51° ESLAB SYMPOSIUM - EXTREME HABITABLE WORLDS
04-08 DECEMBER 2017, ESA ESTEC

STUDY OF ISOKINETIC STRUCTURES AND APPLICATIONS FOR EXPANDABLE AND ADAPTIVE HABITATS USING IN-SITU LUNAR RESOURCES FOR FUTURE MOON SURFACE MISSIONS

Presented by HADY GHASSABIAN

SPACE GENERATION ADVISORY COUNCIL

SGAC

The Space Generation Advisory Council (SGAC) in support of the United Nations Programme on Space Applications is a non-governmental organisation and professional network

- **Create a global volunteer base of university students and young professionals in the space sector who have a passion for making a difference in the space sector and a commitment to action;**
- **Connect them to peers and top space professionals from various organisations;**
- **Give the next generation of space sector leadership opportunities and a voice in global space policy;**
- **6 regions, 100+ countries, 4000+ members;**

SGAC

- Works with the United Nations
- Permanent Observer status at United Nations Committee on the Peaceful Uses of Outer Space (UN COPUOS)
- Consultative status at United Nations Economic and Social Committee Representatives (ECOSOC)
- SGAC presents the outcomes of all of its conferences and projects at:
  - Scientific and Technical Subcommittee of COPUOS
  - Legal Subcommittee of COPUOS
  - COPUOS General Assembly

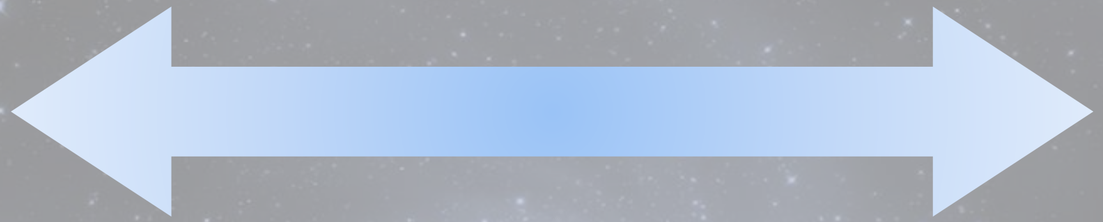
SPACE EXPLORATION PROJECT GROUP

The creation of an international and interdisciplinary forum integrated by students and young professionals to approach Space Exploration from a multidisciplinary point of view and focused in 8 common goals:

- **Develop Exploration Technologies and Capabilities**
- **Engage the Public in Exploration**
- **Enhance Earth Safety**
- **Extend Human Presence**
- **Perform Science to Enable Human Exploration**
- **Perform Space, Earth, and Applied Science**
- **Search for Life**
- **Stimulate Economic Expansion**

OVERVIEW

Highlight expandability



Structurally Sound

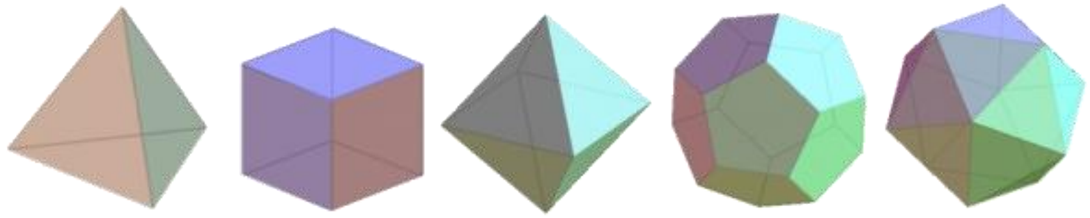
Modular Design

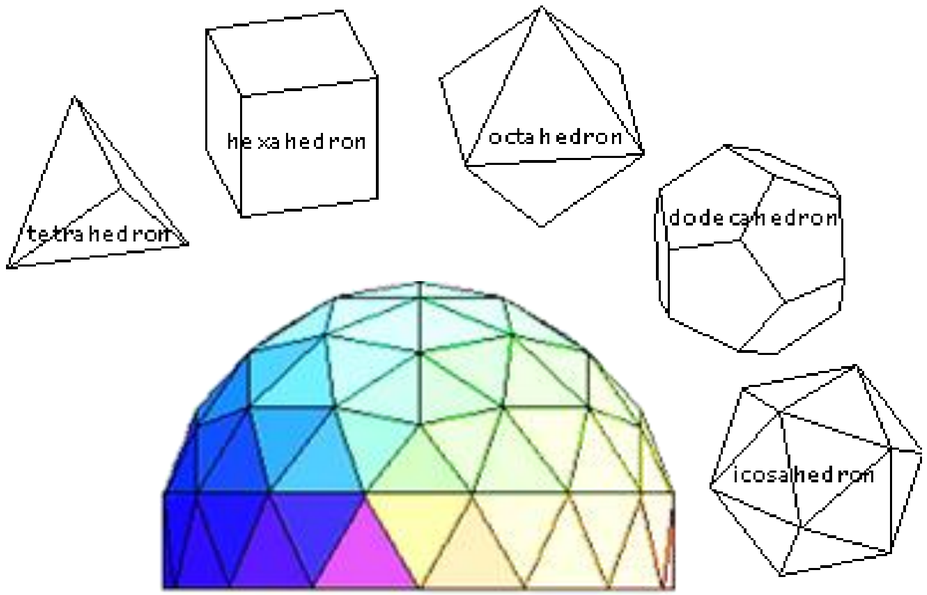
Expandability

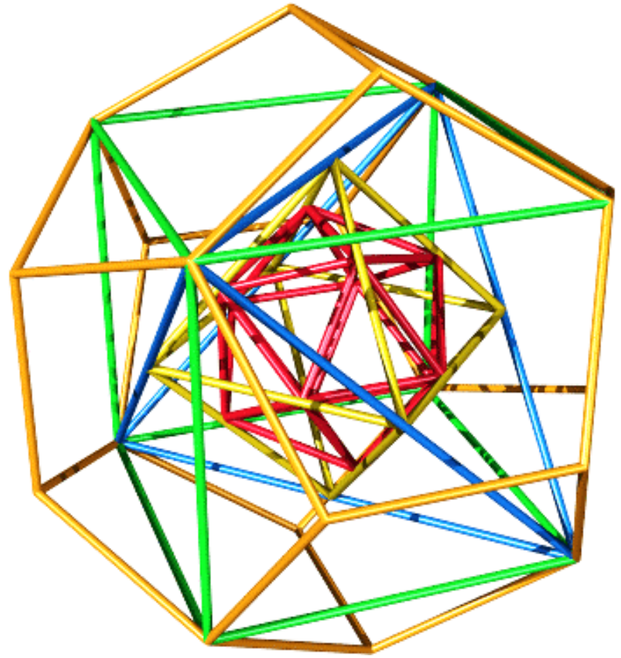
Structurally Sound

In-situ Resources

BASE IDEA

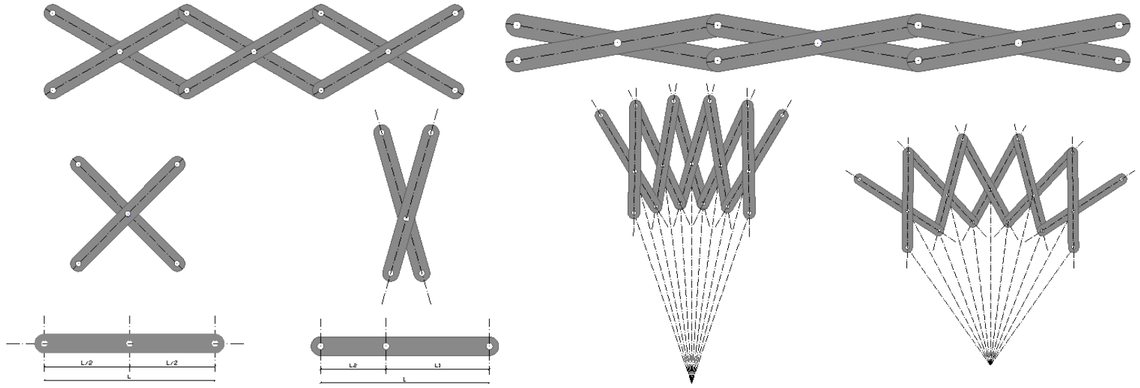


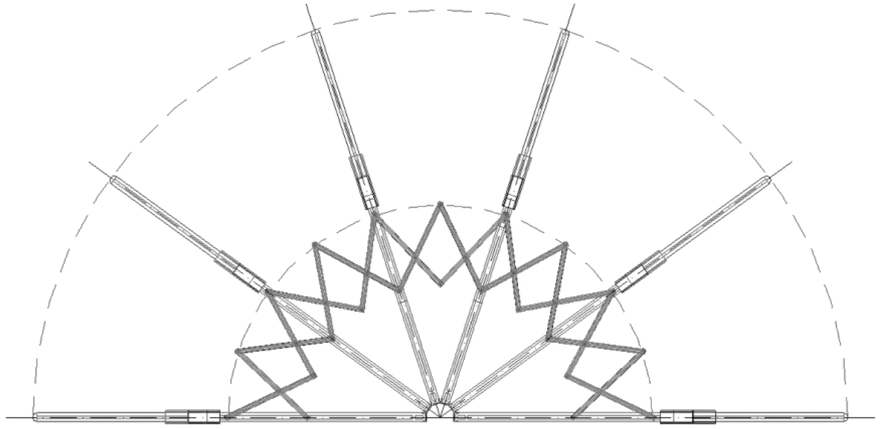


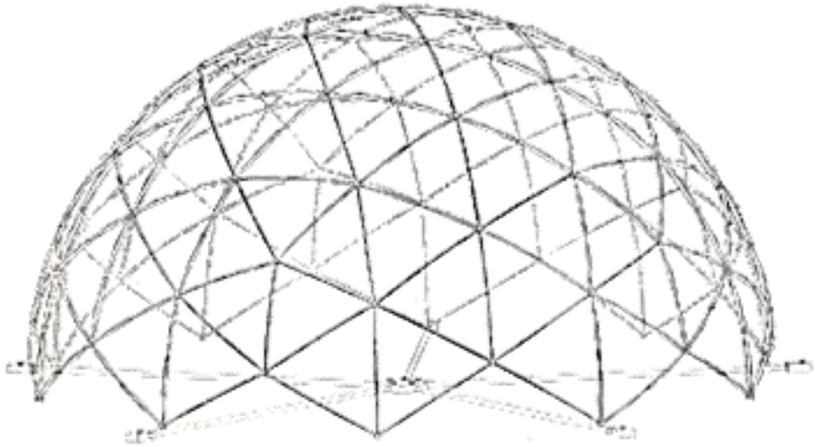


- 1DOF
- Empty Centre
- One platonic solid
- Keep the same shape

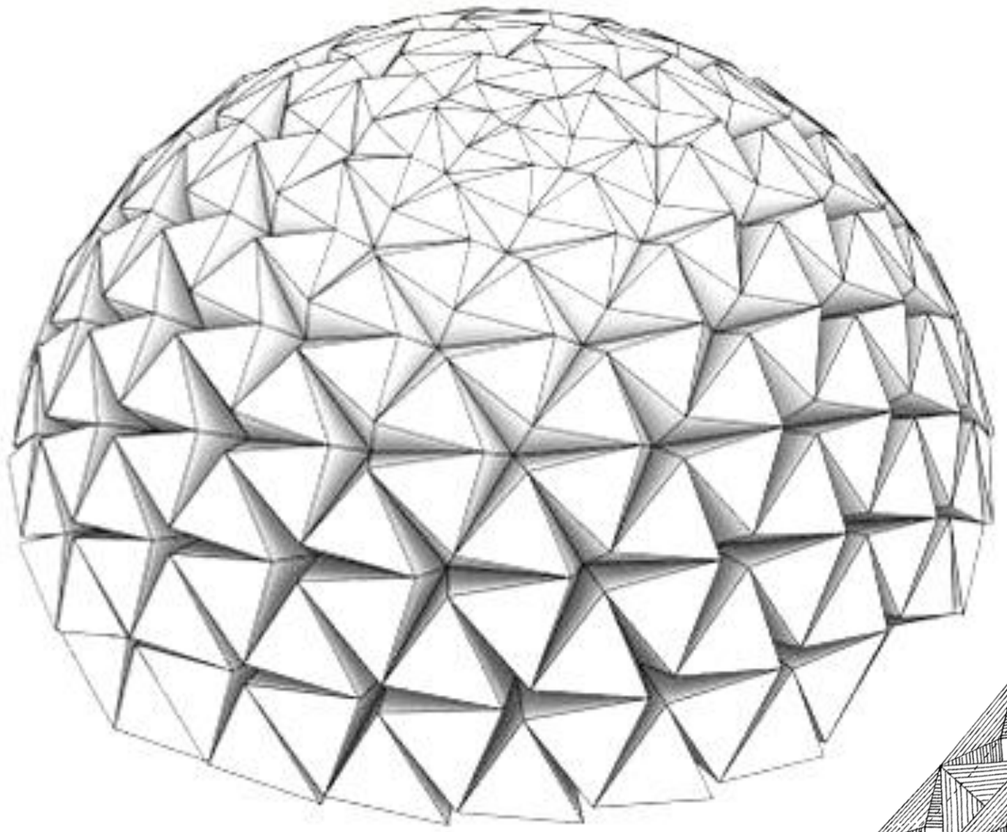
MECHANISM

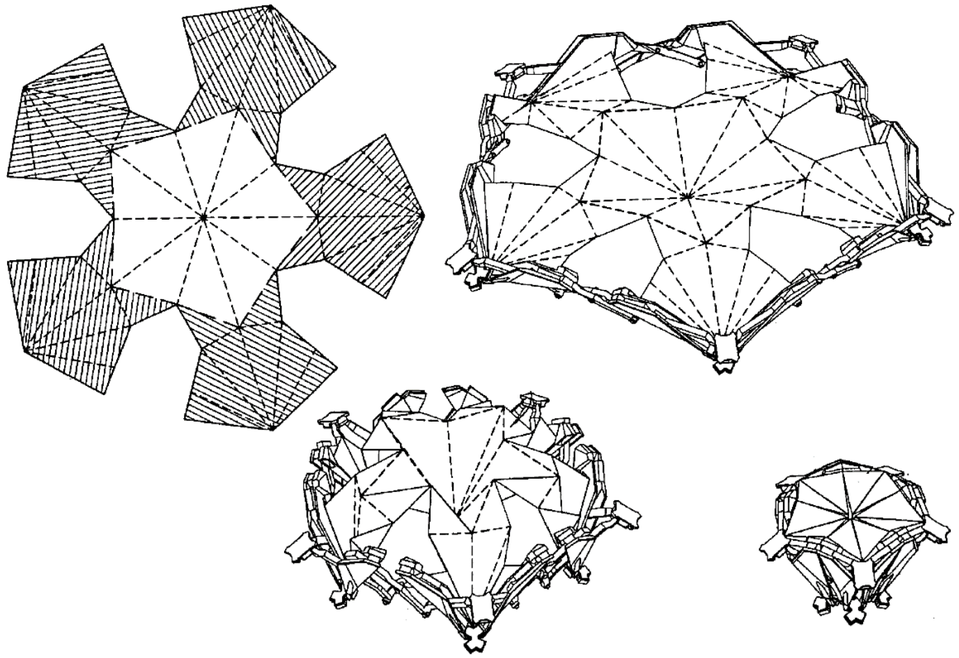


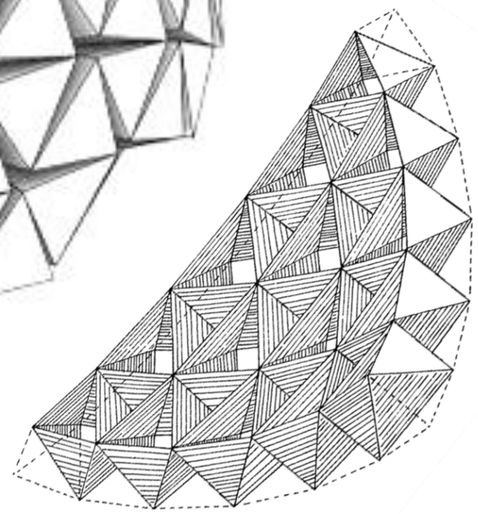


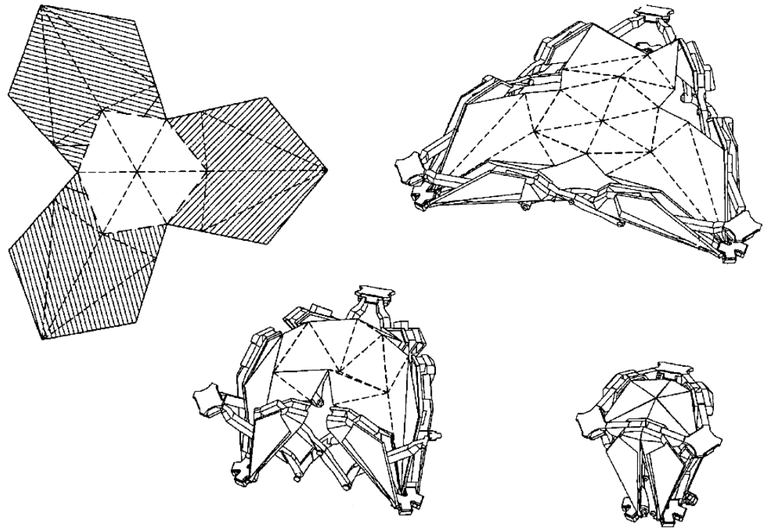


MECHANISM

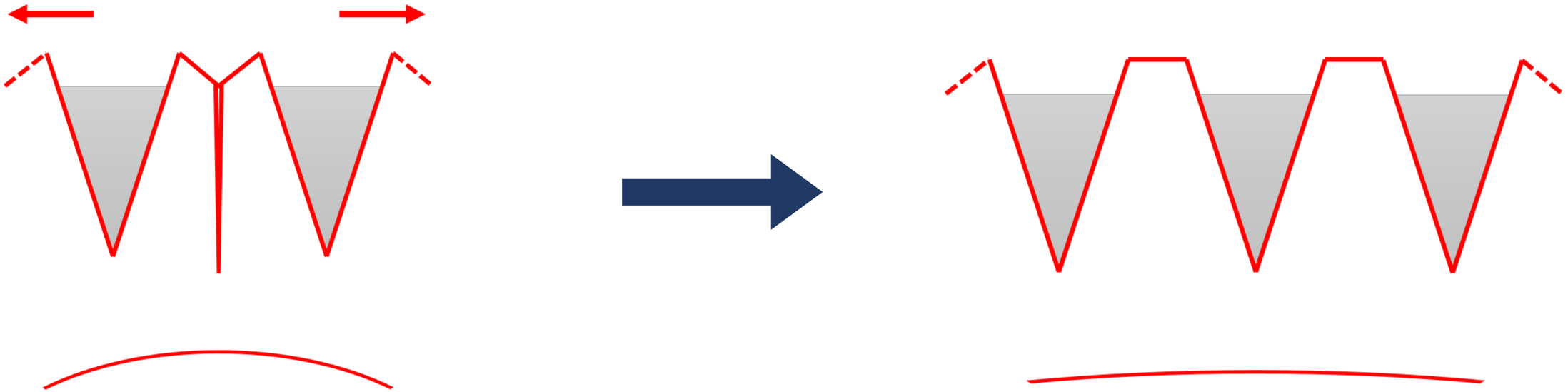






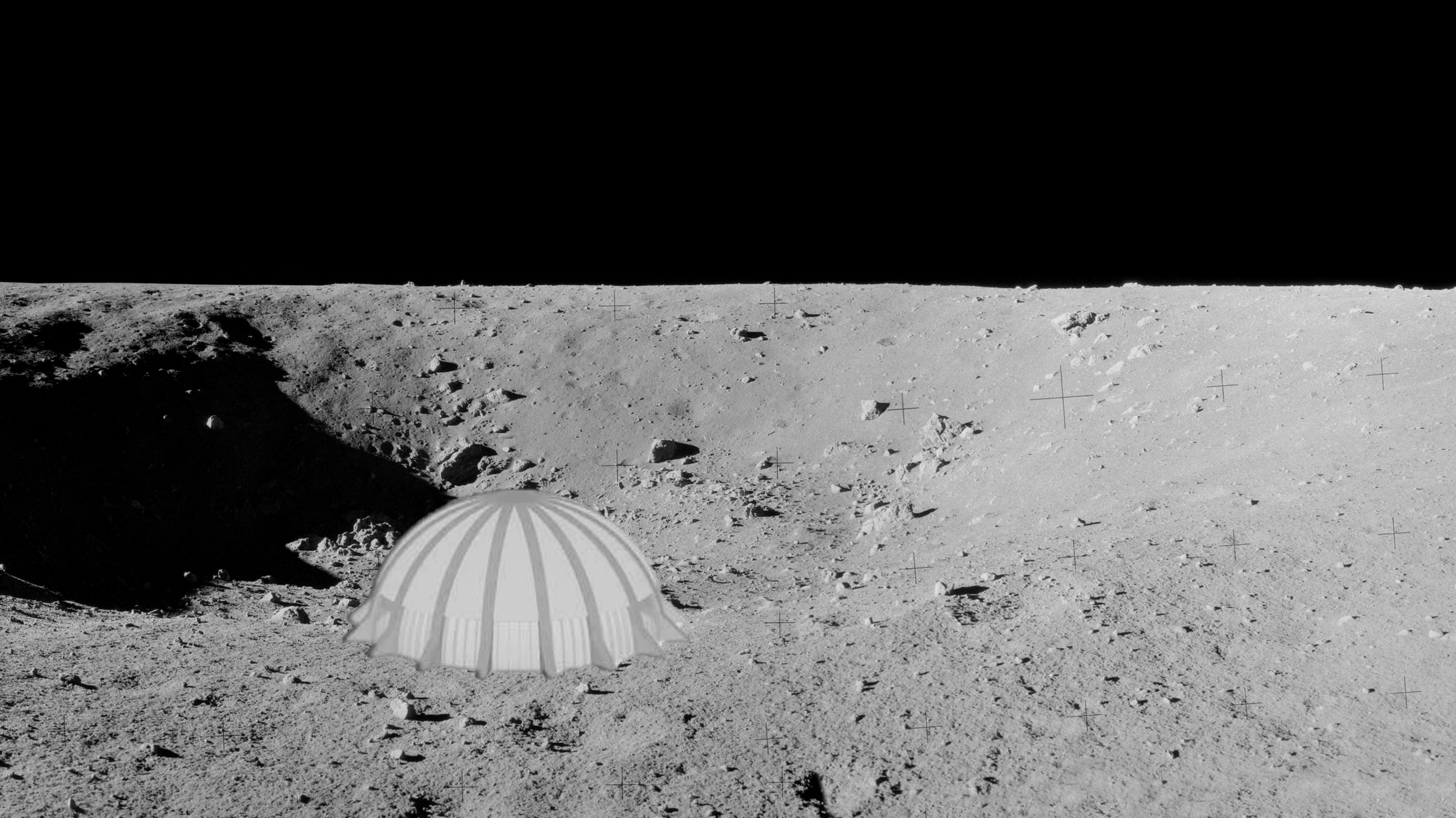


MECHANISM



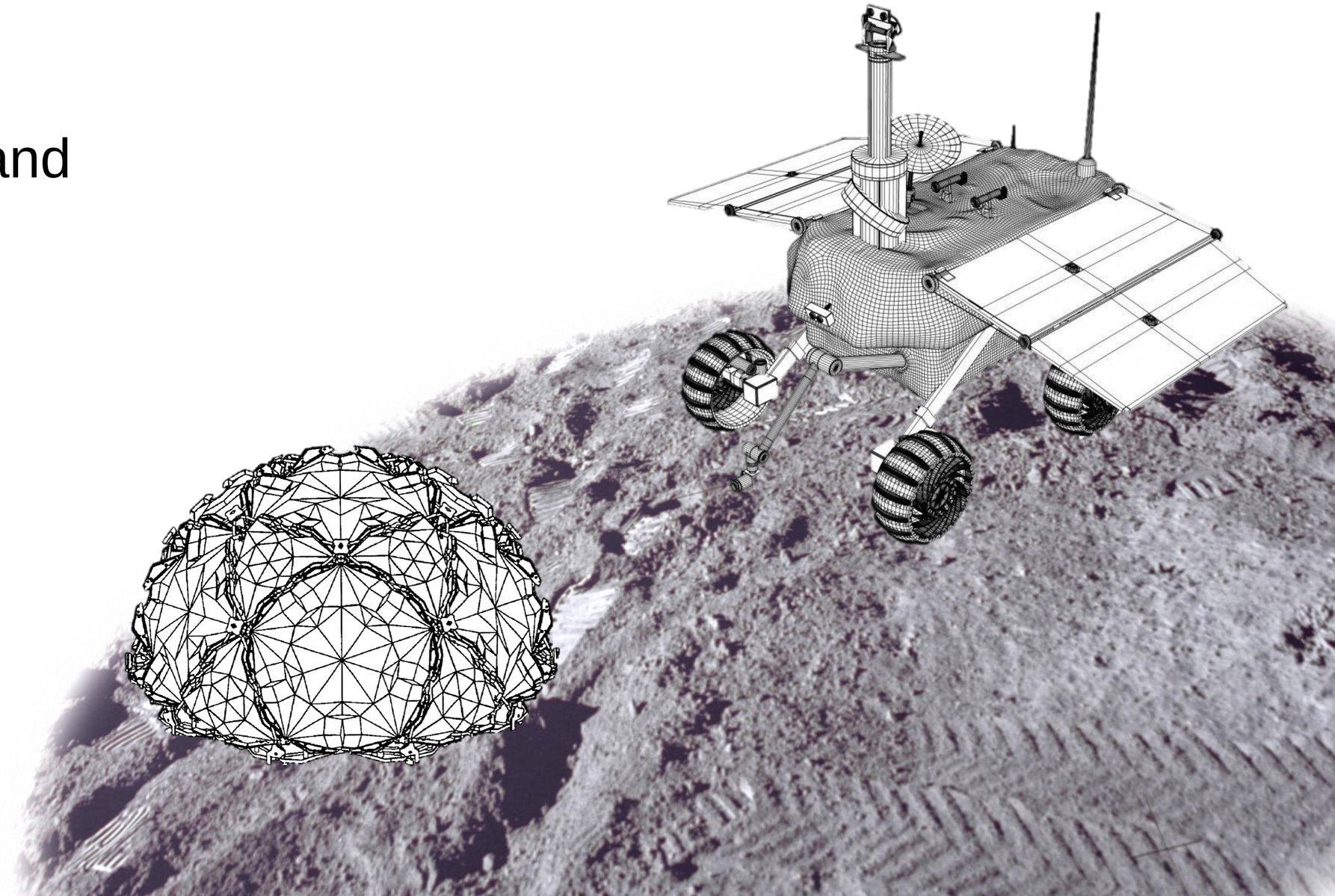
Partial Expansion

Further Expansion



DEPLOYMENT

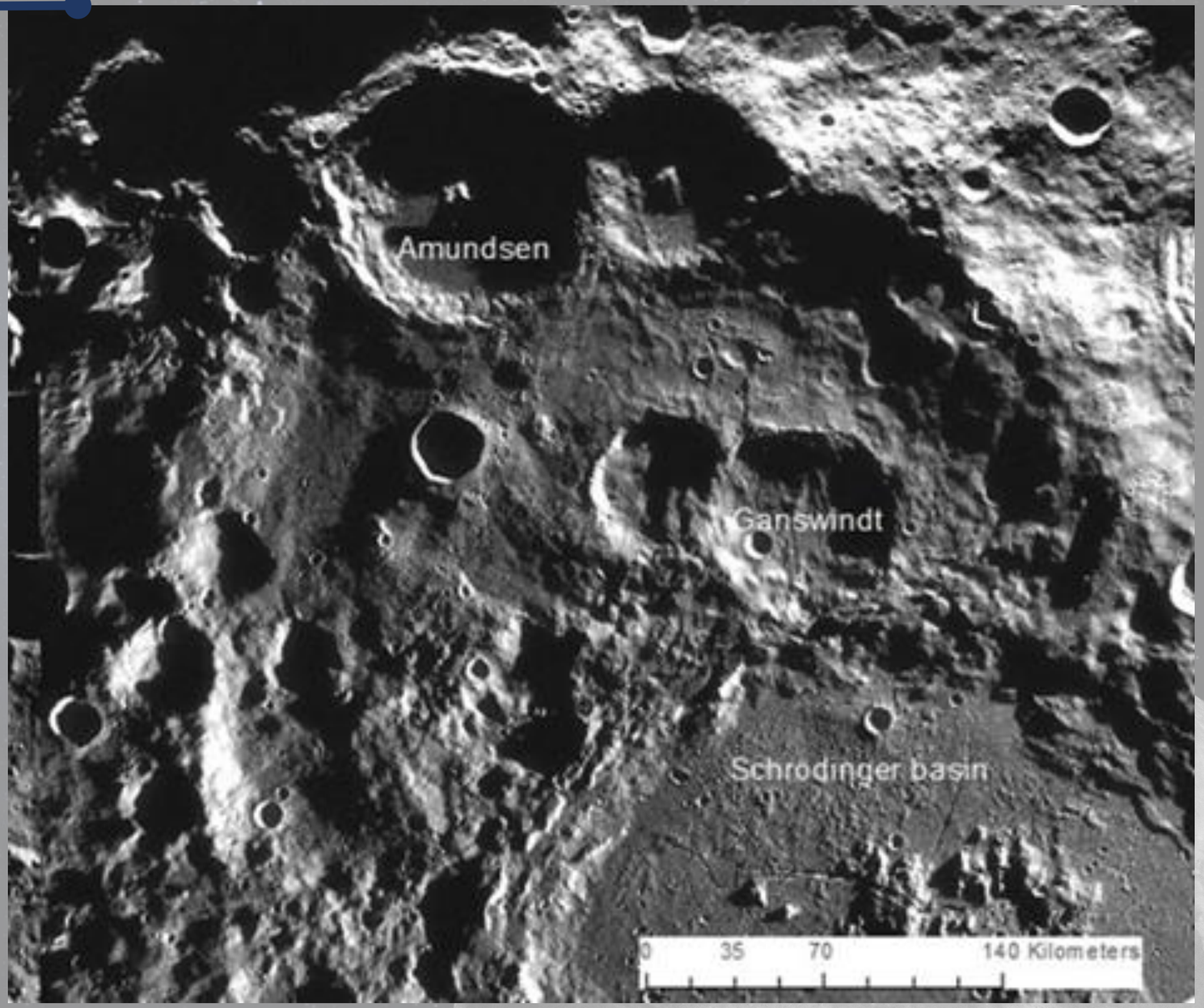
Carried by a rover and placed into the best spot



POSSIBLE AREA OF INTEREST

AMUNDSEN-GANSWINDT basin

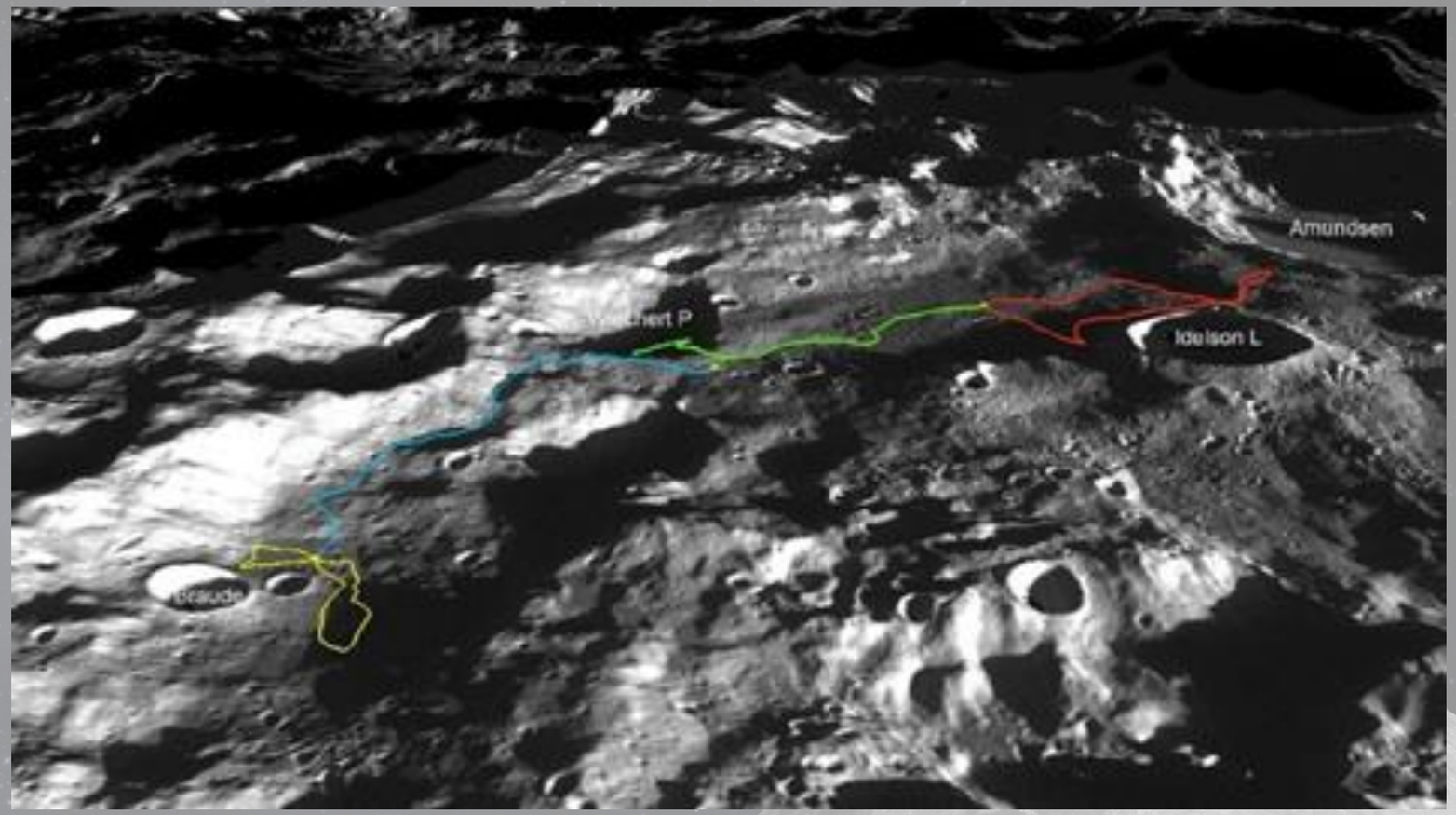
Near the South Pole, possible existence of cold traps and other volatiles



Amundsen-Ganswindt basin
LROC WAC image 100m/pixel of resolution

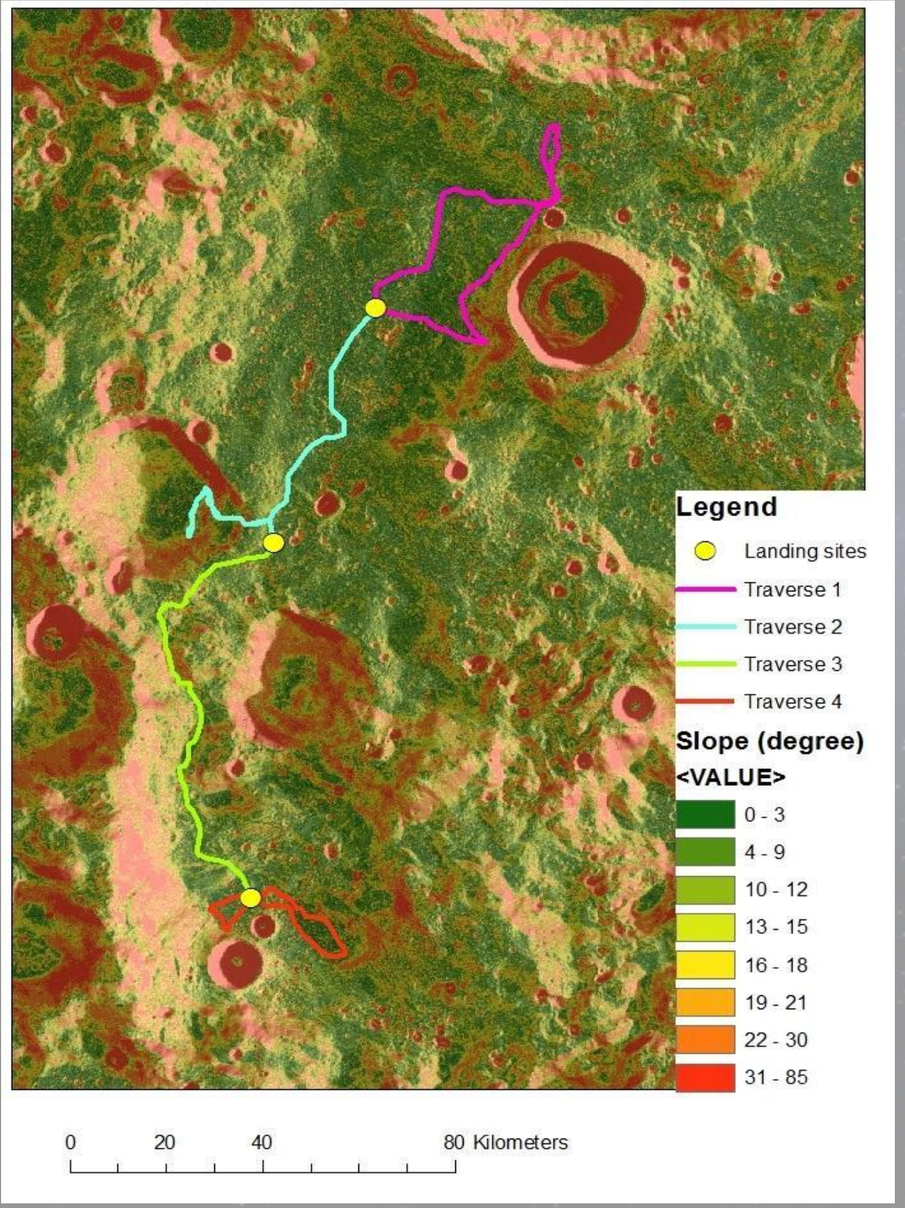
TRAVERSES

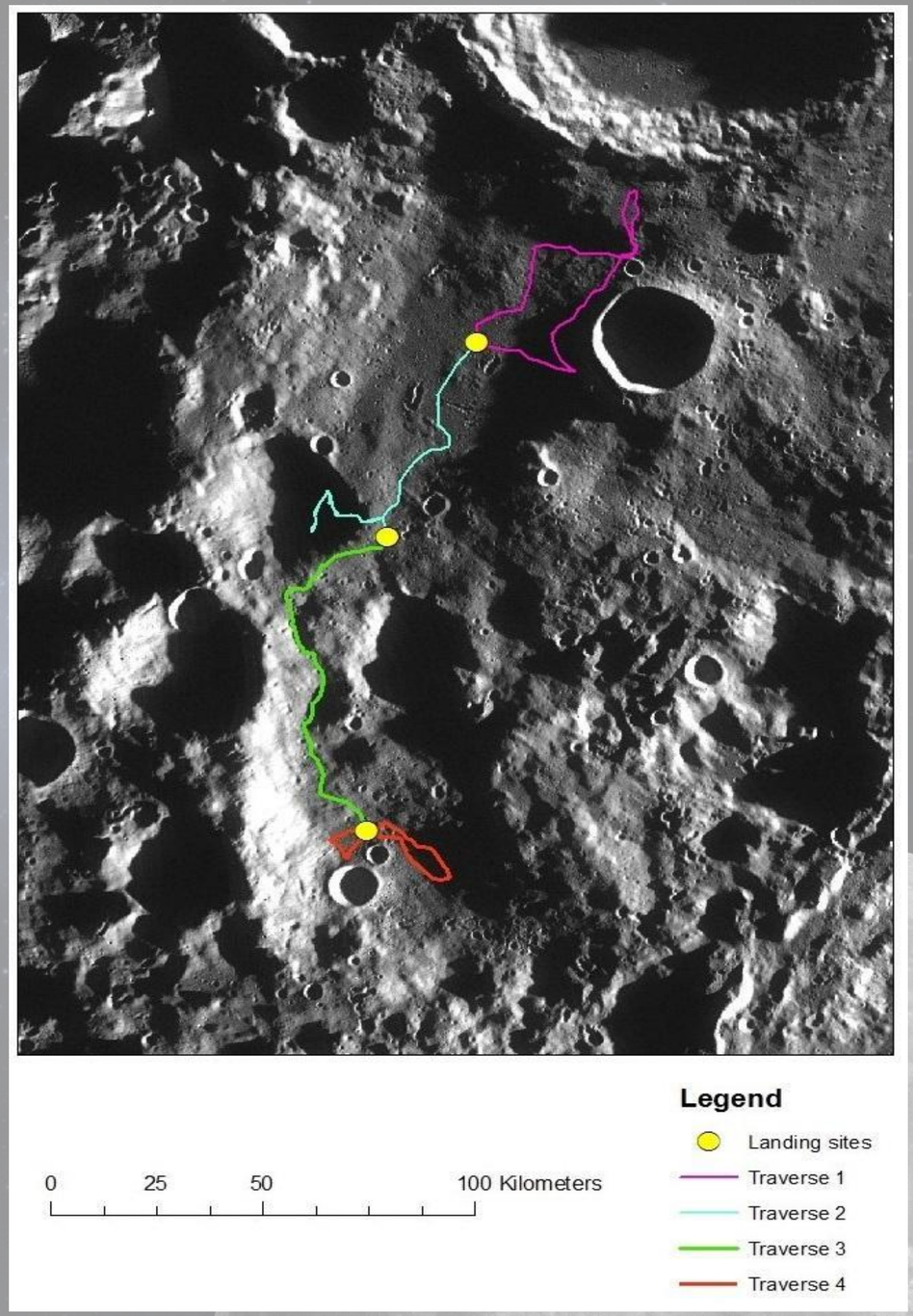
Four traverses are being proposed in this mission architecture to form a route that connects Amundsen crater and the South Polar Region with the Schrödinger basin through the Amundsen-Ganswindt basin



Oblique view of the proposed traverses overimposed to a LRO-WAC image (100m/pixel res). Red, traverse 1; Green, traverse 2; Blue, traverse 3 and Yellow traverse 4

TRAVERSES

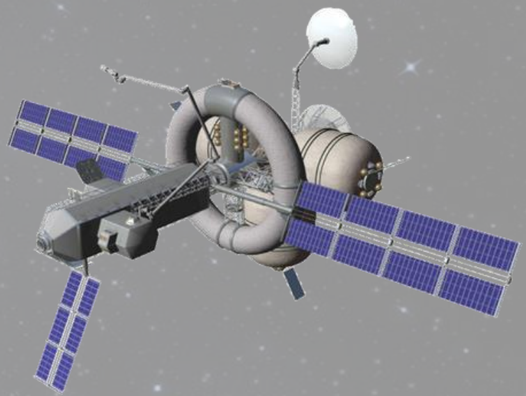

Legend
Landing sites
Traverse 1
Traverse 2
Traverse 3
Traverse 4
Slope (degree)
<VALUE>
0 - 3
4 - 9
10 - 12
13 - 15
16 - 18
19 - 21
22 - 30
31 - 85
0
20
40
80 Kilometers


0
25
50
100 Kilometers
Legend
Landing sites
Traverse 1
Traverse 2
Traverse 3
Traverse 4

MISSION SCENARIO

ASSUMPTIONS

- Lunar Space station (eDSH) in EML2
- Reusable Lander
- Service Module
- Orion vehicle
- Space Exploration Vehicle
- AI/haptic rover, robot
- Penetrator
- Launchers (Falcon heavy, Ariane6, SLS)

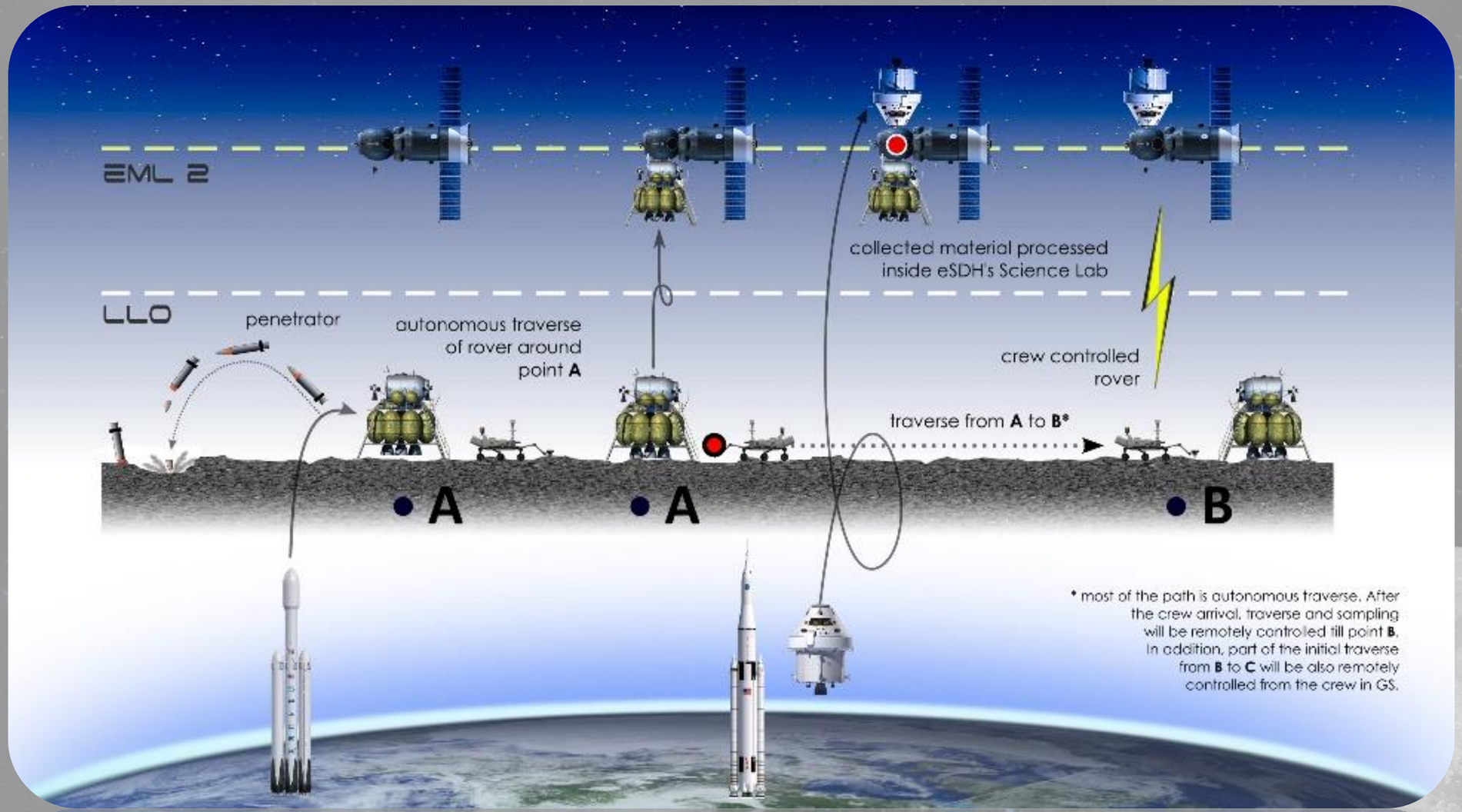


MISSION ELEMENTS

Launchers

VEHICLE	ARIANE 6	FALCON HEAVY	SLS
PAYLOAD CAPACITY	11,000 kg	21,200 kg	37.8 T
STATUS	In Development	In Development	In Development
COST	~$90 million	~$90 million	~$500 million

MISSION ARCHITECTURE



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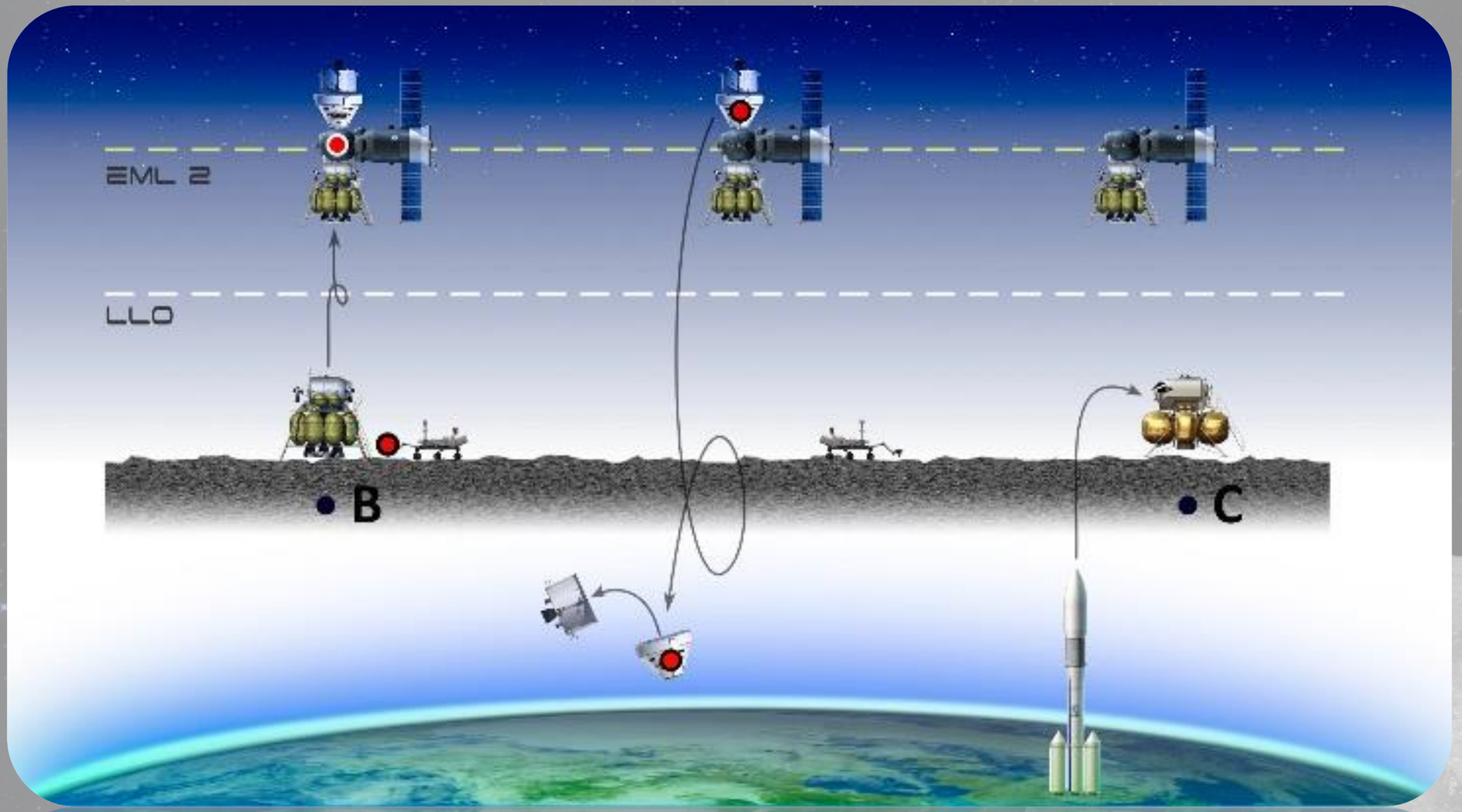

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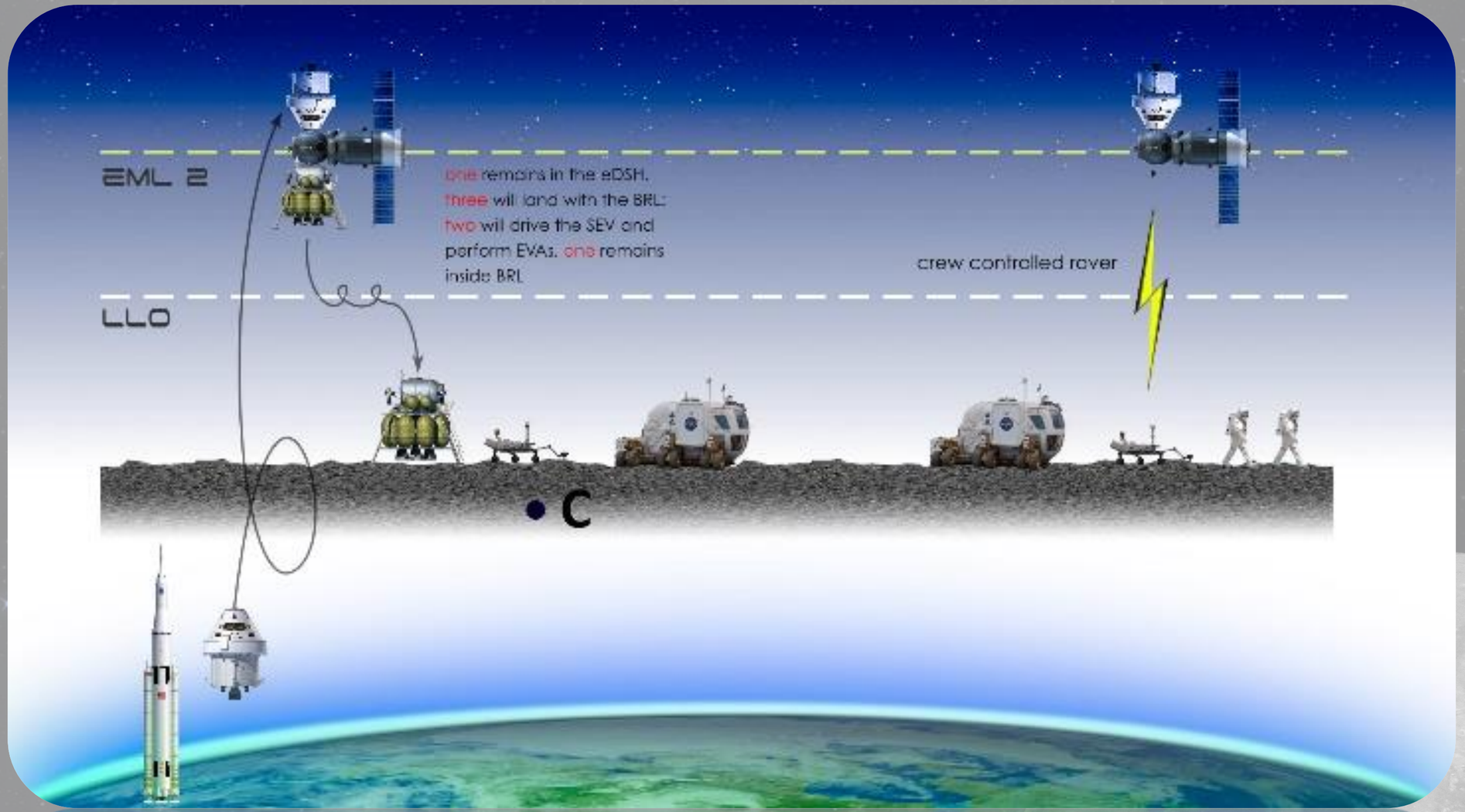

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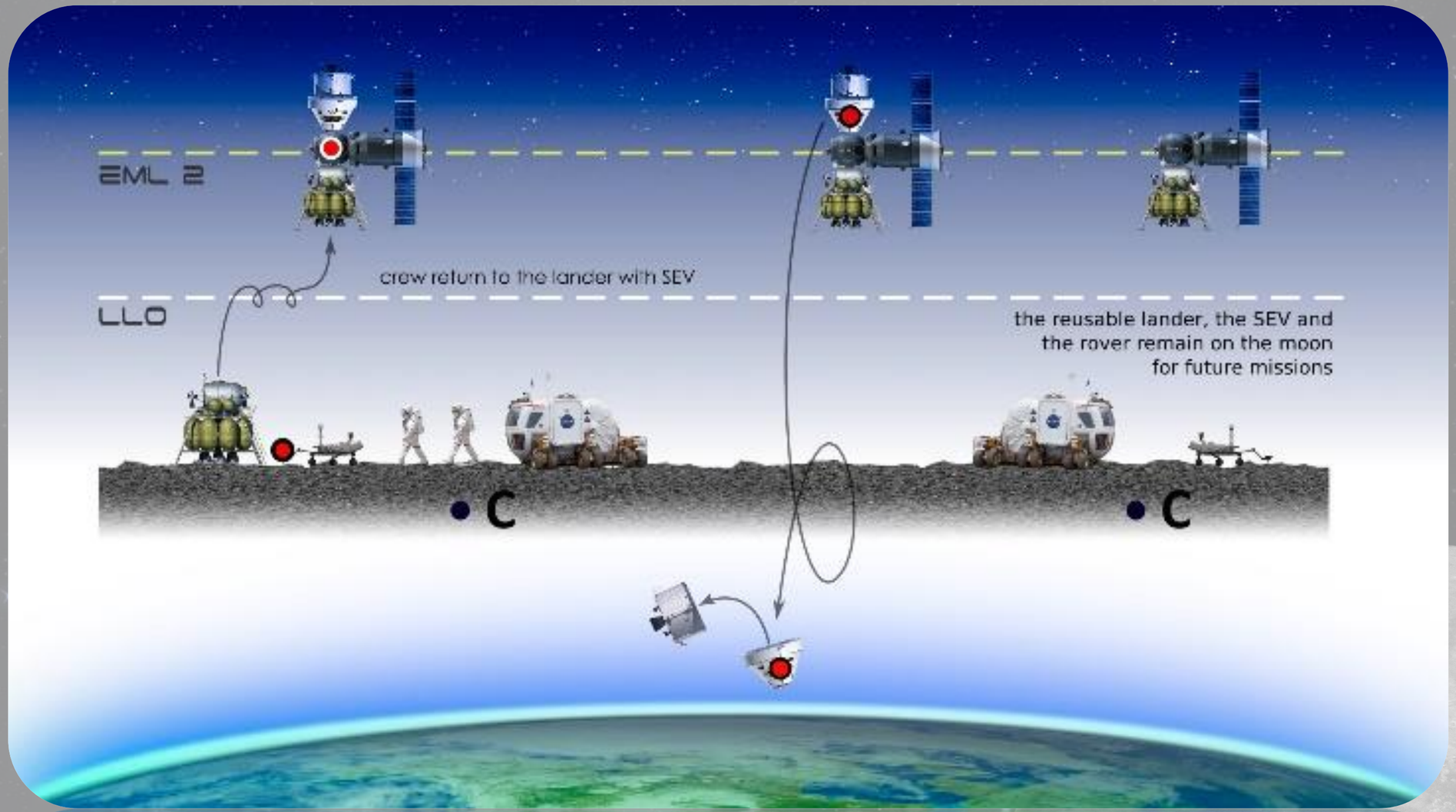
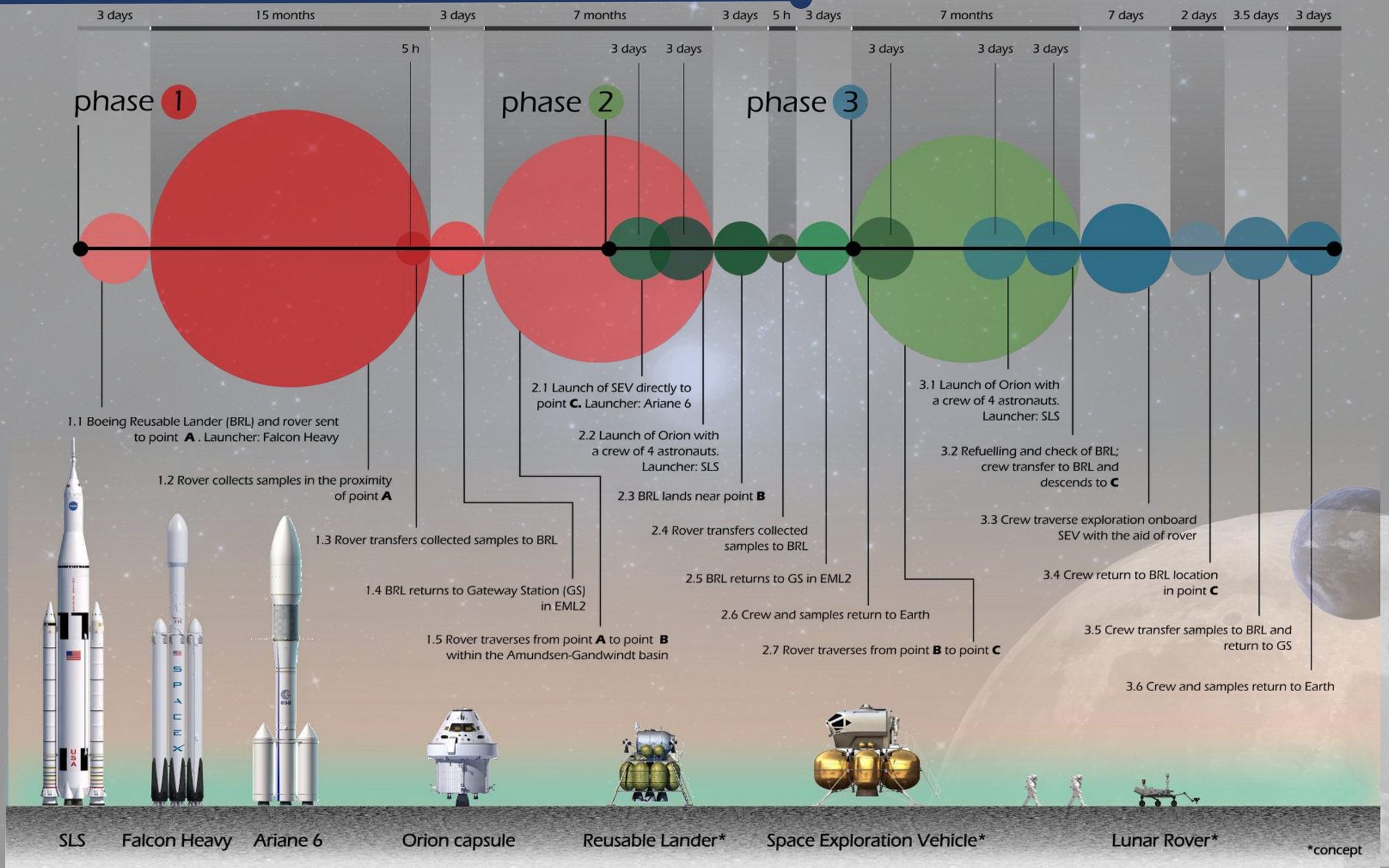


MISSION ARCHITECTURE



CONCLUSION

The proposed system tries to offer an efficient and reliable solution for future outposts on Moon surface.
Inflatable systems are not fully predictable during expansion in vacuum and reduced gravity, the solution discussed in this presentation combines structurally sound structure with a flexible one, besides using in-situ materials for radiation shielding and for more protection against environmental hazards.

Things like structural base, life support, internal design should yet to be considered.

THANK YOU

Space Exploration Project Group
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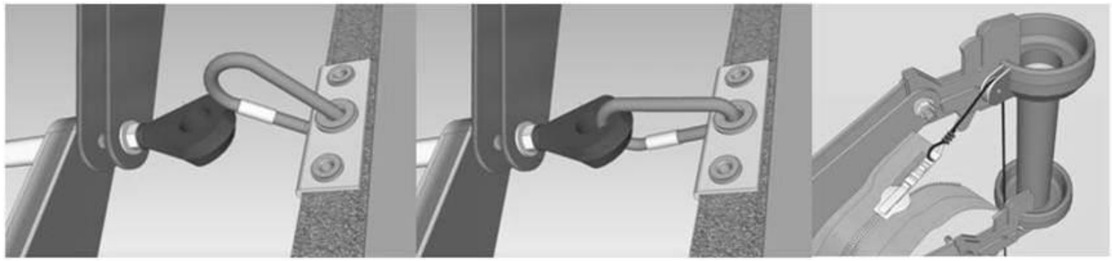
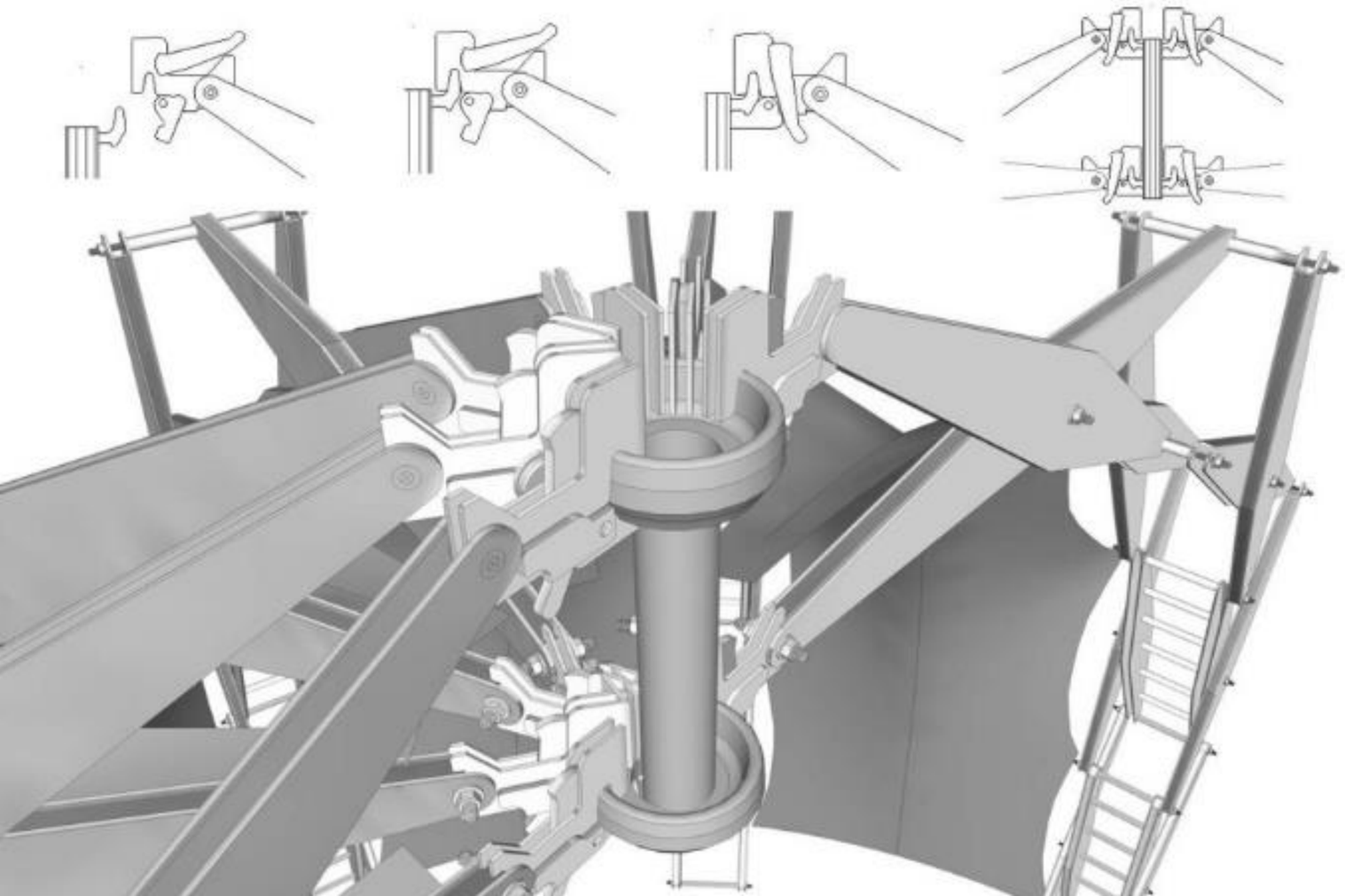
MECHANISM





MECHANISM