# EVA Operational Testing Status

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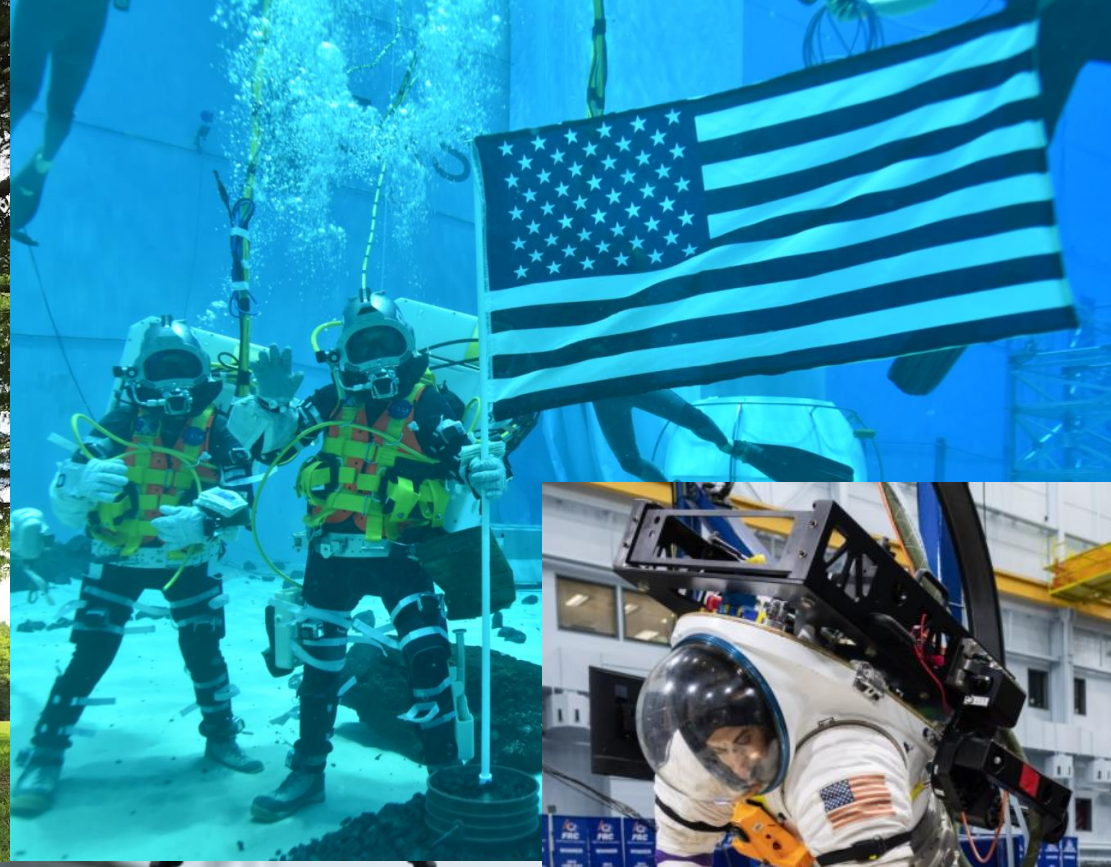
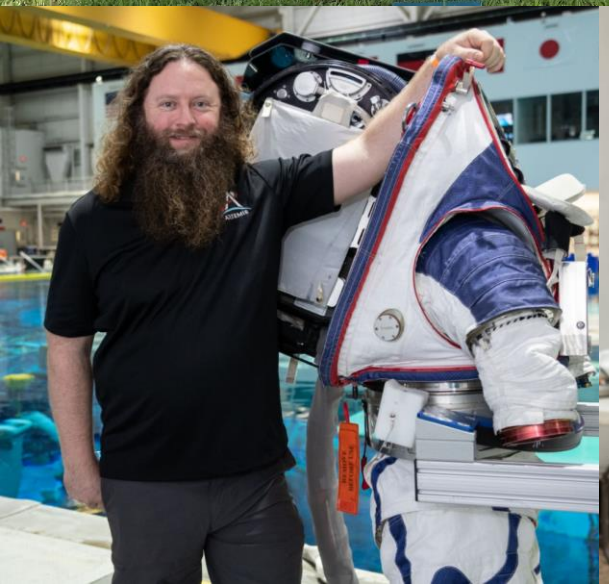
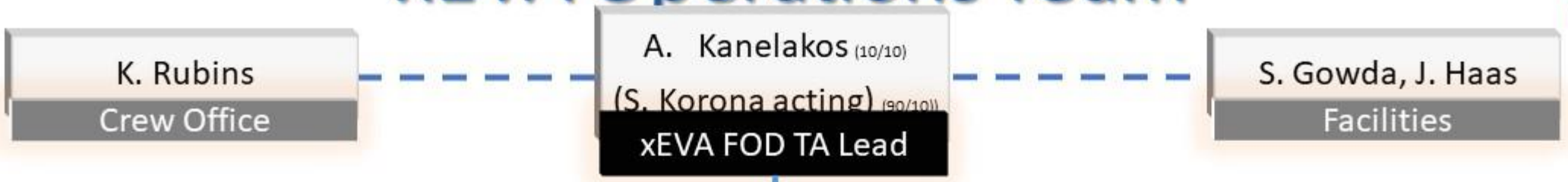
on behalf of the xEVA Operations Testing Team
Exploration EVA Technology Workshop
October 14, 2021

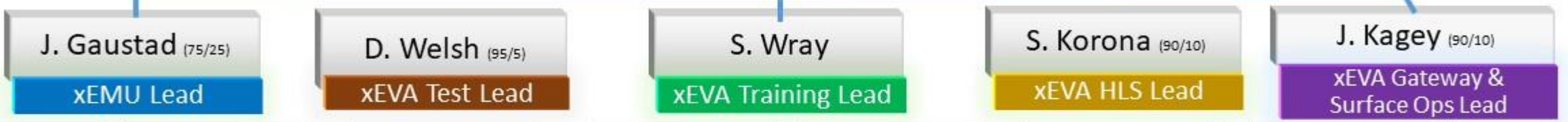
# xEVA Ops Testing in Action



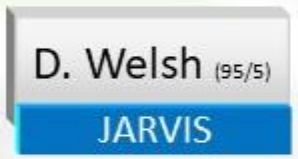


# xEVA Operations Team

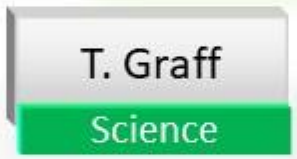


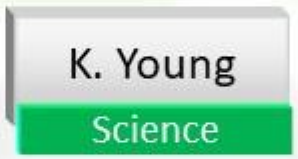











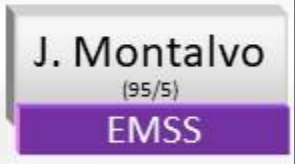


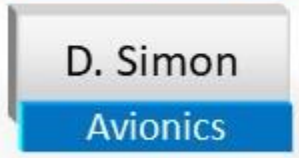










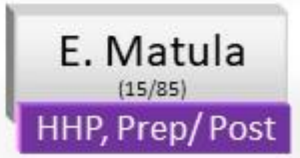




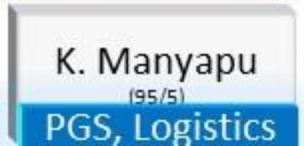






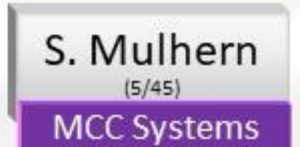







Numbers indicate Exploration vs ISS time (xEVA/ISS)


# The EVA Operations Team

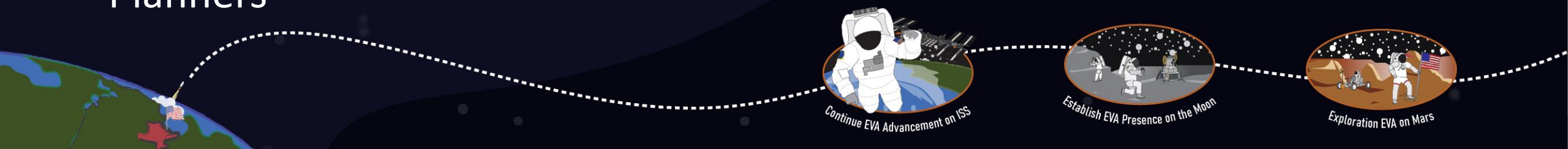
Integrating the xEVA System with Artemis science objectives

Roles

- Crew
- Instructors
- Flight Controllers
- Planners

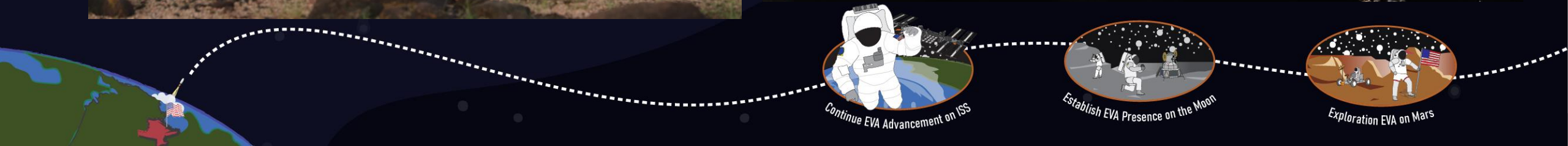
Perspectives

- Human operations
  - How does this all integrate for the crew and ground team?
- Hardware design feedback
  - Suits
  - Vehicles
  - Tools and payloads
- Training
  - Facilities, lesson plans, training flows
- Mission planning and execution



# JSC Rock Yard

- Low overhead
- Quick iteration
- Tools, lighting, sampling con ops



# JSC Rock Yard – Lessons Learned

From this …

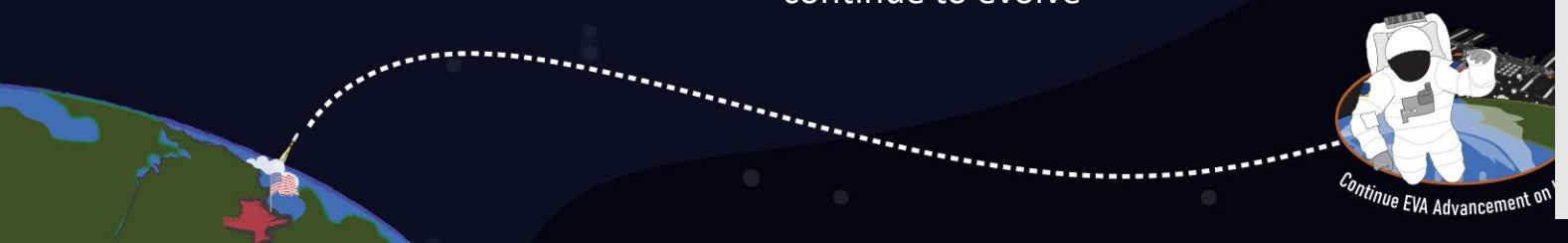
Objectives

- End-to-end sampling protocol and success criteria
- Lunar lighting implications
- EVA tool and logistics development including supplemental lighting
- Real-time comm and imagery requirements definition
- Roles and responsibilities across the xEVA System (EV, IV, ESO, etc.)
- Procedures and cuff checklist development
- Development of rock yard as training facility

Major Take-aways

- Rock yard is valuable to efficiently advance tool design and ops con work in between larger test events
- We have established a baseline tool configuration on the suit
- Initial feedback on ops techniques and supplemental lighting necessary to effectively work in Lunar lighting environment
- Procedures and task tracking products continue to evolve

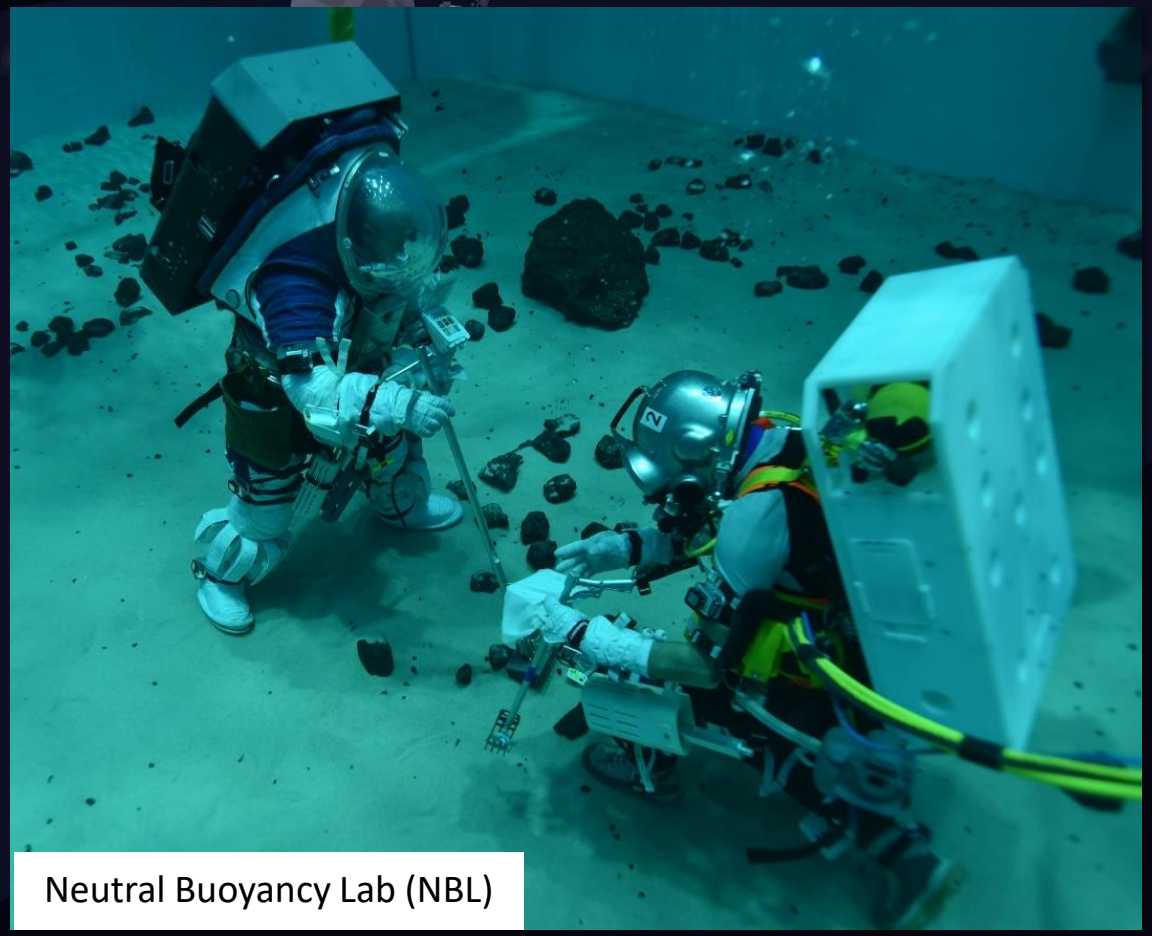
… we inform this, and iterate

# NBL and ARGOS

- Lunar gravity offload
- NBL offloads multiple things and has larger test space
- ARGOS is a dry environment

Active Response Gravity Offload System (ARGOS)



Neutral Buoyancy Lab (NBL)

Continue EVA Advancement on ISS

Establish EVA Presence on the Moon

Exploration EVA on Mars

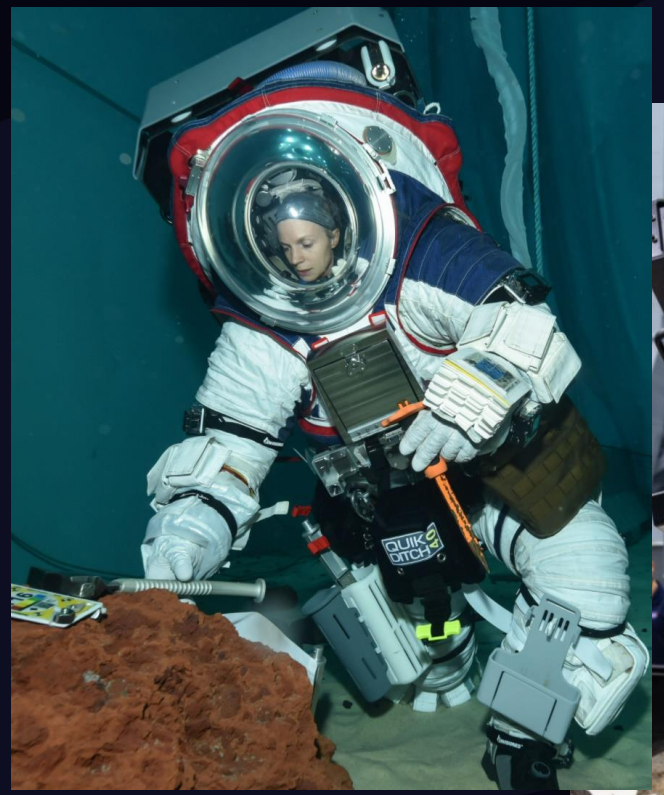
# NBL and ARGOS

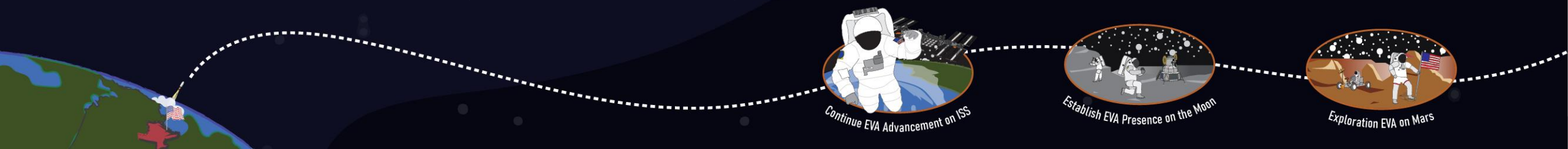
Objectives

- The same ops from the rock yard, but with pressurized suits and gravity offload
- Check any assumptions made in rock yard ops against suited mobility
- Development as training facilities

Major Take-aways

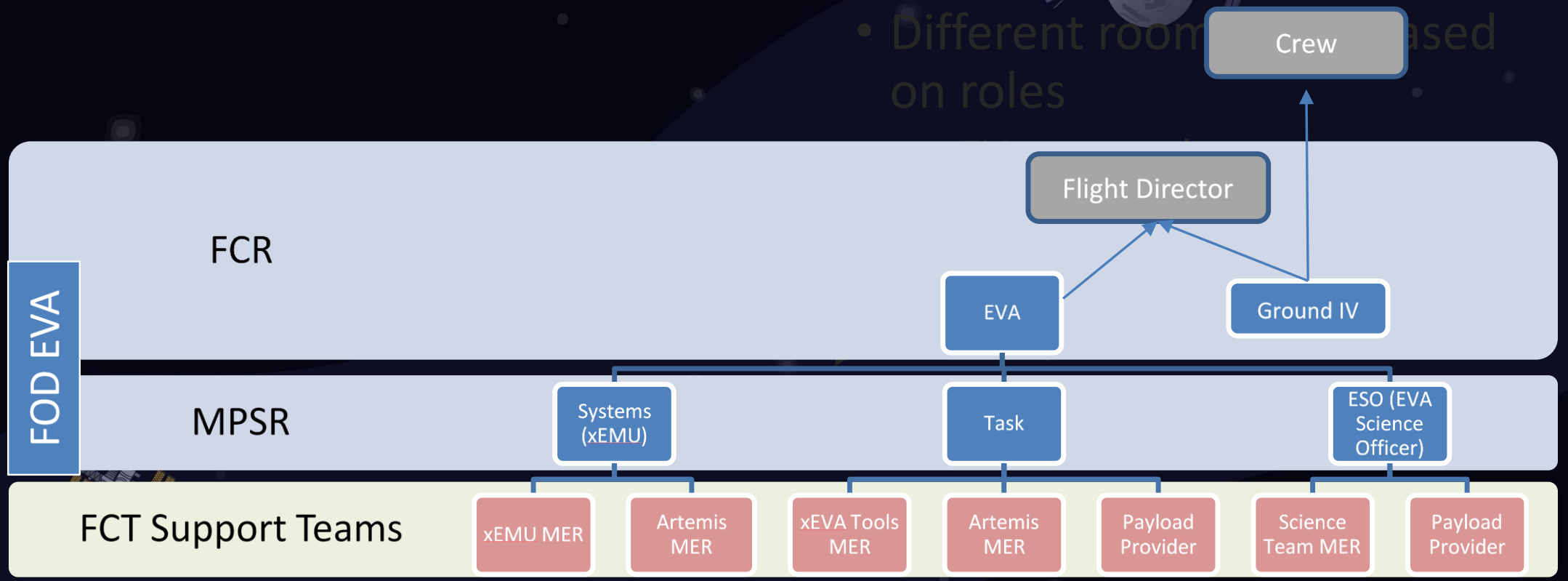
- Con Ops and hardware designs are demonstrated in pressurized suited ops with gravity offload
- Feedback on the ops and tool designs help refine that development
- There is forward work underway to incorporate more Lunar terrain including slopes
- Validation of CG and weigh-out is improving

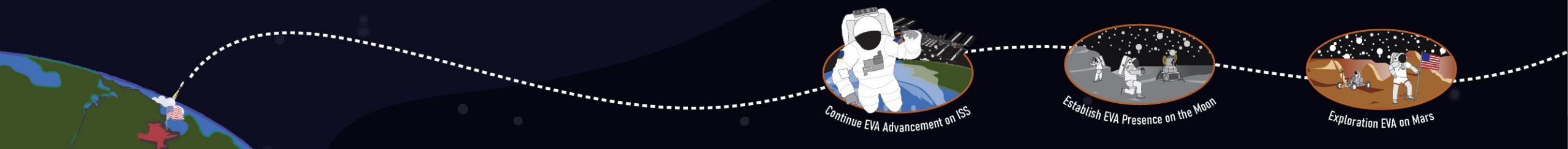




# Flight Control Sim Using VR

- Different room based on roles



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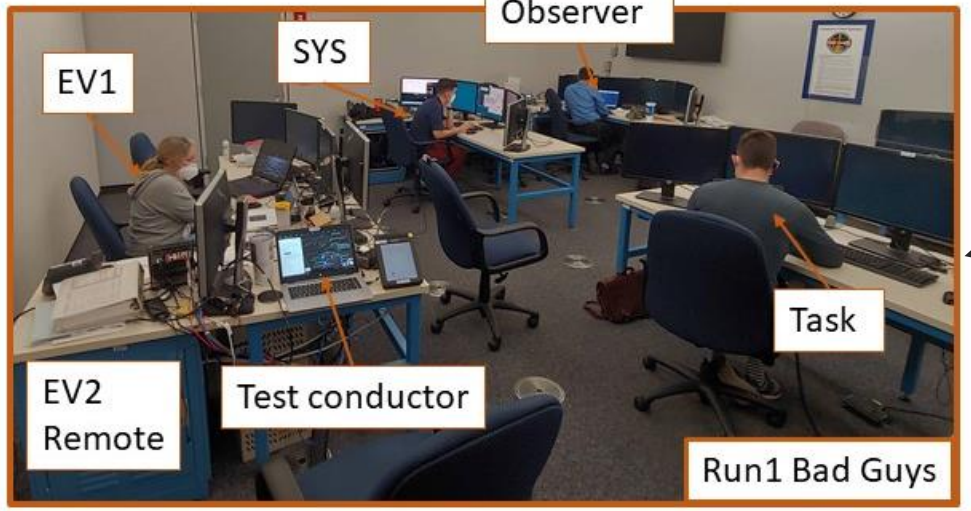
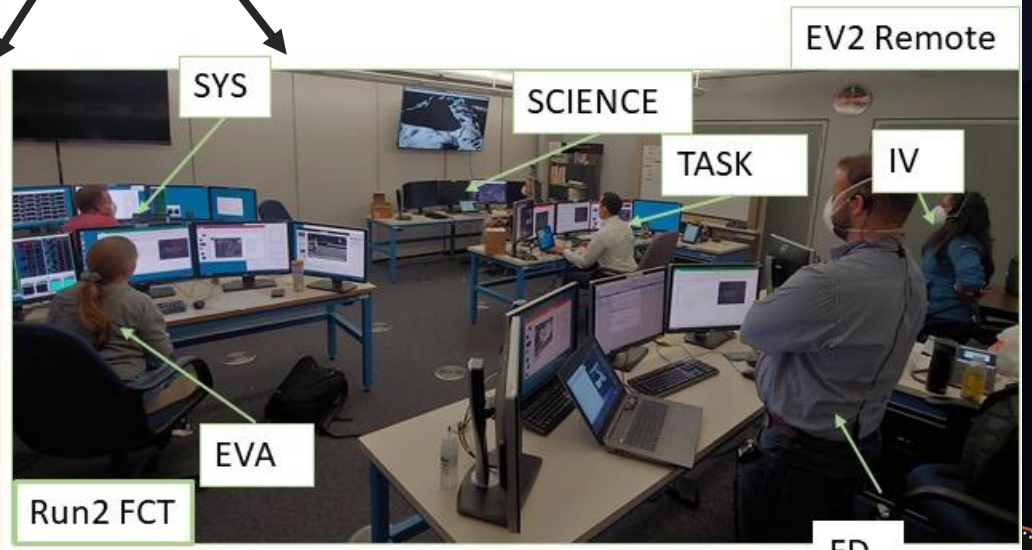
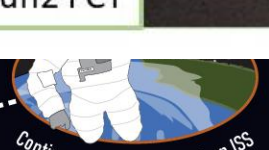



- Different rooms used based on roles
  - EV crew and test team
  - Flight controllers



# Flight Control Sim Using VR

What EV1 sees

Real world source for VR

What MCC sees

Continue EVA Advancement on ISS

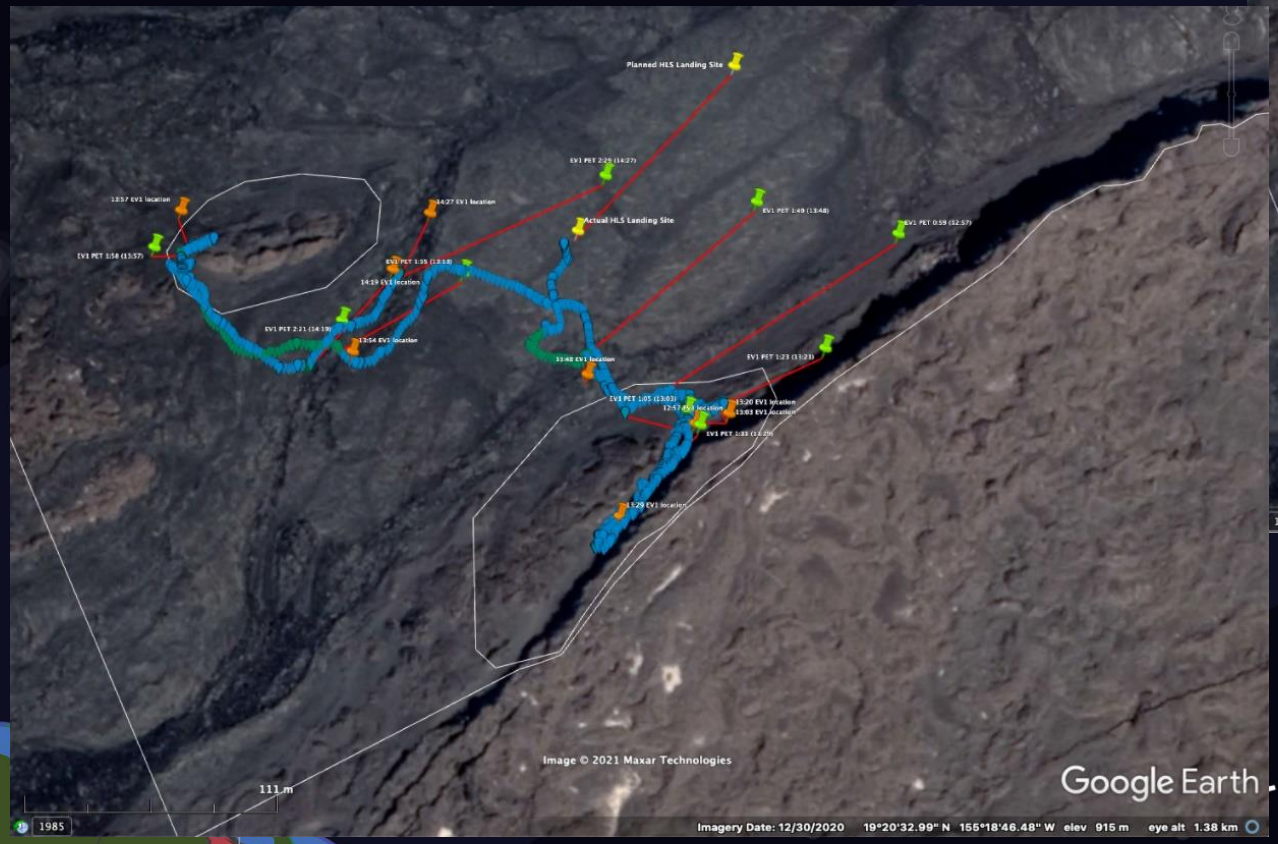
Establish EVA Presence on the Moon

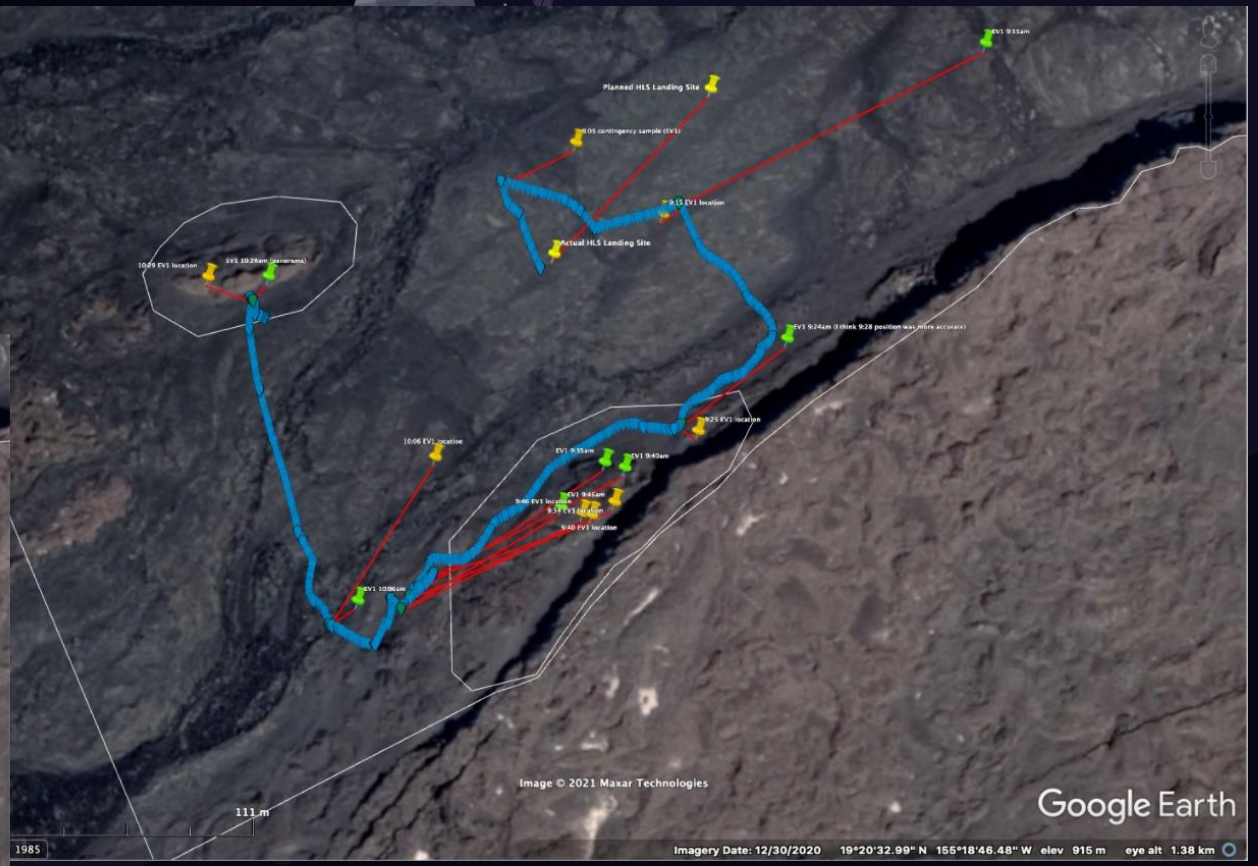
Exploration EVA on Mars

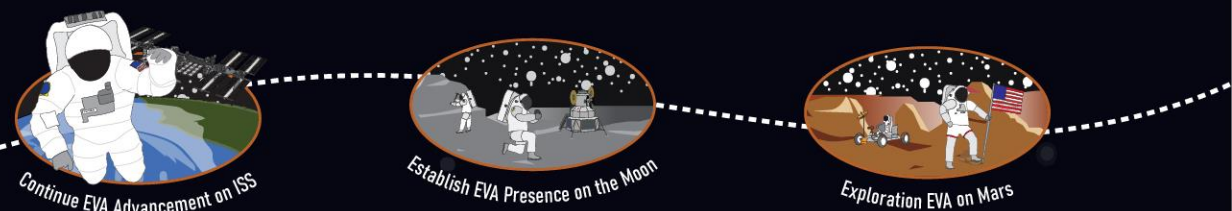
# Flight Control Sim Using VR

1 of 2 environments where we can evaluate ops teamwork & navigation at Artemis scale with relevant science context

- Blue dots = actual EV1 location
- Green dots = where MCC thinks EV1 is located
- Orange dots = where EV1 thinks they are located



# What Objectives Are the Ops Team Focused On?

- How do EVA ops change as the focus shifts from engineering tasks to scientific exploration?
- How do the EVA roles & responsibilities evolve?
- What changes are necessary to work in polar Lunar lighting?
- How do we ensure we know EV crew location and path to a safe haven at all times?
- How do we ensure the crew have the tools and information they need to succeed?
- How do MCC tools and products need to evolve to support exploration EVA?
- What is the most effective use of these facilities to train crew?
- What feedback can we provide to EVA hardware design?