baseplate: 2 m tall by 7 meter taper

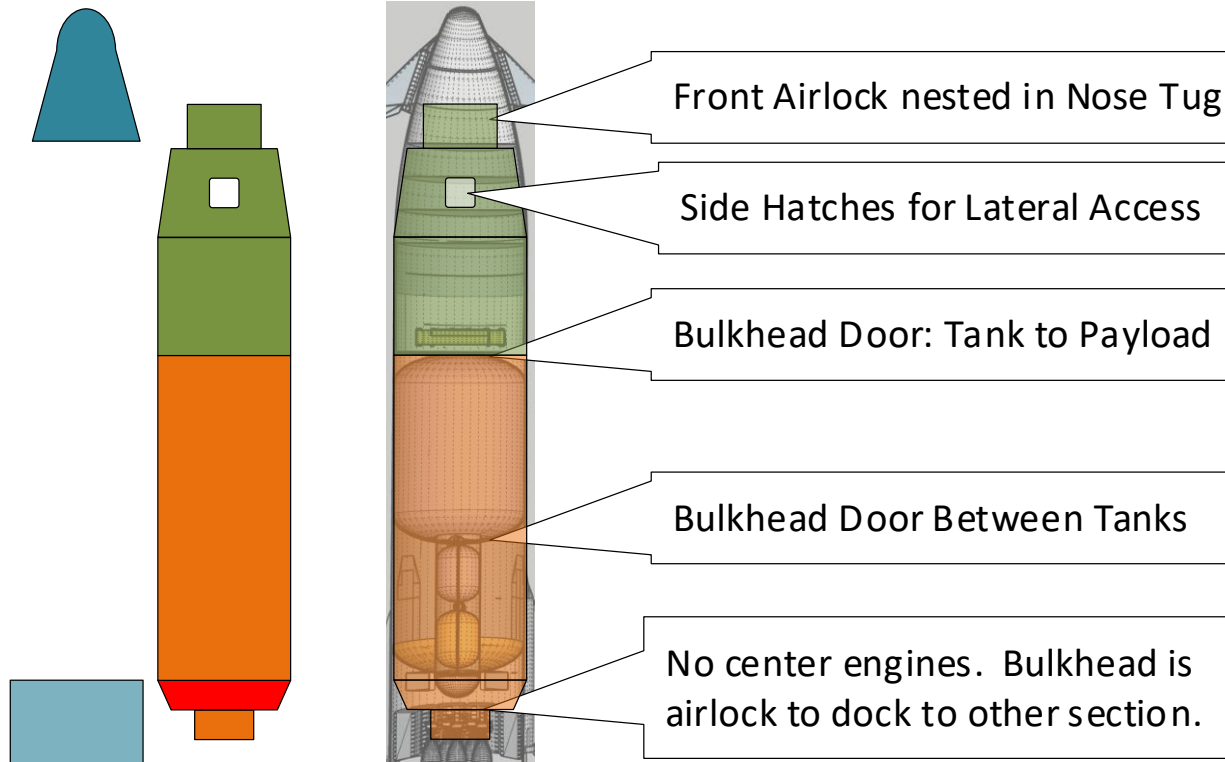
Rear Airlock: 2 m tall by 4 m dia.

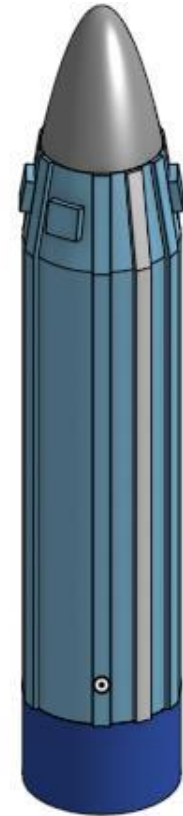
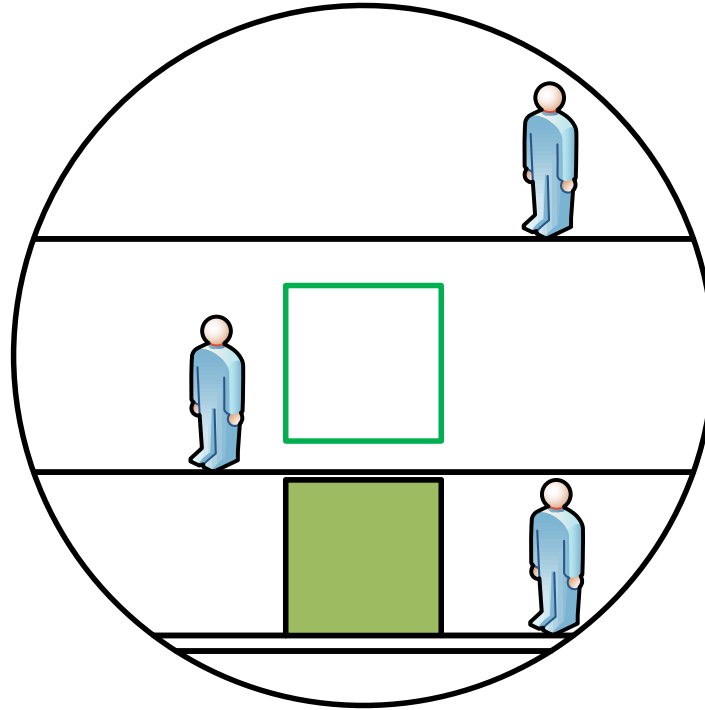
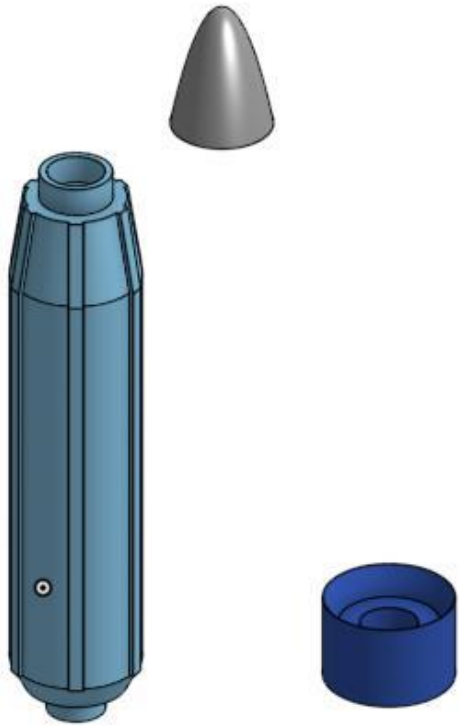
Overall Length: 43 meters

Rear Engine Block

6 m tall ring, 9 m dia.

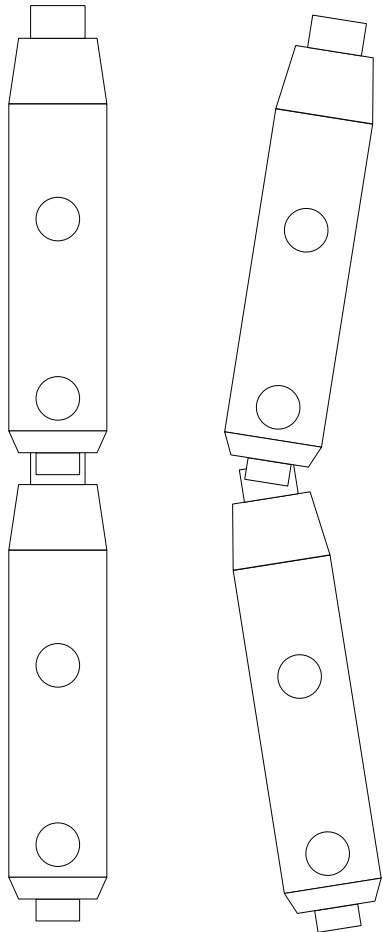
Vac Raptor Engines, RCS, Plumbing.





Starcar: Details

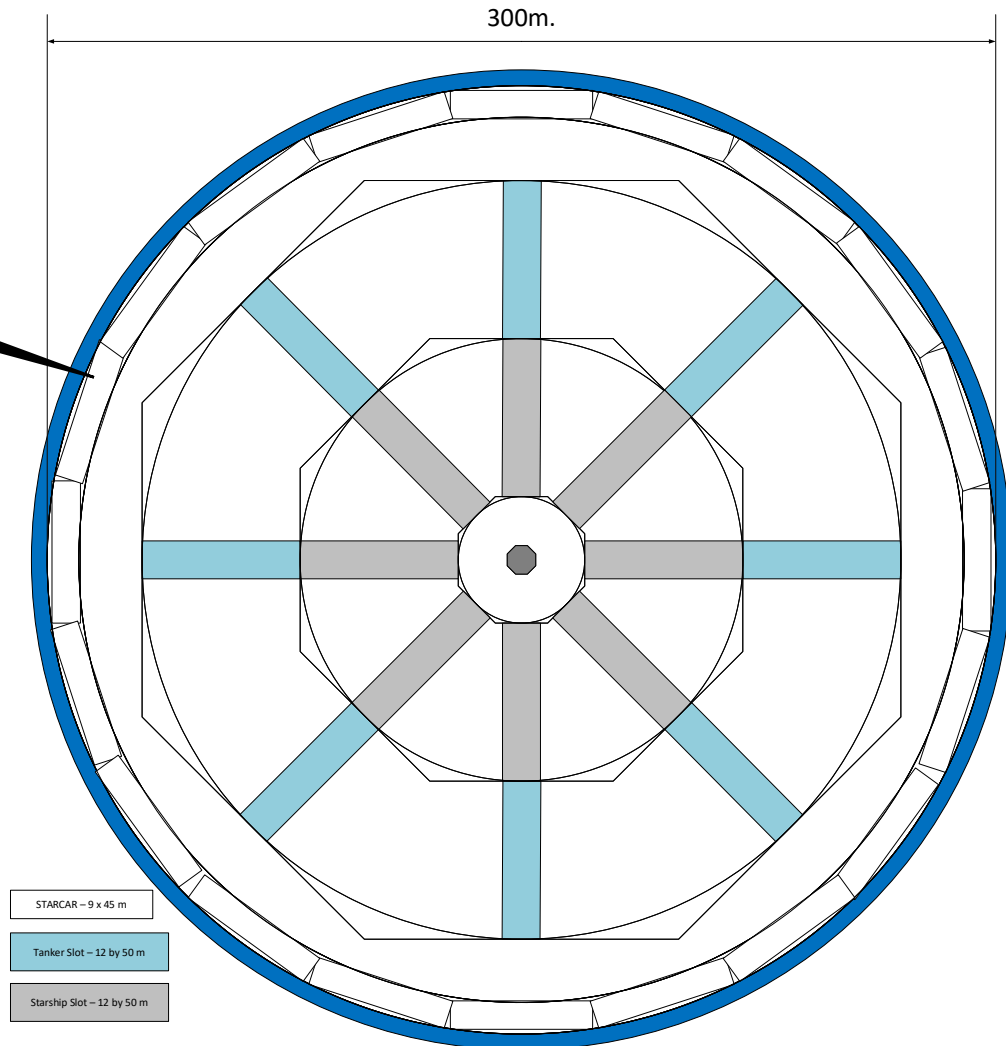
Starcar: Straight (ISS) port or curved (Centrifuge) Adaptors



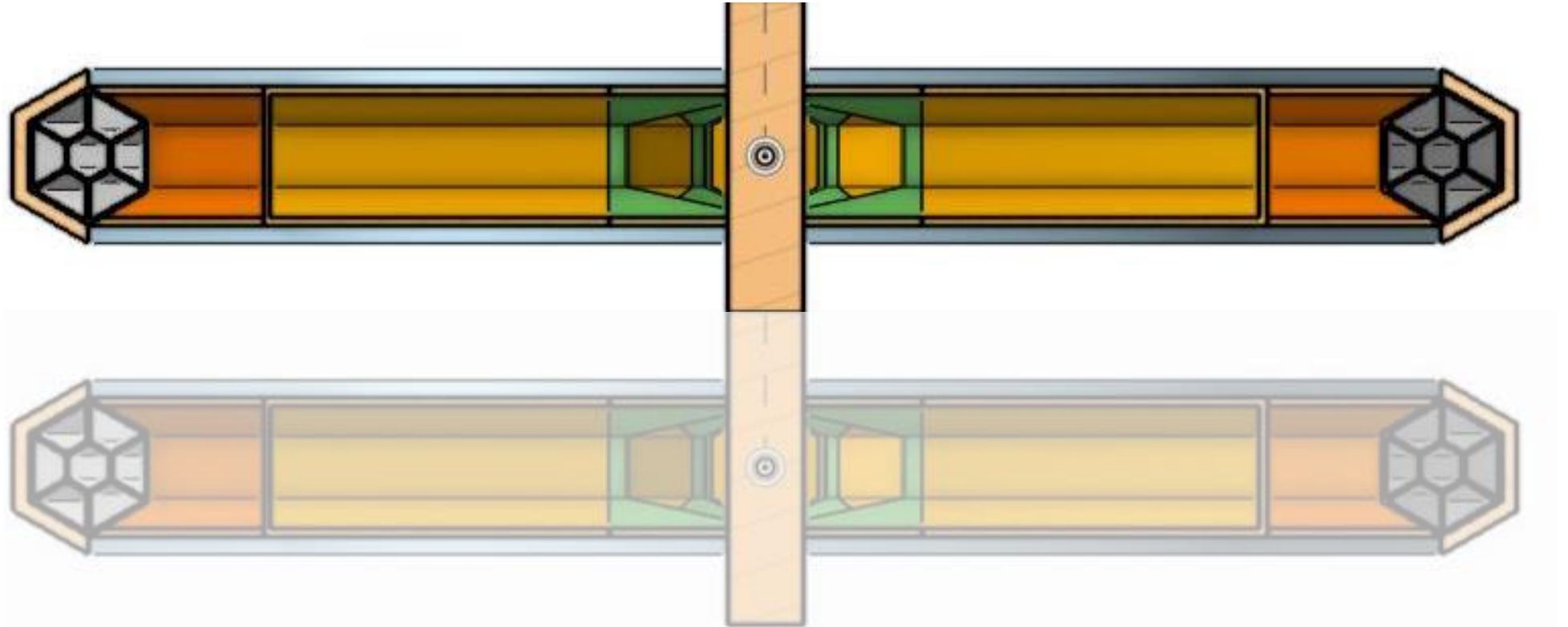
40,000 M³ Per Ring

Full Settlement for 160 People
(4 Rings, ~Dunbar Number)
0.63 gravity

If 0.63 G is inadequate...
Can be scaled up to 1 G or
greater with only car-to-car
docking adaptors changed



Artificial Gravity System



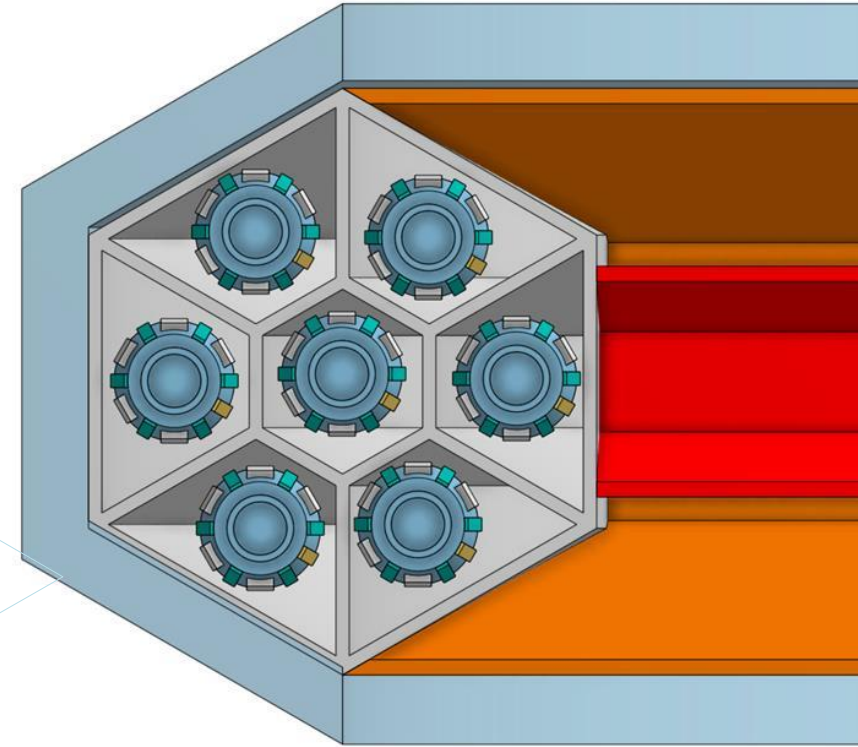
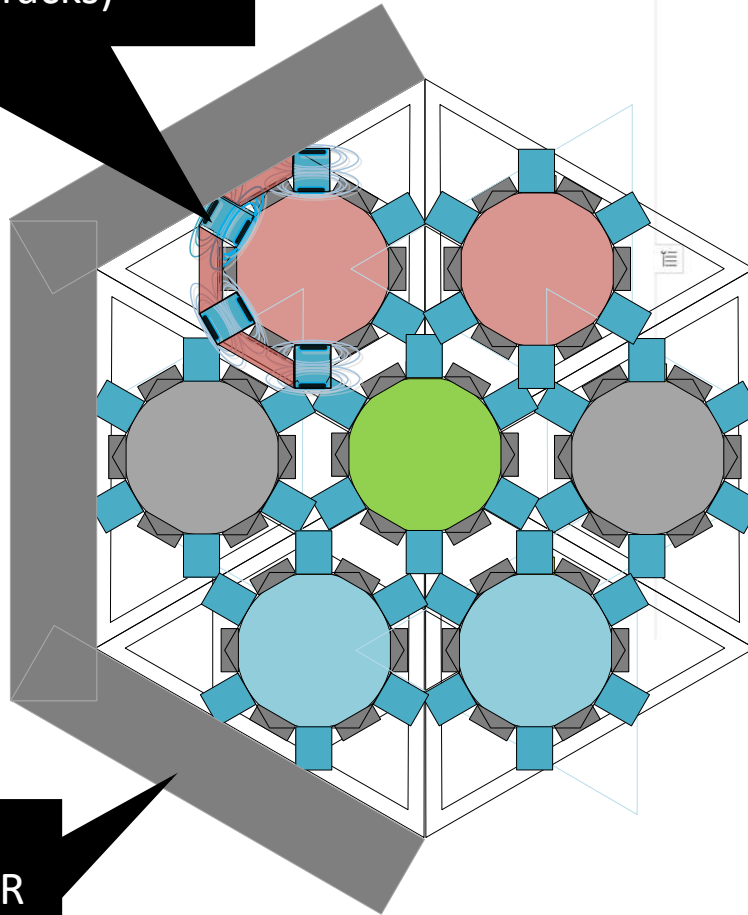
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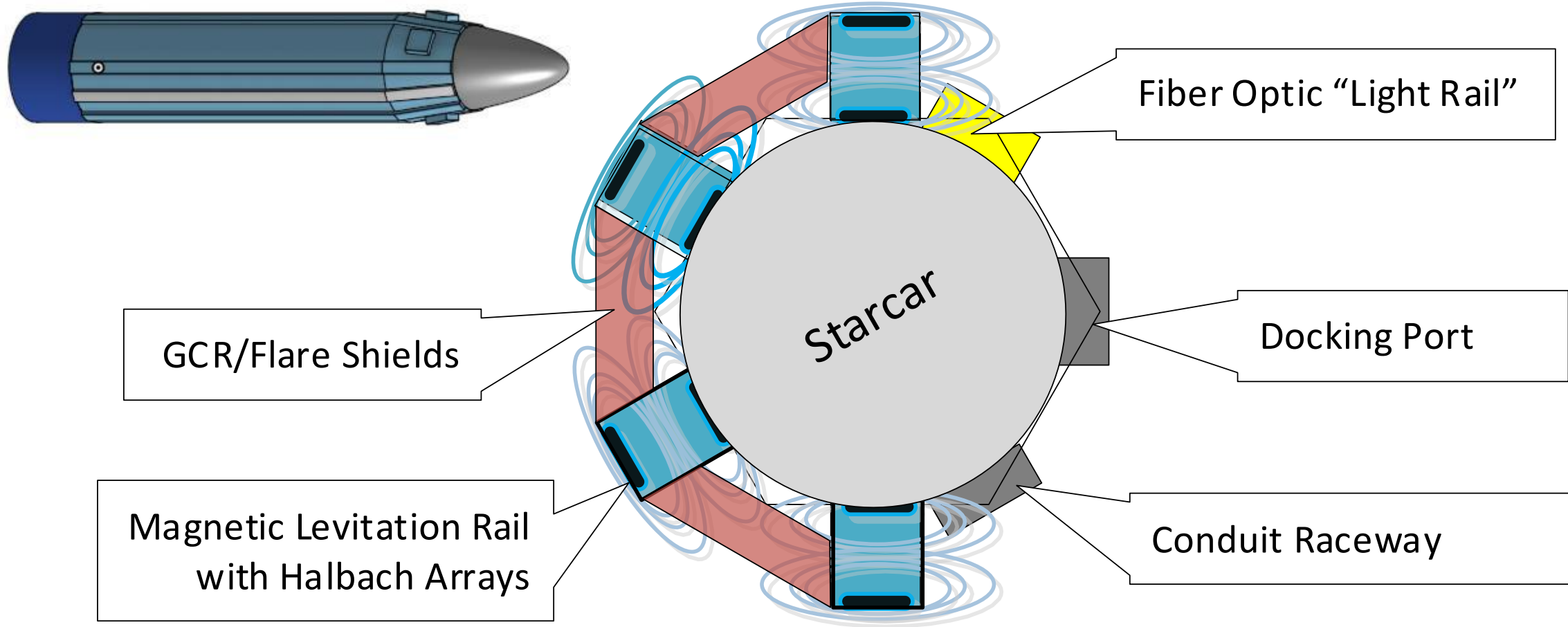
Up to seven rail slots per hexagonal ring module (full ring would require shorter port adaptors on inside tracks)

Magnetic Levitation Rings

Heavy Outer Shield (Full GCR or Orbital Debris Shield)



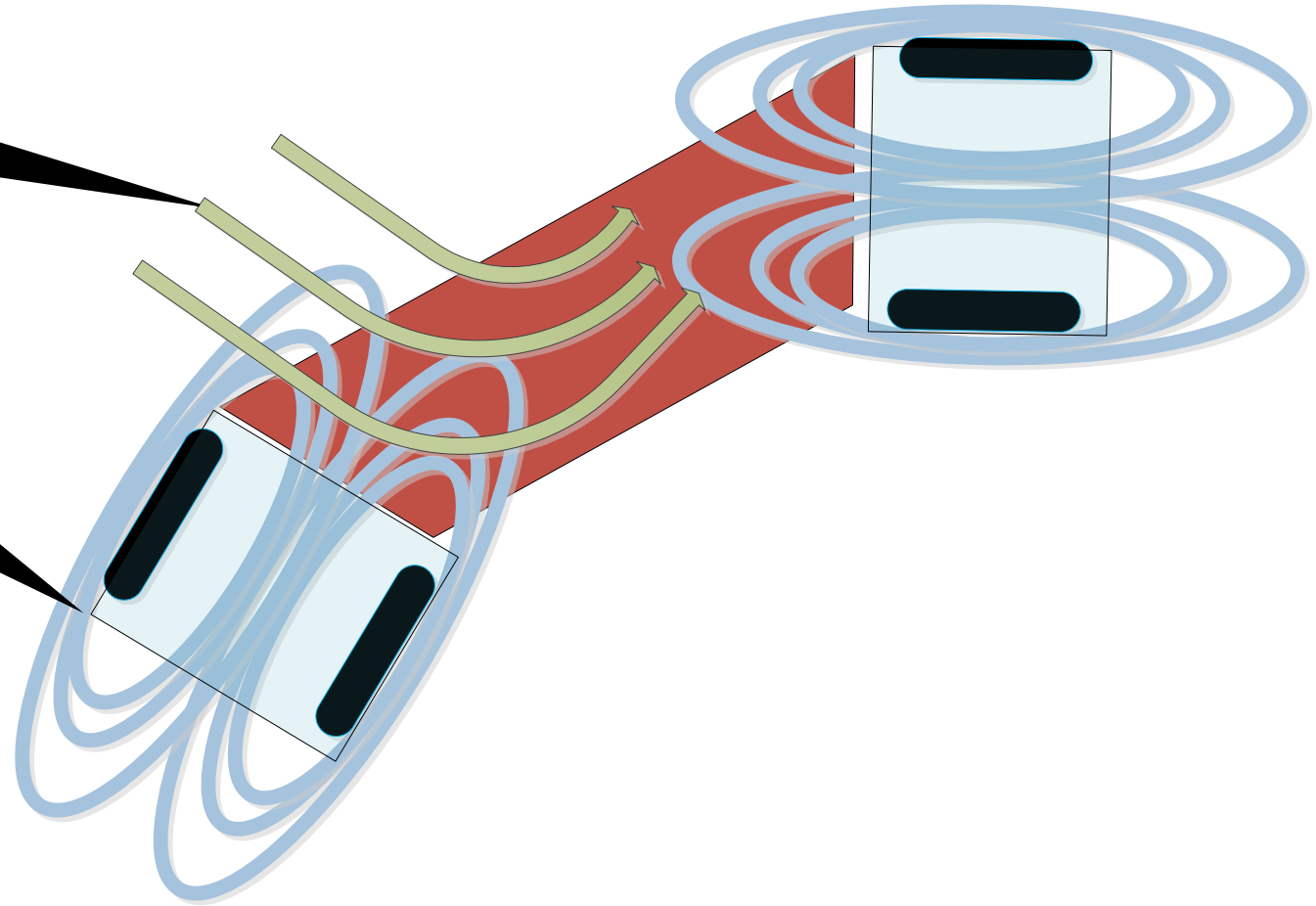
MagLev Track, Light, Docking, Shielding



Halbach Magnets & Galactic Cosmic Rays

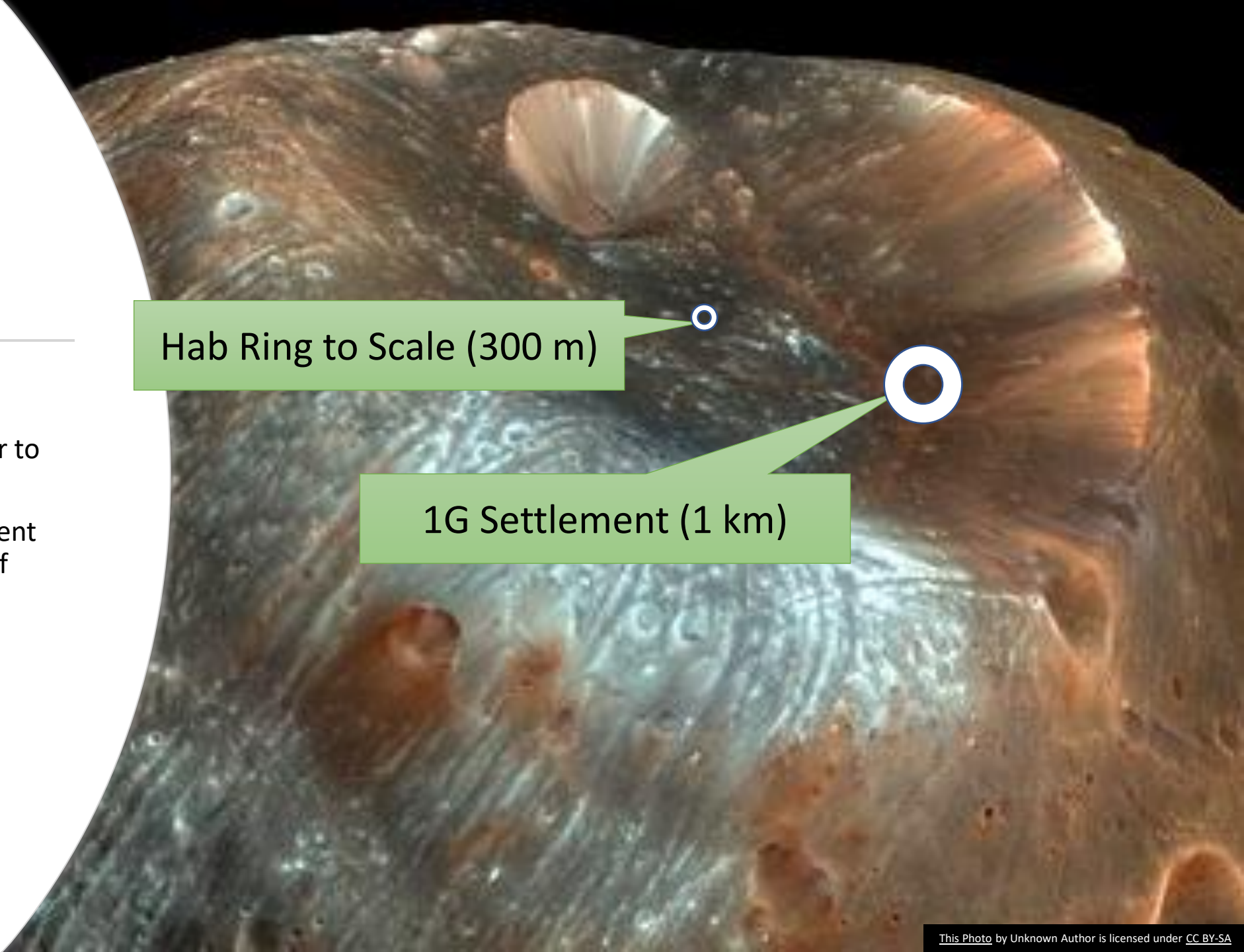
GCR between rails deflected to maximize flight time through shield material

GCR hitting magnet directly has maximum magnetic flux from both inside and outside MagLev arrays



Phobos Base

- No GCR protection required
- Could go directly from starcar to shuttle off surface
- Vertical ring option – equivalent to being on a boat in terms of gravity gradient.
- Escape Velocity of Phobos: 41 kph/25 mph



Hab Ring to Scale (300 m)

1G Settlement (1 km)

Simple, Modular, Scalable

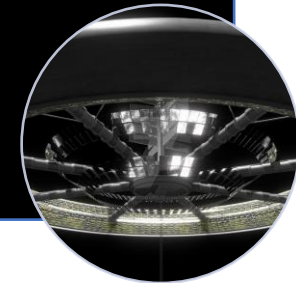
- **StarCar**
 - Bulkhead Changes
 - Docking Ports and Hatch Design
 - Space Tug end caps
- **Frameworks**
 - Shielding Blankets
- **Power Systems**
 - Solar Arrays
 - Light Gathering Arrays

Free
Stations



- **Centrifuge Ring**
 - Frameworks
 - MagRail Tracks
 - Shielding bags
- **Hangars**
 - Doors
 - Docking Robots
 - Plumbing

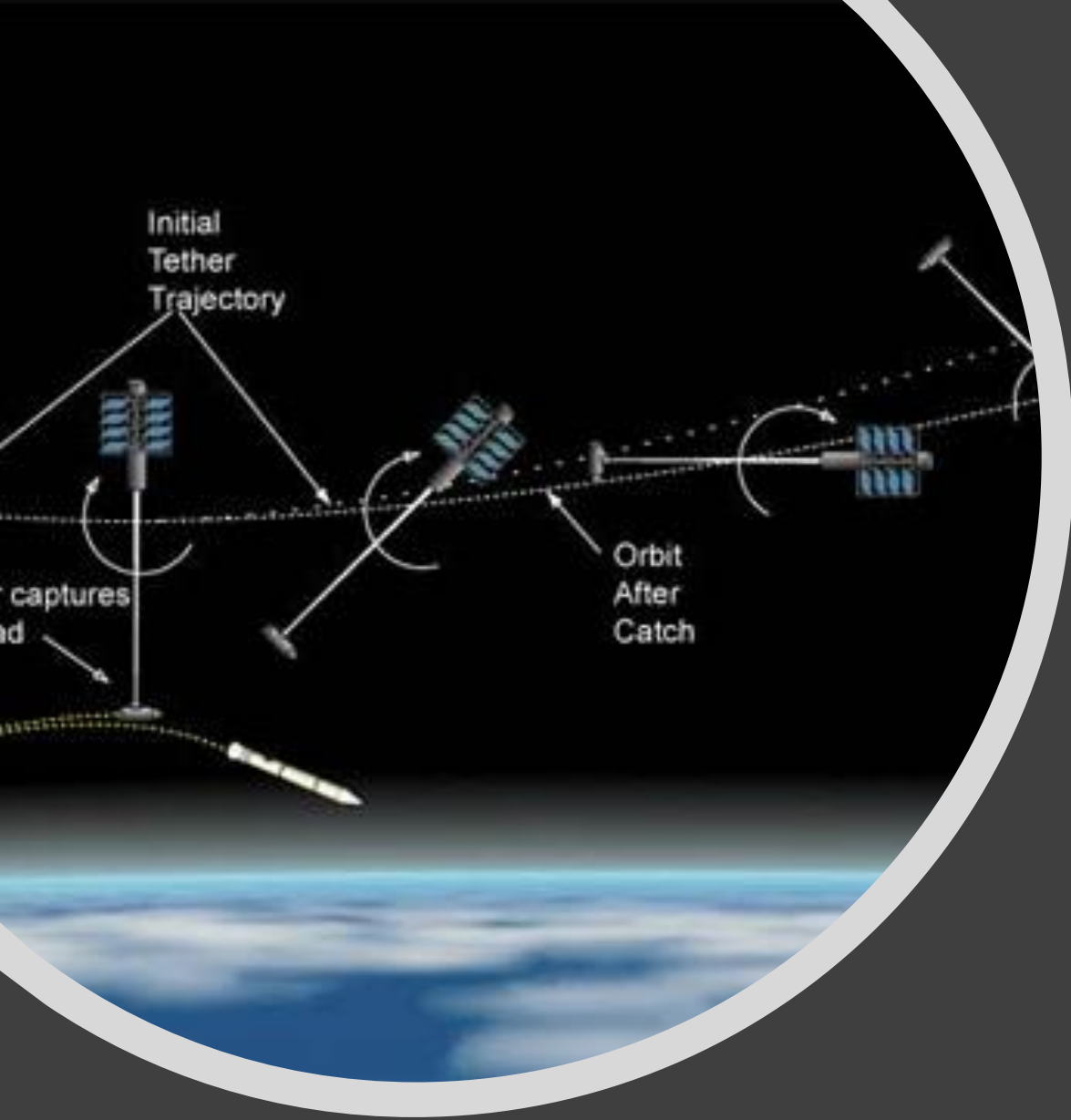
Ring
Habitat





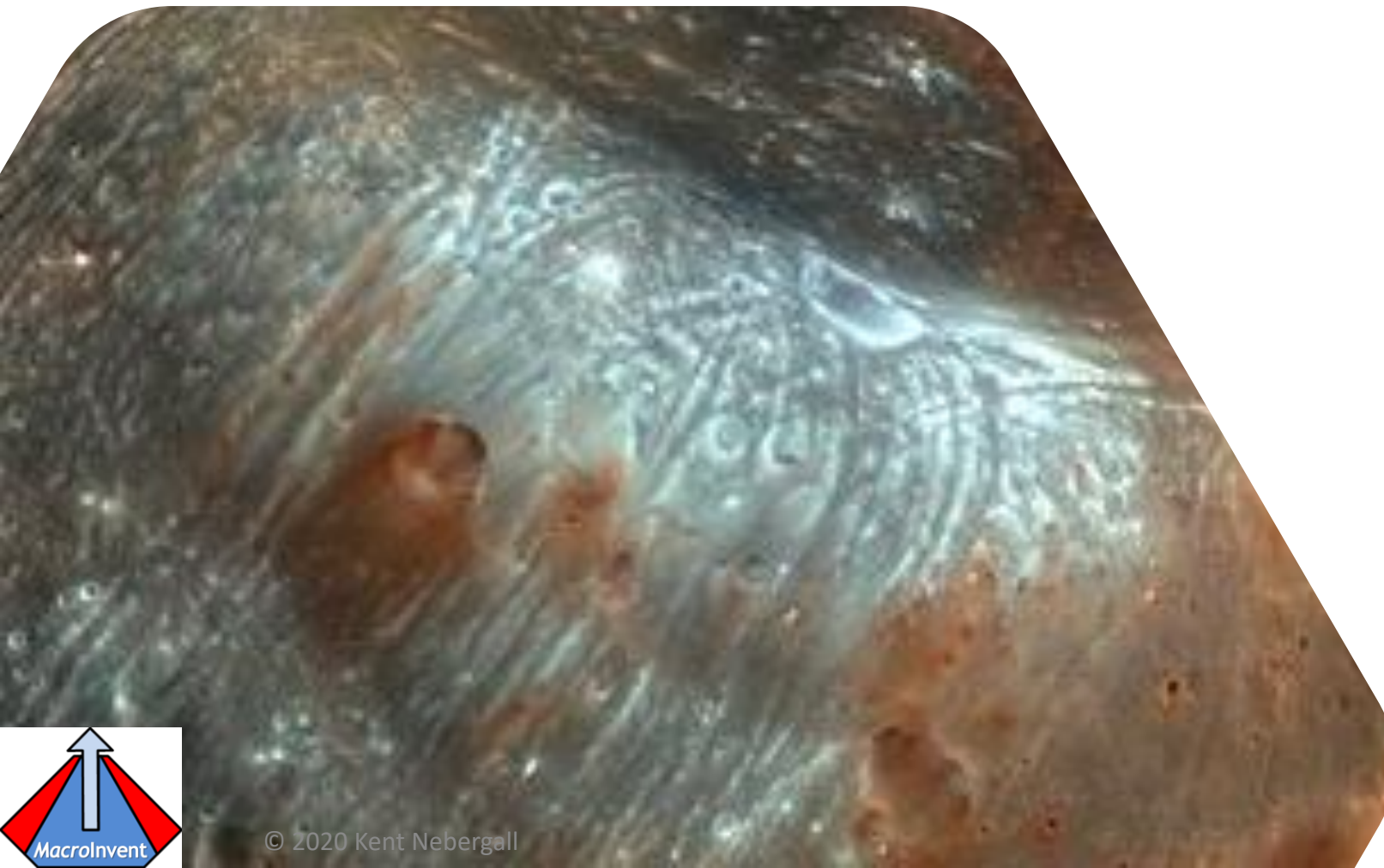
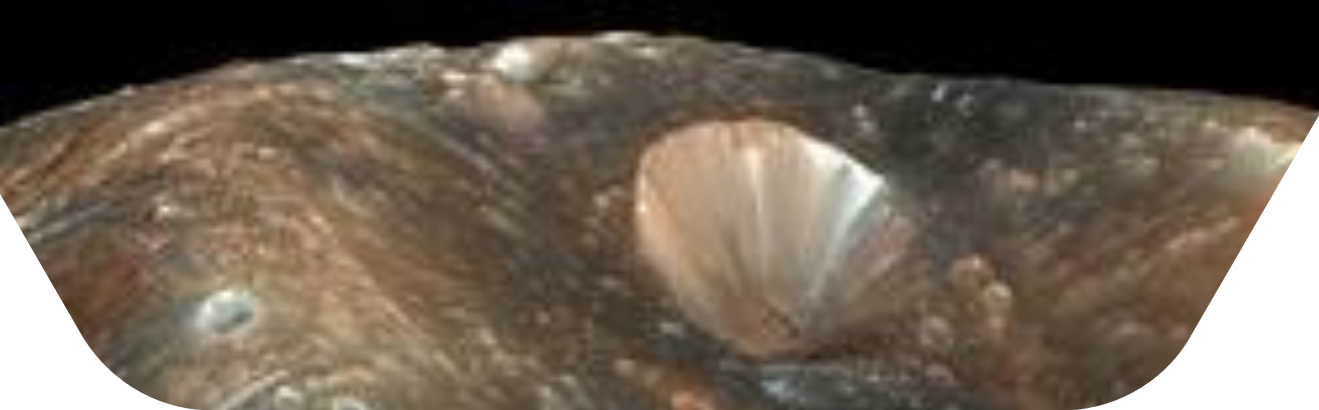
Conclusion

- Extending the Starship Family to include Starcar and the framework system would allow full solar system settlement with near-term hardware, including surfaces.
- A simple frame structure can make space settlements of any size from 10 to 10,000 people possible.
- The Starcar/Frame combination offers a “pay as you go” modular system with almost no technology shift from Starship assembly lines.
- Cities and factories can be built anywhere in the inner solar system and offer near-earth levels of habitat (gravity, shielding, local food, etc.)



Skyhooks: Limited Use Case

- May be used on Phobos, because the moon would dampen shock.
- For most situations, unlikely that vehicles departing in both directions would have identical inclination, departure windows. Probably more trouble than either magnetic or propellant systems.
- A dangling “Phobos Elevator” may interfere with Mars Starlink Constellation.



Thanks!
Questions?

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