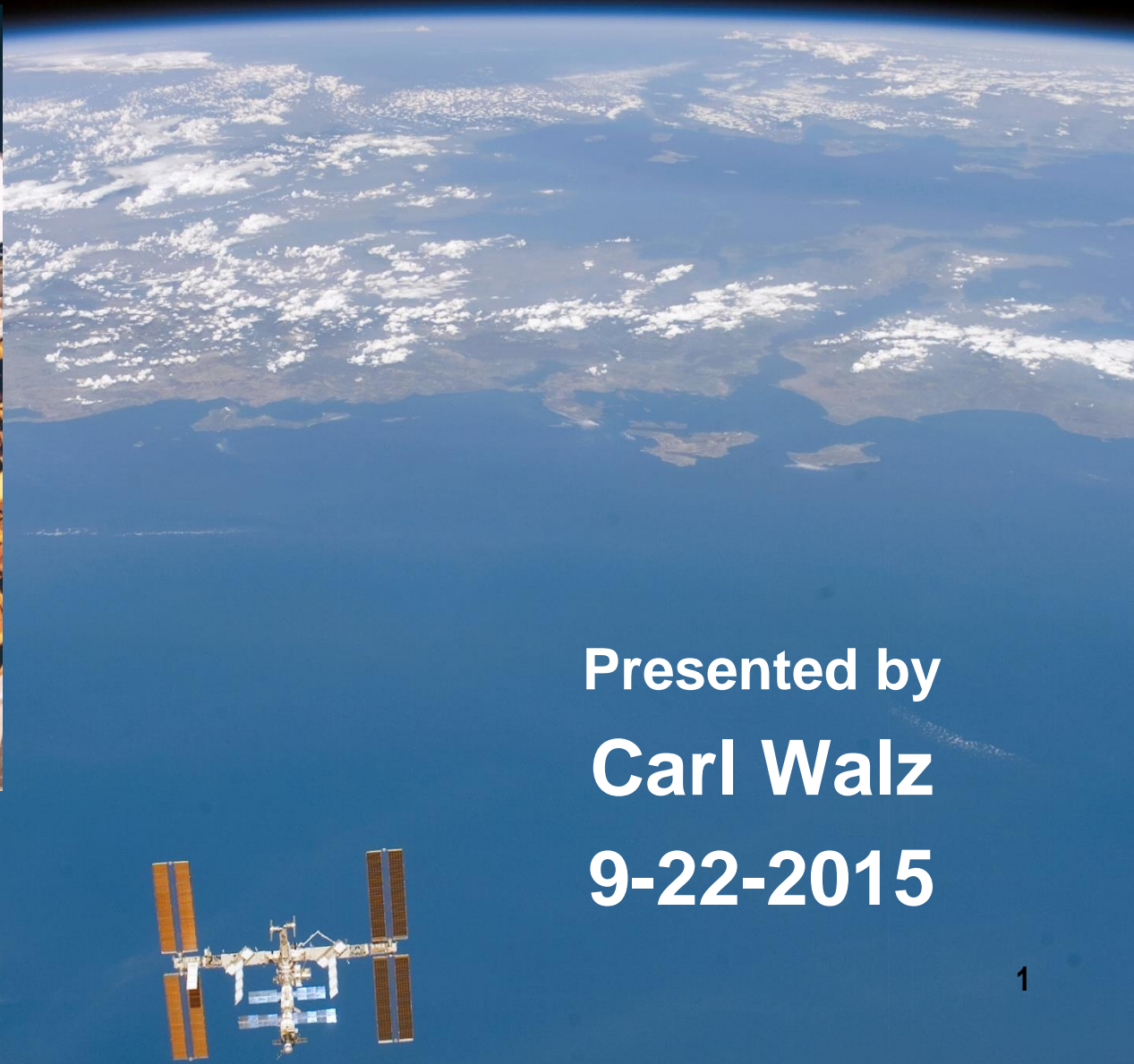


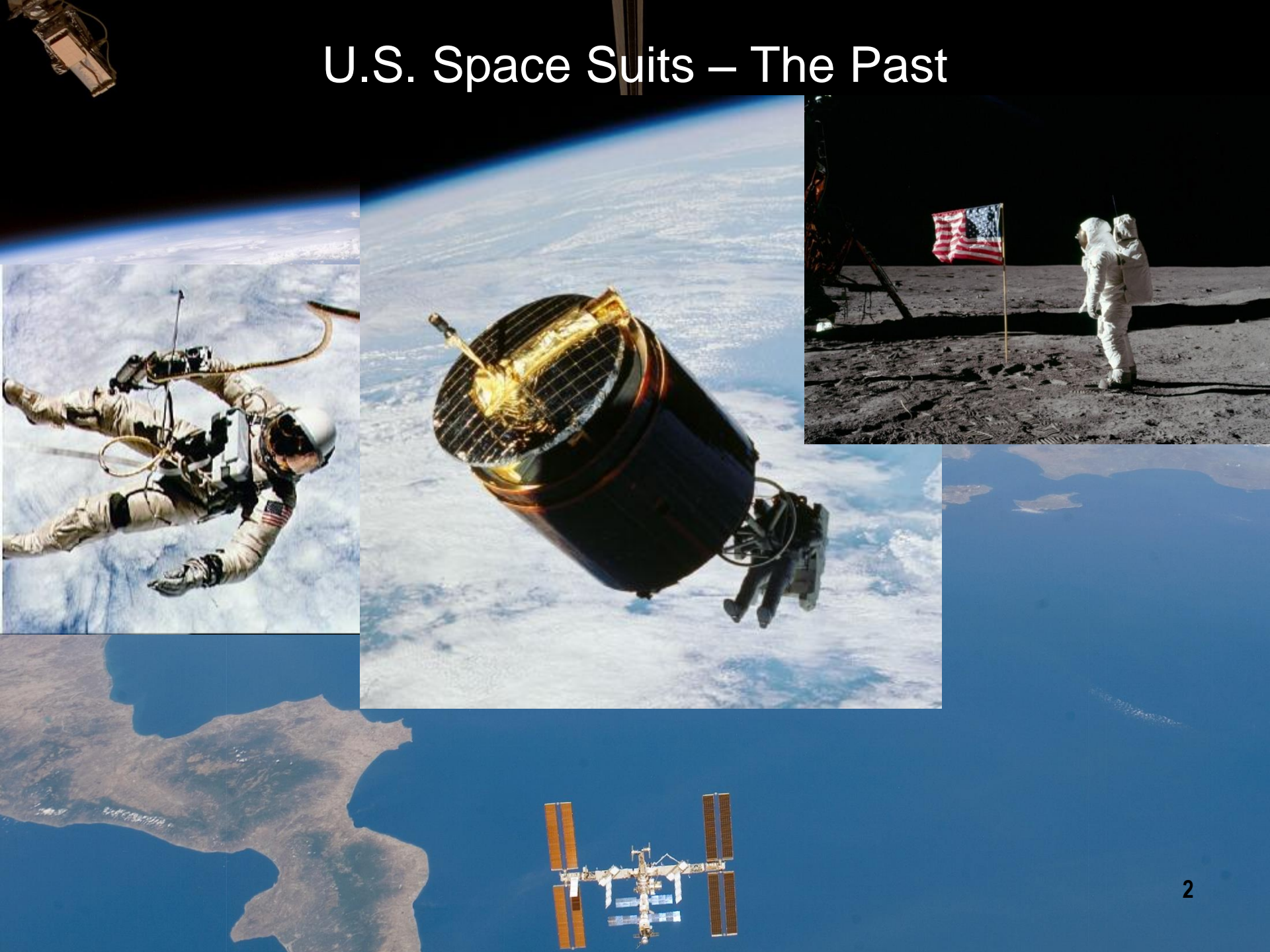
The Future of U.S. Space Suits



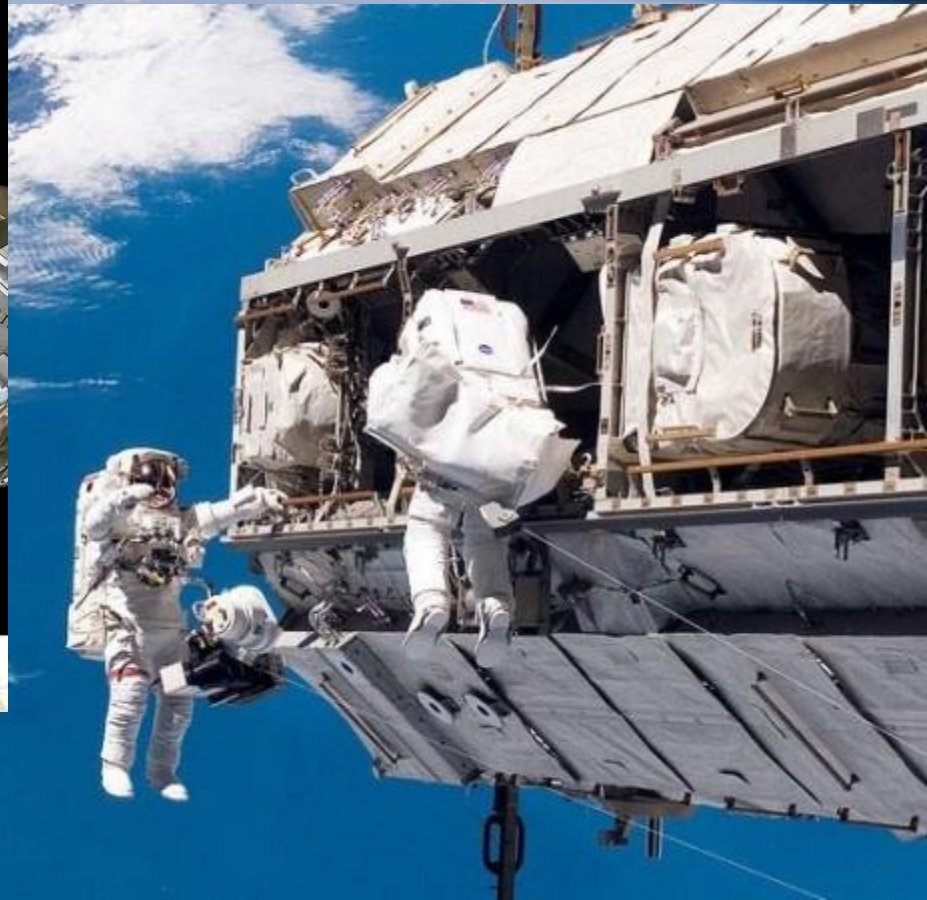
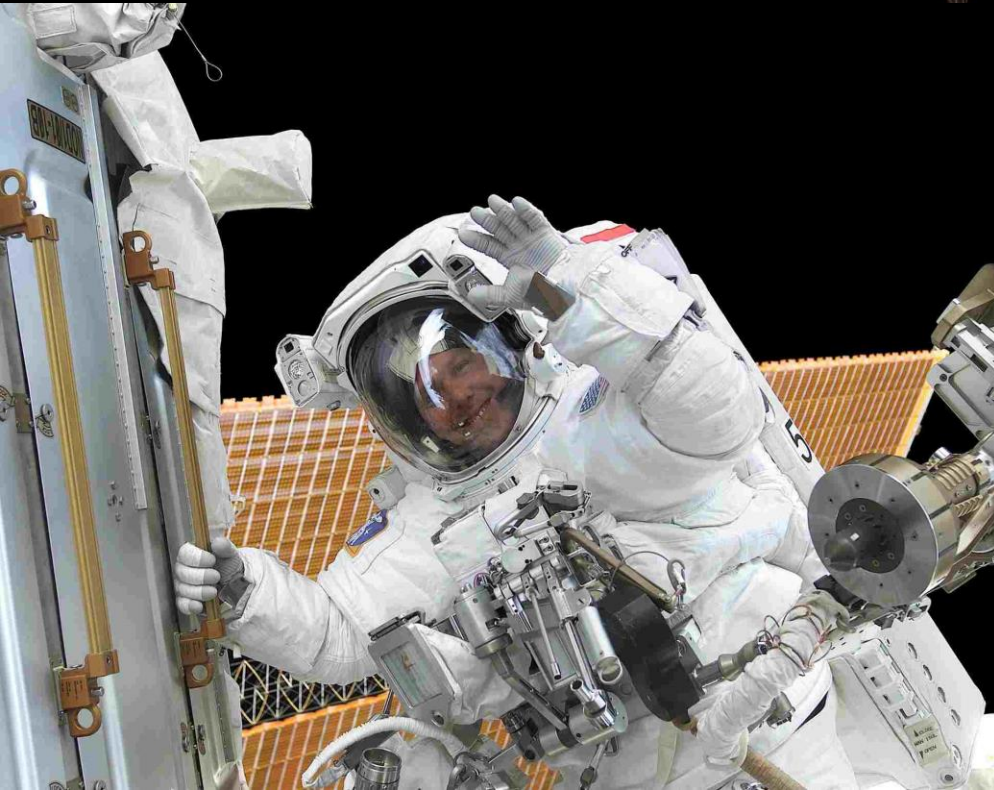
Presented by
Carl Walz
9-22-2015



U.S. Space Suits – The Past



U.S. Space Suits – The Present



Future Human Exploration

HUMAN EXPLORATION

NASA's Journey to Mars



EARTH RELIANT

MISSION: 6 TO 12 MONTHS
RETURN TO EARTH: HOURS

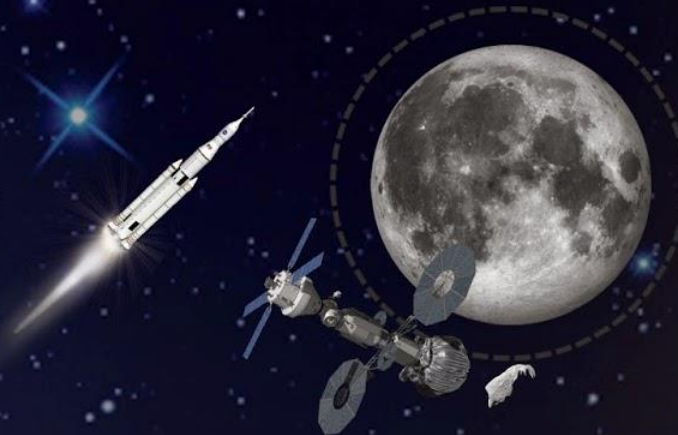


Mastering fundamentals
aboard the International
Space Station

U.S. companies
provide access to
low-Earth orbit

PROVING GROUND

MISSION: 1 TO 12 MONTHS
RETURN TO EARTH: DAYS



Expanding capabilities by
visiting an asteroid redirected
to a lunar distant retrograde orbit

The next step: traveling beyond low-Earth
orbit with the Space Launch System
rocket and Orion spacecraft



MARS READY

MISSION: 2 TO 3 YEARS
RETURN TO EARTH: MONTHS



Developing planetary independence
by exploring Mars, its moons and
other deep space destinations

New Space Suit Development

Defining Questions

- **What Is The Destination And The Destination Environment**
- **What Will Be The Host Spacecraft**
 - What Is The Life Support Interface
 - What Is The Mechanical Interface
- **What Are The Mobility Requirements**
 - Walking, Riding, or Both
- **What Size Suits Are Required**
 - Suit Should Support A Larger Anthropometric Range
- **What Is The Logistical Plan**
 - Suit Must Be Logistically Supportable For Long Periods of Time
- **What Is The Maintenance Plan**
 - Suit Must Be Field Maintainable

NASA EVA Technology Development

NASA Performed Yearly Test Campaigns In The Western U.S. To Develop Requirements For Planetary Surface EVAs



EVA Pressure Garments At Field Testing, Flagstaff AZ 2006

NASA EVA Technology Development

- Mark 3 Planetary Garment Designed For Surface EVAs
 - Hard Upper Torso And Hard Brief
 - Rear Entry
 - Walking Boots
 - Tested During Desert Rats Planetary Exploration Activities



NASA EVA Technology Development

- **ILC Dover I-Suit Pressure Garment**
 - Soft Upper Torso And Soft Brief
 - Waist Or Rear Entry
 - Soft Lower Torso And Walking Boots
 - Tested At ILC And During Desert Rats Planetary Exploration Activities
 - Excellent Surface Mobility



NASA EVA Technology Development

- The Z-1 Pressure Garment Was Developed By NASA Under The Advanced Exploration Systems Program
- Z-1 Suit Represents A Follow-On To The Mark 3
 - Rear Entry
 - Hard Upper Torso And Waist Brief
 - Elliptical Helmet
 - Improved Shoulder Fit
- A Follow-On Z-2 Pressure Garment Is In Development By NASA For Future Risk Reduction Testing
- Portable Life Support System Technology Is Being Tested In Parallel



Constellation Space Suit System Technology Risk Reduction

- **Oceaneering Leads An Industry Team To Perform EVA Technology Risk Reduction Testing**
- **The Prototype Pressure Garment Has Been Developed**
 - Improves Fit, Comfort, Mobility And Safety For Small And Large Crewmembers
 - Supports Multiple Pressures
 - Rear Entry
 - Reduces Mass To Orbit Of The Spacesuit And Supporting Systems
- **Prototype Pressure Garment Testing Is Ongoing At The Oceaneering Space Systems Facility**
- **A Liquid Thermal Garment Has Been Developed That Improves Astronaut Cooling**

