The 3rd International AIAA LA-LV Space Architecture Gathering

Saturday March 27th, 2021, 10:00am-3:30pm (Add to Calendar)

Pacific Daylight Time PDT (GMT -0700)(Los Angeles, US, and Canada)

Welcome and Opening by

Dr. Dan Dumbacher

(AIAA Executive Director)

led and moderated by

Prof. Madhu Thangavelu

USC Astronautical Engineering Department and USC School of Architecture

3rd International Space Architecture Gathering

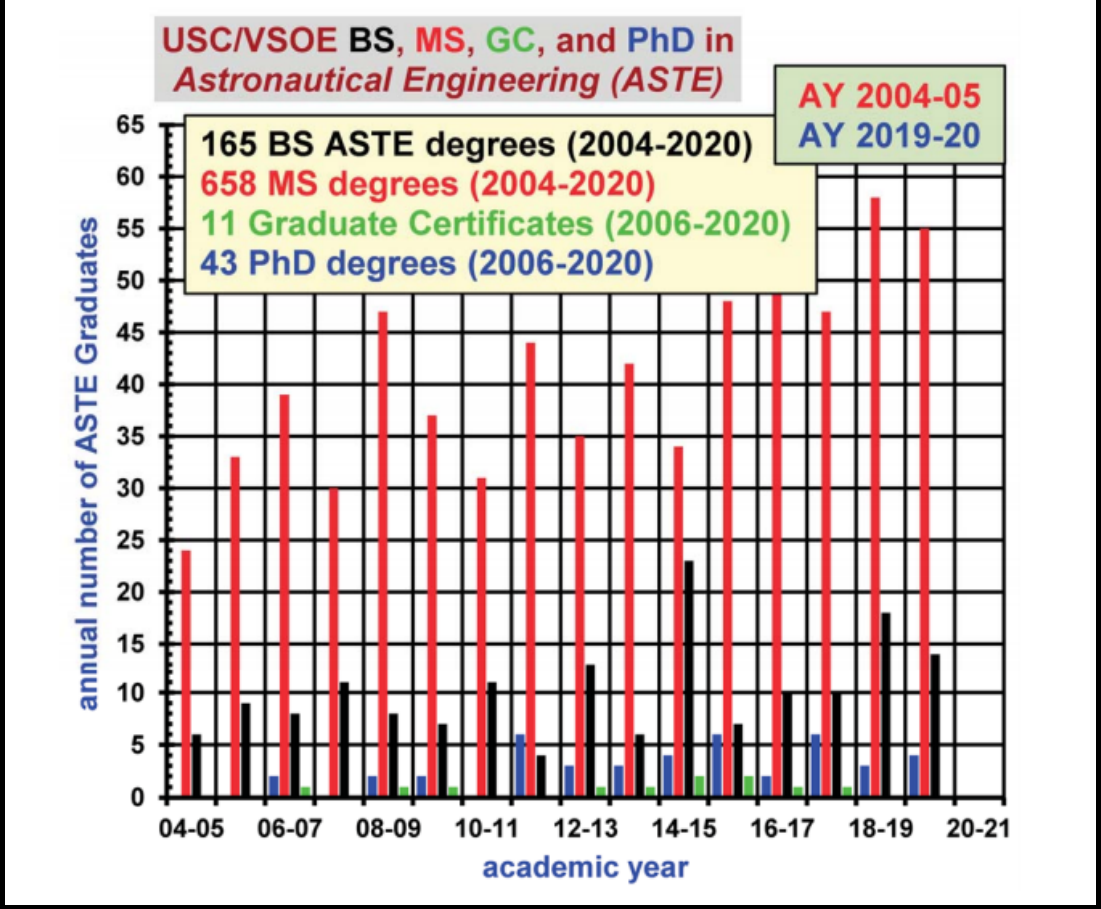
M.Thangavelu

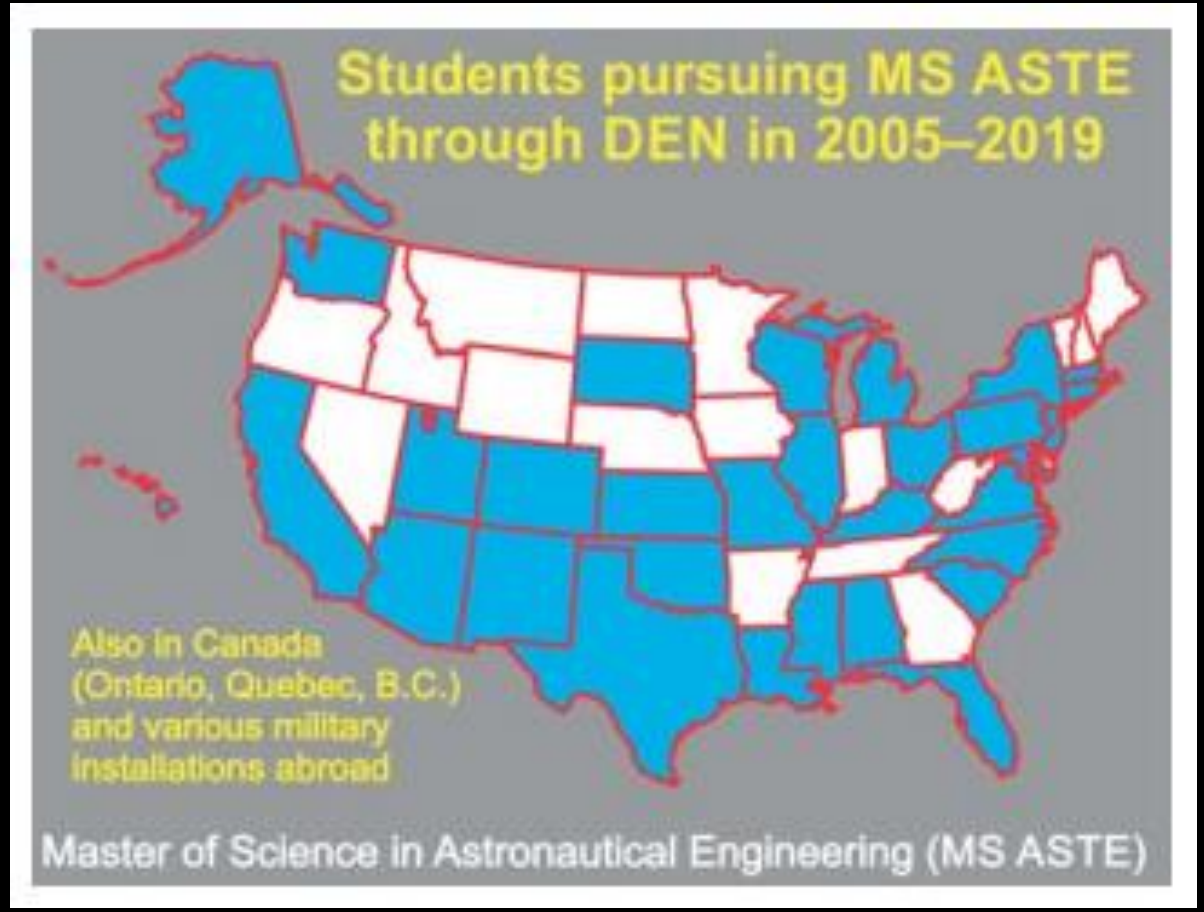
USC School of Engineering & Architecture

Saturday March 27th, 2021

Moon & Mars – Waiting for Architects

USC Astronautical Engineering





USC ASTE527 Studio

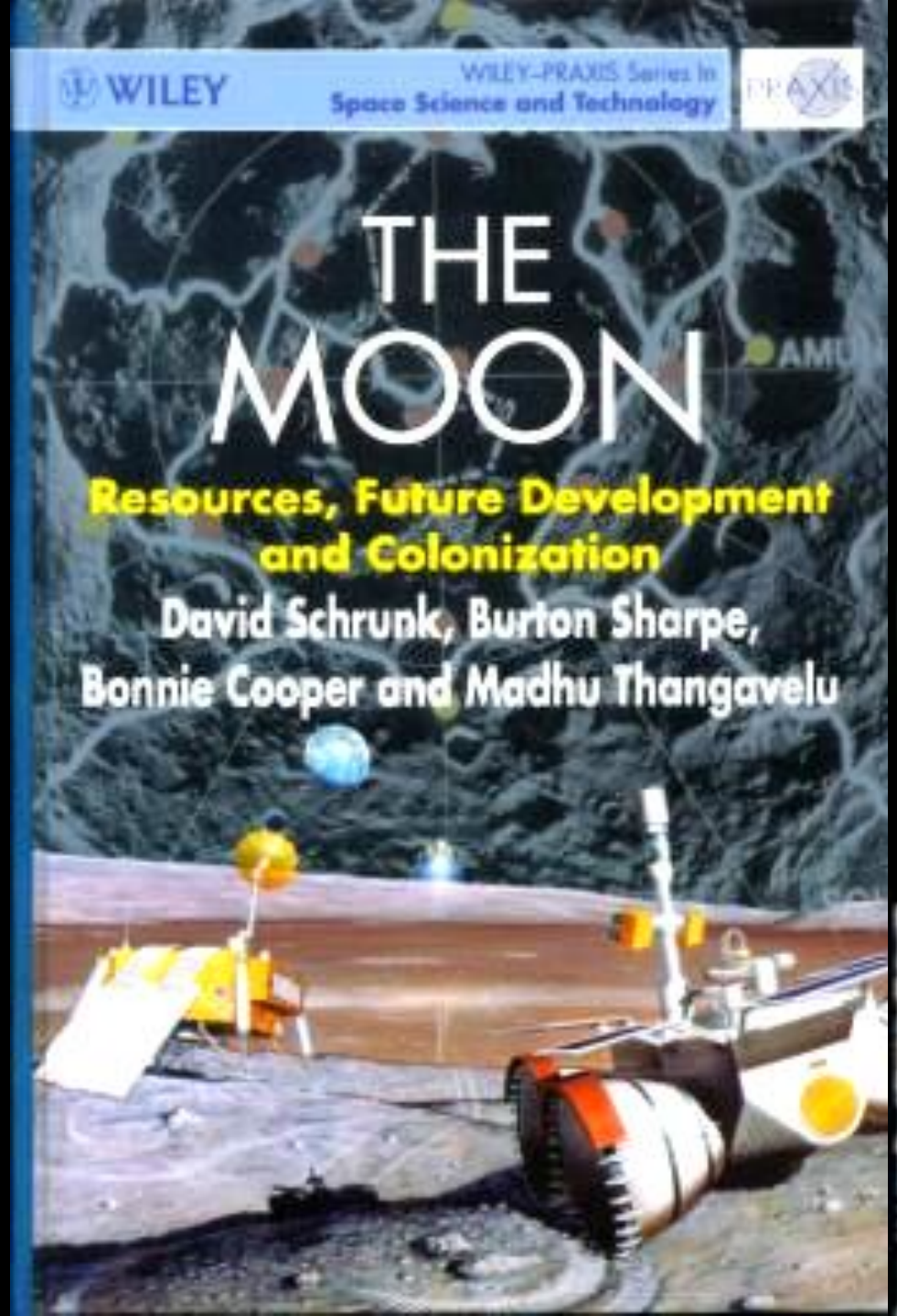
- 3-Unit graduate class
- Focus on Imagination & Creativity
- Concept Creation - Rapid Visual Representation
- Originality
- Academia – Independent of Agency or Industry

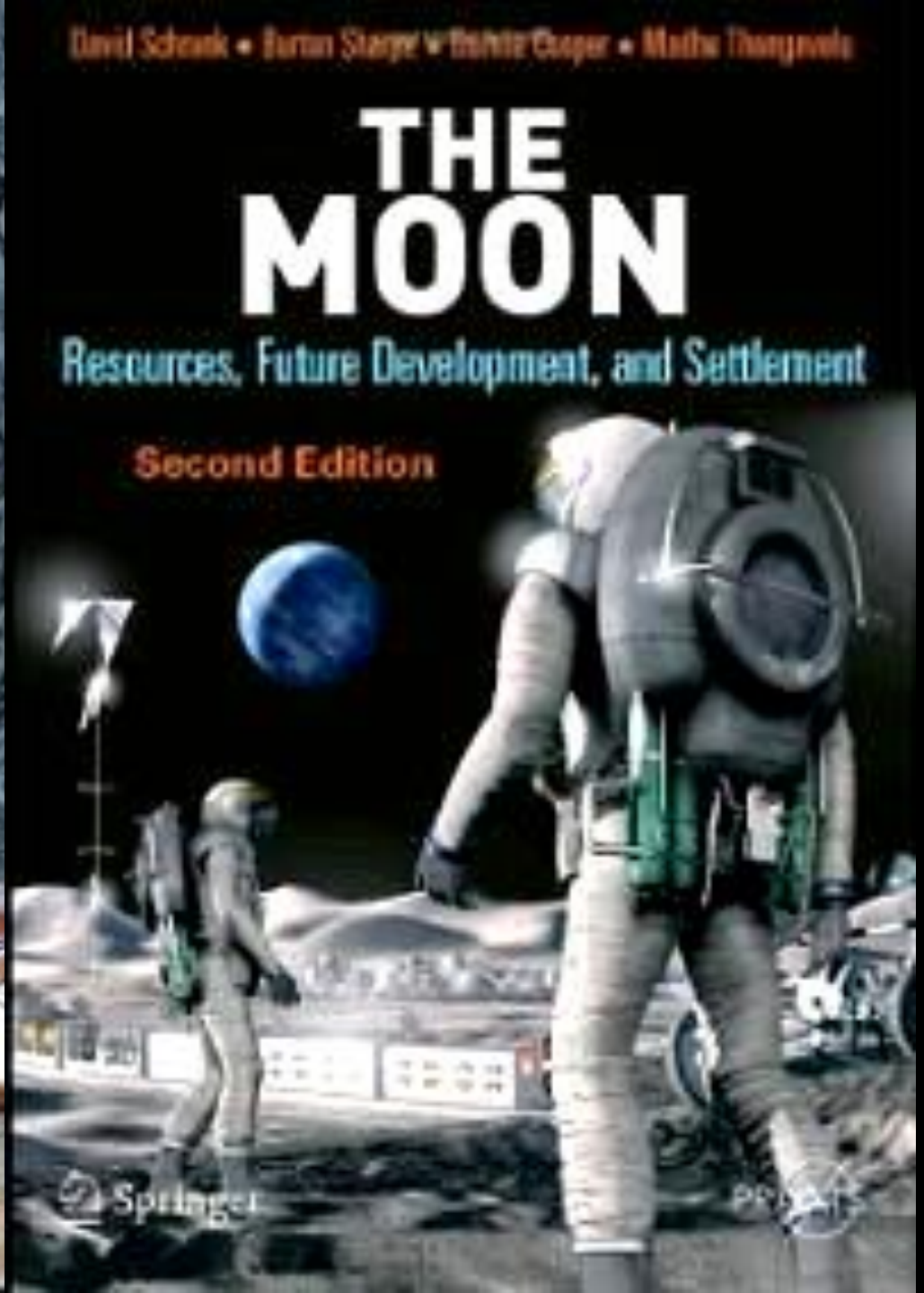
ASTE527 Graduate Space Concepts Studio

USC Architecture School
Extreme Environments Seminar

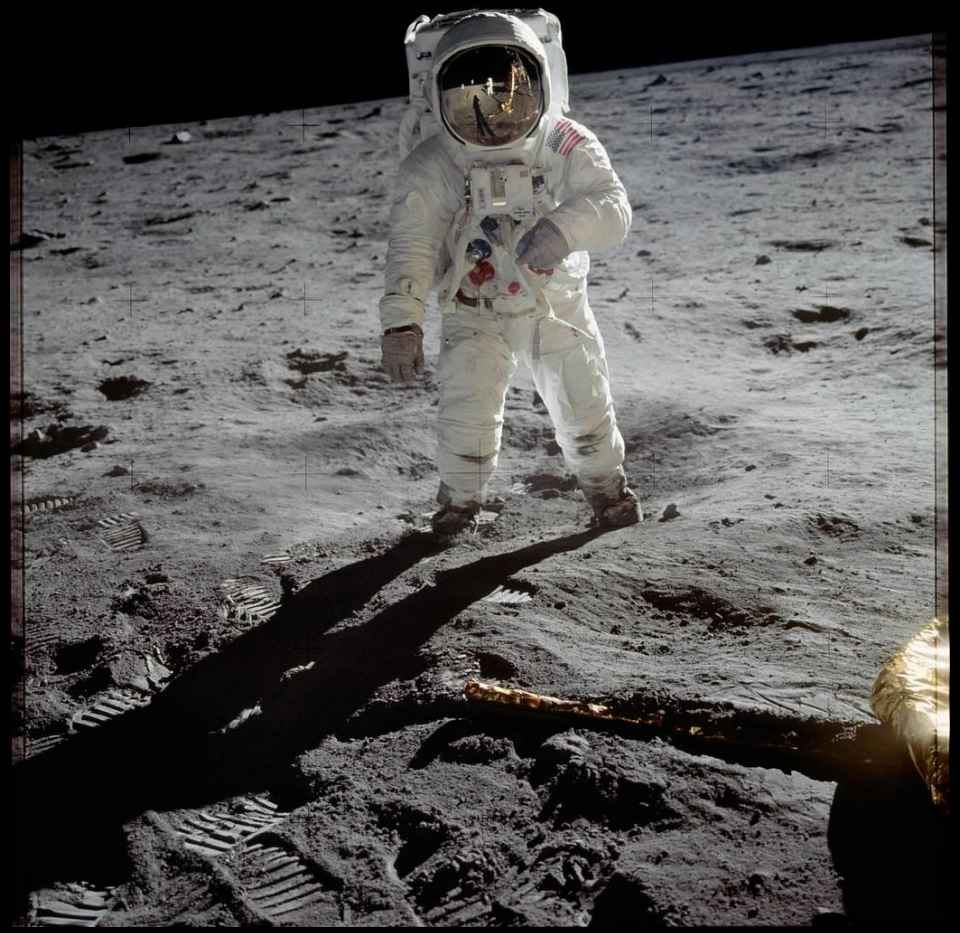
Pondering…

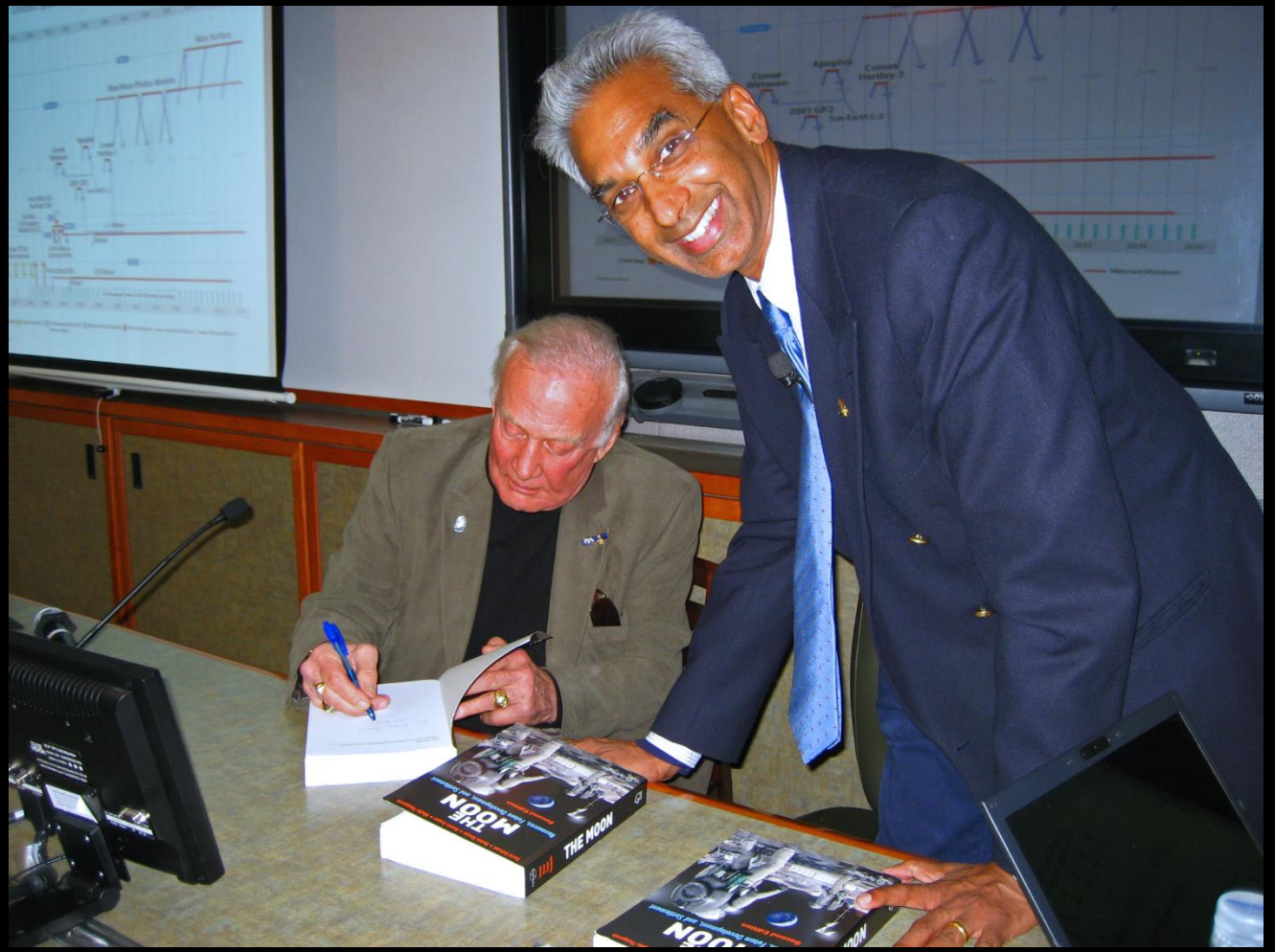
- Setting – Our World in 2050
- Planet Moon
- Implications for Future City
- Philosophy for A Space Faring Civilization ?
- Space Architecture


WILEY
WILEY–PRAXIS Series in
Space Science and Technology
THE
MOON
Resources, Future Development
and Colonization
David Schrunk, Burton Sharpe,
Bonnie Cooper and Madhu Thangavelu

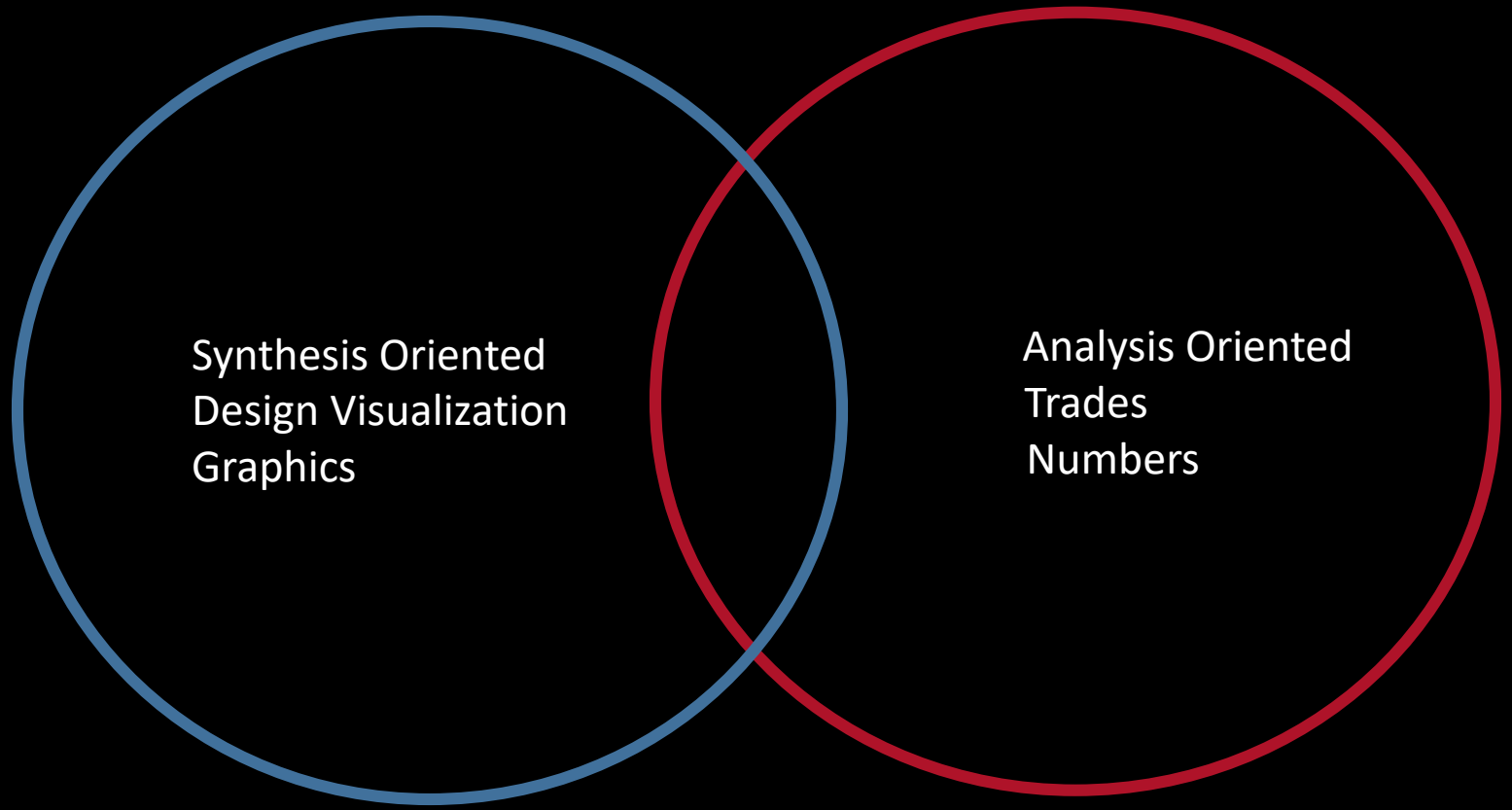

David Schrunk • Burton Sharpe • Bonnie Cooper • Madhu Thangavelu
THE
MOON
Resources, Future Development, and Settlement
Second Edition
Springer
PRAXIS

Buzz Aldrin – Human Spaceflight Institute





Architecture & Engineering



Space Architecture

- Space Habitats
- Alien Environment – Orbital, Transit and Extraterrestrial
- Habitability – Providing Safety, Shelter and Crew Comfort
- Interdisciplinary
- All of Applied Sciences and Professions involved
- Archives :https://sites.google.com/a/usc.edu/aste527/home

ASTE 527

ASTE 527 Archives

1999 - The Exploration of Mars: Crew Surface Activities

2004 - Hercules - Human Earth Moon Rover Competition To Upgrade Lunar Exploration Vehicles

2008 - Return to the Moon - Looking Glass 204

2009 - Evolution of ISS Part 1

2010 - Evolution of ISS Part 2

2011 - The US Department of Space

2012 - Cosmic Synergy - Administration-Enterprise Alliance

2012 - ASTE 527 Midterm Presentations

2013 - Eden Shield - Concept and Strategies for Planetary Defense

2014 - Tipping Point - The Future of Astronaut Activity and Human Spaceflight

2015 - LunaRevolution - Role of the Moon in the Future of Human Space Activity

2016 - SeleneOption : High Fidelity Simulations and Analogs on the Moon

2017 - Renaissance - Commercial Space & The Promise of Self-Sustaining Human Space Activity

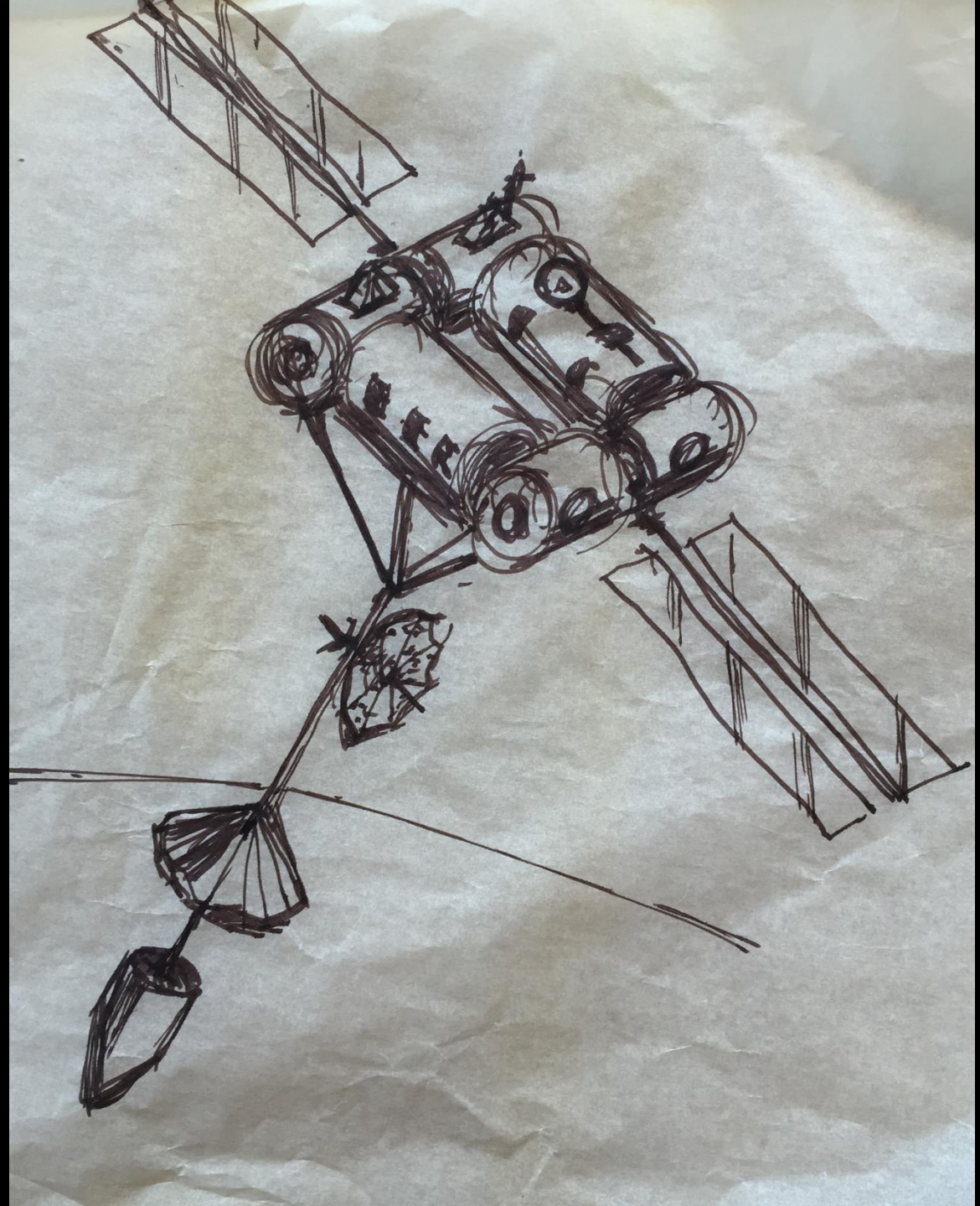
2018 - ADAM

2019 - USC ARTEMIS: MAXIM

2020 - ARTEMIS: TWINS

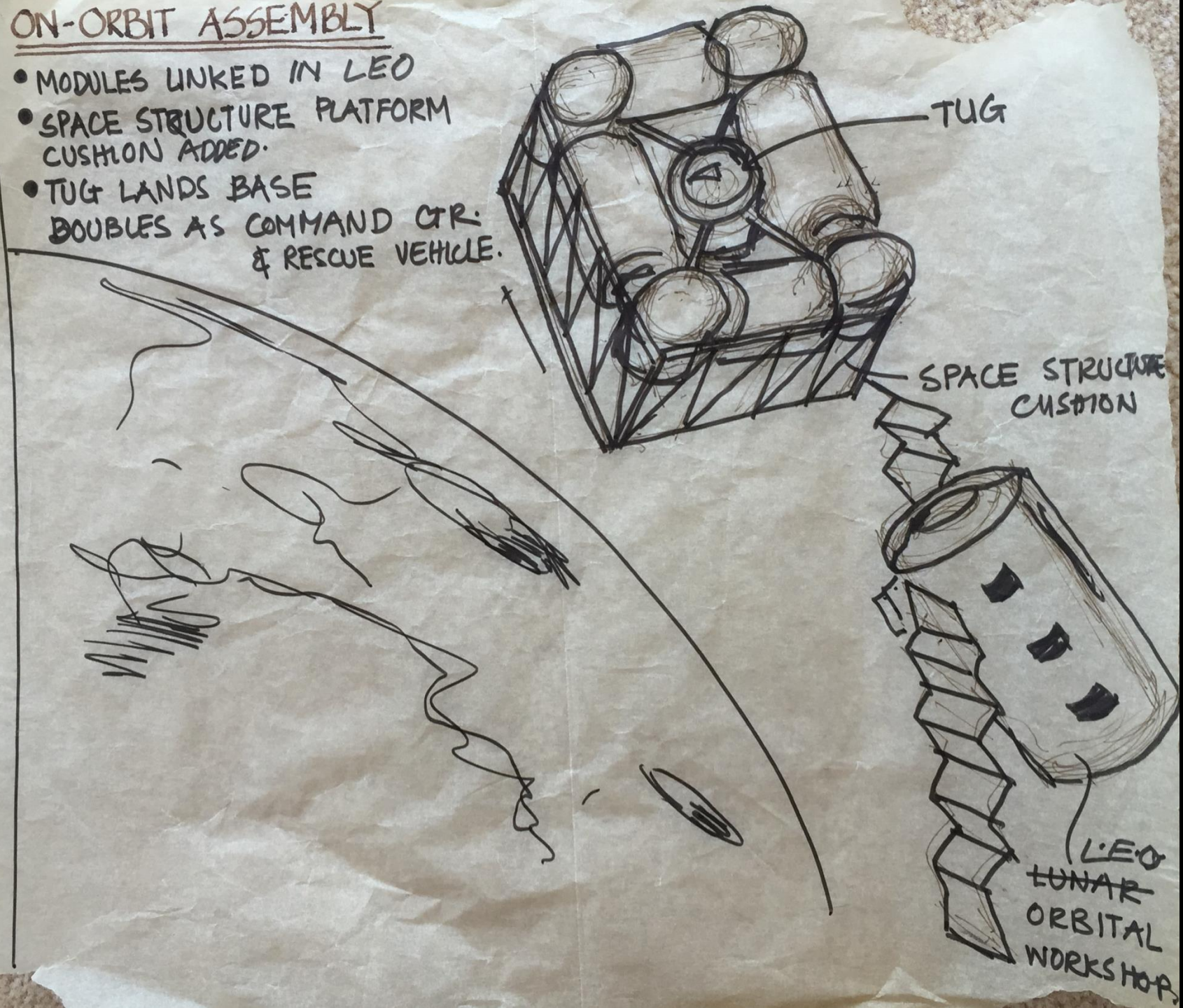
PLANET MOON

Miscellaneous



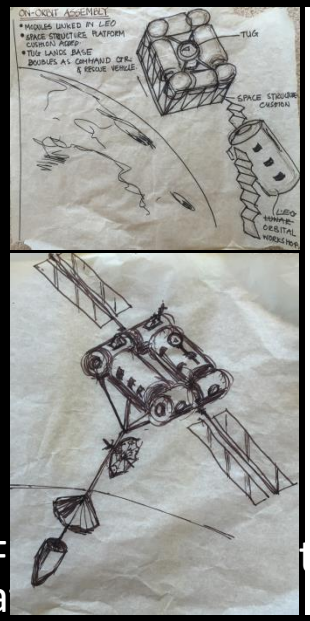
ON-ORBIT ASSEMBLY

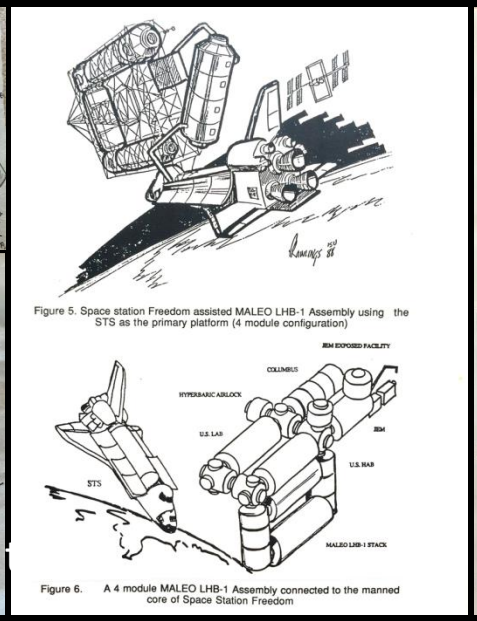
- MODULES LINKED IN LEO
- SPACE STRUCTURE PLATFORM CUSHION ADDED.
- TUG LANDS BASE BOUBLES AS COMMAND CTR. & RESCUE VEHICLE.

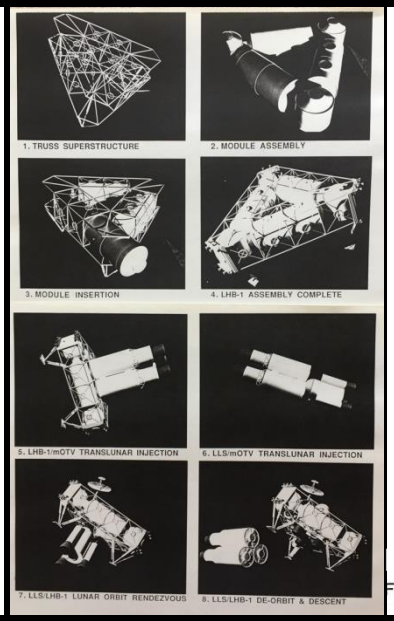


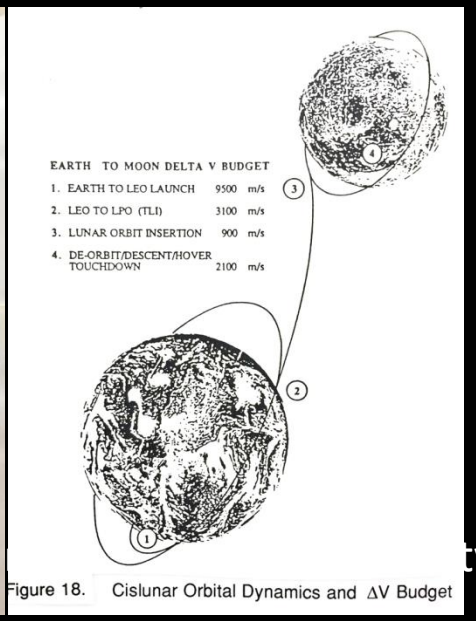
MALEO : Module Assembly in low Earth Orbit

- **A strategy to build and commission a lunar surface habitat complex by integrating several modules in LEO using the ISS and her crew, and ship it to the lunar surface using custom propulsion systems, thereby avoiding the infrastructure otherwise needed to construct one piece by piece, and eliminating the clingy dust nuisance that hampers lunar surface activity**.









- F ty a
- First presented and published at the 1988 IAC in Bangalore, India
- Several subsequent publications including USC 1988, IAC Dresden1990, ASCE 1992, JBIS 1993

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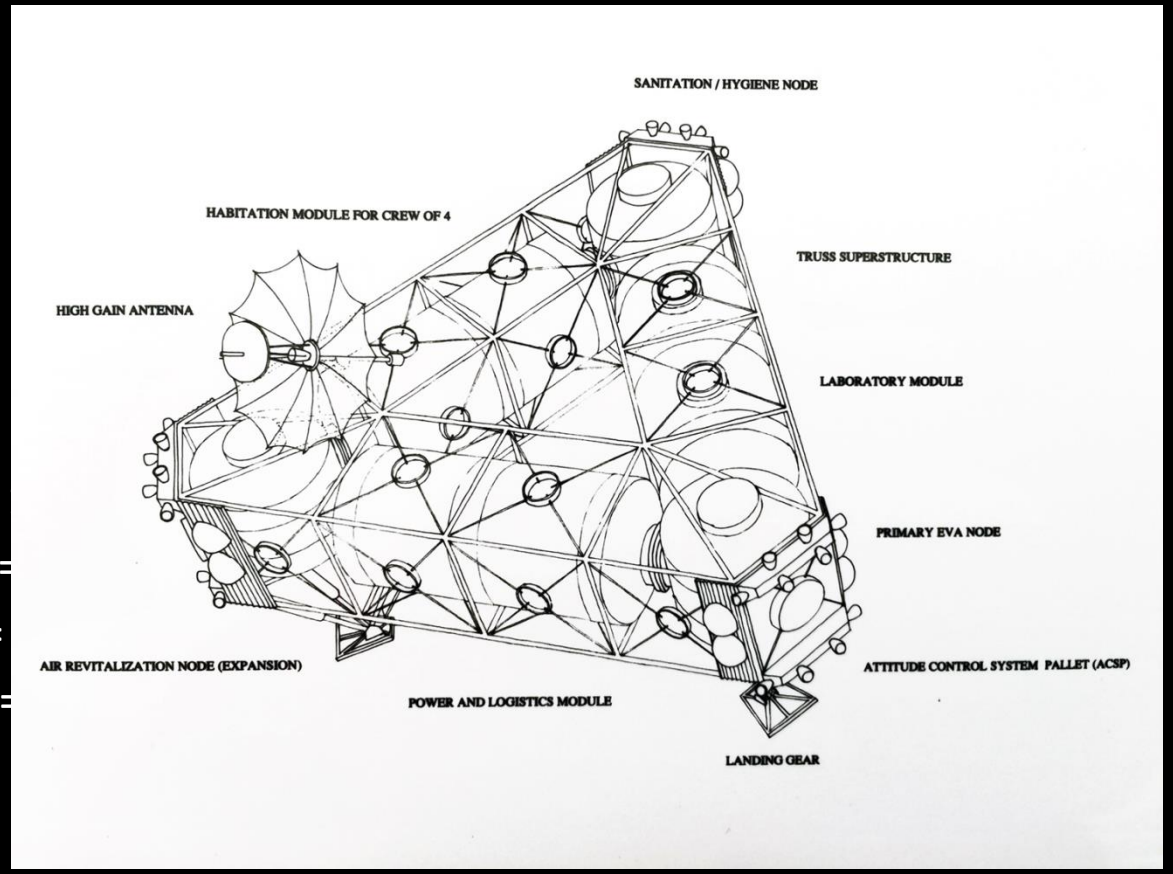
MALEO - Salient Features

- **Payload Summary [MT]**
- Habitat Module = 15
- Lab Module = 15
- Power/Logistics = 15
- ECLSS Node = 5
- Sanitation/Hygiene =
- Airlock/EVA = 10
- Truss/Landing gear =
- 100kWSolar Arrays/Comm =
- Unpress.Electric Rover X2 =
- Attitude Control Pallet X3 =
- **Touchdown Mass**
- + lander propulsion stack



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INTERNATIONAL SPACE UNIVERSITY

USC School of Architecture

MALEO Assembly with ISS Crew – Note Spacex Dragon

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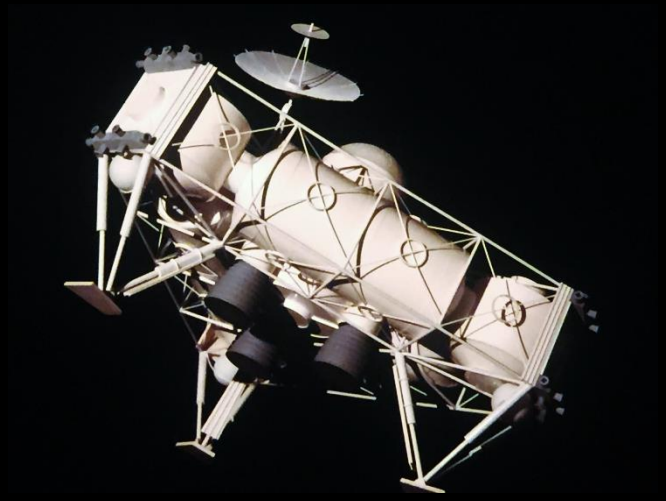
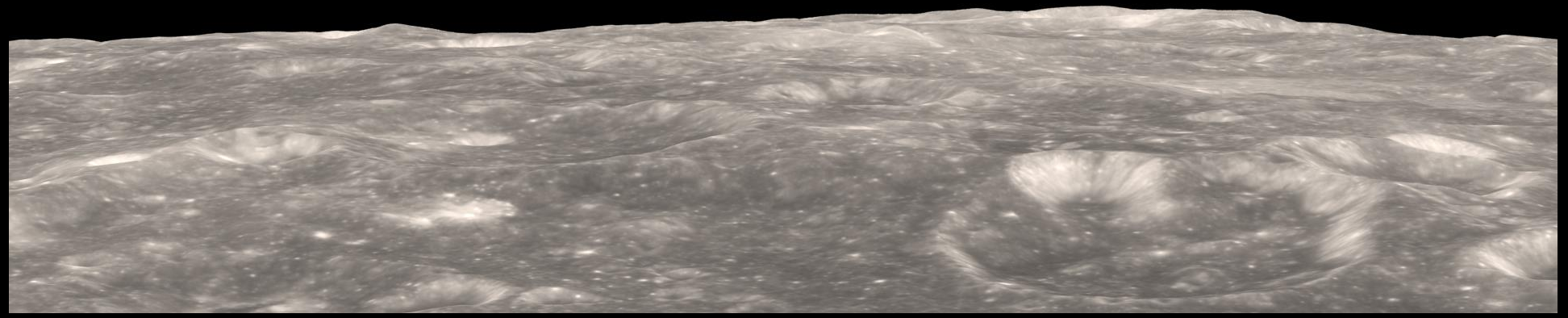
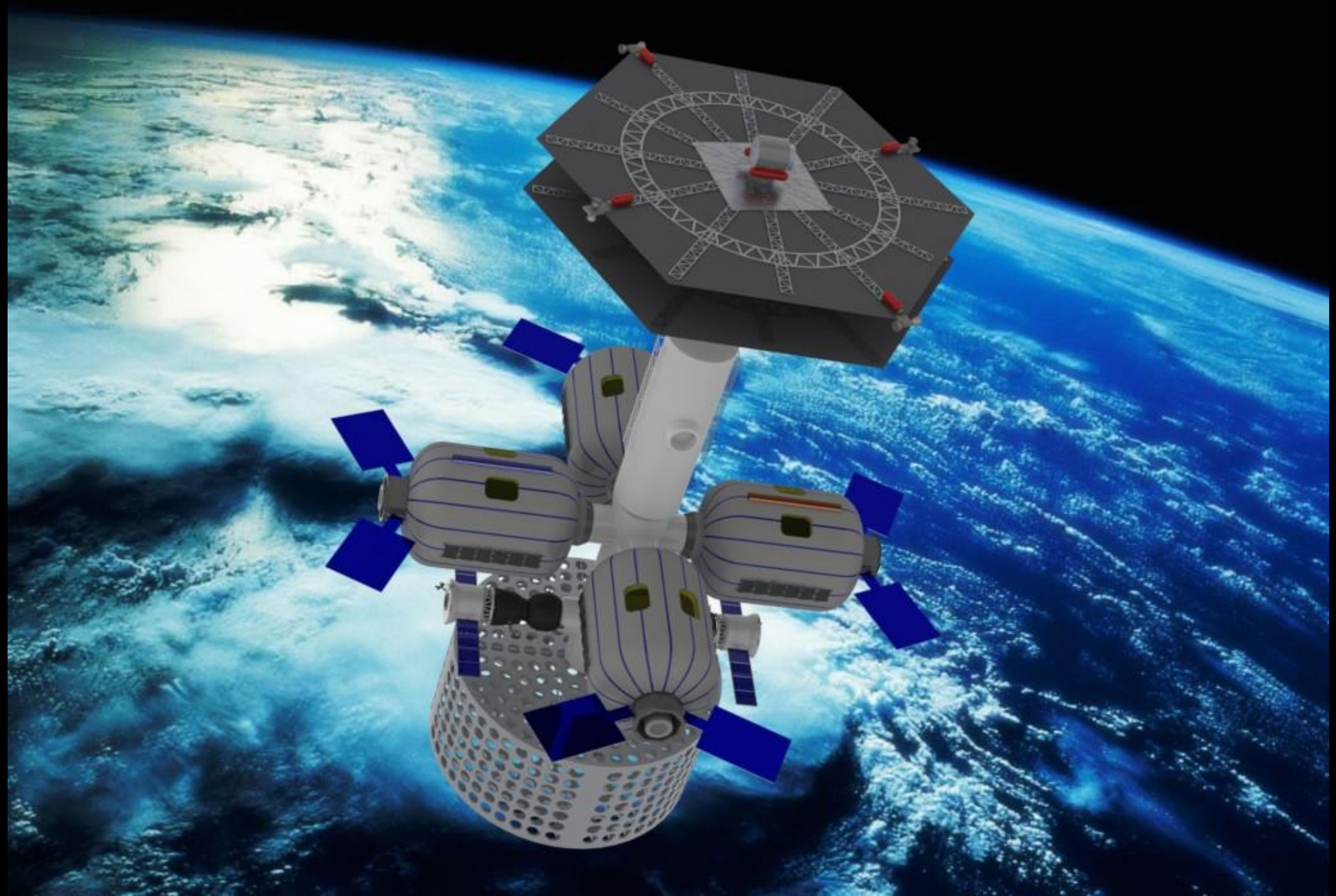
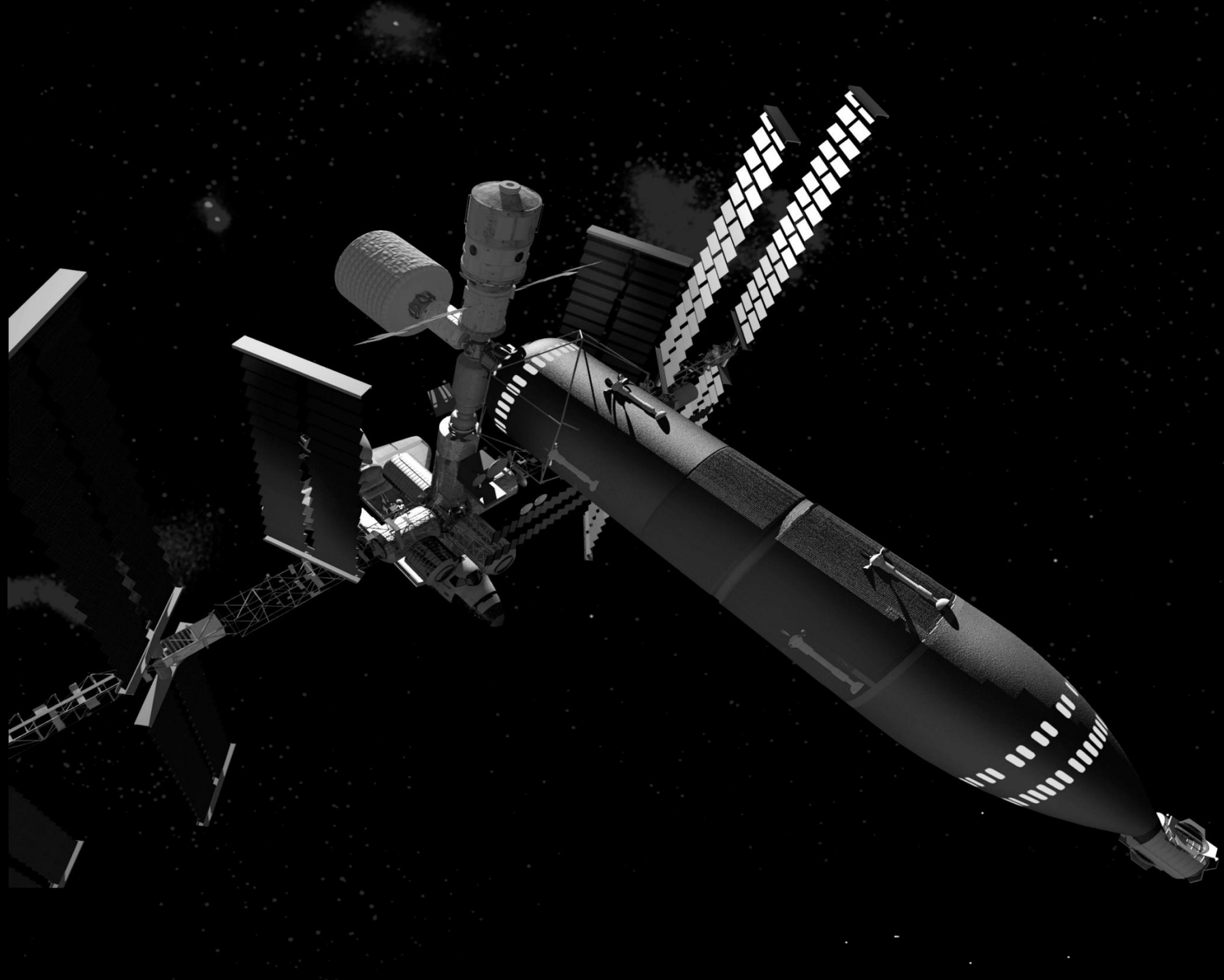
USC School of Architecture

MALEO Lunar Deorbit & Landing

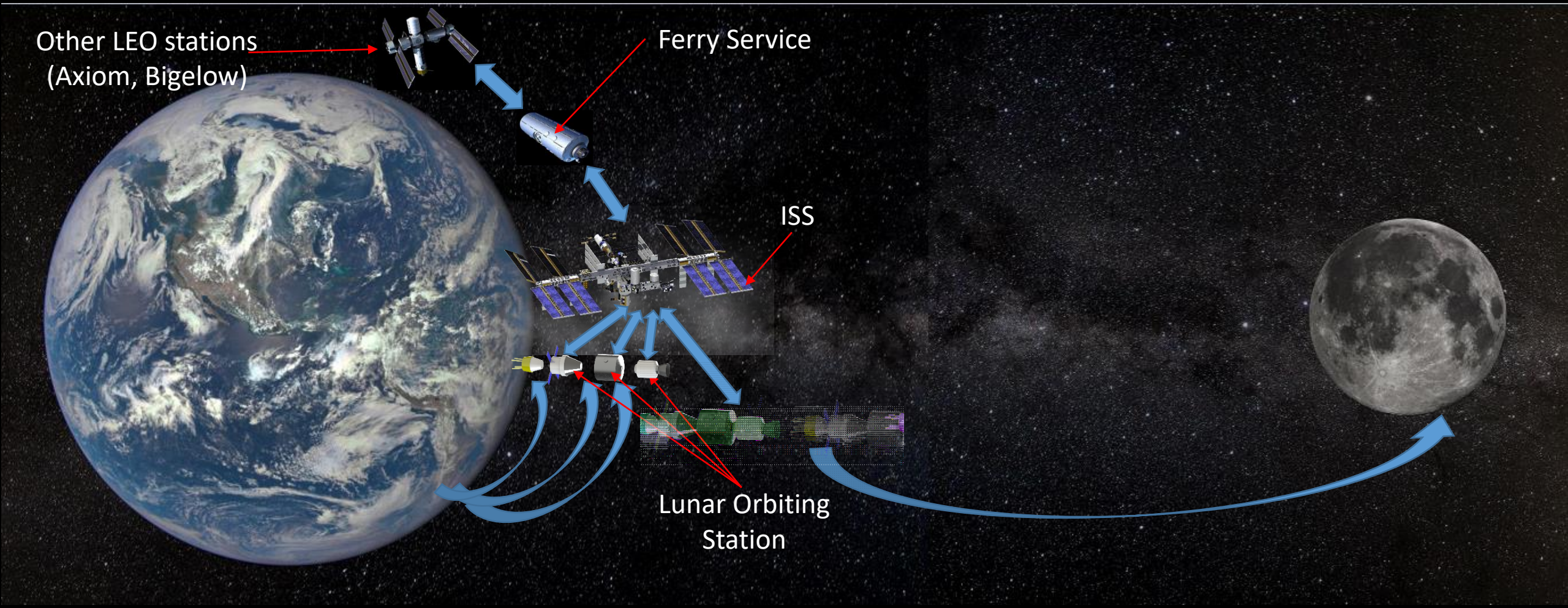


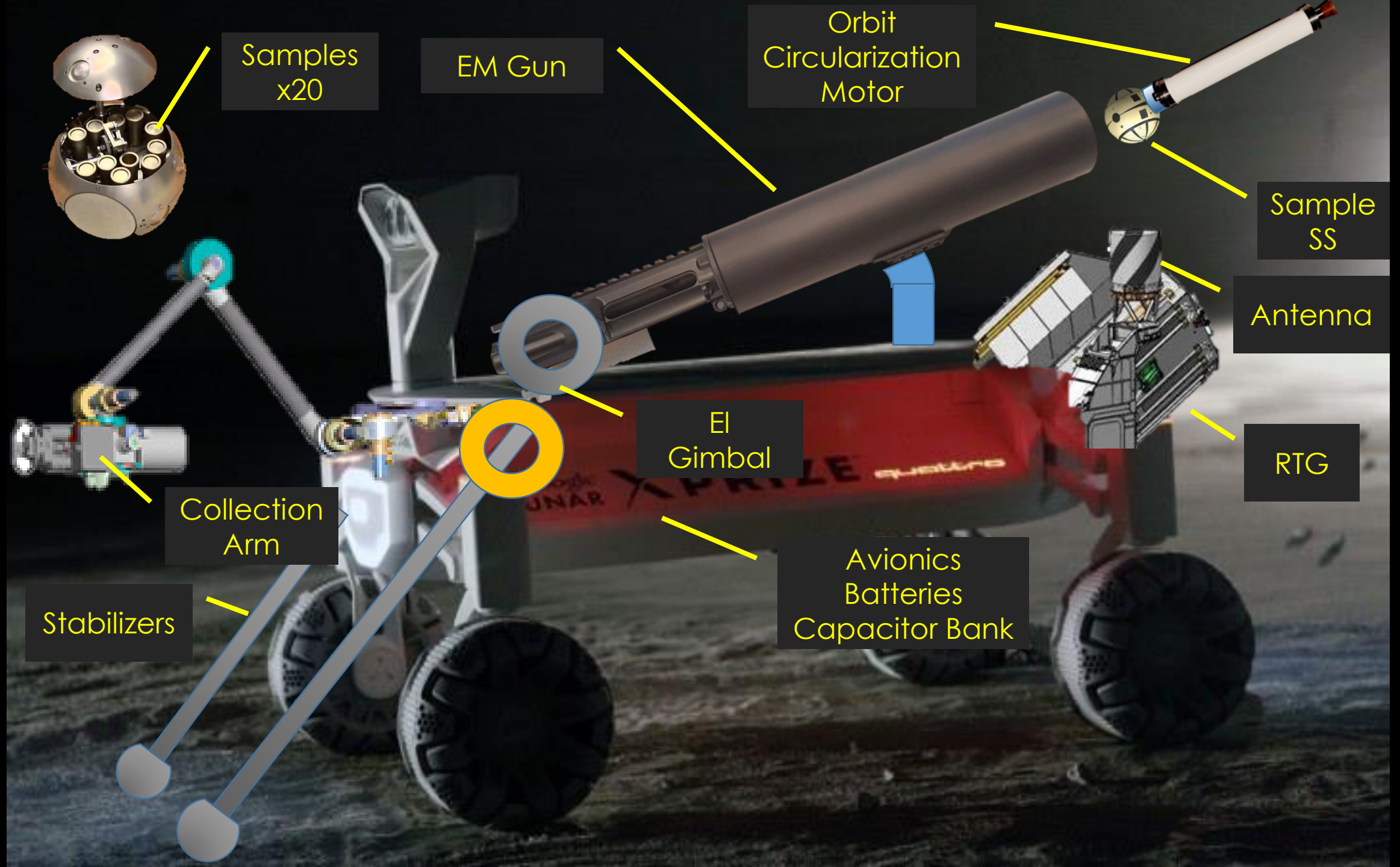






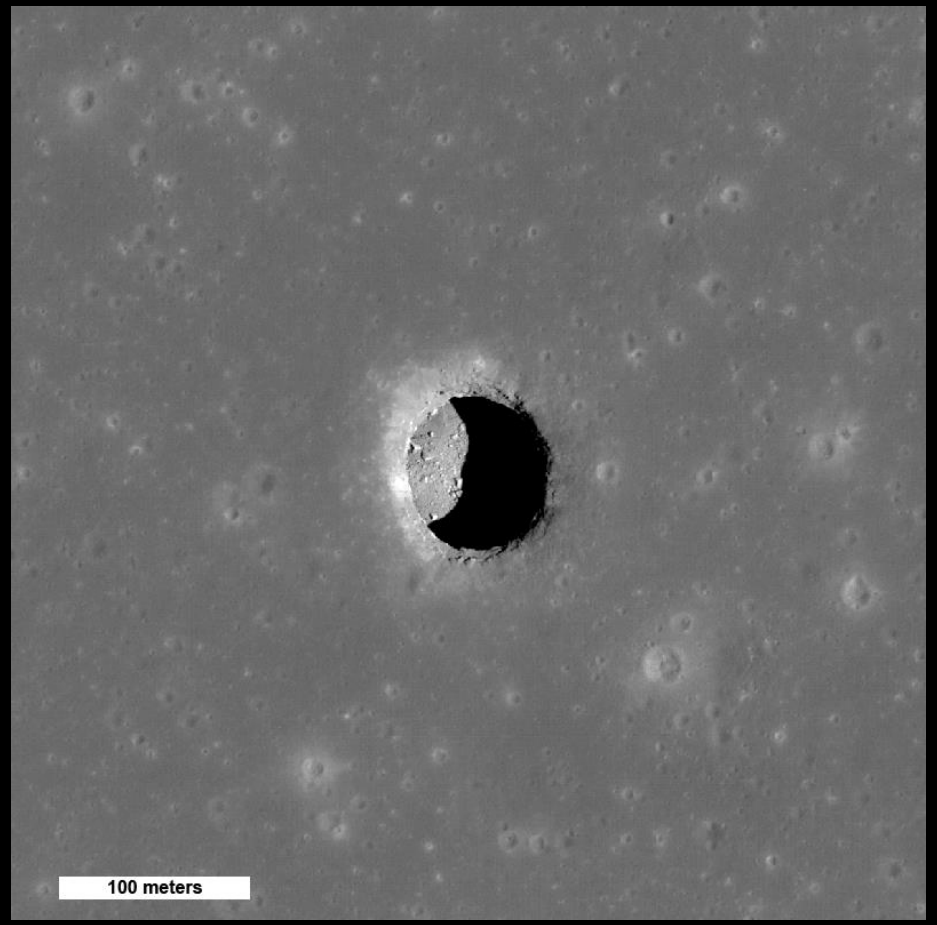
Concept of Operation



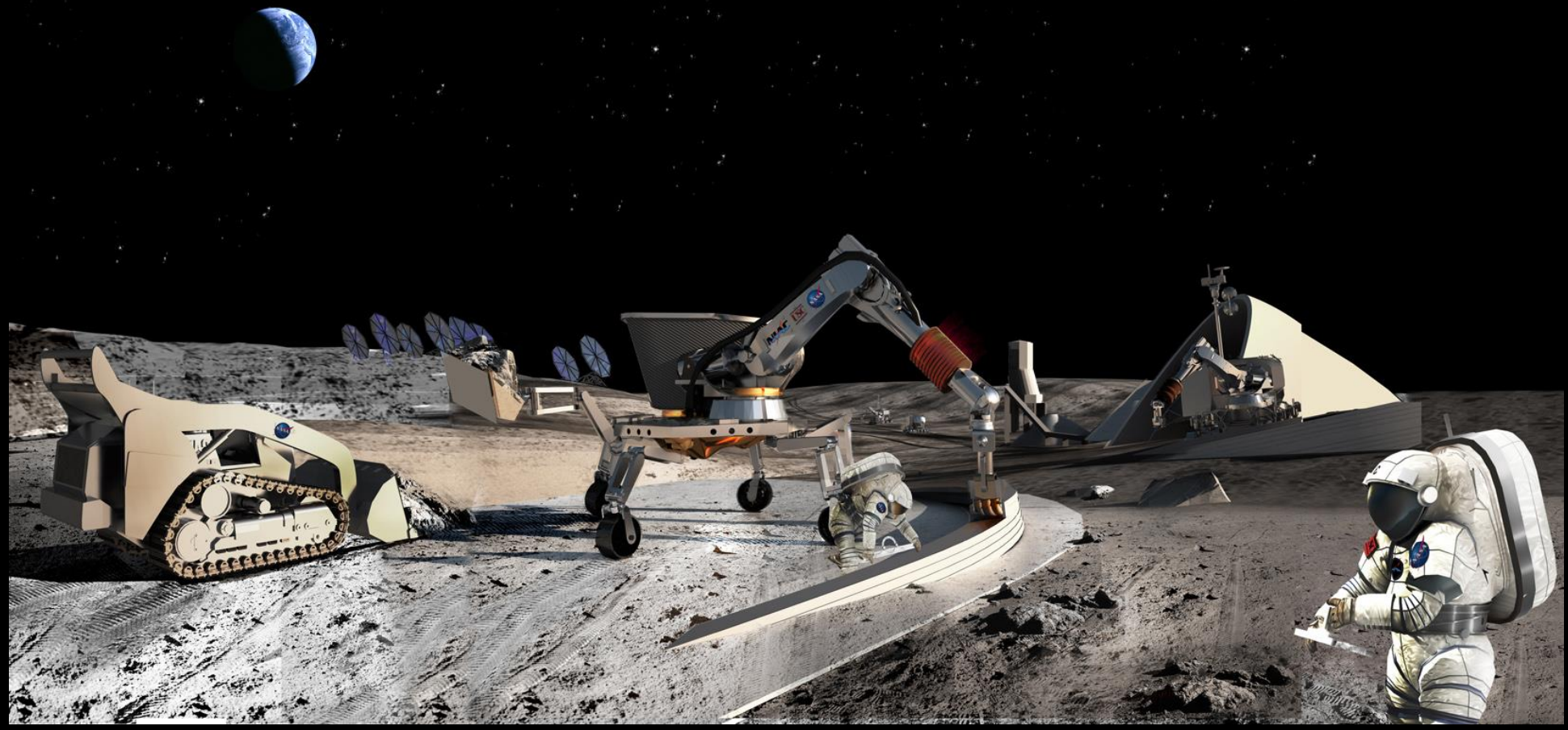

Samples x20
EM Gun
Orbit Circularization Motor
Sample SS
Antenna
El Gimbal
RTG
Collection Arm
Stabilizers
Avionics Batteries Capacitor Bank

Deploy Telescopes, High Resolution Cameras for Apollo 11 Site and Earth Observation – Selene Eyes

Mission2022: Astronaut-Assisted Telerobotic Exploration of Mare Tranquillitatis Pits



Robotic Construction



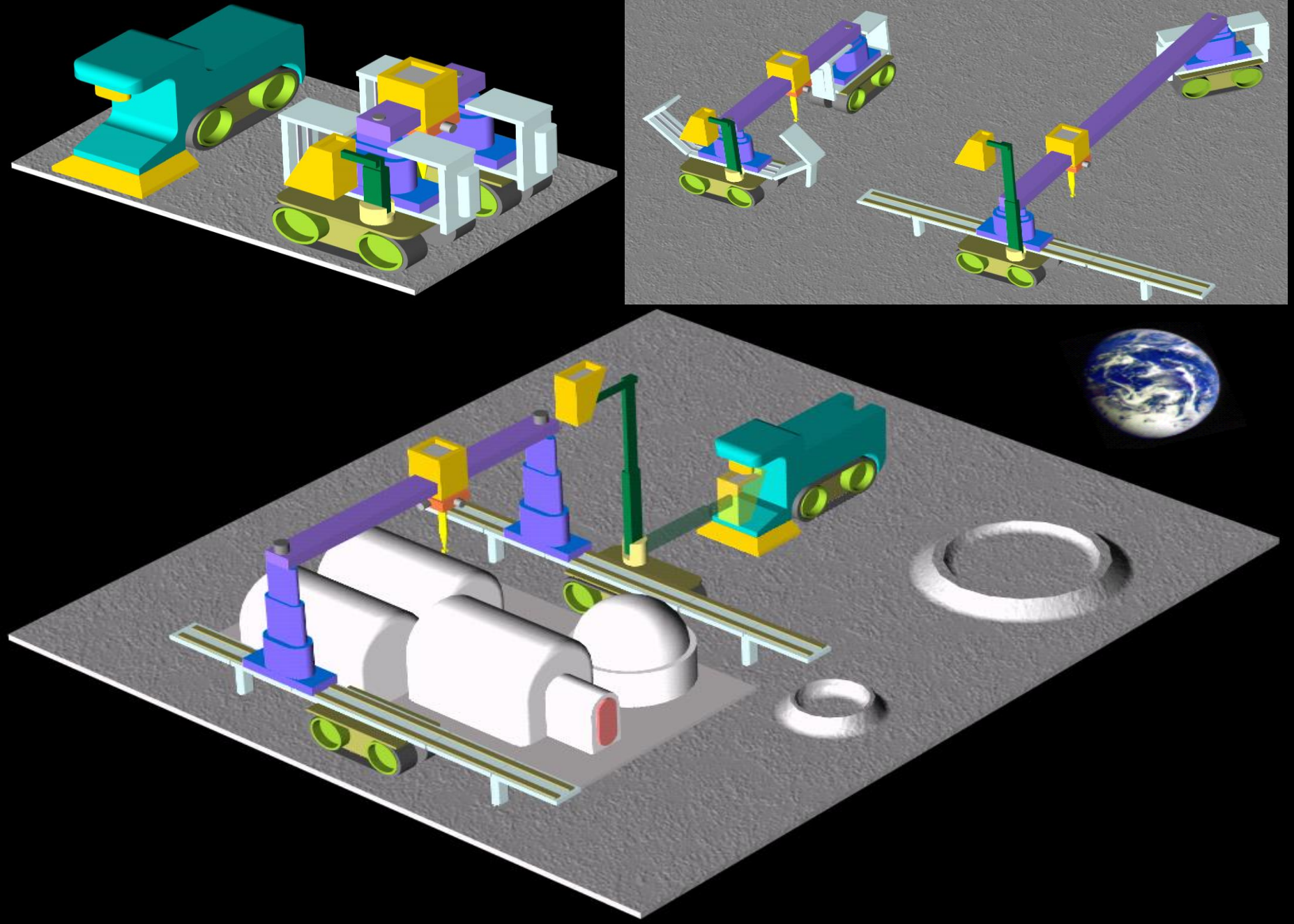
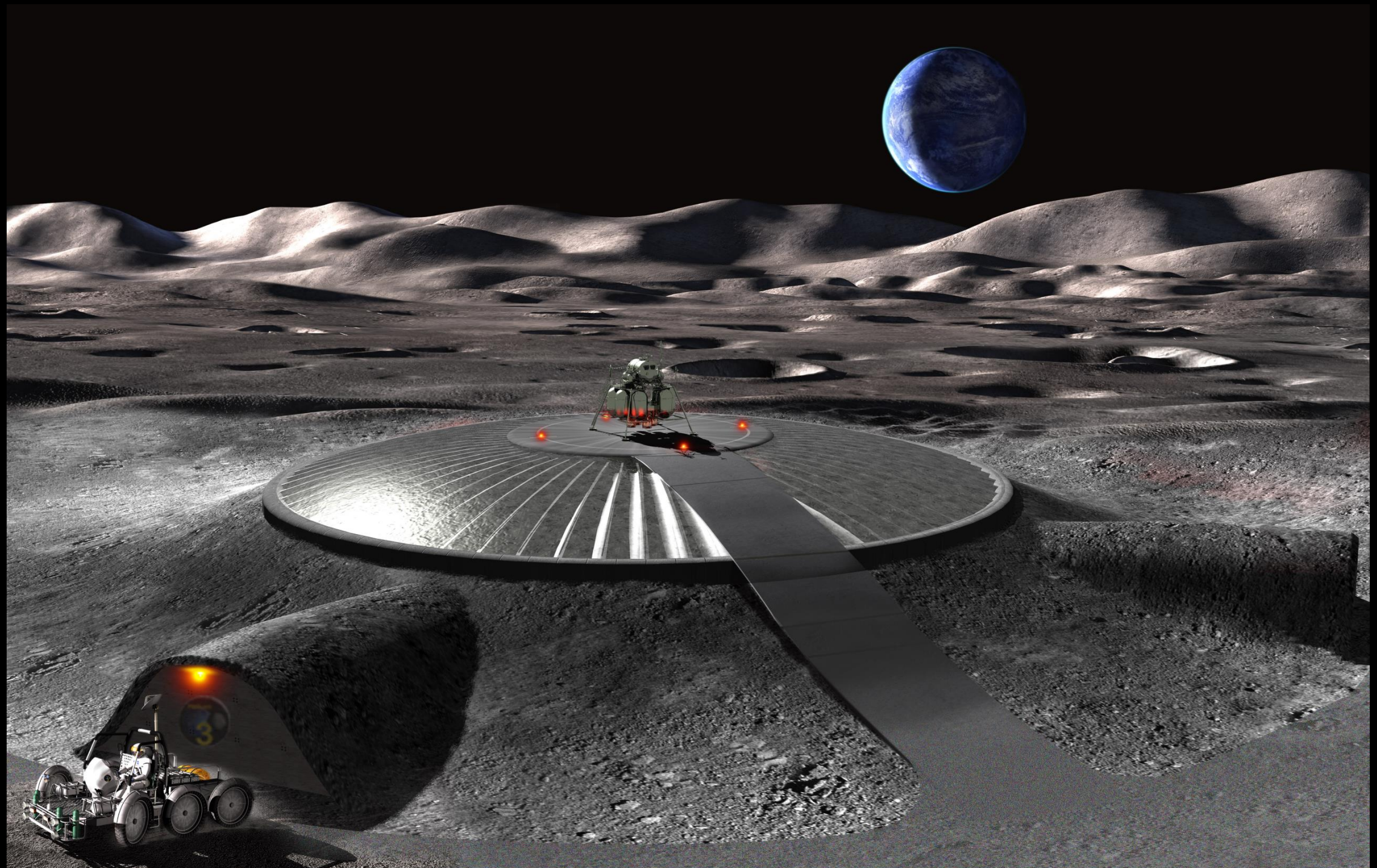
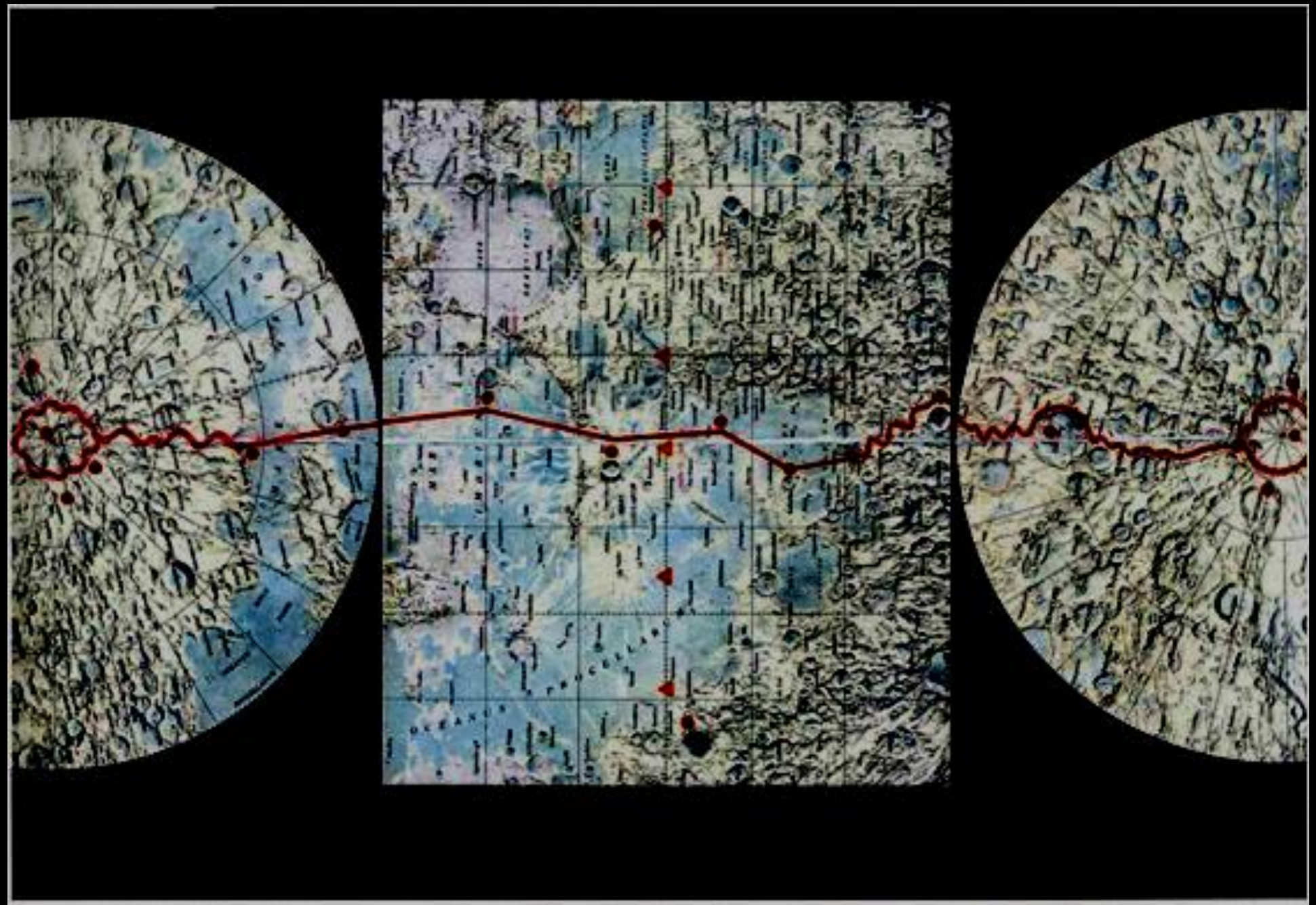
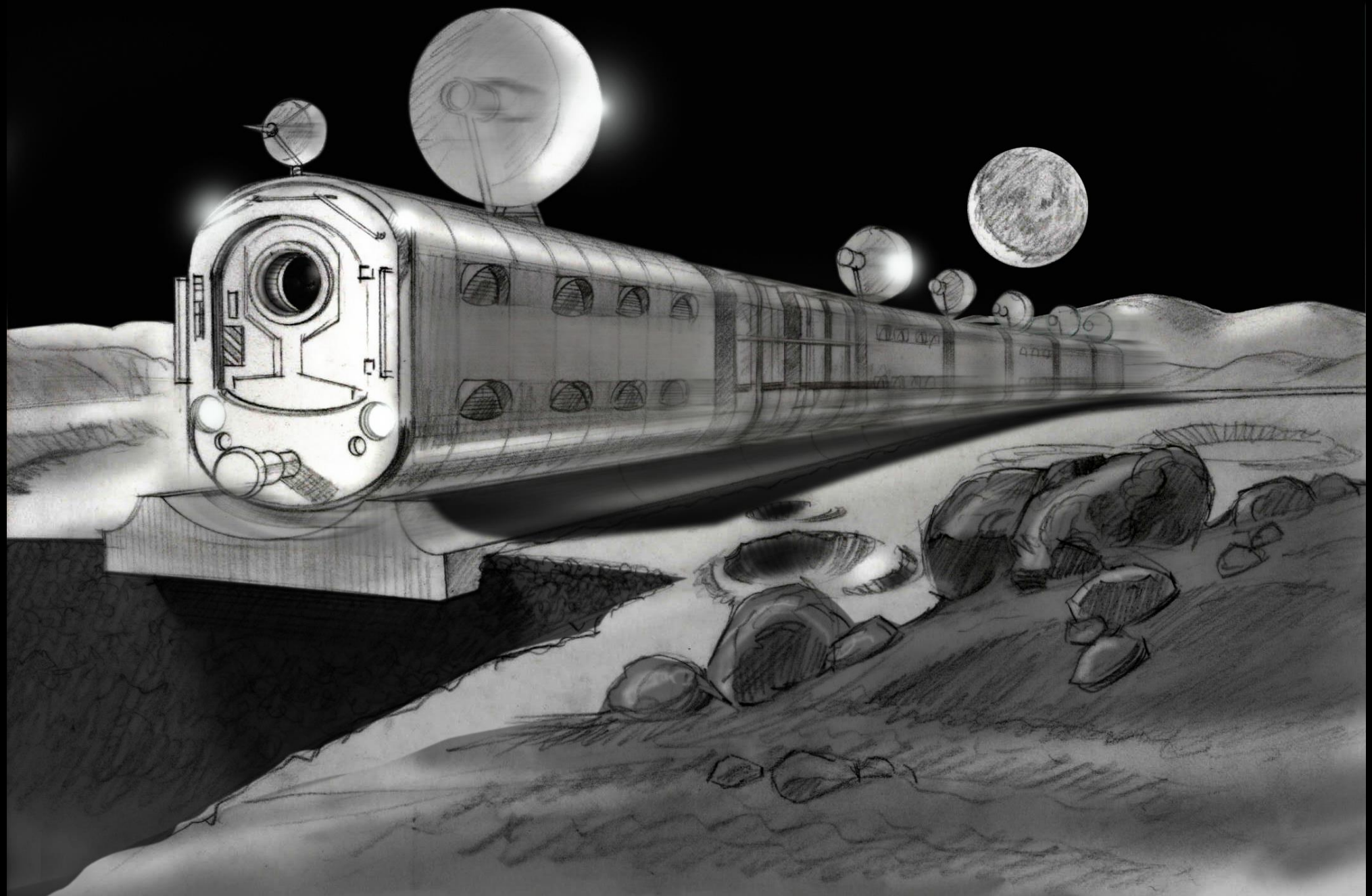


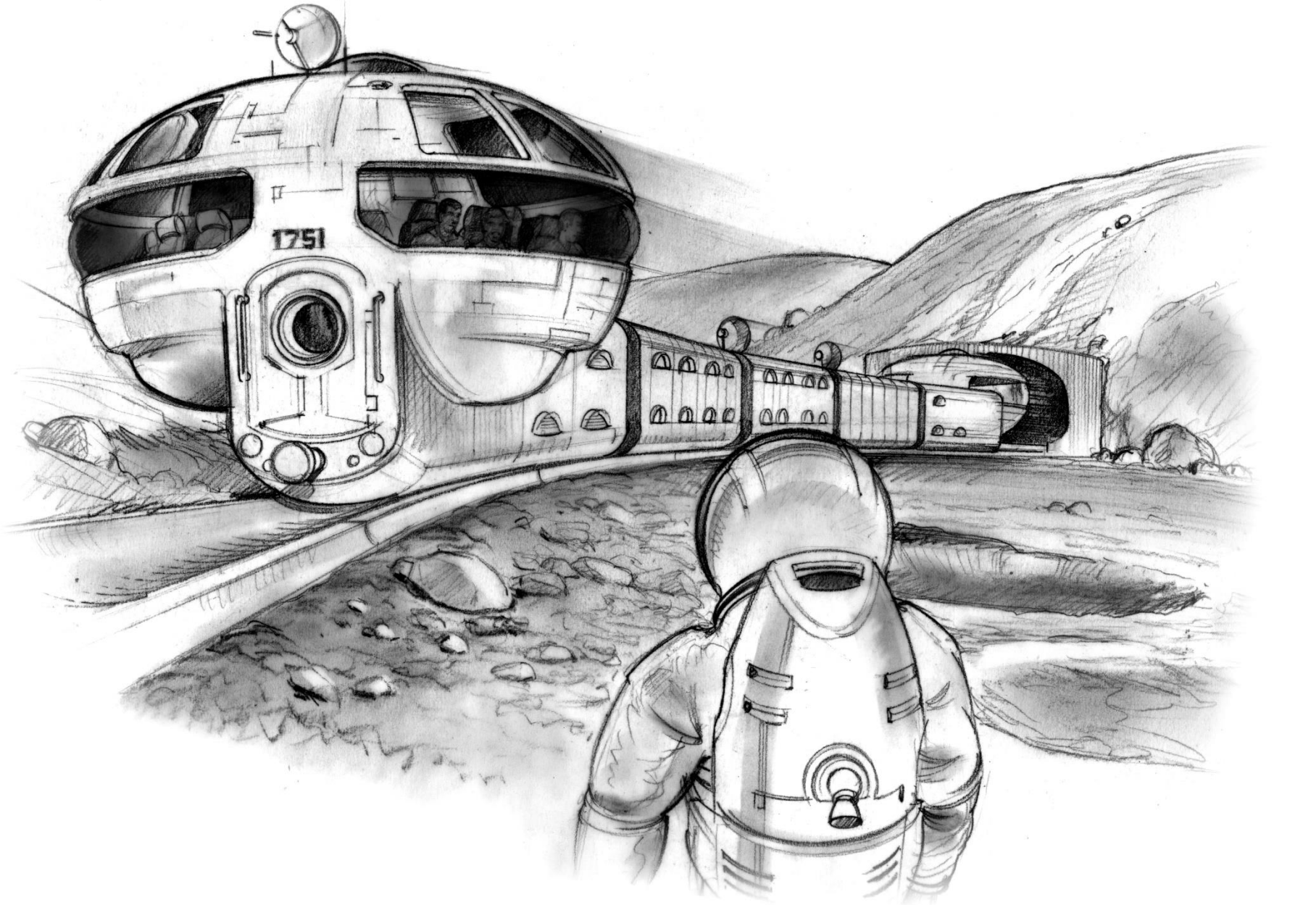
Figure 4. Deployable Contour Crafting Machines could create unpressurized structures and allied building infrastructure for lunar settlements and also in other hostile environments here on Earth



The Ultimate Train Ride – The 345 Pole to Pole Lunar MagLev



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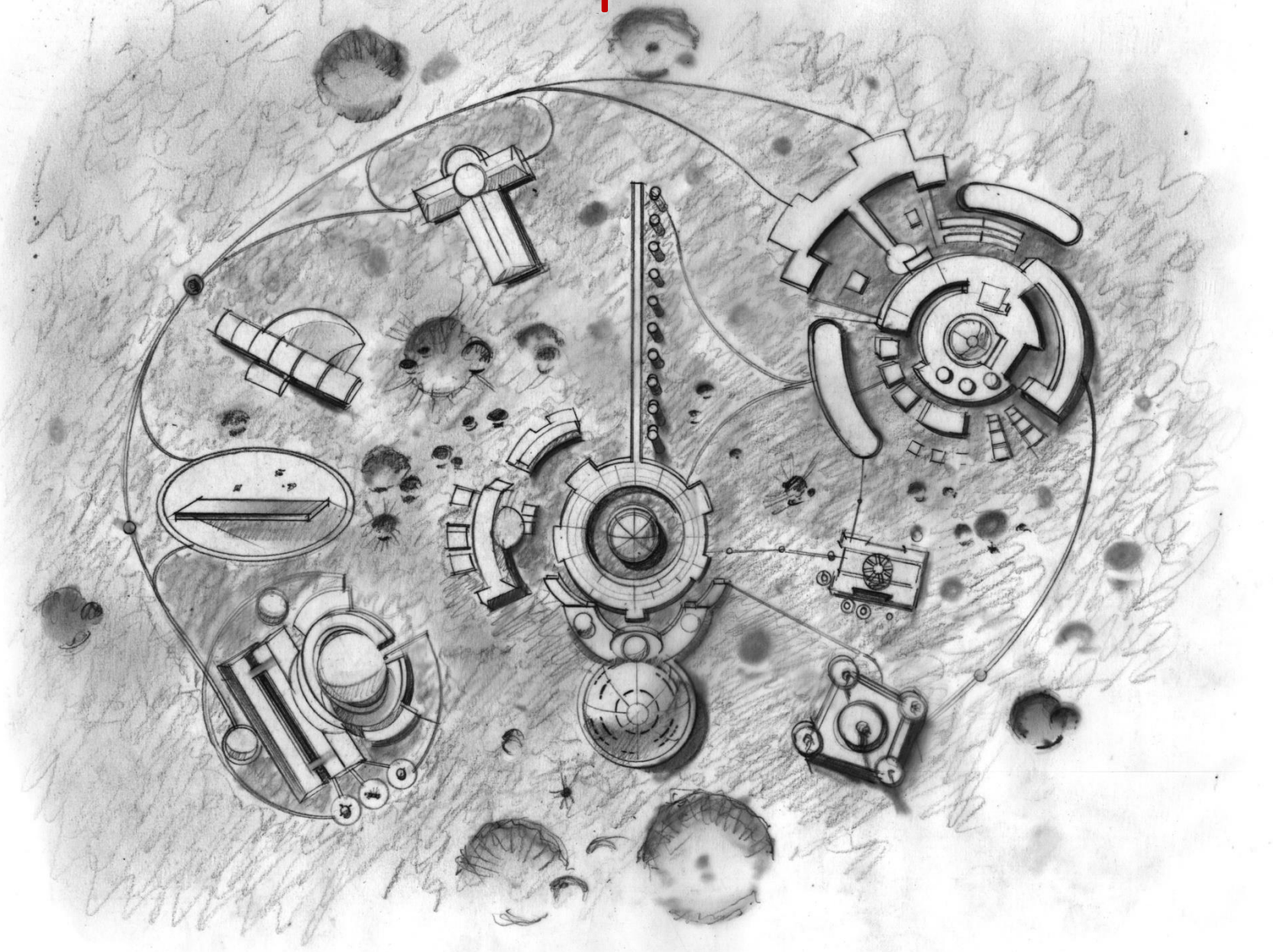
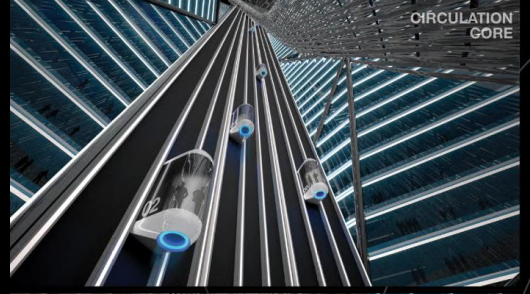
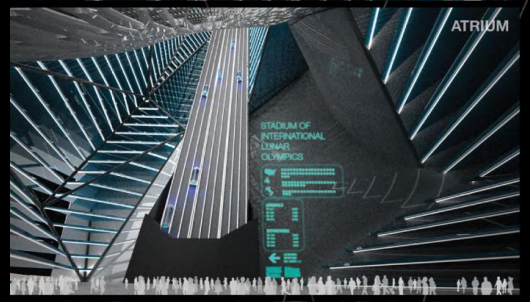
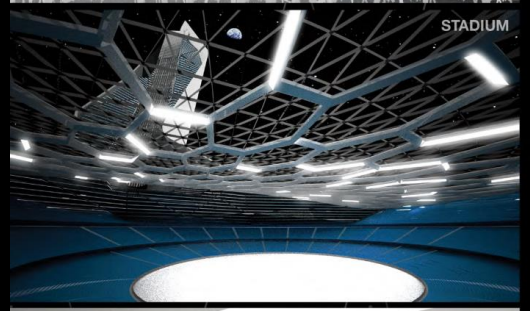
Planetary Defense from the Moon

Lunar UN Summit Hq. & Humanities Nexus









STADIUM OF INTERNATIONAL LUNAR OLYMPICS | SILO

COMMUNICATIONS TOWER / CONTROL ROOMS / BEACON 06

HOTELS / STAFF AREAS /COMMERCIAL AREA / RESTAURANTS 05

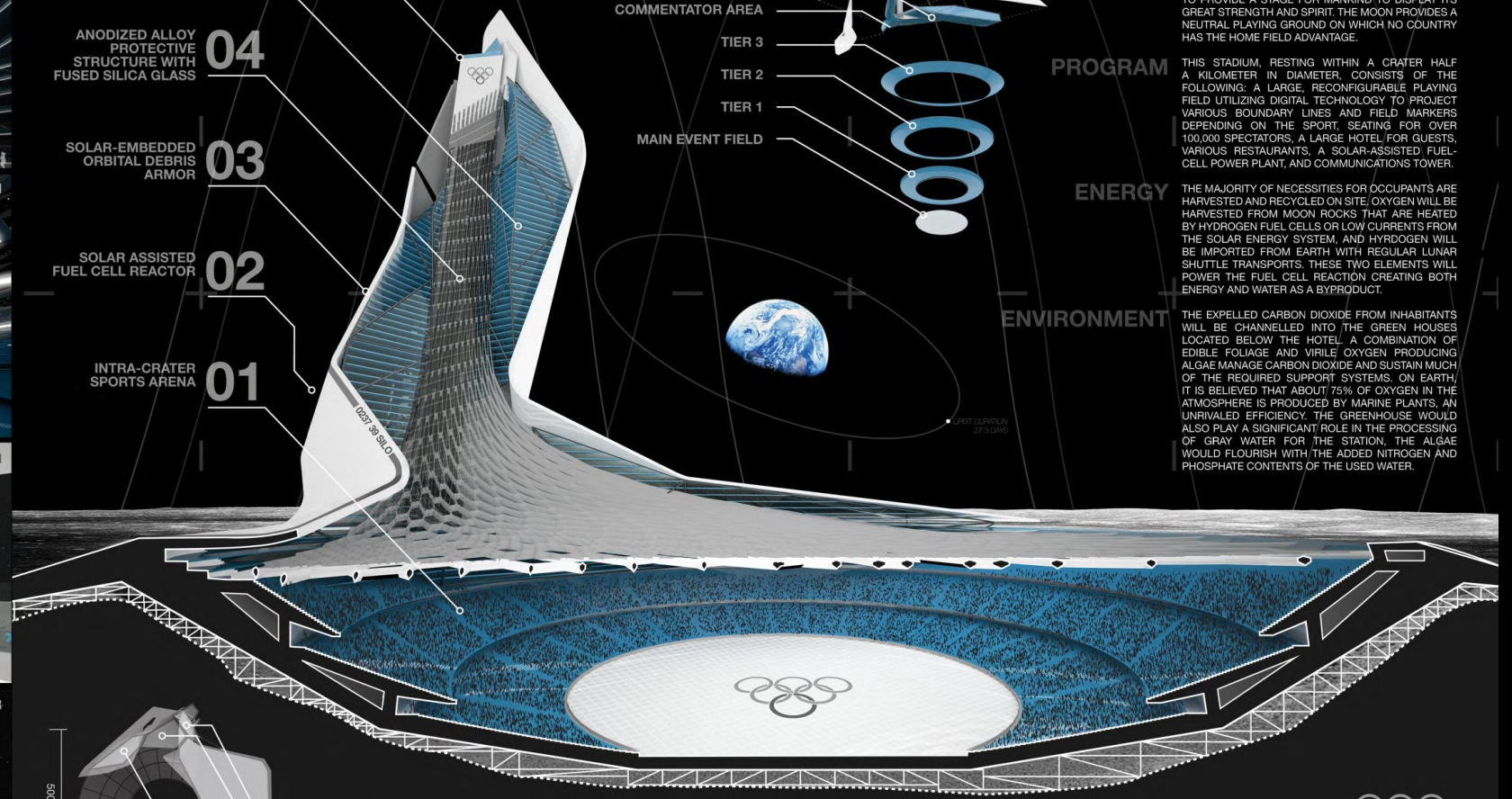
ANODIZED ALLOY PROTECTIVE STRUCTURE WITH FUSED SILICA GLASS 04

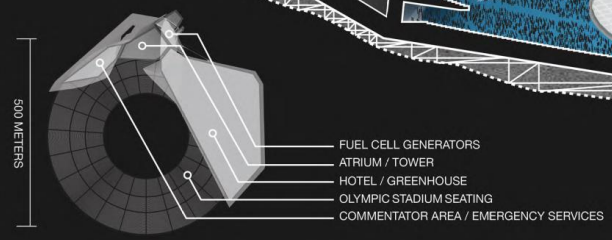
SOLAR-EMBEDDED ORBITAL DEBRIS ARMOR 03

SOLAR ASSISTED FUEL CELL REACTOR 02

INTRA-CRATER SPORTS ARENA 01

PROTECTIVE STRUCTURE
ARMOR
COMMUNICATIONS TOWER
CIRCULATION CORE
HYDROGEN REACTOR
HOTEL / GREENHOUSE
COMMENTATOR AREA
TIER 3
TIER 2
TIER 1
MAIN EVENT FIELD





CONCEPT

WITHIN THE LUNAR COLONIES OF THE FUTURE, RECREATIONAL ACTIVITIES WILL ARISE AND EVOLVE TO TAKE ADVANTAGE OF THE MOON'S MICRO-GRAVITY. THE SPORTS WE KNOW TODAY WILL BE MODIFIED, AND BRAND NEW SPORTS WILL BE INVENTED. LUNAR SPORTS ASSOCIATIONS WILL BE CREATED, TEAMS WILL BE SPONSORED, GAMES WILL BE TELEVISED, AND PEOPLE FROM ALL OVER THE GLOBE WILL WATCH AS THE BEST OF THE BEST COMPETE IN AN ARENA IN WHICH ALL THE RULES HAVE CHANGED. WELCOME TO THE SILO.

THIS COLONIZATION IS A SYMBOL OF MANKIND'S GREAT AMBITION AND ACHIEVEMENT – THE PERFECT LANDSCAPE FOR A STRUCTURE WHOSE PURPOSE IS TO PROVIDE A STAGE FOR MANKIND TO DISPLAY ITS GREAT STRENGTH AND SPIRIT. THE MOON PROVIDES A NEUTRAL PLAYING GROUND ON WHICH NO COUNTRY HAS THE HOME FIELD ADVANTAGE.

PROGRAM

THIS STADIUM, RESTING WITHIN A CRATER HALF A KILOMETER IN DIAMETER, CONSISTS OF THE FOLLOWING: A LARGE, RECONFIGURABLE PLAYING FIELD UTILIZING DIGITAL TECHNOLOGY TO PROJECT VARIOUS BOUNDARY LINES AND FIELD MARKERS DEPENDING ON THE SPORT, SEATING FOR OVER 100,000 SPECTATORS, A LARGE HOTEL FOR GUESTS, VARIOUS RESTAURANTS, A SOLAR-ASSISTED FUEL-CELL POWER PLANT, AND COMMUNICATIONS TOWER.

ENERGY

THE MAJORITY OF NECESSITIES FOR OCCUPANTS ARE HARVESTED AND RECYCLED ON SITE. OXYGEN WILL BE HARVESTED FROM MOON ROCKS THAT ARE HEATED BY HYDROGEN FUEL CELLS OR LOW CURRENTS FROM THE SOLAR ENERGY SYSTEM, AND HYRDOGEN WILL BE IMPORTED FROM EARTH WITH REGULAR LUNAR SHUTTLE TRANSPORTS. THESE TWO ELEMENTS WILL POWER THE FUEL CELL REACTION CREATING BOTH ENERGY AND WATER AS A BYPRODUCT.

ENVIRONMENT

THE EXPELLED CARBON DIOXIDE FROM INHABITANTS WILL BE CHANNELLED INTO THE GREEN HOUSES LOCATED BELOW THE HOTEL. A COMBINATION OF EDIBLE FOLIAGE AND VIRILE OXYGEN PRODUCING ALGAE MANAGE CARBON DIOXIDE AND SUSTAIN MUCH OF THE REQUIRED SUPPORT SYSTEMS. ON EARTH, IT IS BELIEVED THAT ABOUT 75% OF OXYGEN IN THE ATMOSPHERE IS PRODUCED BY MARINE PLANTS, AN UNRIVALED EFFICIENCY. THE GREENHOUSE WOULD ALSO PLAY A SIGNIFICANT ROLE IN THE PROCESSING OF GRAY WATER FOR THE STATION, THE ALGAE WOULD FLOURISH WITH THE ADDED NITROGEN AND PHOSPHATE CONTENTS OF THE USED WATER.

THE FIVE INTERLOCKING RINGS OF THE OLYMPIC LOGO, DESIGNED IN 1912, REPRESENT THE FIVE CONTINENTS INVOLVED IN THE OLYMPICS AT THAT TIME. THE MOON WILL BE REPRESENTED BY AN ADDITIONAL RING.


Site of the Humanity Archives

Tentative Agenda Space Architecture Gathering for Saturday March 27th, 2021
(Note: Pacific Daylight Time=PDT (GMT-0700))
Let us go from Earth orbit to Moon to Mars and then Simulators!

10:00 AM PDT – Welcome (*Dr. Dan Dumbacher, AIAA Executive Director*)
10:15 AM PDT: Prof. Madhu Thangavelu (USC) (Moderator, Welcome, Keynote)
10:30 AM PDT: Prof. Sandra Haeuplik-Meusburger - **Space Habitats and Habitability**, Vienna University of Technology, Austria
10:45 AM PDT: Mr. Vittorio Netti - **Human-Robot Collaboration as an Enabler of Scalable Human Presence in Space**, SICSA and Politecnico di Milano, Italy
11:00 AM PDT: Prof. Behrokh (Berok) Khoshnevis - **Planetary Construction and In-Space Fabrication using Large-Scale 3D printing**, Contour Crafting Corporation, CA
11:15 AM PDT: Mr. John Mankins - **(TBD)**, Mankins Space Technology, Inc.
11:30 AM PDT: Ms. R.Pailes-Friedman, Mr. M.Morris, and Ms. Christina Ciardullo - **Lunar Lantern & Landing Pad**, SEArch+ Architects
11:45 AM PDT: Mr. Rodrigo Romo, **Basalt Sintering for ISRU Applications,** Pacific International Space Center for Exploration Systems (PISCES), Hawaii
12:00 PM PDT: Mr. Daniel Inocente, **Advancing Architecture, Integrated Tectonics,** Senior Designer, Skidmore, Owings & Merrill, New York
12:15 PM PDT: Mr. Giuseppe Calabrese, **Urban farming for extreme environment on Mars**, Sydney, Australia
12:30 PM PDT: Mr. Jim Rhoné, **Building Bioregenerative Worlds**, Interstellar Lab, Paris
12:45 PM PDT: Ms. Mahsa Moghimi Esfandabadi – **Greenhouse for Partial Gravity: Architecture and Systems Approaches**, Independent Space Habitats and Greenhouses Designer, Houston
01:00 PM PDT: Mr. Philip Sadler, **Lunar/Mars Greenhouse**, Sadler Machine Co. & University of Arizona
01:15 PM PDT: Ms. Mirha Vlahovljak, **HiveMars: Design of a Hybrid-class, scalable Settlement on the Martian Surface**, Polytechnic University of Bari, Italy
01:30 PM PDT: Prof. Michael Fox, **A Brief Overview of the CPP NASA X-Hab**, CalPoly Pomona, CA.
01:45 PM PDT: Mr. Xavier de Kestelier, **The Value of Design: Mars Habitat**, Hassell Architects, FL
02:00 PM PDT: Mr. Sebastian Frederiksen, **LUNARK - 100 days Lunar analog in an unfolding habitat in the arctic,** SAGA Space Architects, Denmark
02:15 PM PDT: Prof. Pablo de Leon, **Planetary Habitat Analogs at the University of North Dakota,** University of North Dakota
02:30 PM PDT: Mr. Kriss J. Kennedy, Architect. **A Vision of the Future: Built-in-Place Architectures**, USS, Inc / TECHNE' Architects LLC., Houston
02:45 PM PDT: Discussion
03:30 PM PDT: Adjourn