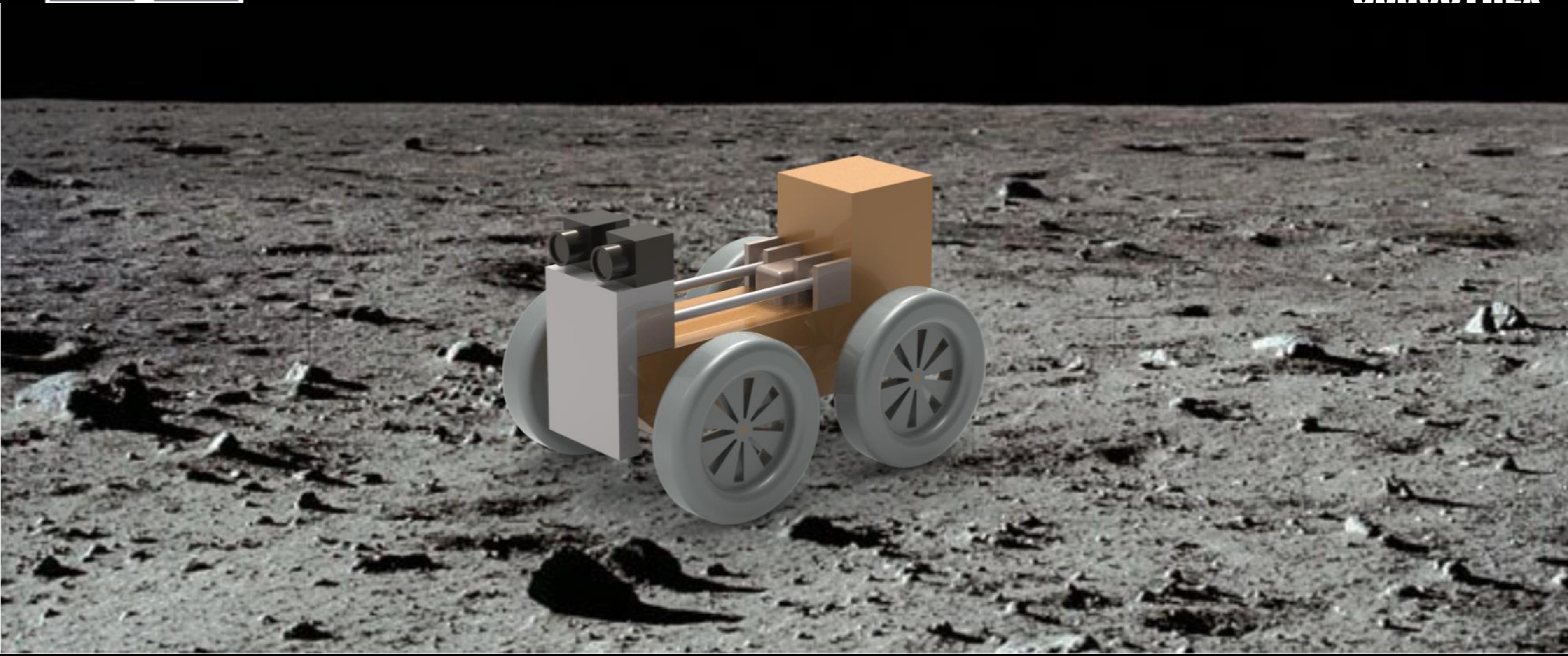

CubeSat based Micro-Rovers

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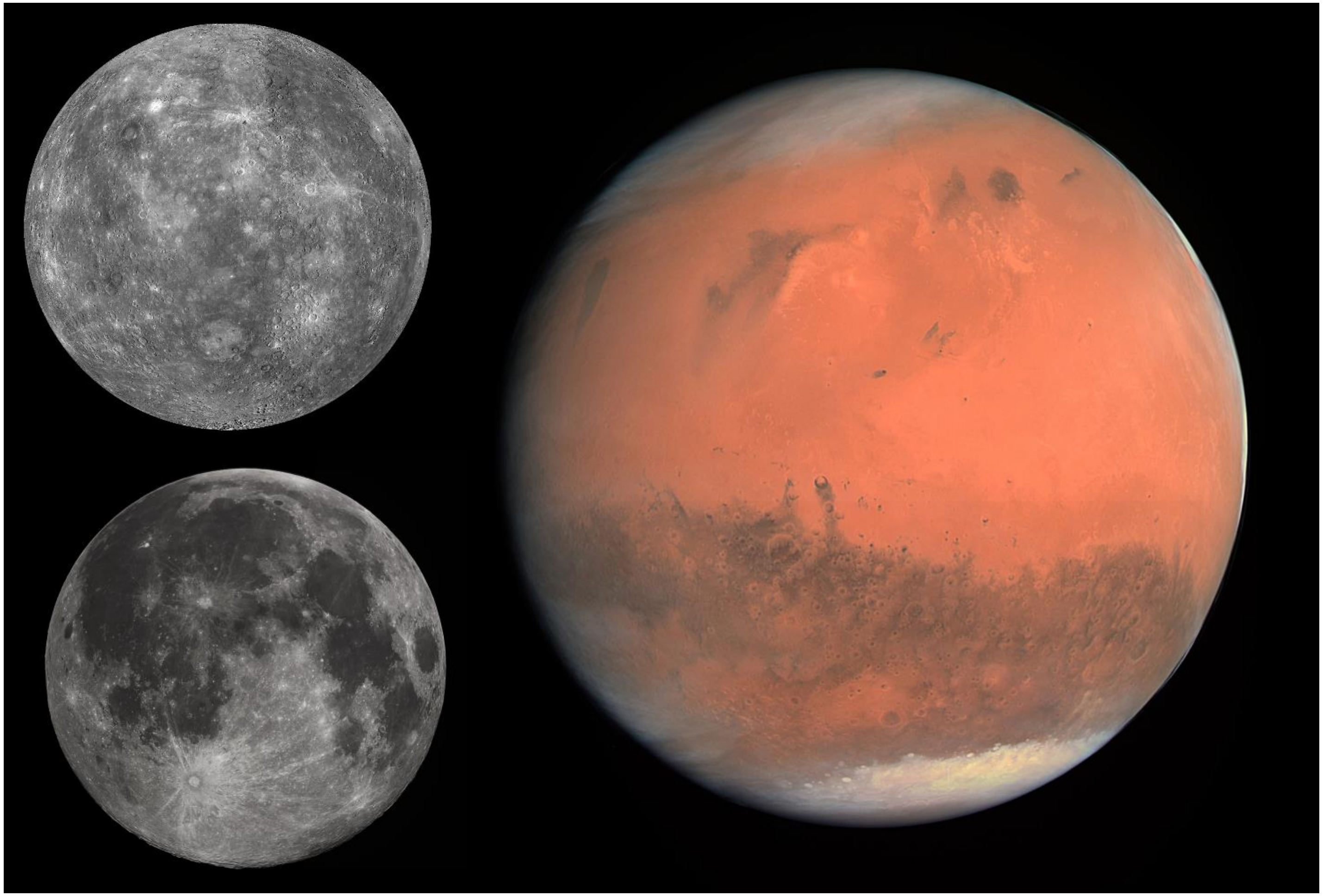
Outline

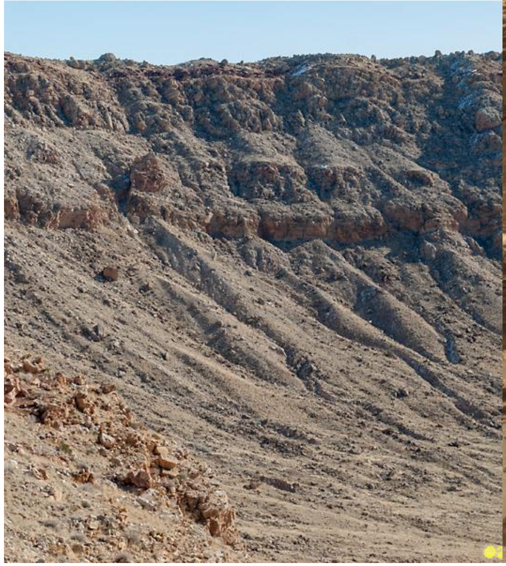
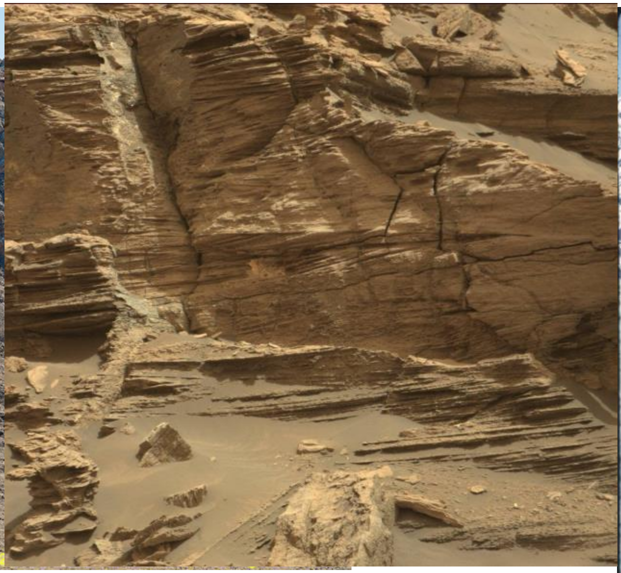
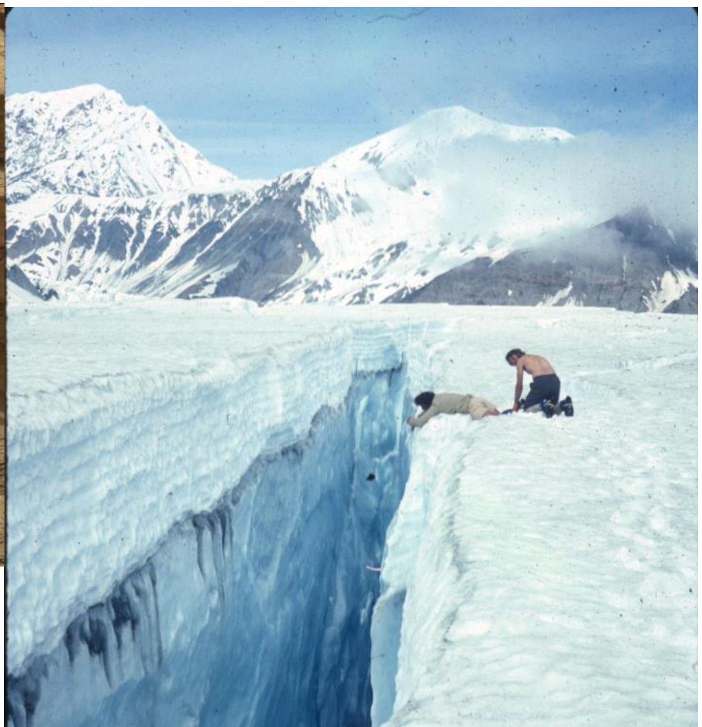
- Introduction
- Motivation
- Challenges
- Objectives
- Approach
- Results and Discussions
- Conclusion

Low Gravity Environments



Motivation

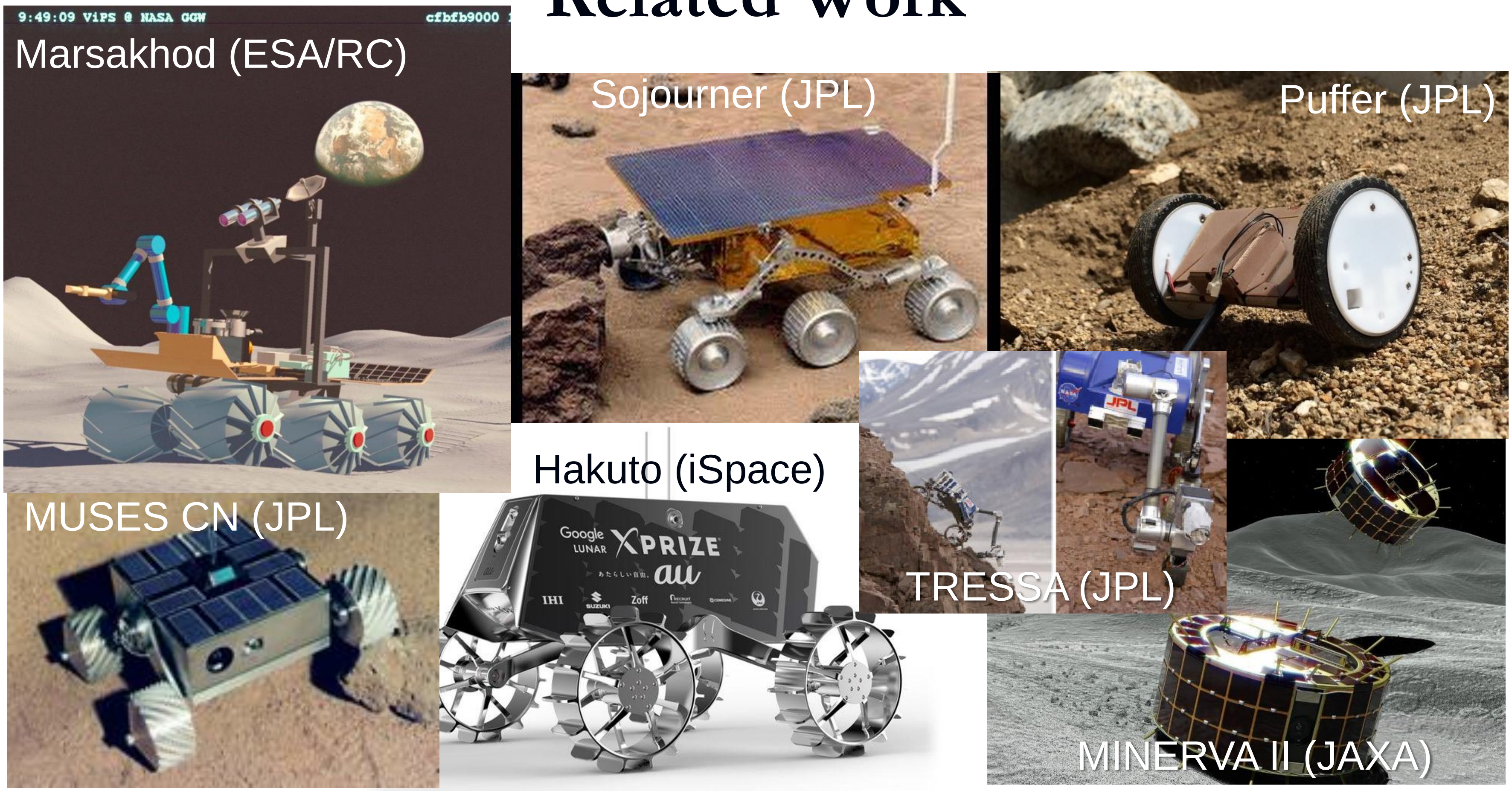
- **Miniaturization of landers and rovers. Payload can be dropped anywhere. Needs to be mobile to make up for lack of precision landing.**

Micro-rover Advantage

- Low mass and volume
- Disposable
- Deployed in-insitu when near interesting science target
- Pursue high-risk, high-reward strategy.
- Return maximized with many small rovers.

Related Work



Design Pathway

- Expands exploration opportunities :
  - Simple mobility system with excellent camera view angles
  - Minimize cost and reduce overall loss due to use of swarms
  - Ability to explore caves and craters in group or side-missions of its own

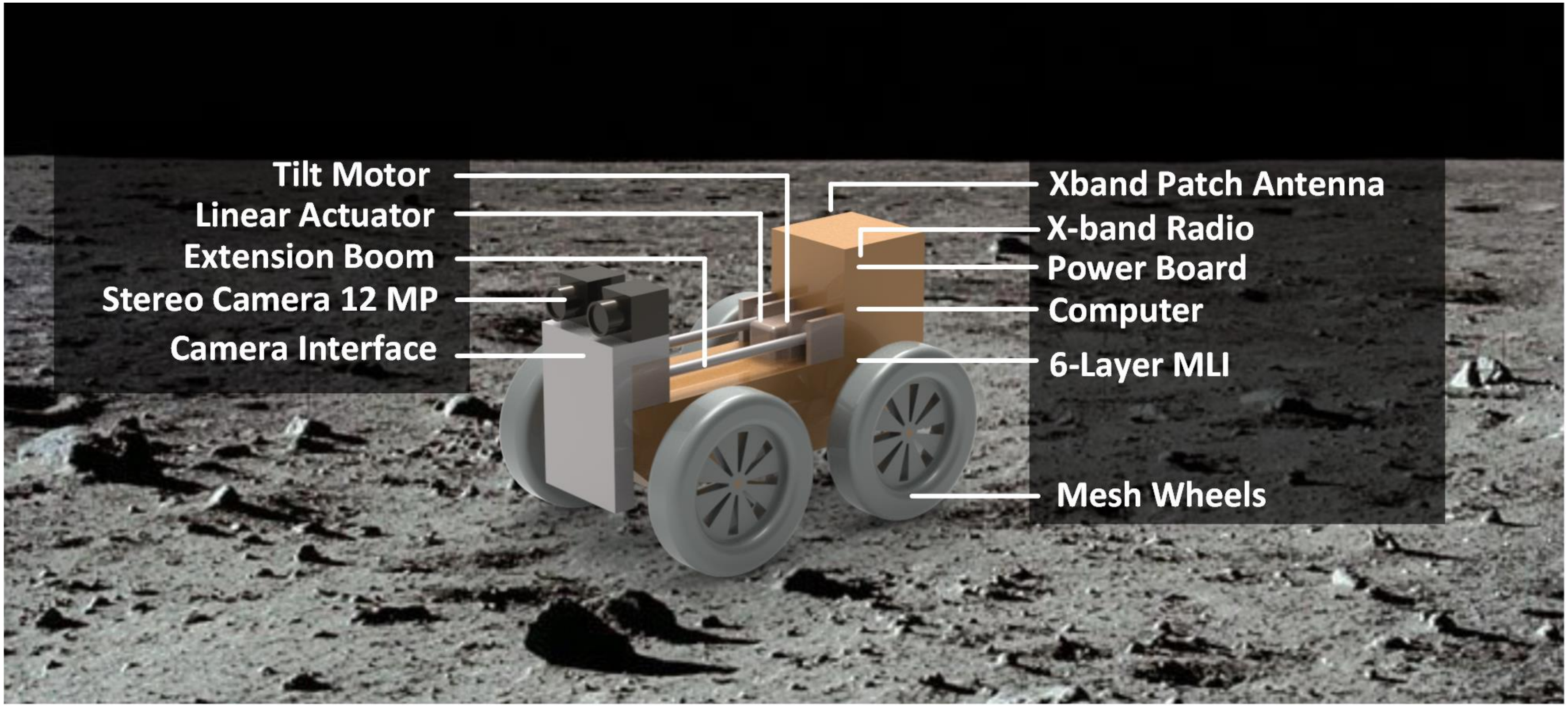
Challenges

- Fit within 12U CubeSat mass and volume constraints
- Keeping design simple, low mass, and adaptable for rough terrains and obstacles
- Optimize mobility of legs while maximizing wheel diameter (work in progress)

Objectives

- **Design and develop a simple rover chassis design that fits inside a 12U CubeSat deployer, provides excellent camera view and houses miniature science instruments**
- **Numerically analyze the structural behavior of the chassis**

System Layout



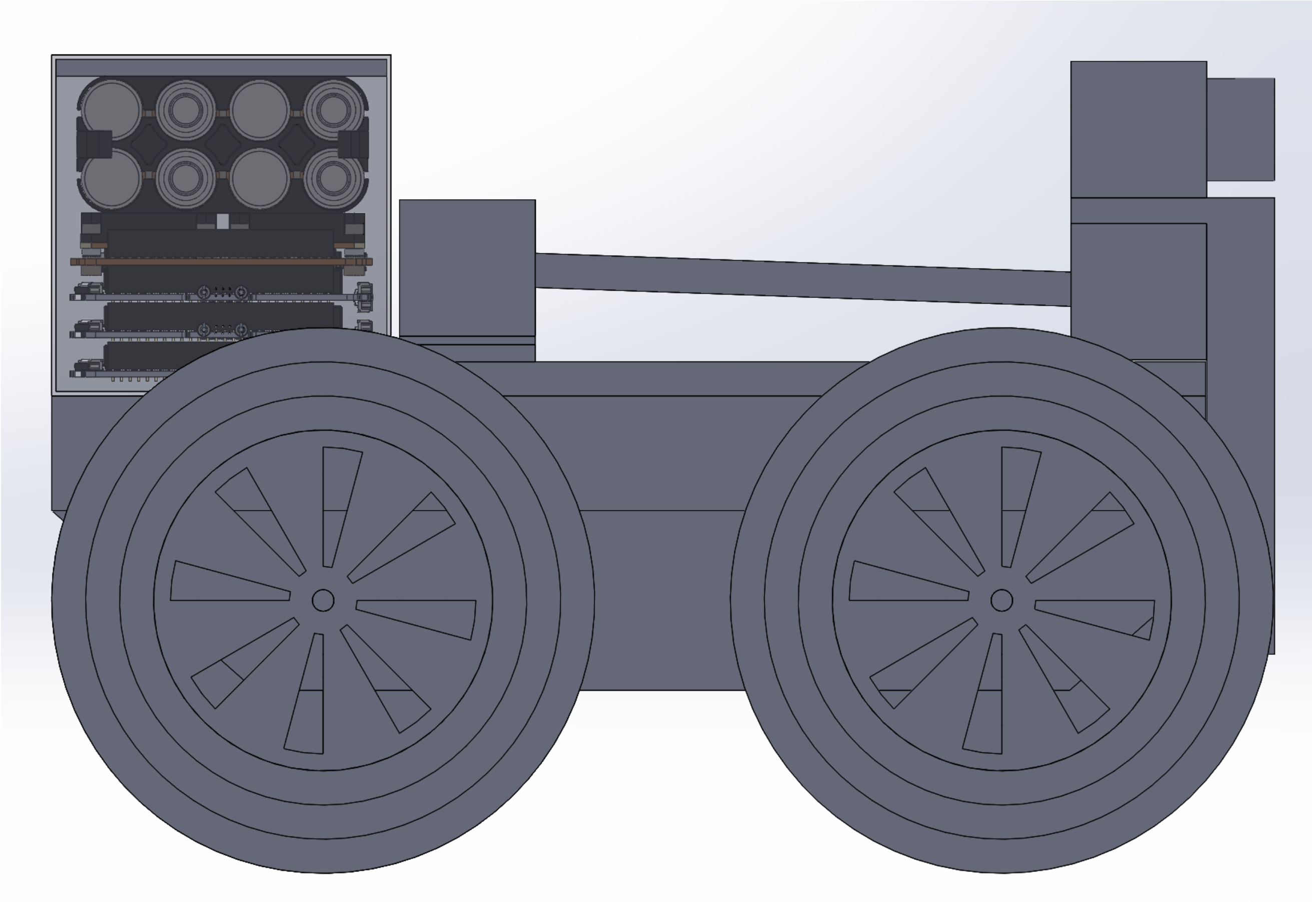
System Description - Mass Budget (12U)

Subsystem	Component	Part	Qty	Mass [kg]	Contingency [%]	Total Mass [kg]
Avionics	EPS	Gomspace Nanopower p60	1	0.043	2	0
Power	Battery	Gomspace Nanopower BPS	1	0.5	2	1
	Solar Panels	TBD	N/A	0.4	25	1
Comms	Antenna	X Band Patch	1	0.3	2	0
Structure	Chassis	Custom Built	1	10.42	25	13
	Wheels	TBD	4	0.5	25	3
Instruments	Cameras	TBD	2	1	2	2
	Motors	TBD	5	0.2	2	1
Total Mass (Kg)						**19.9**
Mass Margin (%) (Max allowed is 24 kg)						**17**

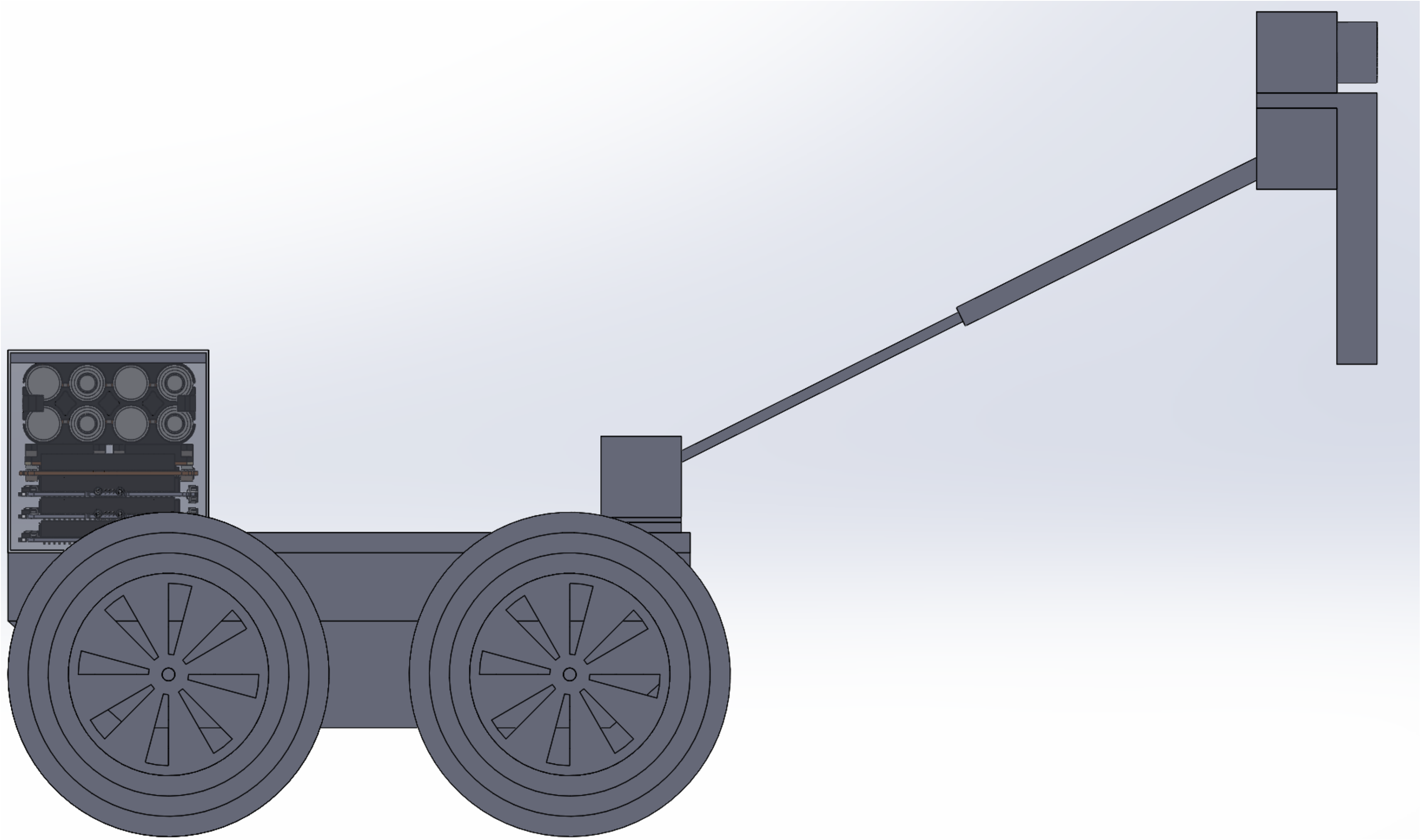
System Description – Volume Budget (12U)

Subsystem	Component	Part	Qty	Vol. [cm^3]	Contingency [%]	Total Vol [cm^3]
Avionics	EPS	Gomspace Nanopower p60	1	500	2	510
Power	Battery	Gomspace Nanopower BPS	1	174	2	177
	Solar Panels	TBD	N/A	450	25	563
Comms	Antenna	X Band Patch	1	47	2	48
Structure	Chassis	Custom Built	1	3759	25	4699
	Wheels	Custom Built	4	542	25	2711
Instruments	Cameras	TBD	2	77	2	157
	Motors (4 drive/1 arm)	TBD	5	40	2	205
Total Vol (cm^3)						9069
Vol Margin (%) (Max allowed is 19872 cm^3)						54

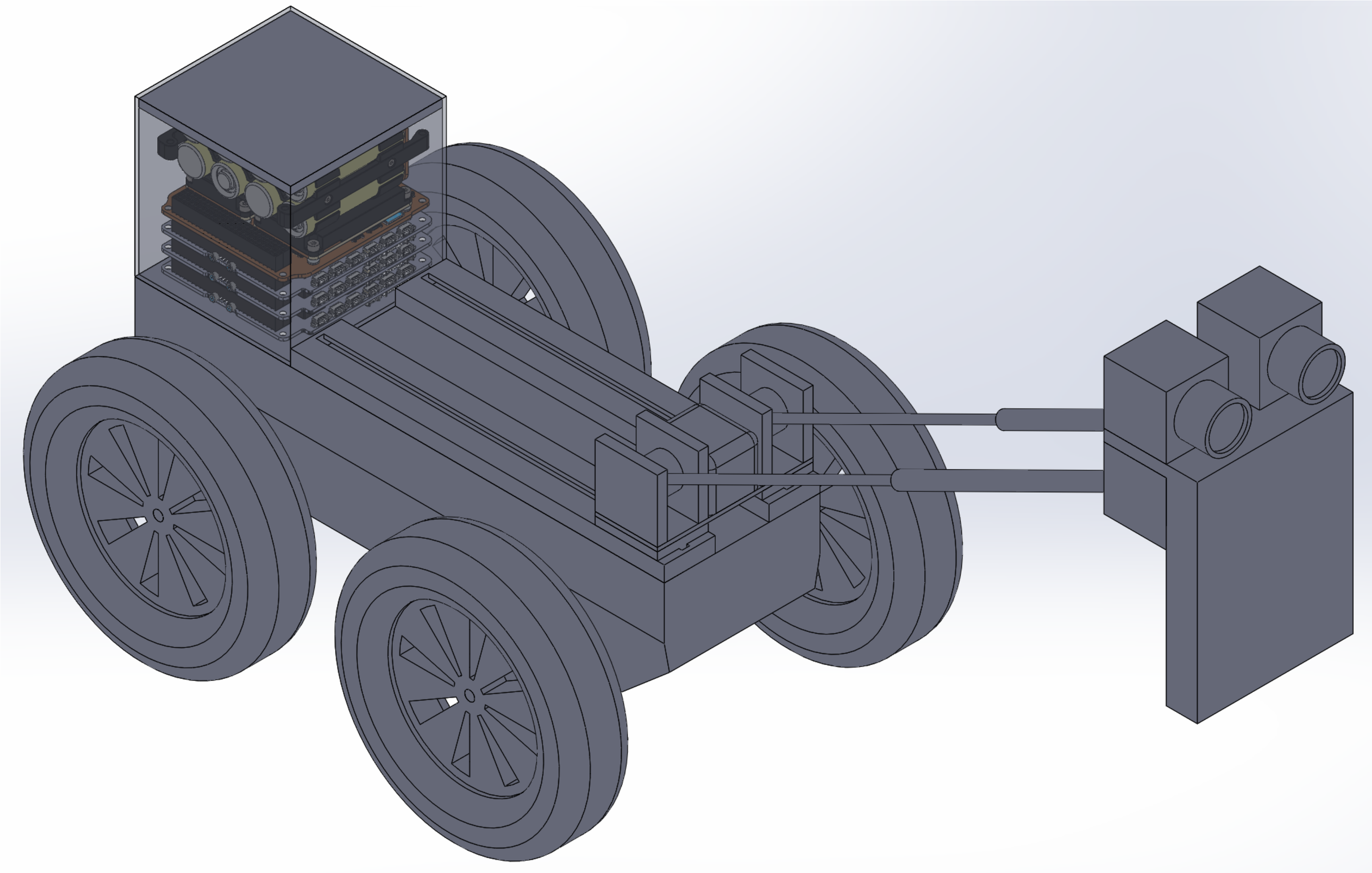
Side Layout



Boom Extended



Boom Extended



Discussion

- Proposed a micro-rover that can fit inside 12U deployer.
- Rover can be carried as secondary payload to lunar surface.
- Includes extendable boom to position stereo camera for pan shots and close-ups of the ground.
- Uses standard COTS with 100 mil Al shielding
- Wheel uses mesh-wires.

Conclusions

- First of several CubeSat-sized rovers being designed.
- Focus has been on providing platform for camera to take pan and close-up shots.
- Conventional mesh-wire wheel system.
- Considering other chassis design to enable better traversal over obstacles.

Thank you