



Wireless Accessories on the Lunar Exploration Spacesuit (xEMU)

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NASA's Artemis Mission



<https://www.nasa.gov/specials/moon2mars/>

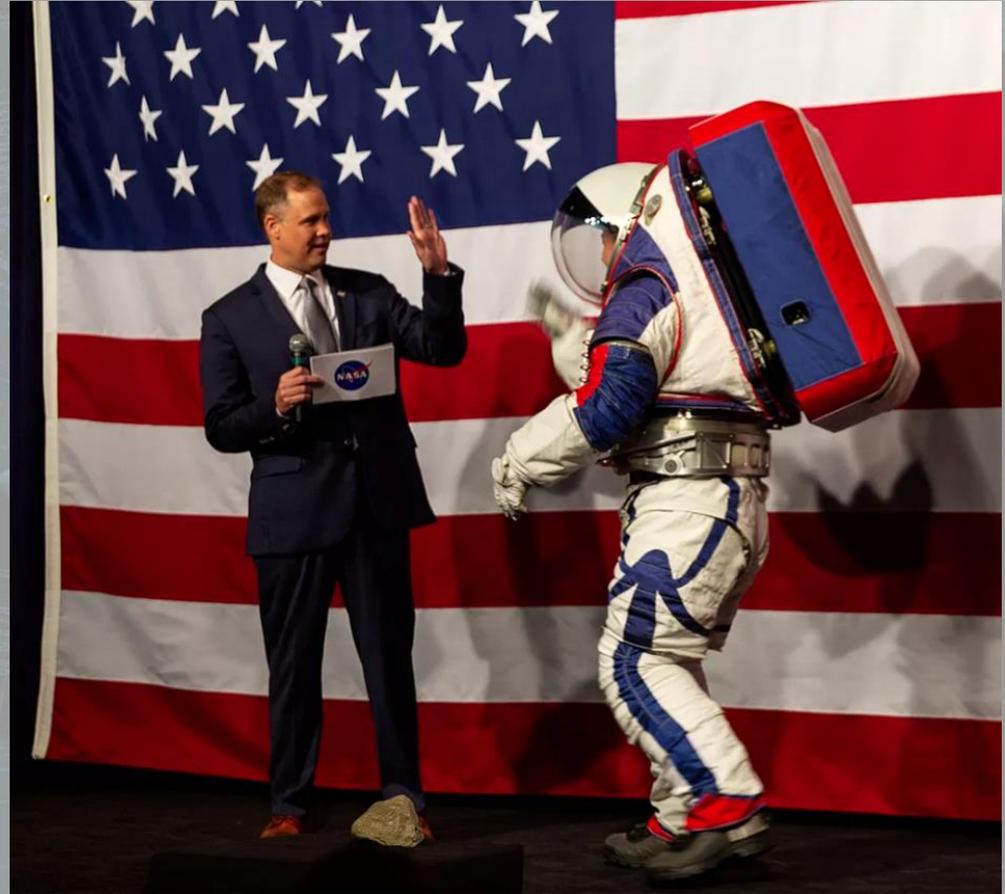
FORWARD TO THE MOON



Recent Events



<https://www.theverge.com/2019/10/15/20916106/nasa-artemis-moon-space-suits-xemu>





Spacesuit Basics



A Whole New Definition to the Word "Suit"



Cooling Garment

Spacewalks typically last multiple hours with astronauts working very hard. To avoid heat accumulation in the suit, crew wear a special cooling garment lined with water tubes to keep them cool throughout the spacewalk.

A spacesuit can have up to **16 LAYERS**

Gloves

Your hands get the coldest while out in space – so these aren't just any gloves. They are equipped with heaters for their fingers and still allow for dexterity for astronauts to be able to use tools.

Display Control Module

At the center of the HUT is the brains of the suit – this box houses a control panel which operates the backpack of our mini-spacecraft.

Colored Stripes

Red or white stripes are used on this strip of the lower torso. This enables us to identify the individual spacewalkers while they are on the spacewalk.

Helmet

This isn't the helmet you wear to ride your bike or play sports. The helmet used for spacesuits has a visor with a special gold coating that protects the astronaut from the strong sun rays. It also has a ventilation system that provides astronauts with oxygen.

Portable Life Support System (PLSS)

This high-tech backpack has everything astronauts need while they explore space! Electricity, a fan, carbon dioxide removal system, water tank for the cooling garment, and a 2-way radio.

Hard Upper Torso (HUT)

The HUT connects the internal workings of the suit with the appropriate systems in the PLSS.

Lower Torso

The lower torso keeps legs and feet safe from the harsh space environment. Along the waist there are a series of rings which are used to tether astronauts to the space station or to attach different tools that might be needed during the spacewalk.



Communication

Communication is essential between spacewalking astronauts. They must be able to talk to the astronauts inside an orbiting spacecraft and the mission control team back on Earth.

MANUFACTURING

Design Integration
+ Modeling
+ Procurement
+ Fabrication

Spacewalk Ready

The longest U.S. spacewalk was performed by Susan Helms and Jim Voss and lasted **8 Hours : 56 Minutes**

#SUITUP

Every time an astronaut goes out into space (called a spacewalk) – they wear a special suit. It's actually a personal spacecraft. It keeps the astronaut safe while they perform tasks outside the International Space Station, and when they explore the lunar surface beginning in 2024.



Status of xEMU as the Next US Spacesuit



Moon to Mars

**xEMU will perform
ISS and Lunar
missions by 2024**

- One suit to ISS for a micro-G EVA alongside an EMU
- Two suits support Artemis III mission to the lunar surface
- RFI for follow-on suits released

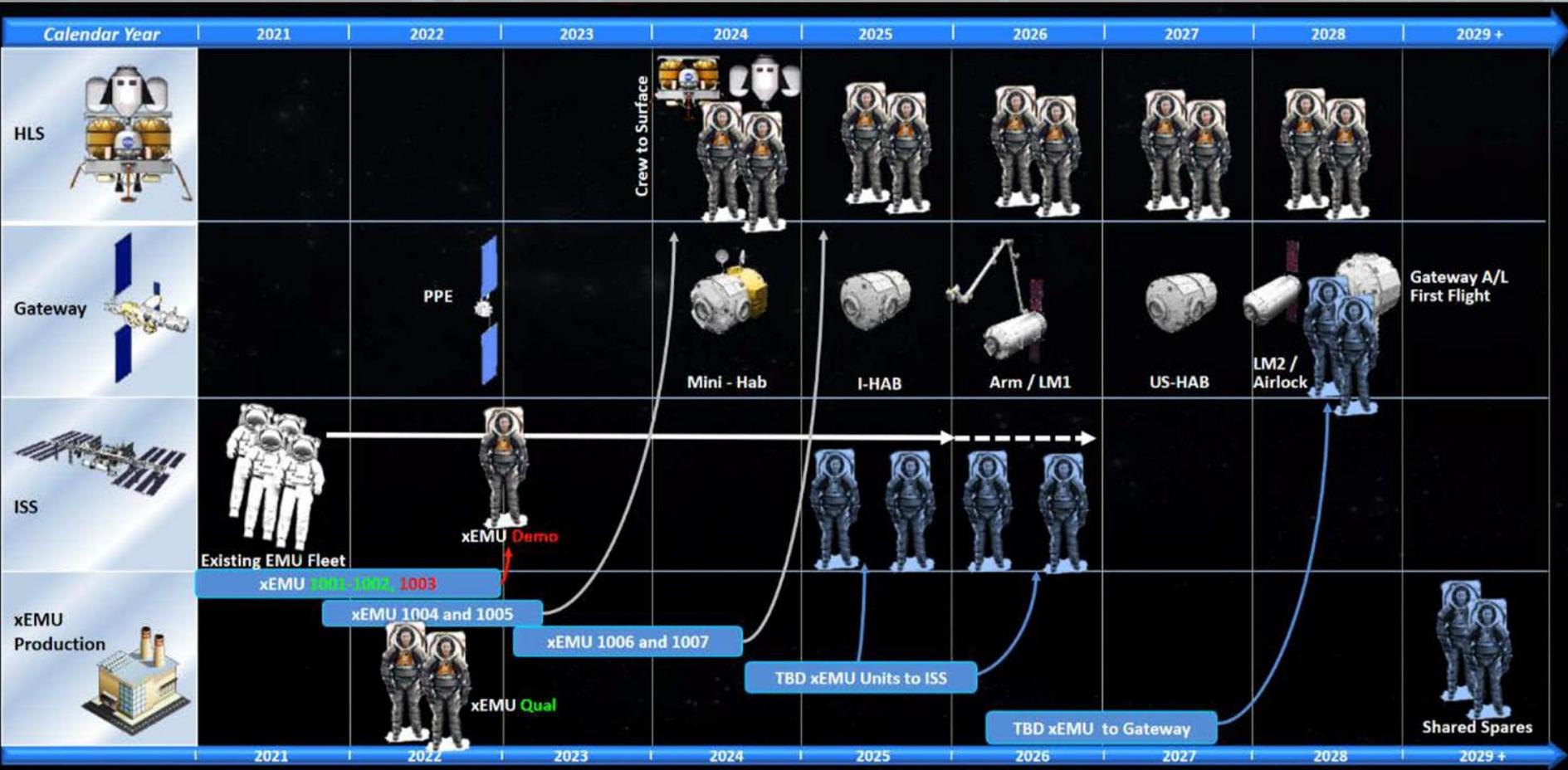


Oct. 8, 2019

A Next Generation Spacesuit for the Artemis Generation of Astronauts



Notional xEMU Fleet Distribution (from RFI)





xEMU Project



<https://www.nasa.gov/suitup>

Single source of public, technical, proposal, and program information about the xEMU and supporting technology efforts at NASA.

This will be a single, government-led effort to support both the ISS Demo and first Artemis mission to the lunar surface.

Exploration EMU (xEMU) Development Unit



July 2019



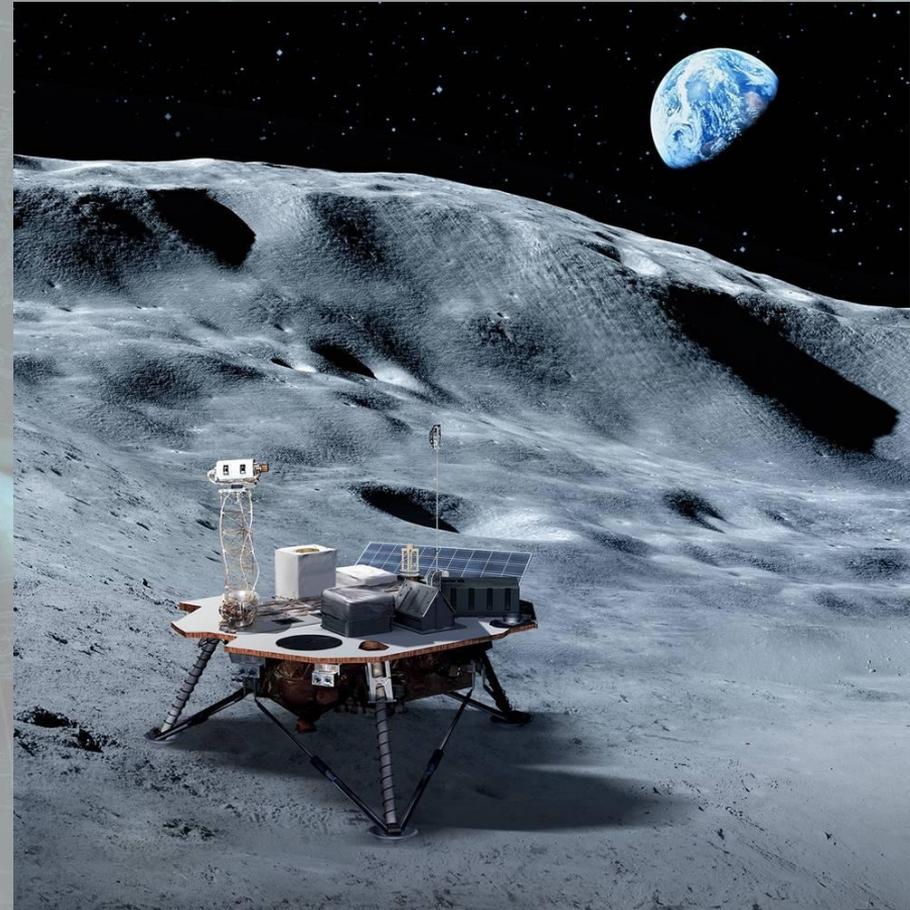
Commercial Lunar Payload Services



<https://www.nasa.gov/content/commercial-lunar-payload-services>

- Commercial payloads will begin to arrive on the lunar surface before humans arrive in 2024.
- Operational concept of these payloads (as it relates to human missions) has yet to be defined
- Opportunity for xEMU extensibility exists...

IF we plan for it in the design





Components of the Lunar xEMU Suit System



EXPLORATION EXTRAVEHICULAR MOBILITY UNIT (xEMU)

National Aeronautics and Space Administration



High Speed Data Comm.

HD Video and Lights

Informatics Display and Control

Integrated Communications (No Snoopy Cap)

Automated Suit Checkout

Enhanced Upper Mobility

Environment Protection Garment (EPG) w/Dust Mitigation

Planetary Mobility

4.3 – 8.2 psi Variable Pressure

1 Hr. Emergency Return

Vacuum Regenerative CO2 Removal System

Membrane Evaporation Cooling

Modular/ORU PLSS Design

Rear Entry Ingress/Egress

The xEMU is the spacesuit that will be worn by the first woman and next man to walk on the Moon. The new generation of technologies and capabilities incorporated into this spacesuit enable spacewalks (EVAs) in deep space, on the lunar surface, and on Mars.

ARTEMIS

EVA SPACESUIT TECHNOLOGY AND DESIGN



xEMU Data: Public resources available



Public xEMU resources

NASA Public Affairs features on Artemis and xEMU:

<https://www.nasa.gov/feature/a-next-generation-spacesuit-for-the-artemis-generation-of-astronauts>

<https://www.nasa.gov/specials/moon2mars/>

<https://www.nasa.gov/feature/spacewalk-spacesuit-basics>

Media attention:

<https://www.space.com/nasa-xemu-moon-spacesuit-2023-test.html>

<https://www.nbcnews.com/mach/science/nasa-unveil-new-spacesuits-astronauts-will-wear-moon-mars-ncna1066121>

<https://techcrunch.com/2019/10/10/nasas-new-moon-bound-spacesuit-is-safer-smarter-and-much-more-comfortable/>

Spacesuit development at NASA:

<https://www.nasa.gov/suitup>

<https://www.nasa.gov/suitup/gallery> (updates graphics resources)

Archives from past EVA workshops:

<https://www.nasa.gov/exploration-eva-virtual-collaboration-event-agenda> (virtual event 2018: [presentation](#))



Next Steps



- Informatics Subsystem within xEMU Project has two major thrusts
 - Deliver xEMU components for 2024
 - Lights, Camera, Wifi infrastructure
 - Prepare (“scar”) for the future iteration of the xEMU
 - In-helmet display
 - Tool port
- Overall lunar architecture will have a big impact on operations of the xEMU in a lunar surface environment
 - Wireless technology
 - Discovery of coverage areas
 - “Location services” effect on navigation

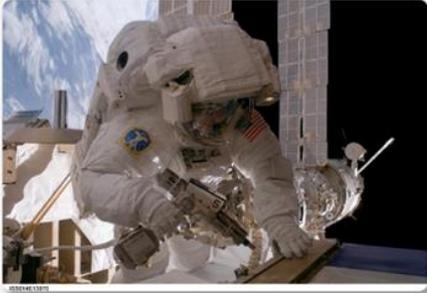


xEMU Interests



- Preparing for the future by leveraging commercial technologies
 - Remaining compatible with current wireless standards in terrestrial use
 - Monitoring trends in exponential tech
- Identifying analog environments
 - Adverse effects are not predictable on the lunar surface
- Developing operational scenarios
 - What will we do on the Moon?
 - How are we going to interact with external payloads?
 - Will any tools or equipment we bring with us need to communicate with the xEMU?
- Develop an upgrade plan
 - Informatics is inherently upgradable
 - Primary life support functions will remain very stable

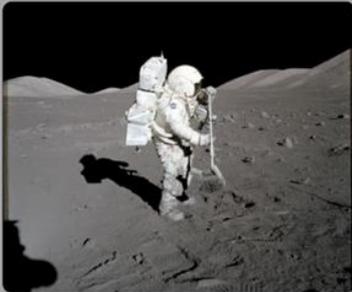
MICRO-GRAVITY EVA ON A SPACECRAFT (ENGINEERED SURFACE)



MICRO-GRAVITY EVA ON A SMALL NATURAL BODY (ASTEROID OR MOONS OF MARS)



PARTIAL-GRAVITY EVA ON LUNAR SURFACE (IN A VACUUM)



PARTIAL-GRAVITY EVA ON MARS SURFACE (IN PARTIAL-ATMOSPHERE)





References



NASA Public Affairs features on Artemis and xEMU:

<https://www.nasa.gov/feature/a-next-generation-spacesuit-for-the-artemis-generation-of-astronauts>

<https://www.nasa.gov/specials/moon2mars/>

<https://www.nasa.gov/feature/spacewalk-spacesuit-basics>

<https://www.nasa.gov/feature/nasa-seeks-industry-input-on-hardware-production-for-lunar-spacesuit/>

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<https://www.nasa.gov/suitup/workshop/extravehicular-activity-technology-workshop-presentations-2017> (all 2017)

<https://www.nasa.gov/suitup/workshop/extravehicular-activity-technology-workshop-presentations-2016> (all 2016)

https://www.nasa.gov/sites/default/files/atoms/files/2019-eva-workshop-xemu-standard-jbuffington_rev.c.pptx

https://www.nasa.gov/sites/default/files/atoms/files/xevaconops_evaworkshop2019_coan_final.pdf

https://nvite.jsc.nasa.gov/presentations/D2_Bioinformatics_Downs.pdf



References



FedBizOps Solicitations related to xEMU:

<https://www.nasa.gov/feature/nasa-seeks-industry-input-on-hardware-production-for-lunar-spacesuit/>

80JSC020xEVAPS: xEVA Production and Services (attachments available with US login and agreement)

<https://www.fbo.gov/notices/6fc7097d4b5b5e738a66ac8e65072105>

<https://www.fbo.gov/utills/view?id=d1def301ee8b81c372ff0fd3558f4189> (direct link to RFI)

NNH19ZCQ001K_APPENDIX-H-HLS: Human Landing System solicitation (all attachments available)

<https://www.fbo.gov/notices/d5460a204ab23cc0035c088dcc580d17>

Commercial Lunar Payload Services (CLPS):

<https://www.nasa.gov/content/commercial-lunar-payload-services>

<https://www.nasa.gov/press-release/nasa-announces-new-partnerships-for-commercial-lunar-payload-delivery-services>

<https://www.nasa.gov/press-release/nasa-selects-experiments-for-possible-lunar-flights-in-2019>