

# Virtual Community Bulletin Board

This is a space to share ideas, inspire one another, and foster excitement for the Habitable Worlds Observatory. We hope you enjoy reading and engaging with the diverse visions presented here.

I envision an observatory with picometer stability and UV cleanliness that is serviceable to extend the science mission life and to reduce reliability and build cost/risks.

Julie Van Campen  
NASA Goddard

To enable world-class science by advancing the state of the art in instrument technologies, robotics and in-space servicing; to provide mentorship to young engineers and scientists to continue the journey.

Joe Schepis  
NASA

HWO should have the same prolonged life of scientific productivity as Hubble. We should leverage the best practices from Hubble and build upon them to not only easily upgrade instruments but to also have access to the most important limited-life functions of the observatory.

Jeanette Domber  
BAE Systems

Don't approach servicing of the HWO as a traditional, government-owned mission capability set. Approach it instead as a government partnership with industry which allows industry to truly innovate, truly economize, and truly proliferate capabilities for the widest range of applications possible.

David Cunniff  
Peraton

**THE SPACE DYNAMICS LABORATORY (SDL) IS A LEADER IN THE DOD RENDEZVOUS, PROXIMITY OPERATIONS, AND DOCKING (RPDD) COMMUNITY AND SEEKS TO UTILIZE OUR EXPERTISE TO FACILITATE THE SERVICING OF HWO. OUR WAYFINDER TECHNOLOGY MAY BE WELL SUITED FOR AUTONOMOUSLY HWO DOCKING IN PREPARATION FOR SERVICING.**

DAVID GELLER  
UTAH STATE UNIVERSITY SPACE DYNAMICS  
LABORATORY

Through servicing, HWO will continuously evolve with new instruments and capabilities, and expand beyond what we imagined it could do today.

Nikolai Joseph  
Air Force Research Lab

HWO will be serviced with care and confidence, to augment its value to humanity through lifetime and capability expansion

Ryan Martineau  
Space Dynamics Laboratory

HWO's internal electrical architecture is designed with the capacity to support the power, telemetry, and processing needs for the last generation instrument. As the observatory is upgraded with new spacecraft subsystems, only the volume of replacement instruments will need to be restricted.

Tammy Brown  
NASA Goddard Space Flight Center  
(GSFC)

Shared complexity between a servicer and the observatory is important to the success of any servicing strategy. A comprehensive trade study between servicing solutions and services on board the observatory should illustrate where risk is hidden and how to design in possible alternate solutions.

Walter Smith  
NASA Goddard Code 544

Creative, integrated system wide servicing & enhancement capability is essential for longterm, cost effective, mission success

Richard (Rick) Decker  
Retired US Army SES, DoD

I believe that the HWO architecture will allow it to be highly modular. It may have on-board hot-swappable instruments to streamline the task of servicing and enable it to be retrofitted with newer instruments easily and efficiently.

Brianna Hobert  
NYIT (New York Institute of  
Technology & NASA GSFC

HWO is a multipurpose astronomical observatory that will transform humanity's understanding of our place in the cosmos: individually as a life-abundant planet and as an 8-planet solar system. HWO will tell the story of life in the universe through cosmic time and remotely monitor our S.S. bodies.

Julie Crooke  
NASA

Spacecraft servicing in deep space, such as the HWO at SEL2, requires autonomous operations well beyond the current state of the art. Successful demonstration of on-board autonomy for servicing will support missions ranging from solar system exploration to search and rescue in earth orbit.

Bogdan Udrea  
VisSidus Technologies, Inc.

*Simple, efficient, robust, safe, cost and schedule effective servicing approach (agent + infrastructure) for a system (HWO) designed for, and with, simplified servicing / re-life and standardized interfaces.*

Warren Soh  
Honeywell Aerospace

*Using sound engineering principals, servicing instruments at L2 robotically with a waypoint at Lunar Gateway.*

Vivek Dwivedi  
NASA GSFC

*We will design HWO with remote serviceability highly focused on only the capability most valuable to the HWO User community.*

John Lymer  
MDA Systems Inc

Habitable Worlds observatory could be serviced by robotic servicing that is being demonstrated by NASA OSAM-1 mission. OSAM-1 will help standardize/generalize servicing interfaces, conops and technologies to be used for robotic servicing.

Badri Shirgur  
NASA Goddard

*Refueling upgrading instruments in-space assembly in-space serviceability re-location of the observatory*

Deepak Patel  
NASA

The Habitable Worlds Observatory will operate at L2 like a mountaintop observatory here on Earth. The planned servicing will be used to reduce risks, streamline the initial instrument suite, and provide a substantial increase to the science return per dollar invested.

Michael McElwain  
NASA GSFC

My vision is for servicing at L2 very similar to Hubble servicing except use 2 robotic arms instead of astronauts and the dedicated servicer can dock/redock in multiple locations and then returns to earth. The servicer has thermal controlled boxes (SIPES on HST) that hold instruments.

Lee Feinberg  
NASA Goddard Space Flight Center

Ground-based digital twin, where Mission Control conducts servicing operations in simulated environment, and can expect those exact operations to be carried out successfully in the future when the commands reach the spacecraft.

Chris Garry  
NASA GSFC

*With VR tele-operated AI-enhanced robots.*

Ryan McClelland  
NASA Goddard Space Flight Center

*The bus is replaced by adding a new full capability bus to the bottom of the existing bus. Nothing is removed; nothing is refueled; nothing is serviced.*

Tupper Hyde  
NASA

**TO BEST SERVE THE OBSERVATORY'S GOALS, DO WE ENVISION PRIMARILY REMOTE SERVICING WITH ON-SITE INTERVENTION FOR CRITICAL SITUATIONS OR A MORE BALANCED APPROACH?**

**GAGANDEEP KAUR  
NA**

**WE HAVE ALL SEEN THE INCREDIBLE SCIENCE ENABLED BY THE ABILITY TO SERVICE THE HUBBLE SPACE TELESCOPE. THE ABILITY TO UPGRADE THE INSTRUMENTS AND PROLONG THE LIFETIME OF HST RESULTED IN DECADES OF ADDITIONAL OBSERVING. I ENVISION A SIMILAR PLAN FOR HWO BASED ON VALUABLE LESSONS LEARNED FROM HST.**

**LARRY DUNHAM  
LENTECH INC.**

Engineering/GSFC - Goddard Space Flight Center - NASA - National Air Space Administration Vision for How Habitable Worlds Observatory will be Serviced"" L2 will include a 1,000m3 capacity warehouse for tools common for servicing of all spacecraft in vicinity. "Leg-room" for visiting robotic or manned servicing mission will be accommodated including emergency fuel, coms, sleeping, etc

Benny Prats  
PEL - Planetary Environments Lab/eINFORMe Inc/UMD-University of Maryland - Aerospace

My vision on how HWO would be serviced would be through human-robot collaborative efforts. Both autonomous robotic platforms and teleoperator robots could assist EVA astronauts with intense servicing operations, or possible carry out servicing themselves for less intense servicing missions!

Romeo Perlstein  
University of Maryland Space Systems Laboratory



HWO = a telescope that lasts for decades and can do science that wasn't dreamed of when the observatory was originally designed.

Aki Roberge  
NASA Goddard Space Flight Center

The HWO is an augmentable and sustainable observatory with a modular design to enable ease of robotic refueling, inspection, repair, equipment replacement, and capability upgrades.

Robert Biggs  
Lockheed Martin

Servicing of HabWorlds will be accomplished by both humans and semi-autonomous robots, leveraging experience gained from cislunar endeavors. This will enable HabWorlds to be kept current and powerful with the latest instrument technology and capable with normal maintenance, maximizing return.

Paul Geithner  
Heliospace Corp.  
(supporting NASA)

Servicing Habitable Worlds Observatory will enable generations of explorers - scientists, engineers, students and the public - to search for life on other worlds and pursue new investigations into our universe we can't even think of yet.

John Ziemer  
Jet Propulsion Laboratory

*Robotic spacecraft will refuel HWO, swap out instruments, and perform other maintenance. Once these servicing runs become more routine, robotic spacecraft perhaps could be used for additional purposes at L2.*

Richard Cartwright  
JHU AP&L

Implement serviceability at all phases of development and determine the value at each phase. Servicing includes preparing the spacecraft and instruments, on-orbit inspection, orbit adjustments, assistance with deployables, launch and transport, instrument and spacecraft upgrades and repairs.

Russ Snyder  
NASA

**HABITABLE WORLDS OBSERVATORY WILL BE SERVICED TO PROVIDE ENDURING OBSERVATIONS, ADVANCE CAPABILITY OVER TIME, AND ADAPT TO AN UNCERTAIN FUTURE.**

**DALE ARNEY  
NASA**

HWO servicing increases science yield, reduces cost, and includes future generations and their technologies.

Matthew East  
L3Harris Technologies, Inc.

Autonomous Robotic Servicing of Telescopes is a two-fold problem. Both construction and maintenance will be essential technologies as mankind works to continue to explore the universe with ever larger observation platforms.

Nicholas Limparis  
University of Maryland

*Habitable Worlds Observatory will be serviced using robotic systems with embedded intelligence that adapt to the change needs of the Observatory throughout its Mission life and enable high operability.*

Matthew Gildner  
JPL

*Every e-box and science instrument on the space vehicle should be replaceable in flight. Modularity should be an architecture driver with wireless signal interfaces used throughout. With autonomous servicing at SEL2 as a goal, the formulation baseline should be low latency telerobotic servicing at EML1 to minimize the TRL maturation challenge. SEL2 - EML1 transfer is very low energy (~10 m/s).*

Matt Greenhouse  
GSFC Emeritus

*We need to prepare for the scientific unknown: What will HWO show us that requires a new capability?*

John Mather  
NASA GSFC

Habitable Worlds Observatory will be serviced by designing modularity into the telescope from the beginning. Based on analysis of other modular spacecraft, this modularity will save integration test time (and therefore money) in addition to making servicing in space possible.

Brian Roberts  
NASA GSFC

**SERVICING CAN COMMENCE IN LEO IF NEEDED BASED ON INITIAL CHECKOUT. SERVICING CAN THEN OCCUR IN ITS FINAL ORBIT (ASSUMED L2) VIA ROBOTIC SERVICING FOR FUEL REPLENISHMENT OR VERY BASIC WHOLE MODULE REPLACEMENT.**

**CATHY BARCLAY  
NASA GSFC**

*HWO will be serviced in a sustainable way, both economically and environmentally.*

Nicholas Flagey  
Space Telescope Science Institute

I envision Hab Worlds to be composed of multiple parts aligned in orbit, where major components can be replaced easily with precise in-space alignment.

Scarlett Hao  
University of California, Berkeley

Routine servicing intended to improve capability and lengthen operational lifetime via a series of refueling and component upgrade services provided by a commercial partner.

Alec Cavaciuti  
The Aerospace Corporation

*Robotically. Autonomously.  
Correctly. Cost effectively.*

Rudra Mukherjee  
JPL

*Let's enable the engineers of HWO be bold and daring. Servicing allows them to take calculated risks that can be fixed if necessary.*

Curtis Iwata  
The Aerospace Corporation

**HWO SERVICING WILL ENABLE THE OBSERVATORY TO EXTEND ITS MISSION LIFE TO A SIMILAR LIFE SPAN AS THAT OF HUBBLE THROUGH A FREE FLOATER SERVICING VEHICLE REPLACING INSTRUMENTS AND REFUELING THE SPACECRAFT IN ADDITION TO PERFORMING MINOR REPAIRS TO THE VEHICLE.**

ERIC DIXON  
LOCKHEED MARTIN

I envision the Habitable Worlds Observatory utilizing autonomous robotic servicing and advanced AI to ensure sustained operability and optimize data acquisition. This approach will maximize scientific output through efficient maintenance and repair missions.

Jaheim Goodwin  
STScI/SASP/NRAO/NAC

*I see onsite humans or robots if the environment is too extreme.*

Shirah Abrishamian  
University of Maryland

In envisioning how the Habitable Worlds Observatory (HWO) will be serviced, I see a diverse team with specialized roles. This includes tasks such as maintenance, innovation, and cost management. Ensuring the HWO is well-maintained and improved is crucial to meet the needs of scientific research.

Hamza Souissi  
University of Maryland

Within the framework of the HWO, I envision a future where the detection and study of habitable exoplanets are optimized through innovative technologies and international collaboration. Together, let us make this observatory a model of scientific cooperation and a beacon of astronomical research.

Chafi Jamal  
Cadi Ayyad University

*As a PhD student at Cadi Ayyad University, I envision sustainable, innovative, and collaborative servicing for the HWO. Autonomous robots, AI-driven maintenance, and global partnerships will ensure its longevity, efficiency, and scientific advancement.*

Aziz Qazbour  
Cadi Ayyad University

Our vision for servicing the HWO includes a comprehensive architecture with modular design, autonomous servicing spacecraft, and collaborative infrastructure to enable seamless instrument and technology upgrades, thereby extending HWO's operational life and scientific capabilities.

Adam Black  
Lockheed Martin

**Once in orbit and beyond, direct practice to solve technical issues will prove to be challenging. This next-gen telescope will require as much servicing in the autonomous operations field as in the robotic one to ensure an operational lifespan.**

Malek Souissi  
Virginia Polytechnic Institute and State University

In the future I believe that it is impertinent to have the moon as an intermediary for servicing HWO. Although it is only a bit closer to Lagrange point two, launching off from the moon would cost less and be more fuel efficient meaning that servicing could be done faster and at a lower cost.

Ricardo Yanez Gonzalez  
University of Maryland

**At LaRC, I work on a project called Precision Assembled Space Structure (PASS). We are using robotic manipulators to assemble a 20 m mirror truss. Future large telescopes like HWO might be assembled in space instead of on the ground. The assembly robots could then be reused to service the telescope.**

David Bacher  
Langley Research Center

*An autonomous fleet of heterogenous robots will be responsible for all forms of manufacturing and assembly operations.*

Kartik Nagpal  
University of California Berkeley



In-space refueling could help extend the mission lifespan of the HWO. This would be easier if HWO is designed to be refueled in orbit, unlike Landsat 7. Robotic manipulation (autonomous or telepresence) could also repair or upgrade sensors over time.

Henry Wolf  
National Aeronautics and Space  
Administration, Langley Research  
Center

*HWO will continually  
advance the study of  
nearby Earths, by  
continually advancing  
its capability via  
servicing.*

Jon Lawrence  
NASA

*Servicing for HWO should not only  
support sustainment of the  
observatory, but also improvements  
that can be supported over time to  
expand its capabilities and  
transition its priorities as it makes  
discoveries.*

Doyle Towles  
Northrop Grumman

**Provide servicing capabilities to  
reduce the risk for successful  
implementation and sustainment of  
the Habitable Worlds Observatory.**

Rob Morgenstern  
NASA Goddard Space Flight Center

*Scientific excellence at an  
unprecedented pace via  
planned instrument upgrade.*

Bo Naasz  
NASA

**HWO WILL BE SERVICED TO EXTEND MISSION  
LIFE TO 30 YEARS, ALLOWING FOR  
EVOLUTION OF SCIENCE INVESTIGATIONS,  
IMPROVEMENT IN ULTRA-STABILITY, AND  
OVERALL ENDURANCE.**

**RHONDA MORGAN  
NASA/JPL**

*In combination with an  
energy sufficient Moon  
Base!*

Durgesh Rai  
GSFC

*Long-term systems life-cycle  
management with modular  
structures and robotics.*

Kenneth Cheung  
NASA ARC

**HWO will be a pathfinder for in-space  
servicing of large observatories in the  
21st century. It will learn lessons from  
ground observatories, HST servicing,  
and ISS servicing. It will learn from  
commercial satellite servicing, such as  
NG's Cygnus, MEV, MRV and MEP  
vehicles. Perpetual observatory.**

Stephen Leete  
Northrop Grumman

**As a veteran of HST, JWST and RST who  
was engaged in servicing trades, I  
believe that at least limited servicing is  
advisable. Instrument changeout is  
highly dependent on thermal and  
contamination considerations and  
assumptions regarding remote robotic  
capabilities but should remain in the  
trade.**

John Hagopian  
Lambda Consulting

**In order to service the Habitable  
Worlds Observatory, I envision a  
remote-controlled robotic system  
that can be transformed into a fully  
automated system integrated with  
the HWO, allowing for seamless  
repairs and installations for effective  
planetary data recollection and  
transmission.**

Sri Chokkaku  
University of Maryland