Tuesday, February 27, 2018
OPENING PLENARY
8:30 a.m. Alder Ballroom

Chair: **Ben Bussey**
Michael New

8:30 a.m. Bussey B. *
Welcome and Goals of the Workshop

8:45 a.m. Zurbuchen T. *
SMD Overview

9:00 a.m. Crusan J. *
Human Exploration and Operations Mission Directorate Overview

9:15 a.m. Craig D. *
Deep Space Gateway Overview

9:45 a.m. Whitley R. *
Deep Space Gateway Orbits

10:15 a.m. BREAK

10:30 a.m. Robinson J. *
International Space Station Utilization

11:00 a.m. Carpenter J. *
Review of European Space Agency Deep Space Gateway Science Workshop

11:15 a.m. Hipkin V. *
Review of Canadian Space Agency Deep Space Gateway Science Study

11:30 a.m. DISCUSSION

Tuesday, February 27, 2018
ASTROPHYSICS: FUNDAMENTAL PHYSICS
1:00 p.m. Aspen Meeting Room

Chair: Jack Burns

1:00 p.m. Gozutok A. A. * Gozutok M. I.
Compact Experimental High Energy Telescope on Deep Space Gateway **[#3003]**
Compact sized high energy telescope is an advantageous project which would be conducted on Deep Space Gateway. The project includes the exploration of higher energetic universe with wider spectrum reach in order to use lunar orbits efficiently.

1:15 p.m. Turyshev S. G. * Shao M. Hahn I.
Testing Fundamental Gravity with Interplanetary Laser Ranging **[#3013]**
Very accurate range measurements with the Interplanetary Laser Ranging Terminal (ILRT) will push high-precision tests of astrophysics/gravitation into a new regime. It could be used for navigation and investigations in planetary/lunar science.

1:30 p.m. Mohageg M. * Strekalov D. Dolinar S. Shaw M. Yu N.
Deep Space Quantum Link **[#3039]**
The Deep Space Quantum Link will test the effects of gravity on quantum systems, test the non-locality of quantum states at deep space distances, and perform long distance quantum teleportation to an Earth-based receiver.

1:45 p.m. Williams J. R. Yu N. *
Clock Comparison and Distribution Beacon at Cislunar Orbits **[#3088]**
We propose an advanced optical clock system for Deep Space Gateway as a high-precision time beacon, seeking direct detection of dark matter fields; tests of gravity-induced frequency shifts for fundamental physics; and precision one-way spacecraft tracking/ranging.

2:00 p.m. Eubanks T. M. * Matsakis D. Rodal J. J. A. Fearn H. Radley C. F.
Time, Metrology, and Fundamental Physics with the Deep Space Gateway **[#3172]**
We describe how the Deep Space Gateway, equipped with optical atomic clocks, can be used to both test fundamental physics and develop chronometric spacecraft navigation techniques.

2:15 p.m. Chiow S. -w. * Yu N.
Dark Energy and Gravity Experiment Explorer and Pathfinder **[#3040]**
We propose to utilize the unique gravity and vacuum environment in the orbits of the Deep Space Gateway for direct detections of dark energy using atom interferometers, and for pathfinder experiments for future gravitational wave and dark matter detections.

2:30 p.m. Losekamm M. J. * Berger T.
Low-Energy Cosmic Rays: Radiation Environment Studies and Astrophysics on the Deep Space Gateway **[#3108]**
The Deep Space Gateway will be ideally located to investigate the cosmic radiation that astronauts are subjected to in deep space and to help shed light on one of the most intriguing astrophysical mysteries of today: What is the universe made of?

2:45 p.m. DISCUSSION

3:05 p.m. BREAK

Tuesday, February 27, 2018
ASTROPHYSICS: ASTROPHYSICS
3:15 p.m. Aspen Meeting Room

Chair: Harley Thronson

3:15 p.m. Hahn I. * Shao M. Turyshev S. G.
Microarcsecond Astrometry Telescope on the DSG **[#3015]**
Microarcsecond Astrometry Telescope is a small size telescope which extends accuracy beyond the current space telescopes to a microarcsecond level, by measuring systematic errors in the telescope optics and the focal plane using a laser metrology.

3:30 p.m. Miller R. S. * Ajello M. Beacom J. F. Bloser P. F. Burrows A. Errando M. Goldsten J. O. Hartmann D. Hoeflich P. Hungerford A. Lawrence D. J. Leary J. C. Leising M. D. Milne P. Peplowski P. N. The L. -S.
The Lunar Occultation Explorer (LOX): Establishing the Moon as a Platform for Next-Generation Nuclear Astrophysics Investigations **[#3094]**
The Lunar Occultation Explorer (LOX) is a paradigm shift that will leverage the power of a new observational paradigm to transform our understanding of the nuclear cosmos (0.1–10 MeV) and establish the Moon as a platform for astrophysics.

3:45 p.m. Hui C. M. * Briggs M. S. Goldstein A. Jenke P. Kocevski D. Wilson-Hodge C. A.
MoonBEAM: A Beyond-LEO Gamma-Ray Burst Detector for Gravitational-Wave Astronomy **[#3060]**
MoonBEAM, together with an Earth-orbit instrument, would probe the extreme processes in cosmic collision of compact objects and facilitate multi-messenger time-domain astronomy to explore the end of stellar life cycles and black hole formations.

4:00 p.m. Tauscher K. * Burns J. O. Monsalve R. Rapetti D.
The Gateway to Cosmic Dawn: A Low Frequency Radio Telescope for the Deep Space Gateway **[#3096]**
We suggest that, with a suitable antenna and receiver, the Deep Space Gateway can be used to measure the highly redshifted, global 21-cm signal from neutral hydrogen, a spectral imprint of the history of the universe onto cosmic background radiation.

4:15 p.m. Caldwell D. A. * Marchis F. Batalha N. M. Cabrol N. A. Smith J. C.
Earth as an Exoplanet: Spectral Monitoring of an Inhabited Planet **[#3180]**
We propose a spectrometer for the Deep Space Gateway to monitor Earth as an exoplanet. We will measure the variability with illumination phase, rotation, clouds, and season. Results will inform future searches for biomarkers on distant exoplanets.

4:30 p.m. DISCUSSION

Tuesday, February 27, 2018
SLPSRA: DISCUSSING AND DEFINING
DEEP SPACE GATEWAY RADIATION ENVIRONMENT
1:00 p.m. Birch Meeting Room

Chair: Jim Mantovani

1:00 p.m. Minow J. I. * Neergaard Parker L.
Space Radiation and Plasma Science Enabled by the Deep Space Gateway **[#3182]**
Deep Space Gateway (DSG) opportunities for investigating space radiation and plasma environments are discussed, including options that can be done at the DSG vehicle in lunar orbit, from DSG logistics vehicles, and subsatellites supported by DSG.

1:05 p.m. Spence H. E. * Jordan A. P. Joyce C. Rahmanifard F. Schwadron N. A. Smith S. S. Wilson J. K. Winslow R. Blake J. B. Mazur J. E. Townsend L. deWet W. Kasper J. C. Case A. W. Zeitlin C. J.
From Tempe to Denver: Realizing the Wargo Axiom with the Cosmic Ray Telescope for the Effects of Radiation (CRaTER) **[#3150]**
We present a retrospective of LRO from the perspective of space radiation. We review synergies between exploration enabling science and science enabling exploration. We describe how CRaTER's flight spare contributes both to the Deep Space Gateway.

1:10 p.m. Hassler D. M. * Ehresmann B.
Next Generation Fast Neutron Detector for Space Exploration (Mini-FND) **[#3175]**
SwRI has developed a miniature Fast Neutron Detector (mini-FND), for use in the Deep Space Gateway, to characterize the neutron albedo radiation. Mini-FND will provide coverage of the biologically relevant neutrons at energies of 500 keV and greater.

1:15 p.m. Kennedy S. O. Jr. * Dunn A. Lecomte J. Buchheim K. Johansson E. Berger T.
Alamos: An International Collaboration to Provide a Space Based Environmental Monitoring Solution for the Deep Space Network **[#3069]**
This abstract proposes the advantages of an externally mounted instrument in support of the human physiology, space biology, and human health and performance key science area. Alamos provides Space-Based Environmental Monitoring capabilities.

1:20 p.m. Narici L. * Baiocco G. Berrilli F. Giraudo M. Ottolenghi A. Rizzo A. Salina G.
Autonomous Monitoring of Radiation Environment and Personal Systems for Crew Enhanced SPE Protection (AMORE and PSYCHE) **[#3065]**
Understand the relationship between SPE precursors, the related SPE radiation inside the Deep Space Gateway, and the associated risk levels, validating existing models, proposing countermeasures actions via a real time, autonomous intelligent system.

1:25 p.m. Leitgab M. Semones E. * Mcleod C.
High Fidelity Measurement of Deep Space Gateway Intra-Vehicular Neutron Environment **[#3144]**
This neutron experiment will be designed to measure and characterize, at various locations inside the Deep Space Gateway, the neutron fields, and indirectly, the human impact of the shielding distribution of the vehicle and its payloads.

1:30 p.m. Rahmanifard F. * Schwadron N. A. Wilson J. Jordan A. Joyce C. J. Spence H. E. Blake J. B. Case A. W. Farrell W. M. Kasper J. C. Looper M. D. Lugaz N. Mays L. Mazur J. E. Petro N. Smith C. W. Townsend L. W. de Wet W. C. Winslow R. Zeitlin C.
The Worsening Space Environment: Increased Galactic Cosmic Radiation from Historically Weak Solar Magnetic Fields But with a Sun Still Spawning Historically Intense Solar Particle Events **[#3143]**
We report on observations from CRaTER on LRO and predict the dose rates of galactic cosmic rays throughout the next solar cycle. We use these results to predict the most conservative allowable mission durations.

1:35 p.m. Mantovani J. G. *
Deep Space Gateway as a Testbed to Study Effects of Regolith-Derived Radiation Shielding on Plant Growth During Long-Duration Exposure to Space Radiation **[#3148]**
Study of hydrogen-rich regolith as a radiation shield for plant growth during long-duration exposure to high energy space radiation. Comparable long-duration testing on Earth under similar radiation and vacuum conditions is not feasible due to costs.

1:40 p.m. DISCUSSION

2:10 p.m. BREAK

Tuesday, February 27, 2018
SLPSRA: DISCUSSING THE GENETIC IMPACT OF RADIATION AT THE DEEP SPACE GATEWAY
2:25 p.m. Birch Meeting Room

Chair: David Smith

2:25 p.m. Zea L. * Niederwieser T. Anthony J. Stodieck L.
Utilizing the Deep Space Gateway to Characterize DNA Damage Due to Space Radiation and Repair Mechanisms **[#3100]**
The radiation environment experienced in the Deep Space Gateway enables the interrogation of DNA damage and repair mechanisms, which may serve to determine the likelihood and consequence of the high radiation risk to prolonged human presence beyond LEO.

2:30 p.m. Venkateswaran K. * Wang C. Smith D. Mason C. Landry K. Rettberg P.
Characterization of Outer Space Radiation Induced Changes in Extremophiles Utilizing Deep Space Gateway Opportunities **[#3007]**
Extremophilic microbial survival, adaptation, biological functions, and molecular mechanisms associated with outer space radiation can be tested by exposing them onto Deep Space Gateway hardware (inside/outside) using microbiology and molecular biology techniques.

2:35 p.m. Griko Y. V. * Smith D. J.
Testing Survivability of Life Forms in Open Space Beyond LEO **[#3036]**
The Deep Space Gateway survivability experiments of microorganisms in open space beyond LEO are proposed in order to establish how deep space conditions are uniquely influential.

2:40 p.m. DISCUSSION

3:00 p.m. BREAK

Tuesday, February 27, 2018
SLPSRA: DISCUSSING THE EFFECTS OF DEEP SPACE GATEWAY RADIATION ON HUMANS, CELLS, AND DRUGS
3:15 p.m. Birch Meeting Room

Chair: Marianne Sowa

3:15 p.m. Hussey S. Blue R. S. Daniels V. Bayuse T. Zoldak J. Antonsen E. Lehnhardt K. *
Deep Space Radiation Effects on Pharmaceuticals **[#3149]**
This proposal seeks to identify detrimental effects on pharmaceutical stability imposed by the deep space radiation environment over time.

3:20 p.m. Almeida E. A. C. *
Deep Space Gateway as a Platform to Study Synergistic Radiation and Microgravity-Induced Tissue Degeneration Using the Bioculture System Single Cassette Hardware Design **[#3011]**
A major unknown for human exploration of deep space is the question of how the degenerative effects of microgravity unloading of cells and tissues may synergize with radiation. Here we describe cell culture hardware to study those combined effects.

3:25 p.m. Sowa M. B. * Lusby T. C. Straume T.
Considerations for the Study of Biological Effects in the Deep Space Environment **[#3121]**
Accurate prediction of the fundamental biological responses induced by radiation and microgravity exposures in deep space will benefit from inclusion of high-throughput data collection, computational approaches, and integrated radiation dosimetry.

3:30 p.m. Anthony J. H. * Niederwieser T. Zea L. Stodieck L.
Key Challenges for Life Science Payloads on the Deep Space Gateway **[#3107]**
Compared to ISS, Deep Space Gateway life science payloads will be challenged by deep space radiation and non-continuous habitation. The impacts of these two differences on payload requirements, design, and operations are discussed.

3:35 p.m. Jejelowo O. A. * Tariq M. A.
Exploring the Role of Piwi/piRNA Pathway in Epigenetic Dysregulation in Low Dose Radiation Induced Cardiovascular Disease **[#3178]**
We will utilize multi-omics to identify robust biomarkers and to understand radiation effects and develop countermeasures. Information obtained will enhance development of capabilities to monitor health in real time and for mitigation of risks.

3:40 p.m. Norsk P. * Simonsen L. C. Alwood J.
Synergistic and Additive Effects of Deep-Space Radiation and Weightlessness on Cell and Organ Function **[#3051]**
Investigations of mammalian cell cultures as well as organs-on-chips will be done from the Deep Space Gateway by telemetry. Cells will be monitored regularly for metabolic activity, growth, and viability, and results compared to ground control data.

3:45 p.m. Gaza R. * Hussein H. Murrow D. Hopkins J. Waterman G. Milstein O. Berger T. Przybyla B. Aeckerlein J. Marsalek K. Matthiae D. Rutczynska A.
Matroshka AstroRad Radiation Experiment (MARE) on the Deep Space Gateway **[#3042]**
The Matroshka AstroRad Radiation Experiment is a science payload on Orion EM-1 flight. A research platform derived from MARE is proposed for the Deep Space Gateway. Feedback is invited on desired Deep Space Gateway design features to maximize its science potential.

3:50 p.m. DISCUSSION

4:20 p.m. BREAK

Tuesday, February 27, 2018
SLPSRA: ALIGNING THE DEEP SPACE GATEWAY SCIENCE INVESTIGATIONS WITH THE DECADEL SURVEY AND THE SPACE BIOLOGY SCIENCE PLAN
4:35 p.m. Birch Meeting Room

Chair: Kevin Sato

4:35 p.m. Ferl R. J. *
Space Life and Physical Sciences in Deep Space: Perspective from an Observer of the Current Decadal **[#3064]**
Perspectives from the current Decadal Study on Space Life and Physical Sciences.

4:40 p.m. Quincy C. D. * Charles J. B. Hamill D. L. Sun S. C.
Deep Space Gateway Science Opportunities **[#3052]**
Life sciences see the Deep Space Gateway as an opportunity to investigate biological organisms in a unique environment that cannot be replicated in Earth-based labs or on LEO platforms. The needed capabilities must be built into the Gateway facility.

4:45 p.m. Bhattacharya S. *
The Importance of Conducting Life Sciences Experiments on the Deep Space Gateway Platform **[#3023]**
Life science research on the Deep Space Gateway platform is an important precursor for long term human exploration of deep space. Ideas for utilizing flight hardware and well characterized model organisms will be discussed.

4:50 p.m. Paul A-L. * Ferl R. J.
Plants as Part of the Deep Space Exploration Schema **[#3059]**
Modern molecular data evaluating the physiological impact of the deep space environment on terrestrial biology are non-existent. The cis-lunar habitat of Gateway can provide a research platform to fill this gap in knowledge crucial to exploration.

4:55 p.m. Sato K. Y. * Tomko D. L. Levine H. G. Quincy C. D. Rayl N. A. Sowa M. B. Taylor E. M. Sun S. C. Kundrot C. E.
Space Biology Model Organism Research on the Deep Space Gateway to Pioneer Discovery and Advance Human Space Exploration **[#3081]**
Model organisms are foundational for conducting physiological and systems biology research to define how life responds to the deep space environment. The organisms, areas of research, and Deep Space Gateway capabilities needed will be presented.

5:00 p.m. DISCUSSION

Tuesday, February 27, 2018
LUNAR AND PLANETARY: EXTERNAL INSTRUMENTS
1:00 p.m. Boxelder Meeting Room

Chairs: **Rick Elphic**
Dana Hurley

1:00 p.m. Stickle A. M. * Cahill J. T. S. Greenhagen B. T. Ernst C. M.
Moon Watch: Continuous Monitoring of the Lunar Surface to Constrain Impact Flux **[#3128]**
Current impact flux / Watch light curves and images / To find where and when.

1:05 p.m. Klene S. A. * Gural P. S.
Enhanced Benefits of Lunar Orbit Video Astrophotography **[#3160]**
Video astrophotography is capable of detecting transient events, which could be meteoroid impact flashes on the Moon, light curves from approaching near-Earth asteroids, and various forms of stellar occultations.

1:10 p.m. Needham D. H. * Moser D. E. Suggs R. M. Cooke W. J. Kring D. A. Neal C. R. Fassett C. I.
Impact Flash Monitoring Facility on the Deep Space Gateway **[#3031]**
Cameras mounted to the Deep Space Gateway exterior will detect flashes caused by impacts on the lunar surface. Observed flashes will help constrain the current lunar impact flux and assess hazards faced by crews living and working in cislunar space.

1:15 p.m. Keszthelyi L. * Gaddis L. Archinal B. Kirk R. Stone T. Portree D.
Using the Deep Space Gateway to Map Resources and Defend Earth **[#3116]**
The Deep Space Gateway would be a valuable platform for assessing lunar and asteroid resources for in situ utilization and for characterizing potentially hazardous near-Earth objects.

1:20 p.m. Englert C. R. * Nicholas A. C. Janches D. Pokorny P.
Lightsheet Meteoroid Detector **[#3070]**
Detecting meteoroids close to the Moon presents unique science opportunities. A novel instrument concept that uses a lightsheet to create a "virtual witness plate" allows large sensitive areas without requiring a physical structure to support it.

1:25 p.m. DISCUSSION

1:45 p.m. Honniball C. I. * Lucey P. G. Petro N. Hurley D. Farrell W.
Lunar Volatile System Dynamics: Observations Enabled by the Deep Space Gateway **[#3101]**
A UV spectrometer-imager and IR spectrometer are proposed to solve questions regarding the lunar volatile system. The instrument takes advantage of highly elliptical orbits and the thermal management system of the Deep Space Gateway.

1:50 p.m. Livengood T. A. * Anderson C. M. Chin G. Cohen B. Feaga L. Hewagama T. Protopapa S. Racette P.
SOLVENT – Simultaneous Observations of the Lunar Volatile EnvironmeNT **[#3125]**
SOLVENT will make Simultaneous Observations of the Lunar Volatile EnviornmeNT in complementary wavelength regimes, to measure the abundance of water and hydroxyl in the illuminated lunar surface and in the free space above it.

1:55 p.m. Hayne P. O. * Greenhagen B. T. Paige D. A. Cohen B. A.
Detection and Mapping of Lunar Ice with Active Illumination from the Deep Space Gateway **[#3141]**
We propose to illuminate the Moon's permanently shadowed regions using a high-power light source from the Gateway, to search for water and other volatiles.

2:00 p.m. Siegler M. * Ruf C. Putzig N. Morgan G. Hayne P. Paige D. Nagihara S. Weber R.
Lunar Heat Flux Measurements Enabled by a Microwave Radiometer Aboard the Deep Space Gateway **[#3123]**
We would like to present a concept to use the Deep Space Gateway as a platform for constraining the geothermal heat production, surface, and near-surface rocks, and dielectric properties of the Moon from orbit with passive microwave radiometery.

2:05 p.m. Archinal B. Gaddis L. Kirk R. Edmundson K. Stone T. Portree D. Keszthelyi L. *
Global Lunar Topography from the Deep Space Gateway for Science and Exploration **[#3174]**
The Deep Space Gateway, in low lunar orbit, could be used to achieve a long standing goal of lunar science, collecting stereo images in two months to make a complete, uniform, high resolution, known accuracy, global topographic model of the Moon.

2:10 p.m. Nuth J. A. III * Jenniskens P. M.
Gateway Studies of Dust Impacts at the Earth and Moon **[#3159]**
Analysis of ultraviolet meteor spectra impacting Earth would provide unbiased data for meteors and meteor streams traceable to their sources to provide chemical data for large samples of small bodies and better models of particle flux in cislunar space.

2:15 p.m. DISCUSSION

2:35 p.m. BREAK

Tuesday, February 27, 2018
LUNAR AND PLANETARY: CUBESATS
3:10 p.m. Boxelder Meeting Room

Chair: Shankar Bhattarai

3:10 p.m. Cadavid S. C. *
Mission Design and Selection of Nanosatellite Subsystems for Exploration of Lunar Water Deposits **[#3047]**
This project presents an initiative for the development of a lunar exploration mission, looking to cover the first steps of mission design and the specifications of the mission subsystems; the Cubesat 6U configuration is taken as the low cost platform.

3:15 p.m. Fisher K. R. *
Utilizing the Deep Space Gateway as a Platform for Deploying CubeSats into Lunar Orbit **[#3138]**
The Deep Space Gateway could serve as a platform to deploy CubeSats into lunar orbit by utilizing technology already developed for this purpose on the International Space Station.

3:20 p.m. Batchelor D. A. *
Occultation and Triangulation Camera (OcTriCam) Cubesat **[#3071]**
A camera at Sun-Earth L2 would provide a 240,000 km triangulation baseline to augment near-Earth object observations with Earth-based telescopes such as Pan-STARRS, and planetary occultation research to refine ephemerides and probe ring systems.

3:25 p.m. Dunham D. W. * Stakkestad K. Vedder P. McAdams J. Horsewood J. Genova A. L.
Exploration of Near-Earth Objects from the Deep Space Gateway **[#3140]**
The paper will show how clever use of orbital dynamics can lower delta-V costs to enable scientifically interesting missions. The high-energy Deep Space Gateway orbits can be used to reach NEOs, a trans node for crews, or to deploy small sats. Examples are given.

3:30 p.m. DISCUSSION

Tuesday, February 27, 2018
LUNAR AND PLANETARY: NEAR-EARTH OBJECTS SCIENCE
3:45 p.m. Boxelder Meeting Room

Chair: Angela Stickle

3:45 p.m. Asphaug E. * Thangavelautham J. Schwartz S.
Low-Gravity Centrifuge Facilities for Asteroid Lander and Material Processing and Manufacturing **[#3179]**
We are developing space centrifuge research facilities for attaining low-gravity to micro-gravity geological environmental conditions representative of the environment on the surfaces of asteroids and comets.

3:50 p.m. Graham L. * Fries M. Hamilton J. Landis R. John K. O'Hara W.
Deep Space Gateway "Recycler" Mission **[#3122]**
Use of the Deep Space Gateway provides a hub for a reusable planetary sample return vehicle for missions to gather star dust as well as samples from various parts of the solar system including main belt asteroids, near-Earth asteroids, and Mars moon.

3:55 p.m. Landis R. R. * Graham L. D.
Poor Man's Asteroid Sample Return Missions **[#3152]**
A cislunar platform at a Near-Rectilinear [Halo] Orbit in the vicinity of the Moon could provide an opportunity for a small NEA sample return mission at relatively low cost. There are a couple potential small (~1m) object target dynamical groups.

4:00 p.m. Shao M. * Turyshev S. Zhai C. Trahan R. Saini N.
Search for Near-Earth Objects from the Deep Space Gateway **[#3020]**
Synthetic tracking is a technique that can significantly increase sensitivity to detecting moving objects. A 30cm telescope on the Deep Space Gateway would significantly increase our discovery rate of small NEOs and of interstellar asteroids by ~30X.

4:05 p.m. DISCUSSION

4:20 p.m. BREAK

Tuesday, February 27, 2018
LUNAR AND PLANETARY: TELEROBOTICS
4:35 p.m. Boxelder Meeting Room

Chair: David Kring

4:35 p.m. Head J. W. * Pieters C. M. Scott D. R.
Deep Space Gateway Facilitates Exploration of Planetary Crusts: A Human/Robotic Exploration Design Reference Campaign to the Lunar Orientale Basin **[#3157]**
We outline an Orientale Basin Human/Robotic Architecture that can be facilitated by a Deep Space Gateway International Science Operations Center (DSG-ISOC) (like McMurdo/Antarctica) to address fundamental scientific problems about the Moon and Mars.

4:45 p.m. Lester D. F. *
Exploration Telepresence for Science, and Options at the Deep Space Gateway **[#3045]**
This paper reviews science opportunities for exploration telepresence, which is using low-latency telerobotics to perform high quality research from a safe and convenient site. This pertains to doing lunar surface science from the Deep Space Gateway.

4:55 p.m. Mellinkoff B. J. * Spydell M. M. Burns J. O.
Operational Constraints of Low-Latency Telerobotics from the Deep Space Gateway Due to Limited Bandwidth **[#3089]**
The operational constraints of low-latency telerobotics must be investigated to prepare for science missions enabled by telerobotics from the Deep Space Gateway. We conducted low-latency telerobotic experiments to identify constraints due to reduced bandwidth.

5:05 p.m. Walker M. E. * Burns J. O. Szafir D. J.
VR Simulation Testbed: Improving Surface Telerobotics for the Deep Space Gateway **[#3095]**
Design of a virtual reality simulation testbed for prototyping surface telerobotics. The goal is to create a framework with robust physics and kinematics to allow simulated teleoperation and supervised control of lunar rovers and rapid UI prototyping.

5:15 p.m. Da-Poian V. D.P. * Koryanov V.V. K.
CRAFT: Collaborative Rover and Astronauts Future Technology **[#3030]**
Our project is focusing on the relationship between astronauts and rovers to best work together during surface explorations. Robots will help and assist astronauts, and will also work autonomously. Our project is to develop this type of rover.

5:25 p.m. DISCUSSION

Tuesday, February 27, 2018
EARTH OBSERVATIONS: EXTERNAL INSTRUMENTS I
1:00 p.m. Cherry Meeting Room

Chair: Michael Ramsey

1:00 p.m. Krotkov N. * Bhartia P. K. Torres O. Li C. Sander S. Realmuto V. Carn S. Herman J.
Volcanic Cloud and Aerosol Monitor (VOLCAM) for Deep Space Gateway **[#3076]**
We propose complementary ultraviolet (UV) and thermal Infrared (TIR) filter cameras for a dual-purpose whole Earth imaging with complementary natural hazards applications and Earth system science goals.

1:20 p.m. Marchenko S. V. *
Monitoring the Earth's Radiation Budget **[#3027]**
The proposal describes a suite of broad-band radiometers aimed at precise (~0.1%) long-term monitoring of the Earth's radiative budget.

1:40 p.m. Marshak A. * Herman J.
Deep Space Earth Observations from DSCOVR **[#3005]**
The Deep Space Climate Observatory (DSCOVR) at Sun-Earth L1 orbit observes the full sunlit disk of Earth. There are two Earth science instruments on board DSCOVR — EPIC and NISTAR. We discuss if EPIC and NISAR-like instruments can be used in Deep Space Gateway.

2:00 p.m. Swartz W. H. * Lorentz S. R. Erlandson R. E. Cahalan R. F. Huang P. M.
Measuring Earth's Radiation Budget from the Vicinity of the Moon **[#3105]**
We propose to measure Earth's radiation budget (integrated total and solar-reflected shortwave) using broadband radiometers and other technology demonstrated in space. The instrument is compact, autonomous, and has modest resource requirements.

2:20 p.m. BREAK

2:40 p.m. Butler J. J. * Thome K. J.
Radiometric Calibration of Earth Science Imagers Using HyCalCam on the Deep Space Gateway Platform **[#3053]**
HyCalCam, an SI-traceable imaging spectrometer on the Deep Space Gateway, acquires images of the Moon and Earth to characterize the lunar surface and terrestrial scenes for use as absolute calibration targets for on-orbit LEO and GEO sensors.

3:55 p.m. Hu Y. * Marshak A. Omar A. Lin B. Baize R.
A Concept for Differential Absorption Lidar and Radar Remote Sensing of the Earth's Atmosphere and Ocean from NRHO Orbit **[#3130]**
We propose a concept that will put microwave and laser transmitters on the Deep Space Gateway platform for measurements of the Earth's atmosphere and ocean. Receivers will be placed on the ground, buoys, Argo floats, and cube satellites.

3:25 p.m. Huemmrich K. F. * Campbell P. E. Middleton E. M.
Deep Space Gateway Ecosystem Observatory **[#3153]**
Advance global understanding of seasonal change and diurnal variability of terrestrial ecosystem function, photosynthesis, and stress responses using spectral reflectance, thermal, and fluorescence signals.

3:45 p.m. Knyazikhin Y. * Park T. Hu B.
Earth Observation and Science: Monitoring Vegetation Dynamics from Deep Space Gateway **[#3181]**
Retrieving diurnal courses of sunlit (SLAI) and shaded (ShLAI) leaf area indices, fraction of photosynthetically active radiation (PAR) absorbed by vegetation (FPAR), and Normalized Difference Vegetation Index (NDVI) from Deep Space Gateway data.

4:05 p.m. Davis A. B. * Marshak A.
Complex Cloud and Radiative Processes Unfolding at the Earth's Terminator: A Unique Perspective from the Proposed Deep Space Gateway **[#3187]**
The Deep Space Gateway offers a unique vantage for Earth observation using reflected sunlight: day/night or night/day terminators slowly marching across the disc. It's an opportunity to improve our understanding of clouds at that key moment in their daily cycle.

4:25 p.m. DISCUSSION

Tuesday, February 27, 2018
HELIOPHYSICS: EXTERNAL PAYLOADS
1:00 p.m. Douglas Fir Meeting Room

Chairs: **Edward DeLuca**
Sabrina Savage

1:00 p.m. Savage S. * DeLuca E. Cheimets P. Golub L. Kobayashi K. McKenzie D. Rachmeler L. Winebarger A.
CisLunar Interchangeable Observatory for Heliophysics (CLIOH): A Deep Space Gateway Solar Viewing Platform for Technology Development and Research Payloads **[#3061]**
The Deep Space Gateway offers an unparalleled opportunity to test and operate solar instrumentation in a radiation hard environment, which can be achieved via an external pointing platform designed to accommodate multiple interchangeable payloads.

1:15 p.m. Cooper J. F. * Habbal S. R. Stubbs T. J. Glenar D. A.
Lunar Solar Origins Explorer (LunaSOX) for the Deep Space Gateway **[#3038]**
A solar telescope on Deep Space Gateway in lunar orbit could provide unprecedented brightness and spatial resolution for measurements of complex structures and small-scale features in the inner solar corona by using the lunar limb for occultation.

1:25 p.m. Newmark J. S. * Davila J. M.
Solar Coronagraphs from the DSG **[#3079]**
A solar coronagraph mounted on the Deep Space Gateway will enable unprecedented observations of the low solar corona; in particular provide key observational constraints on the initiation of Coronal Mass Ejections (CMEs).

1:35 p.m. Dennis B. R. Christe S. D. Shih A. Y. Holman G. D. Emslie A. G. Caspi A. *
Solar X-Ray and Gamma-Ray Imaging Spectroscopy **[#3186]**
X-ray and gamma-ray Sun observations from a lunar-based observatory would provide unique information on solar atmosphere thermal and nonthermal processes. EUV and energetic neutral atom imaging spectroscopy would augment the scientific value.

1:45 p.m. Provornikova E. P. * Izmodenov V. V. Laming J. M. Strachan L. Wood B. E. Katushkina O. A. Ko Y.-K. Tun Beltran S. Chakrabarti S.
Diagnostics of the Solar Wind and Global Heliosphere with Lyman-α Emission Measurements **[#3154]**
We propose to develop an instrument measuring full sky intensity maps and spectra of interplanetary Lyman- α emission to reveal the global solar wind variability and the nature of the heliosphere and the local interstellar medium.

1:55 p.m. Kontar E. P. * Emslie A. G.
Radio Imaging Spectroscopy of Physical Processes in the Inner Heliosphere **[#3185]**
Radio observations below ~100 MHz made using an array of small radio antennae on the lunar surface can provide unique insight into non-thermal processes in the corona and heliosphere. Such an array fits within reasonable weight, power, telemetry, and cost constraints.

2:05 p.m. DISCUSSION

2:15 p.m. BREAK

2:25 p.m. Paxton L. J. *
Imaging Geospace from Cis-Lunar Orbit **[#3098]**
I will discuss far ultraviolet remote sensing of the geospace environment from a platform in near-Earth space — in particular one in a cis-lunar orbit. I will discuss simple instrument designs that could be used to provide a low-cost solution.

2:40 p.m. Chua D. H. Socker D. G. Englert C. R. Carter M. T. Plunkett S. P. *
Korendyke C. M. Meier R. R.
Global Magnetospheric Imaging from the Deep Space Gateway in Lunar Orbit **[#3161]**
We propose to use the Deep Space Gateway as an observing platform for a magnetospheric imager that will capture the first direct global images of the interface between the incident solar wind and the Earth's magnetosphere.

2:50 p.m. Waldrop L. * Immel T. Clarke J. Fillingim M. Rider K. Qin J.
Bhattacharyya D. Doe R.
Geocoronal Imaging from the Deep Space Gateway **[#3134]**
UV imaging of geocoronal emission at high spatial and temporal resolution from deep space would provide crucial new constraints on global exospheric structure and dynamics, significantly advancing models of space weather and atmospheric escape.

3:00 p.m. Sibeck D. G. * Collier M. R. Porter F. S.
Observing the Magnetosphere in Soft X-Rays: The Lunar X-Ray Observatory (LXO) **[#3019]**
Wide field-of-view soft X-ray imagers in lunar orbit or on the lunar surface can be used to address many heliophysics objectives, including the nature of the solar wind magnetosphere-interaction, the lunar exosphere, and the helium focusing cone.

3:10 p.m. Halekas J. S. * Poppe A. R.
Monitoring the Outflow of Matter from the Earth and the Moon from the Deep Space Gateway **[#3106]**
The Deep Space Gateway provides an ideal vantage point from which to monitor the outflow of matter from the Earth and the Moon.

3:20 p.m. DISCUSSION

3:40 p.m. BREAK

Tuesday, February 27, 2018
HELIOPHYSICS: DUSTY PLASMAS — SMALL PARTICLES
3:50 p.m. Douglas Fir Meeting Room

Chair: Mihaly Horanyi

3:50 p.m. Malaspina D. M. * Horanyi M. Sternovsky Z.
Revolutionizing Our Understanding of Heliospheric Dust Dynamics from the Deep Space Gateway **[#3010]**
The Deep Space Gateway provides an opportunity for novel measurements of heliospheric nanometer dust grains, quantifying their interaction with the solar wind and leading to new advances in both dust physics and dust impact predictive capability.

4:00 p.m. Horanyi M. * Kempf S. Malaspina D. Poppe A. Srama R. Sternovsky Z. Szalay J.
Dust Measurements Onboard the Deep Space Gateway **[#3169]**
A dust instrument onboard the Deep Space Gateway will revolutionize our understanding of the dust environment at 1 AU, help our understanding of the evolution of the solar system, and improve dust hazard models for the safety of crewed and robotic missions.

4:10 p.m. Farrell W. M. * Orlando T. M. Dyar M. D. Hurley D. M. Hibbitts C. A. Jones B. M. McLain J. L.
Long Duration Exposure Platform (LDEP) **[#3132]**
We describe a facility to analyze material samples exposed externally to the harsh space plasma and meteoroid environment. We especially focus on examining any hydroxylation occurring within the top layers of the plasma-activated samples.

4:20 p.m. Wiens R. C. * Burnett D. S. Jurewicz A. Rieck K. Reisenfeld D. Kasper J. Clark B.
Solar Wind Sample Collection at the Deep Space Gateway **[#3151]**
A simple, long-term collection of solar wind at the Deep Space Gateway would provide new, higher-fluence samples to address a number of science objectives relating to solar abundances, solar physics, and heliophysics.

4:30 p.m. BREAK

4:40 p.m. Fries M. * Fisher K.
Direct Characterization of Comets and Asteroids via Cosmic Dust Analysis from the Deep Space Gateway **[#3120]**
The Deep Space Gateway can allow direct analysis of dust from over a dozen comets, using an instrument similar to the successful Cassini Dust Analyzer (CDA). Long-term measurements are preferred. Compositions of over a dozen asteroids and comets can be obtained.

4:50 p.m. Westphal A. J. * Butterworth A. L. Jilly-Rehak C. E. Gainsforth Z. Messenger S. R. Ogliore R. Stroud R. M.
DISC: Deep-Space Interstellar Dust Collector **[#3037]**
Deep Space Gateway presents an unprecedented opportunity to carry out an interstellar dust sample return mission with a collecting power sufficient to collect and return hundreds of tiny interstellar rocks to terrestrial laboratories.

5:00 p.m. Hu Z. W. *
What Could Be Learned from Phase Contrast X-Ray Nanotomography Analysis of Cosmic Dust Potentially Collected in Deep Space? **[#3099]**
Collecting cosmic dust in deep space would provide unbiased samples of primitive solar system materials for study. Nanotomography analysis of the most primitive dust particles would reveal direct new information on formation of our solar system.

5:10 p.m. DISCUSSION

Wednesday, February 28, 2018
ASTROPHYSICS: TELESCOPE ASSEMBLY AND SERVICING
8:30 a.m. Aspen Meeting Room

Chair: Slava Turyshev

8:30 a.m. Siegler N. * Mukherjee R. Greenhouse M. A. Grunsfeld J. M. MacEwen H. A. Peterson B. M. Pollidan R. S. Thronson H. A.
In-Space Assembly of Large Telescopes for Exoplanet Imaging and Characterization **[#3146]**
We will present a few different concepts in which the Deep Space Gateway can be used to robotically assemble large space telescopes and interferometers.

8:45 a.m. Peterson B. M. * Feinberg L. D. Greenhouse M. A. Grunsfeld J. M. Polidan R. S. Siegler N. Thronson H. A.
Servicing Large Space Telescopes with the Deep Space Gateway **[#3024]**
Future large space telescopes will require servicing to operate over lifetimes long enough to realize their full value and justify their expense. We discuss scenarios that will make servicing telescopes at Sun-Earth L2 possible.

9:00 a.m. Apai D. * Milster T. D. Arenberg J. Kim D. Liang R. Bixel A. Fellows C. Grunsfeld J.
Nautilus Deep Space Observatory: A Giant Segmented Space Telescope Array for a Galactic Biosignature Survey **[#3127]**
The preliminary design for a very large array of light-weight telescopes that will provide a light-collecting area equivalent to a 50m telescope, enabling an atmospheric biosignature survey in 1,000 earth-like transiting planets.

9:15 a.m. Grunsfeld J. M. * Siegler N. Mukherjee R.
Starshade Assembly Enabled by the Deep Space Gateway Architecture **[#3136]**
A starshade is a large external coronagraph which will allow the direct imaging and analysis of planets around nearby stars. We present how the Deep Space Gateway would enable the robotic/astronaut construction of a starshade.

9:30 a.m. DISCUSSION

9:50 a.m. BREAK

Wednesday, February 28, 2018
ASTROPHYSICS:
LOW FREQUENCY TELESCOPE AND SURFACE TELEROBOTICS
10:00 a.m. Aspen Meeting Room

Chair: Jennifer Heldmann

10:00 a.m. Burns J. O. * Fong T. Kring D. A. Hopkins J. B.
Space Science and Exploration on the Lunar Farside Facilitated by Surface Telerobotics from the Deep Space Gateway **[#3004]**
We discuss how surface telerobotics from the Deep Space Gateway can be used to collect geological samples from the Moon's far-side and deploy a low frequency radio telescope to study the unexplored Cosmic Dawn epoch of the early universe.

10:15 a.m. MacDowall R. J. * Farrell W. M. Burns J. O.
Importance of a Low Radio Frequency Interference Environment for the DSG **[#3165]**
The Deep Space Gateway (DSG) can serve radio astronomy in a variety of ways. Thus, it is important that DSG electronics, transmitters, and the instruments located on the DSG avoid contaminating the radio-quiet environment of the lunar far-side.

10:30 a.m. Monsalve R. A. * Burns J. O. Tauscher K. Rapetti D.
Telerobotic Deployment and Operation of a Lunar Farside Low Radio Frequency Cosmology Telescope from the Deep Space Gateway **[#3109]**
The Deep Space Gateway represents a unique opportunity to enable cosmological observations of the redshifted 21-cm line from the Lunar Farside, which emitted hydrogen gas during the formation of the first galaxies in the universe.

10:45 a.m. Rapetti D. * Tauscher K. Burns J. O. Switzer E. Mirocha J. Furlanetto S. Monsalve R.
Hydrogen Cosmology from the Deep Space Gateway: Data Analysis Pipeline for Low-Frequency Radio Telescopes **[#3087]**
The Deep Space Gateway will provide a unique opportunity for low-frequency radio telescopes shielded by the Moon to study the unexplored Cosmic Dawn, which our novel pipeline is able to constrain by extracting the spectrum of a neutral hydrogen line.

11:00 a.m. Bowman J. D. * Hallinan G. W. MacDowall R. J. Burns J. O.
Lunar Farside Radio Array Pathfinder Enabled by the Deep Space Gateway **[#3129]**
Two pressing questions in astrophysics and heliophysics can be addressed by a radio array on the lunar farside enabled by the Deep Space Gateway: 1) what is the habitability of exoplanets? and 2) how are energetic particles accelerated in solar bursts?

11:15 a.m. DISCUSSION

Wednesday, February 28, 2018
SLPSRA: DISCUSSING ASTRONAUT IMPACTS OF LIVING AT THE DEEP SPACE GATEWAY
8:30 a.m. Birch Meeting Room

Chair: Jennifer Fogarty

8:30 a.m. Shelhamer M. * Mindock J. A.
Tools for Systematic Identification of Cross-Disciplinary Research Relevant to Exploration Missions **[#3034]**
A Contributing Factor Map and text analytics on articles and reports can identify connections between major factors contributing to health and performance on Deep Space Gateway missions. Connections suggest experiment complements to maximize use of these flights.

8:35 a.m. Crucian B. * Zwart S. Smith S. M. Simonsen L. C. Williams T. Antonsen E.
Deep Space Environmental Effects on Immune, Oxidative Stress and Damage, and Health and Behavioral Biomarkers in Humans **[#3054]**
Biomarkers will be assessed in biological samples (saliva, blood, urine, feces) collected from crewmembers and returned to Earth at various intervals, mirroring (where feasible) collection timepoints used on the International Space Station (ISS).

8:40 a.m. Douglas G. L. * Barr Y. R.
Long-Term Stability of Spaceflight Food for Multi-Year Exploration Missions **[#3049]**
Stability of macro- and micro-nutrients and undesirable changes to texture and taste will be evaluated in food samples returned from the Deep Space Gateway after 1, 3, and 5 years of storage in the deep space radiation environment.

8:45 a.m. Thaxton S. S. Williams T. J. * Norsk P. Zwart S. Crucian B. Antonsen E. L.
Deep Space Spaceflight: The Challenge of Crew Performance in Autonomous Operations **[#3168]**
Distance from Earth and limited communications in future missions will increase the demands for crew autonomy and dependence on automation, and Deep Space Gateway presents an opportunity to study the impacts of these increased demands on human performance.

8:50 a.m. Williams T. J. * Norsk P. Zwart S. Crucian B. Simonsen L. C. Antonsen E.
Deep Space Spaceflight Hazards Effects on Cognition, Behavioral Health, and Behavioral Biomarkers in Humans **[#3167]**
Deep Space Gateway missions provide testing grounds to identify the risk of both behavioral performance and cognitive perturbations caused by stressors of spaceflight such as radiation, fluid shifts, sleep deprivation, chronic stress, and others.

8:55 a.m. Wotring V. E. * Strangman G. E. Donoviel D.
TRI-Worthy Projects for the Deep Space Gateway **[#3158]**
Preparations for exploration will require exposure to the actual deep space environment. The new TRI for Space Health proposes innovative projects using real space radiation to make medically-relevant measurements affecting human physiology.

9:00 a.m. Lagarde T. L. *
Habitability Study for Optimal Human Behavior **[#3113]**
The habitable volume per crew on the Deep Space Gateway will be smaller than on the ISS, going from 60 cubic meters to 20. This new confined space requires new accommodations and new techniques. This study will explore those techniques and the decisions required.

9:05 a.m. Stenger M. B. * Laurie S. S. Macias B. R. Barr Y. R.
Retinal Evaluation Using Optical Coherence Tomography (OCT) During Deep Space Gateway Missions **[#3063]**
Optical Coherence Tomography (OCT) imaging will be conducted before, during, and after Deep Space Gateway missions to evaluate changes in the retina and, in particular, the optic nerve head and surrounding structures. Additional parameters will be collected before and after flight.

9:10 a.m. DISCUSSION

9:40 a.m. BREAK

Wednesday, February 28, 2018
SLPSRA: REQUIREMENTS FOR INVESTIGATIONS AT DEEP SPACE GATEWAY
9:55 a.m. Birch Meeting Room

Chair: Charles Quincy

9:55 a.m. Lewis R. * Wright M.
Packing a Punch: Enabling Cutting Edge Science and Research on the Deep Space Gateway — Despite Constraints **[#3183]**
Techniques, systems, and processes employed to enable, enhance, produce, and deliver significant, breakthrough science and research results under mass-volume-energy constraints, as with the Deep Space Gateway, are discussed.

10:00 a.m. Santa Maria S. R. * Liddell L. C. Tieze S. M. Ricco A. J. Hanel R. Bhattacharya S.
Using Autonomous Bio Nanosatellites for Deep Space Exploration **[#3022]**
NASA's BioSentinel mission will conduct the first study of biological response to deep-space radiation in 45 years. It is an automated nanosatellite that will measure the DNA damage response to ambient space radiation in a model biological organism.

10:05 a.m. Anikushina V. * Taratukhin V. Stutterheim C. v. Gushin V.
Innovative Method in Improving Communication Issues by Applying Interdisciplinary Approach. Psycholinguistic Perspective to Mitigate Communication Troubles During Cislunar Travel. **[#3102]**
A new psycholinguistic view on the crew communication, combined with biochemical and psychological data, contributes to noninvasive methods for stress appraisal and proposes alternative approaches to improve in-group communication and cohesion.

10:10 a.m. Niederwieser T. * Zea L. Anthony J. Stodieck L.
Basic and Applied Algal Life Support System Research on Board the Deep Space Gateway **[#3104]**
We study the effect of long-term preservation methods on DNA damage of algal cultures for BLSS applications. In a secondary step, the Deep Space Gateway serves as a technology demonstration platform for algal photobioreactors in intermittently occupied habitats.

10:15 a.m. Smith D. J. * Parra M. Lane M. Almeida E. A. Space Biosciences Research Branch
Gateway BioBox: A Compact, Multi-Purpose Biological Hardware Suite for In Situ Experiments and Analyses in Deep Space **[#3041]**
A compilation of NASA's smallest biological hardware systems (plus 1-g gravity controls and ancillary sensors) that will allow for a wide range of specimen cultivation and analysis, from molecular measurements to broader cell and tissue assays.

10:20 a.m. Alwood J. S. * Shirazi-Fard Y. Pletcher D. Globus R. K.
Semi-Autonomous Rodent Habitat for Deep Space Exploration **[#3115]**
More autonomous rodent research systems will facilitate longer duration experiments to be conducted farther from Earth.

10:25 a.m. Fritsche R. F. * Romeyn M. W. Massa G.
The Gateway Garden — A Prototype Food Production Facility for Deep Space Exploration **[#3026]**
CIS-lunar space provides a unique opportunity to perform deep space microgravity crop science research while also addressing and advancing food production technologies that will be deployed on the Deep Space Transport.

10:30 a.m. Morrow R. C. * Wetzel J. P. Richter R. C.
Hybrid Life Support System Technology Demonstrations **[#3126]**
Demonstration of plant-based hybrid life support technologies in deep space will validate the function of these technologies for long duration missions, such as Mars transit, while providing dietary variety to improve habitability.

10:35 a.m. Brassard D. Clime L. Daoud J. Geissler M. Malic L. Charlebois D. Buckley N. Veres T. *
Microfluidic-Based Platform for Universal Sample Preparation and Biological Assays Automation for Life-Sciences Research and Remote Medical Applications **[#3190]**
An innovative centrifugal microfluidic universal platform for remote bio-analytical assays automation required in life-sciences research and medical applications, including purification and analysis from body fluids of cellular and circulating markers.

10:40 a.m. DISCUSSION

11:10 a.m. BREAK

Wednesday, February 28, 2018
SLPSRA: MOVING FORWARD WITH EXPANDED DEEP SPACE GATEWAY SCIENCE CONCEPTS
11:25 a.m. Birch Meeting Room

Chair: Doris Hamill

11:25 a.m. Menezes A. A. *
Realizing a Self-Reproducing Space Factory with Engineered and Programmed Biology **[#3145]**
We propose testing a data-driven, technologically-backed space biomanufacturing platform at the Deep Space Gateway that realizes a highly-valued concept, a self-reproducing space factory.

11:30 a.m. Meier A. J. * Hintze P. E.
Closing the Loop on Space Waste **[#3086]**
A heat transfer study of mission mixed waste streams in a reactor hot zone, along with solid, tar, and water recovery. This research enables reliability and benefit on waste conversion systems to manage our environmental impact, on- and off-Earth.

11:35 a.m. Wallace S. * Graham L.
Partial Gravity Biological Tether Experiment on the Deep Space Gateway **[#3184]**
A tether-based partial gravity bacterial biological experiment represents a viable biological experiment to investigate the fundamental internal cellular processes between altered levels of gravity and cellular adaption.

11:40 a.m. Raychev R. * Griko Y. V.
Technology Assessment for External Implementation of Artificial Gravity Utilizing the Deep Space Gateway Platform **[#3083]**
Scenario drafting for early technology assessment of the external space centrifuge with little mass and variable radius of rotation is proposed to counteract micro gravity-associated physiological alterations in all physiological systems.

11:45 a.m. Seyedmadani K. * Gruber J. A. Clark T. K.
The Linear Sled "Hybrid" Approach for Artificial Gravity as a Countermeasure for Crewed Deep Space Gateway Missions **[#3082]**
Our proposed linear sled-hybrid artificial gravity subsystem is a potential comprehensive approach to physiological deconditioning due to microgravity for the crew during long-duration and Deep Space Gateway missions.

11:50 a.m. Hamill D. L. *
Biological Observatory at the Deep Space Gateway **[#3033]**
The Deep Space Gateway offers invaluable opportunities for important life sciences research. But the research needs vastly outstrip the Deep Space Gateway's capacity to support them. A biological observatory would enhance its ability to support life sciences.

11:55 a.m. DISCUSSION

Wednesday, February 28, 2018
LUNAR AND PLANETARY: SAMPLES
8:30 a.m. Boxelder Meeting Room

Chair: Cindy Evans

8:30 a.m. Bakambu J. N. Shaw A. * Fulford P. Osinski G. Bourassa M. Rehmatullah F. Zanetti M. Rembala R.
Lunar Science Enabled by the Deep Space Gateway and PHASR Rover **[#3103]**
The Deep Space Gateway will be a tremendous boon to lunar surface science. It will enable the PHASR Rover, a concept for a Canadian rover system, with international contributions and the goal of sample acquisition and lunar surface science.

8:35 a.m. Bourassa M. * Osinski G. R. Cross M. Hill P. King D. Morse Z. Pilles E. Tolometti G. Tornabene L. L. Zanetti M.
Science Goals and Objectives for Canadian Robotic Exploration of the Moon Enabled by the Deep Space Gateway **[#3135]**
Canadian contributions to the science goals and objectives of a lunar precursor rover for HERACLES, an international mission concept, are discussed. Enabled by the Deep Space Gateway, this rover is a technical demonstrator for robotic sample return.

8:40 a.m. Kring D. A. *
Accessing the Lunar Farside and Facilitating Human-Assisted Sample Return with the Deep Space Gateway **[#3043]**
The Deep Space Gateway provides a platform for crew to tele-operate a sample-collecting rover and also provides a communication relay to farside surface sites.

8:45 a.m. Downes H. * Crawford I. A. Alexander L.
Lunar Sample Return Missions Using a Tele-Robotic Lander **[#3025]**
Deep Space Gateway would allow tele-robotic landers and rovers to access regions of the Moon which have not been previously sampled. Scientific questions, e.g., the nature and duration of volcanic activity and the composition of the mantle/lower crust, could be addressed.

8:50 a.m. Lupisella M. * Bleacher J. Lewis R. Dworkin J. Wright M. Burton A. Rubins K. Wallace S. Stahl S. John K. Archer D. Niles P. Regberg A. Smith D. Race M. Chiu C. Russell J. Rampe E. Bywaters K.
Low-Latency Telerobotic Sample Return and Biomolecular Sequencing for Deep Space Gateway **[#3032]**
Low-latency telerobotics, crew-assisted sample return, and biomolecular sequencing can be used to acquire and analyze lunar farside and/or Apollo landing site samples. Sequencing can also be used to monitor and study Deep Space Gateway environment and crew health.

8:55 a.m. Berinstain A. * Richards R. D.
Low-Cost Planetary Missions Enabled by the Deep Space Gateway **[#3092]**
The authors will present options for discussion among participants of how low-cost lunar and planetary missions using the Moon Express family of spacecraft can be enabled by the presence of the Deep Space Gateway.

9:00 a.m. Cichan T. * Hopkins J. B. Bierhaus B. Murrow D. W.
Communications Relay and Human-Assisted Sample Return from the Deep Space Gateway **[#3084]**
The Deep Space Gateway can enable or enhance exploration of the lunar surface through two capabilities: 1. communications relay, opening up access to the lunar farside, and 2. sample return, enhancing the ability to return large sample masses.

9:05 a.m. DISCUSSION

9:25 a.m. Regberg A. B. * Fries M. D. Harrington A. D. Mitchell J. L. Snead C. McCubbin F. M.
The Deep Space Gateway as a Testbed for Advanced Curation Concepts **[#3112]**
Samples need a home / For preliminary science / Cold and sterile.

9:30 a.m. DiGregorio B. E. *
The Moon: A 100% Isolation Barrier for Earth During Exobiological Examination of Solar System Sample Return Missions **[#3077]**
The only 100% guarantee of protecting our planet's biosphere from a back contamination event is to use the Moon as a sample return examination facility to qualify samples for eventual return to Earth.

9:35 a.m. Spry J. A. Siegel B. Race M. Rummel J. D. * Pugel D. E. Groen F. J. Kminek G. Conley C. A. Carosso N. J.
Advances in Planetary Protection at the Deep Space Gateway **[#3111]**
Planetary protection knowledge gaps that can be addressed by science performed at the Deep Space Gateway in the areas of human health and performance, space biology, and planetary sciences that enable future exploration in deep space, at Mars, and other targets.

9:40 a.m. DISCUSSION

9:55 a.m. BREAK

10:10 a.m. Cohen B. A. * Eigenbrode J. A. Young K. E. Bleacher J. E. Trainer M. E.
Enabling Global Lunar Sample Return and Life-Detection Studies Using a Deep-Space Gateway **[#3012]**
The Deep Space Gateway could uniquely enable a lunar robotic sampling campaign that would provide incredible science return as well as feed forward to Mars and Europa by testing instrument sterility and ability to distinguish biogenic signals.

10:15 a.m. Calaway M. J. * Evans C. A. Garrison D. H. Bell M. S.
An Integrated Science Glovebox for the Gateway Habitat **[#3058]**
A Deep Space Gateway astromaterials glovebox facility would enable science to return to Earth collected astromaterials from the Moon and ultimately Mars. Next generation habitats will benefit from on-board glovebox capability.

10:20 a.m. Evans M. E. * Needham D. H. Fisher K. R. Lawrence S. J. Niles P. B. Harmeyer S. G. Nguyen H. T. Othon W. L.
Developing Science Procedures for Deep Space Gateway Habitat Mockup Ground Testing **[#3078]**
Science procedures for telerobotics, observations, and lunar sample return packaging have been developed and tested to evaluate NextStep contractor habitation mockups. Test results from these procedures aid requirements development for the Deep Space Gateway.

10:25 a.m. Gernhardt M. L. * Bekdash O. S. Trevino R. C.
Utilizing the Habitable Airlock Transfer Port as a Modular, Low Volume Science Airlock **[#3085]**
The Habitable Airlock, one of several Deep Space Gateway options for providing airlock capabilities, provides the capability of integrating a low volume science airlock for bringing in samples, ORUs, and other hardware into and out of the vehicle.

10:30 a.m. Bleacher J. E. * Gendreau K. Arzoumanian Z. Young K. E. McAdam A.
Using Instruments as Applied Science, Multipurpose Tools During Human Exploration: An XRD/XRF Demonstration Strategy for the Deep Space Gateway **[#3137]**
Science instruments to be used during human exploration should be designed to serve as multipurpose tools that are of use throughout a mission. Here we discuss a multipurpose tool approach to using contact XRD/XRF onboard the Deep Space Gateway.

10:35 a.m. Sibille L. * Mantovani J. G. Townsend I. I. Mueller R. P.
Multifunctional Interface Facility for Receiving and Processing Planetary Surface Materials for Science Investigation and Resource Evaluation at the Deep Space Gateway **[#3142]**
The concepts describe hardware and instrumentation for the study of planetary surface materials at the Deep Space Gateway as a progressive evolution of capabilities for eliminating the need for special handling and Planetary Protection (PP) protocols inside the habitats.

10:40 a.m. DISCUSSION

Wednesday, February 28, 2018
LUNAR AND PLANETARY: SURFACE INSTRUMENT DELIVERY
11:00 a.m. Boxelder Meeting Room

Chair: Greg Chavers

11:00 a.m. Nagihara S. * Zacny K. Chu P. Kiefer W. S.
Lunar Global Heat Flow Mapping with a Reusable Lander Deployed from the Deep Space Gateway Spacecraft **[#3009]**
We propose to equip the Deep Space Gateway spacecraft with a reusable lander that can shuttle to and from the lunar surface, and use it for collecting heat flow measurements globally on the lunar surface.

11:05 a.m. Huang S. *
Deep Space Gateway as a Deployment Staging Platform and Communication Hub of Lunar Heat Flow Experiment **[#3072]**
The idea is to use Deep Space Gateway as a staging platform for the deployment of lunar heat flow experiment, and consequentially as a communication hub of the installed heat flow experiment. The concept was derived from the canceled Lunar-A mission.

11:10 a.m. Weber R. C. * Neal C. R. Kedar S. Panning M. Schmerr N. C. Siegler M. Banerdt W. B.
Lunar Seismology Enabled by a Deep Space Gateway **[#3091]**
The lunar community recognizes geophysics as a high-priority science objective for future lunar landed missions. We outline several concepts for lunar seismology as enabled by the Deep Space Gateway.

11:15 a.m. Wang X. * Sternovsky Z. Horanyi M.
In-Situ Measurements of Electrostatic Dust Transport on the Lunar Surface **[#3066]**
A design of the Cubesat Electrostatic Dust Analyzer (CEDA) is described to verify and characterize the electrostatic dust transport process on the lunar surface and to estimate its effect on the surface evolution.

11:20 a.m. Chi P. J. * Russell C. T. Strangeway R. J. Farrell W. M. Garrick-Bethell I. Taylor P.
Science Investigations Enabled by Magnetic Field Measurements on the Lunar Surface **[#3173]**
We present examples of the geophysical and heliophysics investigations that can be performed with magnetic field measurements on the lunar surface enabled by the support/servicing of lunar landers from the Deep Space Gateway.

11:25 a.m. Chavers D. G. * Whitley R. J. Percy T. K. Needham D. H. Polsgrove T. T.
Enhancing Return from Lunar Surface Missions via the Deep Space Gateway **[#3193]**
The Deep Space Gateway (DSG) will facilitate access to and communication with lunar surface assets. With a science airlock, docking port, and refueling capability in an accessible orbit, the DSG will enable high priority science across the lunar surface.

11:30 a.m. DISCUSSION

Wednesday, February 28, 2018
EARTH OBSERVATIONS: EXTERNAL INSTRUMENTS II
8:30 a.m. Cherry Meeting Room

Chair: Alexander Marshak

8:30 a.m. Jiang J. H. * Natraj V. Herman J. Zhai C. Su H. Yung Y.
A Lunar Orbiter for Earth and Exoplanet Studies **[#3191]**
A study to explore the science and technology of building an Earth observatory in Moon's orbit to provide a stable, serviceable, long-term, global, continuous full spectral view of the Earth from the UV to IR.

8:50 a.m. Varnai T. * Marshak A.
Specular Reflection of Sunlight from Earth **[#3171]**
The Deep Space Gateway vantage point offers advantages in observing specular reflection from water surfaces or ice crystals in clouds. Such data can give information on clouds and atmospheric aerosols, and help test algorithms of future exoplanet characterization.

9:10 a.m. Wu D. L. *
Earth's Microwave Pulses from a Lunar Orbit **[#3008]**
Terrestrial microwave emissions contain rich information on its climate as well as man-made changes. The envisioned instrument is a single-beam spectro-radiometer from a lunar orbit measuring Earth full-disk emissions at 1-2000 GHz.

9:30 a.m. Gorkavyi N. * DeLand M.
Earth-from-Luna Limb Imager (ELLI) for Deep Space Gateway **[#3155]**
The new type of limb imager with a high-frequency imaging proposed for Deep Space Gateway. Each day this CubeSat' scale imager will generate the global 3D model of the aerosol component of the Earth's atmosphere and Polar Mesospheric Clouds.

9:50 a.m. BREAK

10:05 a.m. Ramsey M. S. * Christensen P. R.
Thermal Infrared Earth Imaging from the DSG **[#3164]**
Thermal infrared (TIR) image-based and spectral-based data from the Deep Space Gateway would allow for the detection of thermally-elevated features and detailed compositional analysis of atmospheric and surface processes on the Earth.

10:35 a.m. Ackleson S. G. Bowles J. H. * Mouroulis P. Philpot W. D.
EARTHS (Earth Albedo Radiometer for Temporal Hemispheric Sensing) **[#3133]**
We propose a concept for measuring the hemispherical Earth albedo in high temporal and spectral resolution using a hyperspectral imaging sensor deployed on a lunar satellite, such as the proposed NASA Deep Space Gateway.

10:55 a.m. Lang T. J. * Blakeslee R. J. Cecil D. J. Christian H. J. Gatlin P. N. Goodman S. J. Koshak W. J. Petersen W. A. Quick M. Schultz C. J. Tatum P. F.
The Deep Space Gateway Lightning Mapper (DLM) — Monitoring Global Change and Thunderstorm Processes through Observations of Earth's High-Latitude Lightning from Cis-Lunar Orbit **[#3017]**
We propose the Deep Space Gateway Lightning Mapper (DLM) instrument. The primary goal of the DLM is to optically monitor Earth's high-latitude (50° and poleward) total lightning not observed by current and planned spaceborne lightning mappers.

11:15 a.m. Majid W. A. *
Global Multi-Wavelength Observation of Terrestrial Gamma-Ray Flashes **[#3119]**
Global multi-wavelength observation of terrestrial gamma-ray flashes using platforms on-board the Deep Space Gateway.

11:35 a.m. Luvall J. C. * Tkaczyk T S. Alexander D. Pawlowsk M. E. Dwight J. G. Howell B. Tatum P. F.
Tunable Light-Guide Image Processing Snapshot Hyperspectral Spectrometer (TuLIPSS) for Earth and Moon Observations **[#3139]**
A tunable light-guide hyperspectral image processing snapshot spectrometer (TuLIPSS) for Earth science research and observation is being developed through a NASA instrument incubator project with Rice University and Marshall Space Flight Center.

11:55 a.m. DISCUSSION

Wednesday, February 28, 2018
HELIOPHYSICS: SPACE WEATHER
8:30 a.m. Douglas Fir Meeting Room

Chair: Yaireska Collado-Vega

8:30 a.m. Berger T. E. * Baker D. N. Woods T. N.
Space Weather Research and Operational Observing from a Cis-Lunar Deep Space Gateway **[#3147]**
We review the status of observational architectures for space weather research and operational forecasting and suggest ways in which the Deep Space Gateway may act as an ideal supplement to current and future space weather observing platforms.

8:40 a.m. Barjatya A. *
Spacecraft Charging and Space Environment Monitoring System Using Distributed Langmuir Probes Around the Deep Space Gateway **[#3162]**
The use of a a Langmuir probe suite of instruments distributed around the Deep Space Gateway/habitat to monitor spacecraft charging as well as space environment in the spacecraft vicinity.

8:50 a.m. DeForest C. E. * Laurent G.
Instruments for Deep Space Weather Prediction and Science **[#3176]**
We discuss remote space weather monitoring system concepts that could mount on the Deep Space Gateway and provide predictive capability for space weather events including SEP events and CME crossings, and advance heliophysics of the solar wind.

9:00 a.m. DeLuca E. E. * Golub L. Korreck K. Savage S. McKenzie D. D. Rachmeler L. Winebarger A. Martens P.
Using DSG to Build the Capability of Space Weather Forecasting in Deep Space **[#3050]**
The prospect of astronaut missions to deep space and off the Sun-Earth line raises new challenges for space weather awareness and forecasting. We need to identify the requirements and pathways that will allow us to protect human life and equipment.

9:10 a.m. St Cyr O. C. Davila J. M. Newmark J. *
Space Weather Diamond: A 10x Improvement in Real-Time Forecasting **[#3057]**
Space Weather Diamond is based on a constellation of four platforms that are phased into eccentric heliocentric orbits but, from the perspective of a fixed Sun-Earth line, the spacecraft appear to orbit Earth.

9:20 a.m. Parker L. Minow J. Pulkkinen A. * Fry D. Semones E. Allen J. St Cyr C. Mertens C. Jun I. Onsager T. Hock R.
Evaluating Space Weather Architecture Options to Support Human Deep Space Exploration of the Moon and Mars **[#3170]**
NASA's Engineering and Space Center (NESC) is conducting an independent technical assessment of space environment monitoring and forecasting architecture options to support human and robotic deep space exploration.

9:30 a.m. Collado-Vega Y. M. * Kuznetsova M. Mays L. Pulkkinen A. Zheng Y. Muglach K. Thompson B. Chulaki A. Taktakishvili A. CCMC Team
Space Weather Research and Forecasting Capabilities at the Community Coordinated Modeling Center (CCMC) **[#3090]**
The Community Coordinated Modeling Center (CCMC) supports and enables the research and development of the latest and future space weather models and facilitates the deployment of the latest advances in research of space weather operations.

9:40 a.m. DISCUSSION

9:50 a.m. BREAK

10:00 a.m. Spence H. E. * Jordan A. P. Joyce C. Rahmanifard F. Schwadron N. A. Smith S. S. Wilson J. K. Winslow R. Blake J. B. Mazur J. E. Townsend L. deWet W. Kasper J. C. Case A. W. Zeitlin C. J.
From Tempe to Denver: Realizing the Wargo Axiom with the Cosmic Ray Telescope for the Effects of Radiation (CRaTER) **[#3150]**
We present a retrospective of LRO from the perspective of space radiation. We review synergies between exploration enabling science and science enabling exploration. We describe how CRaTER's flight spare contributes both to the Deep Space Gateway.

10:10 a.m. Wu X. * Ambrosi G. Bertucci B.
Real-Time Penetrating Particle Analyzer (PAN) **[#3029]**
The PAN can measure penetrating particles with great precision to study energetic particles, solar activities, and the origin and propagation of cosmic rays. The real-time monitoring of penetrating particles is crucial for deep space human travel.

10:20 a.m. Schwadron N. A. * Bloser P. Jordan A. Legere J. Mazur J. Rahmanifard F. Ryan J. Spence H. E. Wilson J. Zeitlin C.
Dose Spectra from Energetic Particles and Neutrons (DoSEN) **[#3097]**
DoSEN is an early-stage space technology project that offers advantages for active measurement of the complete spectrum of radiation. DoSEN combines two advanced radiation detection concepts with fundamental advantages over traditional dosimetry.

10:30 a.m. Leitgab M. *
High Fidelity Measurement of Free Space Solar Particle Event and Galactic Cosmic Ray Environments at Intermediate Energies **[#3117]**
A charged particle measurement experiment mounted externally to the Deep Space Gateway is proposed, contributing to improving astronaut radiation exposure management during Solar Particle Events and Extra Vehicular Activities.

10:40 a.m. Martens P. C. *
Forecasting Space Weather Hazards for Astronauts in Deep Space **[#3188]**
Deep Space Gateway provides a unique platform to develop, calibrate, and test a space weather forecasting system for interplanetary travel in a real life setting. We will discuss requirements and design of such a system.

10:50 a.m. Rahmanifard F. * Schwadron N. A. Wilson J. Jordan A. Joyce C. J. Spence H. E. Blake J. B. Case A. W. Farrell W. M. Kasper J. C. Looper M. D. Lugaz N. Mays L. Mazur J. E. Petro N. Smith C. W. Townsend L. W. de Wet W. C. Winslow R. Zeitlin C.
The Worsening Space Environment: Increased Galactic Cosmic Radiation from Historically Weak Solar Magnetic Fields But with a Sun Still Spawning Historically Intense Solar Particle Events **[#3143]**
We report on observations from CRaTER on LRO and predict the dose rates of galactic cosmic rays throughout the next solar cycle. We use these results to predict the most conservative allowable mission durations.

11:00 a.m. Hassler D. M. * Ehresmann B.
Next Generation Fast Neutron Detector for Space Exploration (Mini-FND) **[#3175]**
SwRI has developed a miniature Fast Neutron Detector (mini-FND), for use in the Deep Space Gateway, to characterize the neutron albedo radiation. Mini-FND will provide coverage of the biologically relevant neutrons at energies of 500 keV and greater.

11:10 a.m. Solomey N. * Barghouty N. Christl M. Johnson L. Meyer H.
Deep-Space Test of a Neutrino Detector **[#3002]**
Changes in solar neutrino flux make it advantageous to take a detector into space since it changes as the inverse square of the distance from the Sun. A space-craft with a neutrino detector in solar orbit would perform science study opportunities.

11:20 a.m. DISCUSSION

Wednesday, February 28, 2018
HELIOPHYSICS: CUBESATS AND SMALLSATS
11:30 a.m. Douglas Fir Meeting Room

Chairs: **Justin Kasper**
Pamela Clark

11:30 a.m. Kasper J. C. *
Heliophysics Radio Observations Enabled by the Deep Space Gateway **[#3163]**
This presentation reviews the scientific potential of low frequency radio imaging from space, the SunRISE radio interferometer, and the scientific value of larger future arrays in deep space and how they would benefit from the Deep Space Gateway.

11:40 a.m. Vourlidas A. * Ho G. C. Cohen I. J. Korendyke C. M. Tun-Beltran S. Plunkett S. P. Newmark J. St Cyr O. C. Hoeksema T.
Using the Deep Space Gateway to Build the Next Generation Heliophysics Research Grid **[#3055]**
The Heliophysics Research Grid (HRG) consists of in situ and imaging sensors, distributed in key locations in the heliosphere for research and to support space exploration needs. The Deep Space Gateway enables the HRG as a storage and staging hub for HRG launches.

11:50 a.m. Ho G. C. * Vourlidas A. Westlake J. H. Cohen I. J.
The Deep Space Gateway Opportunity for Next Generation Space Weather Measurements **[#3046]**
The near-Earth vicinity of the Deep Space Gateway could represent the first step in formulation of a new space weather system, potentially providing a broad range of infrastructure to enable a paradigm-shifting approach to how measurements are made.

12:00 p.m. Sibeck D. G. * Batchelor D. A.
Investigation of the Magnetic Fieldsand Energetic Particles in Earth's Magnetotail **[#3124]**
An opportunity to deploy a spacecraft from the Earth-Sun L2 libration point would enable important scientific research to be performed in a region of Earth's magnetic environment that deserves much further study, the region known as the magnetotail.

12:10 p.m. Clark P. E. * Collier M. R. Farrell W. M.
In-Situ Environmental Monitoring and Science Investigations Enabled by the Deep Space Gateway **[#3035]**
A distributed network of instrument packages in an ARTEMIS-like orbit will serve as the much-needed basis for on-going monitoring of cislunar environmental dynamics, critical for a successful human presence on the Moon.

12:20 p.m. DISCUSSION

Wednesday, February 28, 2018
ORBIT DISCUSSION
1:00 p.m. Alder Ballroom

Chair: Ryan Whitley

1:00 p.m. Ryan Whitley *
Deep Space Gateway Orbit Review

1:15 p.m. Gorjian V. *
Breakthrough Science Enabled by Regular Access to Orbits Beyond Earth **[#3118]**
Regular launches to the Deep Space Gateway (DSG) will enable smallsats to access orbits not currently easily available to low cost missions. These orbits will allow great new science, especially when using the DSG as an optical hub for downlink.

1:20 p.m. Genova A. L. * Dunham D. W. Hardgrove C.
Supporting a Deep Space Gateway with Free-Return Earth-Moon Periodic Orbits **[#3131]**
Earth-Moon periodic orbits travel between the Earth and Moon via free-return circumlunar segments and can host a station that can provide architecture support to other nodes near the Moon and Mars while enabling science return from cislunar space.

1:25 p.m. DISCUSSION

Wednesday, February 28, 2018
POTENTIAL FUTURE CAPABILITIES
1:00 p.m. Boxelder Meeting Room

Chair: Steve Mackwell

1:00 p.m. Othon W.L. *
Evaluating Deep Space Gateway Habitats for Science via Ground Test

1:05 p.m. Smitherman D. V. * Needham D. H. Lewis R.
Research Possibilities Beyond Deep Space Gateway **[#3048]**
This abstract explores the possibilities for a large research facilities module attached to the Deep Space Gateway, using the same large module design and basic layout planned for the Deep Space Transport.

1:10 p.m. Wald S. I. * Cummins C. K. Manber J.
Ixion: A Wet-Lab Habitat Platform for Leo and the Deep Space Gateway **[#3192]**
Cislunar and LEO habitats derived from launch vehicle upper stages are technically feasible and continues development toward flight. Present station specifications, configurations, and concepts for scientific, exploration, and commercial utilization.

1:15 p.m. Humphries P. * Barez F. Gowda A.
Manned Mission Space Exploration Utilizing a Flexible Universal Module **[#3068]**
The proposed ASMS, Inc. "Flexible Universal Module" is in support of NASA's Deep Space Gateway project. The Flexible Universal Module provides a possible habitation or manufacturing environment in support of Manned Mission for Space Exploration.

1:20 p.m. Barnes P. K. Haddock A. T. * Cruzen C. A.
Autonomous Science Operations Technologies for Deep Space Gateway **[#3073]**
Autonomous Science Operations Technologies for Deep Space Gateway (DSG) is an overview of how the DSG would benefit from autonomous systems utilizing proven technologies performing telemetry monitoring and science operations.

1:25 p.m. Haddock A. T. Olden G. W. * Barnes P. K.
"Smart" Vehicle Management System: A Necessity for Future Endeavors **[#3074]**
The "Smart" Vehicle Management System (VMS) will give an overview of how a robust VMS would enable experiments to be conducted on the spacecraft in both manned and unmanned states, increasing the scientific benefits.

1:30 p.m. Foster B. D. Matthews B. *
Laser-Assisted Wire Additive Manufacturing System for the Deep Space Gateway **[#3166]**
Investigation on the Deep Space Gateway will involve experiments/operations inside pressurized modules. Support for those experiments may necessitate a means to fabricate and repair required articles. This capability can be provided through an additive manufacturing (AM) system.

1:35 p.m. Galluzzi M. C. *
Remote In-Space Manufacturing Applied with the Science of Interplanetary Supply Chain Modeling for Deep Space Gateway Application **[#3075]**
Three goals can be achieved by 2030: 1. NASA will have the capability for remote on-demand 3d printing of critical hardware using regolith material as feedstock, 2. Logistics footprint reduced by 35%, 3. Deep Space Gateway will become 75% self-sustaining.

1:40 p.m. Koryanov V. V. K. Da-Poian V. D.P. *
INFLATE: INFlate Landing Apparatus Technology **[#3028]**
Our project, named INFLATE (INFlatable Landing Apparatus Technology), aims at reducing space landing risks and constraints and so optimizing space missions (reducing cost, mass, and risk and in the same time improving performance).

1:45 p.m. Cohen M. M. * Bianco S. Avery T.
Antaeus II: Planetary Quarantine Facility at the Deep Space Gateway **[#3189]**
This abstract describes how the Deep Space Gateway would afford the ideal space-time coordinates for the Mars returned sample science receiving lab.

1:50 p.m. DISCUSSION

2:10 p.m. BREAK

Wednesday, February 28, 2018
SUPPORTING HUMAN EXPLORATION SCIENCE
1:40 p.m. Alder Ballroom

Chair: Alex MacDonald

1:40 p.m. Kring D. A. *
Deep Space Gateway Support of Lunar Surface Ops and Tele-Operational Transfer of Surface Assets to the Next Landing Site **[#3044]**
The Deep Space Gateway can support astronauts on the lunar surface, providing them a departure and returning rendezvous point, a communication relay from the lunar farside to Earth, and a transfer point to Orion for return to Earth.

1:50 p.m. Corrigan A. M. * Kitmanyen V. A. Prakash A.
Development of a Lunar Surface Architecture Using the Deep Space Gateway **[#3114]**
Prior to sending crews to Mars, the ability to perform activities intended for martian missions must first be thoroughly tested and successfully demonstrated in a similar environment. This paper outlines a lunar surface architecture to meet this goal.

2:00 p.m. Cassady R. J. * Carberry C. Cichan T.
The Deep Space Gateway: The Next Stepping Stone to Mars **[#3110]**
Human missions to Mars will benefit from precursor missions such as the Deep Space Gateway (DSG) that achieve important science and human health and safety milestones. The DSG can perform lunar science and prepare for future Mars mission science.

2:10 p.m. DISCUSSION

2:25 p.m. BREAK

Wednesday, February 28, 2018
CROSSCUTTING: EXTERNAL INSTRUMENTS
2:40 p.m. Alder Ballroom

This session is a review of the resources required to support externally mounted instruments.

2:40 p.m. Rosenqvist J. F. * Bhardwaj A. Nazarious M. I. Martín-Torres J. Zorzano Mier M. -P. Fernandez-Remolar D. Ramirez-Luque J. Soria-Salinas A. Vakkada A. Mathanlal T. Konatham S.
Platform for Conducting Experiments to Study the Long-Term Exposure Effects of Spacecraft Coating, Materials, and Components in a Deep-Space Environment **[#3067]**
The Central Exposure Platform is designed to hold any type of experiment for testing in a deep-space environment, such as coatings, materials, and technological components. It is designed to optimize the limited useable exterior area on the Deep Space Gateway.

2:45 p.m. Engelhardt J. P.* Heath K.
External Long-Duration Materials Instrument Research Observatory **[#3080]**
The External Long-duration Materials and Instrument Research Observatory (ELMIRO) is a commercial facility that will allow for continuous and repeatable external testing on the Deep Space Gateway of materials, electronics/instruments for future deep space spacecraft.

2:50 p.m. *Earth Science Review*

3:05 p.m. *Heliophysics Review*

3:20 p.m. Astrophysics Review

3:35 p.m. *Lunar and Planetary Review*

3:50 p.m. *SLPSRA Review*

4:05 p.m. DISCUSSION

4:25 p.m. BREAK

Wednesday, February 28, 2018
CROSSCUTTING:
SAMPLE COLLECTION AND HANDLING AT DEEP SPACE GATEWAY
4:40 p.m. Alder Ballroom

This session will recap the sample-related presentations from the Heliophysics, Lunar, and SLPSRA themes to discuss both unique and common elements of collecting, receiving at Deep Space Gateway, handling, potential analysis, and return of physical samples.

4:40 p.m. *SLPSRA Review*

4:50 p.m. *Lunar and Planetary Review*

5:10 p.m. *Heliophysics Review*

5:20 p.m. DISCUSSION

Thursday, March 1, 2018
CROSSCUTTING: TELEROBOTICS AND LEVERAGING
THE DEEP SPACE GATEWAY FOR UNTETHERED SCIENCE OPERATIONS
8:30 a.m. Alder Ballroom

In this session, we will discuss how the Deep Space Gateway can be used to leverage untethered science operations, including telescope servicing, CubeSat deployment, lunar lander deployment, telerobotics for orbital and surface operations, and communication between orbiting and surface assets.

The session will begin with summaries of infrastructure needs identified by each relevant science session, delivered by a representative from each science session. Then we will have topical presentations from each of five capabilities the Deep Space Gateway should have to support the science objectives identified in the science sessions, including:

- *In-orbit telescope servicing*
- *CubeSat deployment*
- *Lunar lander deployment*
- *Telerobotics for orbital and surface operations*
- *Communication relay for orbiting and surface assets*

These presentations will be followed by general discussion of presented topics.

8:30 a.m. *Lunar and Planetary Review*

8:35 a.m. *Astrophysics Review*

8:40 a.m. *Heliophysics Review*

8:45 a.m. *SLPSRA Review*

8:50 a.m. *In-Orbit Telescope Servicing*

8:55 a.m. Shaw A.* Rembala R. Fulford P.
Advantages of Science Cubesat and Microsat Deployment Using DSG Deep Space Exploration Robotics **[#3056]**
Important scientific missions can be accomplished with cubesats/microsats. These missions would benefit from advantages offered by having an independent cubesat/microsat deployment capability as part of Deep Space Gateway's Deep Space Exploration Robotics system.

9:00 a.m. Wald S.
CubeSat Deployment

9:05 a.m. Gonthier Y.
Capabilities for a Deep Space Gateway Robotic Arm: A Potential Canadian Contribution to the Global Exploration Roadmap (GER)

9:10 a.m. DISCUSSION

9:40 a.m. Percy T.
Lunar Lander Deployment

9:45 a.m. Fong T.
Telerobotics of Orbiting and Surface Assets

9:50 a.m. Robinson B. S. * Shih T. Khatri F. I. King T. Seas A.
High-Rate Laser Communications for Human Exploration and Science **[#3014]**
Laser communication links has been successfully demonstrated on recent near-Earth and lunar missions. We present a status of this development work and its relevance to a future Deep Space Gateway supporting human exploration and science activities.

9:55 a.m. *Communication Relay for Orbiting and Surface Assets*

10:00 a.m. DISCUSSION

10:30 a.m. BREAK

Thursday, March 1, 2018
CROSSCUTTING: INTERNAL PAYLOADS
10:45 a.m. Alder Ballroom

In this session, we will begin with presentations on characterization of the deep space environment and potential impacts and effects on the Deep Space Gateway assets and payloads, and current thoughts regarding design criteria and internal configuration and development of the vehicle for research utilization. We will discuss internal infrastructure needs identified during each relevant science session, and conclude with an overall summary of needed capabilities and actions for further study. Topics will include:

- *Internal payload overview*
- *Deep space environment characterization and impact*
- *Vehicle design and interfaces — research facilities, utilities, resources, arrangement*
- *Payload interface design and operations*

Chairs: **Ruthan Lewis**
Rod Jones

10:45 a.m. Lewis R.
Internal Payload Overview

11:00 a.m. Pellish J.
Space Environment

11:15 a.m. Jones R.
Internal Vehicle Design Criteria

11:30 a.m. DISCUSSION