PRINT-ONLY PRESENTATIONS

Although the following abstracts were not selected for oral presentation at the workshop, the organizers selected them for publication on the website so the ideas presented could be viewed by the public, as well as taken into consideration when the panel chairs prepare the report of the workshop.

Adler M. Owen W. Riedel J.
Use of MRO Optical Navigation Camera to Prepare for Mars Sample Return **[#4337]**
The Mars Reconnaissance Orbiter Optical Navigation Camera can be used in a series of experiments to characterize the performance of systems that would be used to locate and track an Orbiting Sample (OS) launched by a Mars Ascent Vehicle.

Allen C. C.
Challenges of a Mars Sample Return Mission from the Samples' Perspective — Contamination Control, Preservations, and Planetary Protection **[#4063]**
To preserve the research value of these precious samples, contamination must be minimized. The samples must also be preserved from physical and chemical alteration. Spacecraft and samples returned from Mars carry unique requirements for planetary protection.

Allen M. Mischna M. Chin G. Stachnik R. Mehdi I. Schlecht E. Jarnot R.
Direct Measurements of Winds from Mars Orbit **[#4105]**
Goals for the Mars Exploration Program in the Planetary Decadal Survey are Mars's present climate and the prospect for extant life. A submillimeter wave spectrometer in Mars orbit can provide wind, temperature, and trace gas constituent measurements.

Anbar A. D. Levin G. V.
A Chiral Labeled Release Instrument for In Situ Detection of Extant Life **[#4319]**
We describe an instrument concept to search for extant life at the Martian surface, building on the heritage of the Viking labeled release (LR) experiment. Chiral substrates with 14-C labels are used to differentiate biotic from abiotic responses.

Antol J. Hajos G. A.
A New Paradigm for Planetary Exploration — The Mars Tumbleweed Rover **[#4142]**
The NASA Langley Research Center Mars Tumbleweed rover is a concept for a lightweight, spherical, deployable structure that captures the martian wind for mobility to conduct distributed geophysical and meteorological surveys of broad areas on Mars.

Asmar S. W. Hinson D. P. Konopliv A. S. Folkner W. M. Oudrhiri K. Preston R. A.
Mars Orbiter Optical Link Science Demonstration for Atmospheric and Interior Structure **[#4288]**
During optical communications, links between spacecraft and ground terminals can be utilized to carry out experiments similar to Radio Science. A hybrid link experiment (Radio-Light) can demonstrate the value for atmospheric and interior structure.

Bar-Cohen Y. Bao X. Badescu M. Sherrit S. Mavroidis C. Unluhisarcikh O. Pietrusinski M. Rajulu S. Berka R. Cowley M.
On-Command Exoskeleton for Countermeasure Microgravity Effects on Muscles and Bones **[#4076]**
On-command exoskeleton with impeding and augmenting elements would support the operation of astronauts traveling to Mars. Thus, countermeasure deleterious effects on the muscles and bones during travel and assist their physical activity on Mars.

Bergstrom J. W. Dissly R. W. Delamere W. A. McEwen A. Keszthelyi L.
High-Resolution Multi-Color Pushbroom Imagers for Mars Surface Characterization and Landing Safety **[#4332]**
Multi-color high resolution imaging from Mars orbit is critical to understanding surface morphology and active processes, as well as safe landing site selection. Improvements over HiRISE capabilities are possible.

Bierhaus E. B. Warwick R. W. Smith N. G. Wade D. W.
Mars Science Payload Accommodation and Operations **[#4267]**
We describe two example payload opportunities to achieve near-subsurface access, one for an orbiter mission and one for a landed mission.

Bills B G. Skillman D. R.
Astronomy from the Vicinity of Mars **[#4171]**
We examine two typical examples of observations which can be made from the vicinity of Mars which complement the Earth-based study of solar system dynamics.

Boom J.
On the Search for Archetypal Life Forms **[#4073]**
A survey is presented of the study of serial discreteness in biological membranes. This may provide clues for the detection of the evolution of early life forms on Mars.

Brullot W. Verbiest T.
Detecting and Identifying Volatile Organic Substances Using Infrared Spectroscopy Combined with Phase Diagrams **[#4046]**
Detecting trace-level organic matter is a challenge area in the project synopsis. Our proposal is to use a combination of gas-phase fingerprint infrared spectroscopy and simultaneous temperature and pressure detection for obtaining phase diagrams.

Bukumira M. B.
The Concept of Mobile Wind Generators **[#4334]**
The concept of mobile wind generators — solve the main problems in mobility wind turbine: surface activity, weight, stability, mobility, adaptability.

Bérczi Sz. Horváth A. Pócs T. Sik A. Szathmáry E. Kereszturi Á.
Targeting In-Situ Liquid Water Analysis with New Probes on Mars **[#4131]**
We summarize parameters and reasons that present rationality of shifting the view of selecting landing sites toward higher latitudes in order to find promisful candidates for liquid water or brine detection and biosignature containing localities.

Calef F. J. III McElrath T. Hemmati H.
The 'Long' View with ASO: The Areostationary Science Orbiter **[#4196]**
An areostationary science orbiter (ASO) would be an innovative spacecraft at Mars that could increase hyperspectral coverage around the equator and support Gb/s data rates for current and future robotic assets, including future human-rated missions.

Calle C. I.
Sensors to Characterize the Properties of the Martian Regolith **[#4206]**
We have developed an early prototype of an electrostatic sensor system that could be built into a future rover wheel that is capable of differentiating minerals in the martian and water content in the martian regolith.

Carr C. E. Ruvkun G. Zuber M. T.
In-Situ Sequencing for Life Detection, Human Health, and Planetary Protection **[#4210]**
Through *in situ* nucleic acid sequencing we can exquisitely characterize living systems and address fundamental elements of Mars exploration, including (1) the search for life beyond Earth, (2) astronaut health and safety, and (3) planetary protection.

Clark I. G.
Development of a New Testing Capability for Future Mars Technologies **[#4095]**
A new test capability is being developed for qualifying decelerator technologies in a high Earth altitude, Mars analog environment. This test capability has additional applications for maturing a number of other technologies including SRP and MAVs.

Cohanim B. Slagowski S. Murphy S. Hoffman J. Cunio P.
New Forms of Planetary Surface Exploration and Mobility Using Hard Landers and Propulsive Hoppers **[#4314]**
This paper will discuss some of the technological advances in using a smaller class of hard landers, called penetrators, that would reduce the mass and cost and propellant of safely placing science payloads on the surface of another body.

Craig L. G.
Launch and Transfer Systems Technology and Architecture Considerations for Mars Exploration **[#4144]**
This paper discusses systems technology considerations for launch and transfer systems for Mars exploration including launch vehicles and Mars ascent vehicles.

Daubar I. J. McEwen A. S. Byrne S. Dundas C.
Ongoing Impact Events on Mars: Implications for Science and Exploration **[#4301]**
Ongoing impacts on Mars are tests of chronology models, probes of the subsurface, and exploration hazards that must be better understood. Finding and studying new craters requires repeat ~20 m/px, color, high SNR imaging and followup <1 m/px imaging.

DeSouza C. A. G.
Conceptual Design of an Unmanned Aerial Vehicle for Mars Exploration (M.I.S.C.A.V.) **[#4200]**
This paper examines the design of an UAV for Mars, to locate subsurface mineral and water deposits. The lifting force is created by both the static lift force from the lifting gas in the wings and the dynamic lift from the flow over the airfoil.

Delamere W. A.
Mars Exploration Plan B **[#4240]**
Mars exploration is at a new crossroads as MEPAG excellent long term goals have been fiscally changed. Recent exciting findings from orbital instruments suggest that there is a strong case for orbit investigations. Plan B is a way forward.

Delamere W. A. McNutt R. L. Jr.
Human Exploration of Mars: Cost Reality **[#4300]**
Mars Human Exploration is at the forefront of our minds today. This paper addresses the technical and fiscal realities of implementing human surface exploration.

Denhar J. D. Faw S. D. Petrilli J. L. Webb S. C.
Mars Cannon Assisted Flying Exploration (CAFE) **[#4271]**
The team of first year graduate students participated in the National Institute of Aerospace’s course “Mars Aerial Exploration” culminating in a conceptual design of a mars mission. The lead author’s research topic is planetary exploration vehicles.

Dischinger H. C. Jr.
Time-Delay Teleoperation to Enable Martian Survey and Sampling Missions **[#4313]**
Abstract proposes a strategy for utilization of scientific rovers. The rovers should be operated in the same fashion as a national or international laboratory or observatory. Researchers would conduct research through virtual interfaces.

Dundas C. M.   McEwen A. S.   Byrne S.   Diniega S.   Hansen C. J.
Recent Gully Activity on Mars: Implications and Objectives for Future Exploration **[#4270]**
Martian gullies are active during seasonal defrosting. This calls into question the role of liquid water in gully formation; more data is needed to assess this and determine the implications for gullies as targets for future exploration.

Edberg S. J.
Explore and Study a Martian Lava Tube or Cave **[#4355]**
A rover exploring Martian lava tubes would provide crucial data for geology, exobiology, and human exploration disciplines. It would engage the public and provide valuable data on the history of Mars and on potential sites for human habitats.

Edmunson J.   McLemore C. A.
In Situ Manufacturing is a Necessary Part of any Planetary Architecture **[#4333]**
The key to any sustainable presence in space is the ability to manufacture necessary tools, parts, structures, spares, etc., *in situ* and on demand. Additive manufacturing provides this ability.

Edmunson J.   McLemore C. A.   Rickman D. L.
Appropriate Simulants are a Requirement for Mars Surface Technology **[#4360]**
Appropriate regolith simulants must be created to test any technology that interacts with the martian surface for flight qualification. Development of these simulants must be included in any Mars exploration architecture.

Edwin L. E.   Hausser D.   Shah P.   Kumar P.
Mars Aerial and Subsurface Exploration Using the 'LArK' (Lighter than Air Kite) Concept **[#4194]**
The LArK (Lighter than Air Kite) is a hybrid between a lighter than air balloon and a kite that can harvest airborne wind energy. It is designed to explore Martian lava-tubes through accessible skylights by anchoring itself to the wall of a skylight.

Eisen H.   Sherwood B.
Contemporary Priorities for Mars Exploration **[#4213]**
Human/robotic exploration implemented by an SMD/HEOMD/OCT partnership should refocus mission objectives beyond either refining prior measurements, or fixating on a singular sample return Pathway. The opportunity cost of default is too high.

El-Gaaly T. O.   McMahan B.   El-Qursh A.
Multi-Segment Zeppelin-Aided Robotic Rover for Ground-Based and Atmospheric Exploration **[#4278]**
To overcome current limitations in exploration range and *in situ* resource utilization, a fast and reliable airborne wind-powered exploratory vehicle capable of unlimited landings and altitude variability is needed to perform a global study of Mars.

Elifritz T. L.
OSIRIS-REx II to Mars — Mars Sample Return from Phobos and Deimos **[#4017]**
I argue that the quickest and least expensive or risky manner by which samples may be returned from Mars is to double the monetary resources available to the OSIRIS-REx program to produce a second spacecraft for Phobos and Deimos operations at Mars.

Elliott J. O.
Solar Electric Power System for the Exploration of Mars **[#4090]**
Recent Mars surface power trades were hampered by a lack of detailed system concepts for large-scale Mars solar power systems. There is an urgent need for such a study to ensure the right decisions are made now to guide future mission development.

Elliott J. O. Easter R. Surampudi S. Voecks G.
ISRU Planning for Mars Exploration **[#4137]**
Applications for use of ISRU in Mars exploration abound. Technologies being developed today need to be guided by appropriate system, mission and campaign analyses to identify optimal paths to large scale applicability.

Eppler D. B. Draper D. Gruener J.
A "Limited First Sample" Approach to Mars Sample Return — Lessons from the Apollo Program **[#4168]**
Complex, multi-opportunity Mars sample return approaches have failed to be selected as a new start twice since 1985. We advocate adopting a simpler strategy of "grab-and-go" for the initial sample return, similar to the approach taken on Apollo 11.

Eubanks T. M. Bills B.
Martian Length of Day Measurements from Rovers **[#4317]**
Changes in the Martian Length of Day (LOD) can be determined at a scientifically use level by a combination of regular (but not necessarily frequent) range and Doppler measurements from Earth and dead reckoning in a Kalman filter.

Farmer J. D.
Science Priorities for Mars Astrobiology **[#4304]**
This abstract outlines major science priorities for Mars astrobiology, with an emphasis on past and present habitability, resources necessary for life, the importance of gaining access to subsurface environments and for targeted sample return.

Fateri M. Khosravi M.
On-Site Additive Manufacturing by Selective Laser Melting of Composite Objects **[#4368]**
This paper proposes a method for cost reduction of future space missions by manufacturing parts on foreign planets. The suitability of Selective Laser Melting process for on-site production of metallic, ceramic and glass products on mars is examined.

Feather M. S. Choset H. Murphy R. R.
Snakes on Mars — For Exploration of Extreme Environments **[#4163]**
Robotic snakes have the unique potential to provide low-cost and low-risk access to locations on the martian surface that are likely to be of greatest interest (e.g., water seeps on slopes) but which pose the greatest challenges for other approaches.

Fergason R. L. Keszthelyi L. P. Titus T. T.
Orbital Infrared Data Sets: An Approach to Improving Our Knowledge of Surface and Subsurface Properties on Mars **[#4164]**
A need exists for thermal IR instrumentation on an orbiter to retain, if not expand, the capabilities provided in the past, including the derivation of temperature, bolometric albedo, and thermal inertia at higher accuracies and spatial resolutions.

Fischer E. Renno N. O. Elliott H. M. Block B. Ponchak G. E.
A Miniature Soil Moisture Sensor to Search for Martian Brines **[#4248]**
We discuss a miniature microwave soil moisture sensor capable of probing the shallow subsurface of Mars to measure the abundance and distribution of brines, without the need for a drill.

Frettlöh M. Lerch T.
Anviums Avatair **[#4084]**
A multiuse and non expansive lighter than gas ship for exploring both different heights of the atmosphere and future landing spots on Mars and also to carry loads like small robots to enhance their range and transport samples to a base station.

Gillotay D. Depiesse C. Daerden F. This N. Muller C.
UV Climate at Mars Surface: A Proposed Sensor for Both Orbit and Ground Stations **[#4020]**
The UV conditions on the surface of Mars are of paramount importance for the human exploration of Mars. We propose to measure spectrally the solar direct and diffuse UV and visible radiations from both Mars orbit and surface with light instruments.

Gilstrap R. Alena R. Stone T.
A Communications Network Architecture for Future Mars Missions **[#4273]**
We propose a Mars communications network architecture incorporating the Internet Protocol, small communications relay satellites, laser communications, delay tolerant networking, mobile ad hoc networking, and wireless sensor networks.

Gim Y. Jordan R. Quddus M. Heggy E. Plaut J.-J.
UltraWide Band (UWB) Radar for the High-resolution Imaging of Martian Regolith for Human Exploration **[#4251]**
We propose to develop an Ultra-WideBand(UWB) radar that would enable a rover or an astronauton the surface of Mars to survey their surroundings andreadily identify water ice, hydrate minerals, or volatilesburied at Mars shallow subsurface <1 m.

Gim Y. Wu X. Jordan R. Heggy E. Plaut J.-J.
Orbiting Sounding Radar for Global 3D Tomography Mapping of the Martian Subsurface **[#4253]**
We propose an orbiting sounding radar mission capableof 3-D mapping of the Martian subsurface, thus revealing layers, local ice deposits, and other volatile materials that are crucial for landing site selection or *in situ* resource utilization.

Graham L. D. Graff T. G.
Increased Science Instrumentation Funding Strengthens Mars Program **[#4226]**
Increase in science instrumentation funding would greatly benefit the Mars program as well as human exploration. We argue for a focus on three primary areas of technology development: (1) carbon nanotubes, (2) MEMS, and (3) NEMS.

Greybush S. J. McConnochie T. H. Montabone L. Wilson R. J. Hoffman M. J. Hoffman R. Forget F. Lewis S. R. Miyoshi T. Ide K. Kalnay E.
Data Assimilation Insights on Selecting the Most Valuable Atmospheric Measurements **[#4323]**
We discuss how objective guidance on selecting the most valuable atmospheric measurements on future Mars spacecraft missions can be provided through Martian atmospheric data assimilation system OSSEs, which are widely used for the Earth.

Grimm R. E. Stillman D. E.
Geophysical Methods to Support Mars Exploration Challenges **[#4364]**
Dielectric spectroscopy, neutron spectrometry, and ground-penetrating radar are the optimal surface methods for characterizing subsurface properties (particularly H_2O) to depths of several meters.

Halleaux D. G. Braswell S. F. Renno N. O.
Dust Forecasting for Human Exploration of Mars **[#4311]**
Forecasting the amount and type of dust suspended in the atmosphere is of increasing importance for planning missions supporting the human exploration of Mars. Electric field strength and wind shear velocity measurements are needed to forecast.

Halliday W. R.
Mega-Caves of Mars Revisited: Speleological Information Systems in Planetary Science and Technology **[#4061]**
Speleological data bases are underutilized. Recently they have shown that lava tube mega-caves at the bottom of pit craters are non-existent and martian lava tube caves appear to be of the same order of magnitude as their terrestrial analogues.

Halsell C. A.   You T-H.
Applications of Extended Autonomous Navigation Capabilities at Mars **[#4097]**
The onboard AutoNav system used for Stardust and Deep Impact is being modified to enable autonomous aerobraking. Landmark tracking and high-precision timing could provide "*in situ*" navigation services to other assets at Mars, Phobos, or Deimos.

Hanna E.   Aaron K.   Blando G.
Mars Hovercraft **[#4369]**
A system to enable expanded exploration, sample return and human flight.

Hecht M. H.   Aubrey A.   Sellar G.   Kounaves S.   Chaniotakis N.   Pike W. T.   Staufer U.
MECA Microscopy, the Next Generation **[#4335]**
We describe efforts to extend the work of the Phoenix microscope system to applications for rovers, and to methodologies that would enable chemical characterization of individual grains.

Hecht M. H.   Blandino J.   Roy T.
Exploring Mars from a Wagon Train **[#4354]**
We suggest a mission architecture that will enable broad participation in Mars missions without imposing burdensome costs on NASA.

Hernandez D.
Mars Minor **[#4055]**
Mars Minor is a study for a low cost exploration mission to Mars. For expecting to reach a low cost the weight of the satellite system send to Mars is limited to around 200 kg in order to be compatible with low cost launchers (with upper stage complement).

Howe S. D.   O'Brien R. C.   Jerred N.   Cooley S.   Crepeau J.   Hansen S.   Klein A.
The Mars Hopper: A Radioisotope Powered, Impulse Driven, Long-Range, Long-Lived Mobile Platform for Exploration of Mars **[#4031]**
The Center for Space Nuclear Research has designed an instrumented platform that will be able to "hop" from one location to the next every 5–7 days with a separation of 5–10 km per hop.

Howe S. D.   Crawford D.   Navarro J.   Ring T.
Economical Production of Pu-238 **[#4034]**
The CSNR is investigating the cost and design of a stand-alone reactor to economically produce Pu-238 to support future Mars missions.

Jordan J. F.
Mars Human Mission Characteristics and Definition **[#4109]**
Proposes a continuing multiple-center working group to define short term relevant agency activities to advance the readiness for sending humans to Mars.

Jordan J. F.
A Recipe for Improving Landing Accuracy at Mars for Missions After MSL **[#4111]**
We list the technical steps for improving Mars landing accuracy beyond the current accuracy predicted for MSL.

Karcz J. S.   Davis S. M.   Aftosmis M. J.   Allen G. A. Jr.   Bakhtian N. M.   Dyakonov A. A.   Edquist K. T.   Glass B. J.   Gonzales A. A.   Heldmann J. L.   Lemke L. G.   Marinova M. M.   McKay C. P.   Stoker C. R.   Wooster P. D.   Zarchi K. A.
Red Dragon: Low-Cost Access to the Surface of Mars Using Commercial Capabilities **[#4315]**
We will discuss the feasibility of using a minimally-modified variant of a SpaceX Dragon capsule as a low-cost, large-capacity, near-term, Mars lander for scientific and human-precursor missions.

Karunatillake S.   Hardgrove C.   Wray J. J.
Importance of Future Gamma and Neutron Spectrometers at Mars **[#4083]**
We propose proven and future deployments of gamma and neutron spectrometers (GRS) to serve challenge area 1. Sub-theme 1 of "Interrogating the shallow subsurface of Mars" would receive critical support from GRS type instruments.

Kennedy B.   Udomkesmalee G.   Backes P.   Trebi-Ollennu A.   Kornfeld R.   Guinn J.
Two-Mission Campaign for Mars Sample Acquisition and Return **[#4225]**
We propose a two-mission mars sample acquisition and return campaign that consists of an orbiter launched in 2018 followed by a surface mission launched in 2020. The resulting campaign would reduce overall cost while increasing relevancy across NASA's interests.

Keszthelyi L.   Dundas C.   Fergason R.   Archinal B.   Kirk R.
Some Requirements for Future Orbital Assets to Support Safe and Productive Landed Missions **[#4232]**
There is an absolute need for high resolution optical and thermal monitoring of Mars from orbit to enable landed missions. Requirements and alternative approaches to meet this need are discussed.

Kim S. S.   Carnes S. R.   Ulmer C. T.
Miniature Ground Penetrating Radar (GPR) for Martian Exploration: Interrogating the Shallow Subsurface of Mars from the Surface **[#4094]**
Through previous NASA instrumentation programs, JPL has developed a miniature ground penetrating radar (electronics, 45g; low power, 1W). The GPR could characterize martian subsurface stratigraphy and guide sampling sites as deployed on a rover.

Klein K. K.   Lindemann R. L.
Universal Tool Suite for Planetary and Small Body Sampling **[#4081]**
Development of a universal tool suite for use as a baseline by subsequent projects to provide a starting point for mission definition, process development, assessing known capabilities vs. stake holder needs, and a reduced development life cycle.

Klesh A. T.   Castillo-Rogez J. C.
Secondary NanoSpacecraft Survey of the Martian Moons **[#4124]**
We propose the deployment of multiple NanoSats at Phobos with an ESPA-ring class mothership to provide a massive spectrum of investigations at a very low cost. PIs could fly focused missions with miniaturized instruments for targeted science.

Kounaves S. P.   Aubrey A. D.   Bauer J. M.   Hecht M. H.   McElhoney K. M.   O'Neil G. D.   Quinn R. C.
Next Generation Wet Chemical Analysis Laboratory for Mars Sample Return and Human Hazard Evaluations **[#4245]**
The Mars chemical analysis lab builds on Phoenix WCL heritage and improvements in sensor and lab-on-a-chip technology. As part of a MER-class rover it can perform wet chemical analyses over a variety of geological surfaces and the mission lifetime.

Kuiper T. B. H.   Clare L. P.   Gao J. L.   Majid W. A.   Meier D. L.   Norton C. D.   Renno N. O.
CubeSat Constellation for Communications and Mars Radio Monitoring **[#4099]**
Communications equipment orbiting Mars and operated by the Deep Space Network can also monitor Mars for electrical activity, which has bearing on the ability of organics to survive and on the safe operation of humans and robotic equipment.

Kutelia E. R.   Bakhtiyarov S. I.   Tsurtsumia O. O.   Bakhtiyarov A. S.   Eristavi B.
High-Temperature Self-Repairing Coating Material for Sample Return Space Capsules (SRSC) for Earth Entry **[#4030]**
This work presents the possibility to realize the self healing mechanisms for heterogeneous architectural metal/ceramic high temperature sandwich thermal barrier coating systems on the surfaces refractory metals by analogy of wound healing in the skin.

Landau D. F. Drake B. G. Strange N. J. Merrill R. G.
Earth Departure Options for Human Missions to Mars **[#4233]**
A comparison of Earth departures from Earth-Moon L2, lunar orbit, high-Earth orbit, and low-Earth orbit is presented. The choice of departure staging node strongly affects vehicle designs, crew contingency options, and mission backup opportunities.

Landau D. F. Barbee B. W. Woolley R. C. Gershman R.
Orbital Transfer Techniques for Round-Trip Mars Missions **[#4237]**
Efficient methods to transfer among a variety of Mars orbits is presented. Emphasis is placed on connecting arrival and departure interplanetary trajectories to an arbitrary circular target orbit for a hybrid human/robotic Mars sample return mission.

Landis G. A. Oleson S. J. McGuire M.
ASRG Mars Geyser Hopper **[#4219]**
The Mars Geyser Hopper is a design concept for a Discovery-class spacecraft using Advanced Stirling Radioisotope Generator (ASRG) power source, with the capability to make a rocket-powered “hop” to investigate regions of scientific interest.

Lang J. J. Baker J. D. Castillo-Rogez J. C. McElrath T. P. Piacentine J. S. Snyder J. S.
Phobos Exploration Using Low Cost, Solar Electric Propulsion Spacecraft **[#4178]**
Phobos Surveyor is an innovative mission concept, utilizing solar electric propulsion to provide a flexible approach to studying the Mars system while addressing both Human Precursor and Decadal Science objectives.

Lemke L. G. Stoker C. R. Glass B. J. Karcz J. S. Bowles J. V. Gonzales A. A. Davis S. M.
High Performance Mars AscentT Vehicles, Earth Return Vehicles and “All-Up” Launch Strategy for Low Cost Sample Return **[#4356]**
We discuss a sample return architecture that reduces risk and cost by eliminating the need for Mars Orbit Rendezvous. This approach may be implemented using commercially procured heavy lift launch services and the Red Dragon Mars Lander.

Lo A. S. Griffin K. Hanson M. Lee G.
ESPA-Based Multiple Satellite Architecture for Mars Science and Exploration **[#4155]**
We propose a LCROSS-based approach, enabled by ts innovative use of the ESPA ring. Exploiting this architecture for Mars mission can use the upcoming Mars launch opportunities to inject multiple satellites that can support the wide range of NASA’s goals.

Lupisella M. L. Mazanek D. D. Antol J. Bass D. Beaty D. Daugherty K. Graham L. Lewis R.
Cis-Lunar Synergies with Human Missions to the Martian Moons **[#4154]**
This presentation will a review recent work from the Human Spaceflight Architecture Team outlining a number of promising activities to conduct in cis-lunar space to help prepare for a human mission to the martian system.

Mackenzie B. A.
Comparing Strategic Knowledge Gaps for Human Mars Settlement vs. Exploration **[#4274]**
We list knowledge needed to establish a permanent Mars base, compared that for round-trip human exploration missions. Topics include site selection, reliable access to water, long term effects of contaminations, and *in situ* materials production.

Marcus D. M.
Habitat on Mars Enabling Surface Testing and Refinement (HOMESTAR) **[#4025]**
Send lightweight, radiation shielded, temperature controlled, inflatable/deflatable habitat to Mars. Sensors, life support, mining and localized manufacturing equipment. Also gather data to improve radiation models of Earth, Mars, and the space in between.

Martinez G.
Monocular Visual Odometry for Mars Exploration Rovers **[#4053]**
As an alternative to stereo visual odometry, we propose a monocular visual odometry algorithm, which is able to estimate the rover´s motion from intensity differences between two images capture by a monocular camera before and after the motion.

Masciarelli J. P.
Aerocapture Guidance Algorithm Development and Testing **[#4379]**
Ball Aerospace has developed and tested aerocapture guidance algorithm in real-time, hardware in the loop simulations.

Maxwell A. M. Wilhite A. W.
Precursor Missions to Reduce Radiation Environment and Effect Uncertainty **[#4153]**
The abstract presents concepts and approaches for the reduction of uncertainty in radiation exposure estimation. Radiation presents a major challenge for human exploration of Mars and some risk could be mitigated through less uncertainty.

McCauley R. J. Fletcher W. G. Crane D. J.
Throttle Control of an Extinguishable Solid Propellant Thruster System — Mars Lander **[#4264]**
This proposal presents an opportunity for NASA to develop and demonstrate an innovative throttlable solid rocket motor through the combination of two developing technologies for use as thrusters for Mars surface landing vehicles.

McConnell B. S. Tolley A. M.
Design Competition and Development Track for a Low Cost Reusable Interplanetary Crewed Spacecraft **[#4272]**
This presentation describes a design competition and development program for interplanetary vessels, composed mostly of water, that utilize simplified RF engines for low thrust, long duration propulsion.

McElrath T. P. Strange N. J. Lang J. J.
Phobos and Deimos Sample Return to Earth-Moon L2 Using Small SEP Spacecraft in 2018–2023 **[#4318]**
Multiple small single-string SEP spacecraft (~600 kg each) could be used to return surface samples from Deimos and Phobos to a MPCV at Earth-Moon L2 in 3–5 years, launching in 2018 or later. The MPCV would then safely return the samples to Earth.

Metzger P. T. Mueller R. P. Hintze P. E.
Precursor Activities to Solve Plume Cratering Problems for Human-Class Mars Landers **[#4359]**
It is unsafe or too risky to land human-class landers (>40 MT) on Martian soil without first constructing a mechanically competent surface, a landing pad. This drives requirements into the precursor mission program.

Milazzo M. Archinal B. Kirk R. Akins S. Hare T. Keszthelyi L. Anderson J. Gaddis L.
Improved Data Processing Approaches for Future Mars Exploration Missions **[#4351]**
Processing of data on the ground to common cartographic standards is an essential, but often overlooked, requirement for successful Mars missions. Here we present a description of the challenge and suggest specific approaches to address this issue.

Miura Yas.
New Concepts of Global and Volatile-Bearing Materials on Mars Exploration **[#4035]**
Martian planet with breccias surface produces void-rich regolith soils by multiple impacts to volatile-bearing deposit through porous soils, which are degassed at martian volcanoes to form present carbon-rich atmosphere (without global water-system).

Mogul R. Stabekis P. D. Race M. S. Conley C. A.
Planetary Protection Considerations for Human And Robotic Missions to Mars **[#4331]**
Incorporating planetary protection into human missions, as supported by NASA Policy Directive NPD 8020.7G, is essential to preventing the forward contamination of Mars, ensuring astronaut health, and preventing backward contamination of Earth.

Morales J. M.
RoverBall **[#4050]**
The RoverBall achieve high mobility, provide a base for exploration and experimentation.

Munk M. M.
Aerocapture Demonstration and Mars Mission Applications **[#4173]**
Aerocapture is an aeroassist technology that can enable large robotic payloads to be placed into Mars orbit, facilitate access to Phobos and Deimos, and support human Mars exploration. Aerocapture is immediately applicable to near-term Mars missions.

Munk M. M.
Application of the MEDLI Suite to Future Mars Entry Vehicles **[#4174]**
The heatshield instrument on MSL, called MEDLI, will measure the pressure and thermal environments during entry, descent and landing. To fulfill scientific and engineering objectives, all future entry vehicles should include similar instrumentation.

Murbach M. S. Colaprete A. Papadopoulos P. Atkinson D.
Atromos: A SALMON-Class Mars Companion Surface Mission **[#4230]**
Atromos is a Mars 'Companion' Surface Mission which would land two independent 10-kg-class science stations. The unique EDL technology makes the accommodation on a carrier spacecraft particularly easy. A two-point network investigation of the Hellas Basin is proposed.

Murbach M. S. Keese D. Gilkey J. Blake D. Papadopoulos P.
Aeolus — Direct Access to Martian Mid-Latitude Aqueous Environments **[#4244]**
Aeolus offers a capability of accessing the mid-latitude aqueous environments. It uses a mature flight system developed and recently re-flown (SWERVE) for which a Mars aerodynamic data base has been created. Targeting strategies are discussed.

Murbach M. S. Papadopoulos P. Guarneros-Luna A.
Five Essential Techologies for Next Generation, Affordable Mars Surface Missions **[#4358]**
Five essential technologies are discussed which will enable affordable future surface missions: novel EDL, 2W-class transciever, rad-hard avionics, radioisotope power systems, and low mass -high ground clearance mobility platforms.

Murchie S. L. Chabot N. L. Yen A. S. Arvidson R. E. Maki J. N. Trebi-Ollennu A. Wang A. Gellert R. Daly M. Rivkin A. S. Seelos F. P. Eng D. Guo Y. Adams E. Y.
MERLIN: Mars-Moon Exploration, Reconnaissance and Landed Investigation **[#4064]**
The Mars-Moon Exploration, Reconnaissance and Landed Investigation (MERLIN) will collect orbital and landed measurements that resolve Mars' moons' composition and origin, and precursor information for future human exploration of the Mars system.

Nakamura T.
Mars Rover Power System for Solar and Laser Beam Utilization **[#4043]**
Physical Sciences Inc. (PSI) proposes to develop a power system which utilizes solar/laser beams to generate electric power or high intensity thermal power for a multitude of applications using single system hardware.

Nebergall K. M.
Sample Return Capsule: Project Rigel **[#4113]**
This design for a sample return capsule adds element for optimal atmospheric sampling, optimal packing of over 100 classified and diverse samples in a very small space, weight and balance control, and planetary protection.

Nebergall K. M.
Sample Collection Devices and Sample Storage for Mars Sample Return **[#4115]**
This paper covers two sample collection designs for any hardness or viscosity of media. It then covers a "bubble tape" approach to storing dozens to hundreds of samples in a space optimized for a sample return capsule or on-site analysis.

Nebergall K. M.
Project Rigel: In Situ Propellant Production Mars Sample Return Concept **[#4116]**
Winner of a 2008 MarsDrive design competition for a $2 billion Mars Sample Return mission, this concept packs an ethelyne ISPP return vehicle, rover, and a very large solar array into a Curiosity-derived aeroshell.

Nebergall k. M.
Advanced Wheeled Cliff Climber Design with Sampling and Extended Range **[#4118]**
This cliff climber concept would be able to swing, traverse, twist, and otherwise escape possible risks. It has sampling capability, very lightweight optics, and the ability to examine the ravine bottom, seeps, or skylight caves.

Osborne J. R. Brunskill C. Jaguste R. Johnson C. D. Sharif H. Silversides I. Trey B. Vlasea M.
An Interdisciplinary Approach to Human-Robot Cooperation in Near-Term Exploration Scenarios **[#4231]**
This paper will present a model for collaborative space exploration through effective and efficient cooperation of humans and robots — CHARM — which is capable of selecting a mission scenario that best utilizes humans and robotics.

Pankine A.
Long Duration Autonomous Balloon Platform for Mars Exploration **[#4246]**
At the center of this mission concept is the long-duration autonomous balloon platform deployed in the atmosphere of Mars. Such a platform combines long-range mobility with opportunity to take *in situ* and high spatial resolution remote measurements.

Plescia J. B.
In Situ Absolute Age Dating: Sample Return Science at a Discovery Price **[#4159]**
In situ absolute age dating on the martian surface is possible and will provide critical constraints on the planet's history. Such an objective does not require sample return but can be done at a Discovery scale.

Pope J. C.
Achieving a Human Mars Exploration Capability with Minimal Launch Site Ground Systems Architecture **[#4106]**
The planning for a Mars human exploration campaign needs to include a vision for launch site architecture. Multi-launch campaigns will provide a number of challenges for the prelaunch processing architecture.

Prince J. L.
Autonomous Aerobraking for Mars Orbiters **[#4130]**
Autonomous Aerobraking is a developing technology that will reduce cost and increase flexibility of an aerobraking orbiter around Mars. Currently in its second phase of development, autonomous aerobraking could be implemented for a 2018 Mars orbiter.

Quinn R. C. Grunthaner F. J. Mielke R. E. Chun W. W. Lee M. C. White V. E. Ehrenfreund P. Ricco A. J. Zent A. P.
Microelectromechanical System (MEMS) Approaches to Chemical Sensing for Mars Exploration **[#4249]**
We are developing microelectromechanical systems (MEMS) as time-of-use technologies to expand the range of state-of-the-art methods of chemical extraction, detection, and measurement that can be used for Mars exploration.

Ray W. Lowenthal M. Oraw B. Youngbull T. Lockette V. Fabisinski L. Frazier D. Johnson C. Rogers J. Fuller K.
Printing the Future of Spaceflight: Simplified, Massively Redundant, Solid State Electronic and Electrical Systems for the Future of Spaceflight **[#4147]**
Printed, massively parallel self similar device arrays of solar cells, power storage and control systems are presented. Such very low mass, robustly persistent systems offer significant opportunity for both martian exploration and spaceflight.

Renno N. O. Ruf C. S.
The Search for Electrostatics Discharges on Mars **[#4345]**
We describe recents findings on the search for electrostatic discharges on Mars. We propose a technique to search for electrostatic discharge that could be used by future landers and orbiters.

Renno N. O. Tratt D. M. Krieger G. Möhlmann D.
An Instrument Suite to Search for Brines in the Shallow Subsurface of Mars **[#4198]**
We propose an instrument suite for probing the surface and subsurface of Mars. Tens of centimeters deep is probed by multispectral and multipolarimetric measurements of radar brightness between 500 MHz and 1 GHz and using advanced methods to analyze the data.

Ricco A. J. Hines J. W. Agasid E. Parra M. Bebout B. Bhattacharya S. Ehrenfreund P. Janhnke L. Marcu O. Nicholson W. Quinn R. Santos O.
Small Satellite-Derived Microfluidic and Microanalytical Technologies for Mars Surface Bio/Chemical Hazards Assessment **[#4102]**
Light-weight, low-cost small satellite instrumentation technology is applicable to Mars exploration challenges including interrogating the shallow subsurface, detecting trace organics, and analyzing samples *in situ* for human health risk reduction.

Robertson G. A.
Condense Matter Propulsion for Mars Probes **[#4087]**
A thruster concept is discussed that uses a large Rydberg molecule, a highly condensed plasma representing a low-temperature state superfluids, to enable new and unique investigations using small probe for both near Mars exploration and Mars descent.

Robertson G. A.
Propellant-Less Launch Platform for Mother Ships **[#4088]**
A new probe launching platform concept from a Mars orbiting “Mother Ship” for either orbit insertion or descent trajectories (Mars or its moons) is discussed.

Roman M. C. Ott C. M. Castro V. A. Birmele M. N. Roberts M. S. Venkateswaran K. J. Jan D. L.
Microbial Monitoring Challenges and Needs for Mars Applications **[#4297]**
The monitoring of microorganisms will be an important part of a Mars mission. Coordinating the different microbial monitoring needs during the early days of mission planning, can provide NASA with with equipment that could meet more than one need.

Scharf D. P. Acikmese B. Chen G. T.
Near-Term Pinpoint Landing with an MSL Cruise/EDL Rebuild **[#4161]**
By reducing the mass of the MSL rover from 900 kg to a MER-class 185 kg and applying the flyable G-FOLD powered descent guidance algorithm, an 8.5 km divert for pinpoint landing is possible with a build-to-print of the MSL Cruise/EDL system.

Scott J. R. Beardsley B. Groenewold G. S. Lammert S. Lee E. McJunkin T. R. Ritchie G. Almirall J. Becker L.
Integrated Portable, Rugged Optical and Mass Instrument Suite (PROMIS) for Geologic, Biologic, and Organic Signature Characterization for Space Exploration **[#4255]**
The portable, rugged optical and mass instrument suite (PROMIS) concept is a fully integrated, multi-functional, miniature laboratory that is lightweight, inexpensive, and low power for identifying high-priority samples and detecting signs of life.

Sheldon D. J. Moeller R. C. Pingree P. Lay N. Reeves G.
Reconfigurable Martian Data Cloud **[#4320]**
The objective is to develop a constellation of small satellites in orbit around Mars that would provide a highly scalable and dynamically allocatable high performance computing resource. Key is use of Field Programmable Gate Arrays for the cloud.

Sherwood B.
Enabling Human-Compatible Planetary Protection: A Mars-Next-Decade Pathway Option **[#4068]**
Human Mars exploration planning could be derailed without a robotic program pathway that aggressively resolves the paradox of biologically dirty human systems exploring before non-viability of special regions is proved.

Singer S. F.
Mars Exploration — From Its Moons **[#4042]**
Proposed robotic exploration with rovers controlled from a manned base on Phobos or Deimos. Hypothesis about the moons' origin, consequences for evolution of Mars (including magnetic field, oceans, and development of life), and observational tests of the hypothesis.

Soto A.
Improved Performance in Mars Sample Access **[#4295]**
The rover ability to reach samples on Mars can determine the constraints of the mission, improve of suspension and robotic arm should be considered part of an accessibility system where both affect performance in sample access.

Staehle R. L. Betts B. Friedman L. D. Hemmati H. Klesh A. T. Lo M. W. Mouroulis P. Pingree P. J. Puig-Suari J. Svitek T. Williams A.
Solar Sails: From Interplanetary CubeSats for Remote Sensing to Phobos Sample Return to Clipper Ships for Pre-Placing Human Exploration Equipment in Mars Orbit **[#4123]**
Solar sails can reduce cost of some Mars missions 5–10×. 2018+ Interplanetary CubeSats could enable low cost missions to Phobos/Deimos, followed by sample returns. 2030+ much larger sails could "truck" supplies to Mars ahead of human explorers.

Stürmer A.
Micro Mars Probes **[#4033]**
Weight is a key issue of all space probes. This abstract describes a new approach that saves weight and thus costs as much as possible.

Sweetser T. H.
Ten Minutes in the Life of Phobos Basecamp **[#4242]**
The Phobos basecamp concept is of a permanent facility at Phobos designed for long-term habitation, which would be initially devoted to telerobotic exploration of Mars. A skit shows what operations at Phobos would be like.

Tanaka K. L. Hare T. M. Skinner J. A. Jr. Fortezzo C. M.
Concepts in Maximizing Science Return: Fusing Orbital Datasets to Support Future Mars Surface Missions **[#4108]**
Here we discuss how fusing orbital datasets in an analyzable geospatial format can help optimize landing-site selection and surface operations for future Mars missions given various technical constraints, with application to each challenge area.

Terrile R. J.
Immersive Telepresence as a New Paradigm for Mars Exploration **[#4169]**
Immersive telepresence systems allow the observer to feel immersed into a simulated environment. It offers a new near-term paradigm to how we explore, how we prepare and train, and how we share the experience of robotic and human Mars exploration.

Tickner J. R. Roach G. J. O'Dwyer J. Van Haarlem Y.
Ultra-Trace X-Ray Analysis of Martian Rocks and Soils Using Low-Cost Commodity Hardware **[#4120]**
We propose a low-cost, light-weight X-ray instrument capable of simultaneously measuring a wide range of elements with detection limits in the parts-per-billion range, the HCNO light-element ratio and overall sample mineralogy.

Trammell H. J. Chavez A. Hockenberry T. Doehring J. Ladewig D.
Element Concepts for a Mars Mission Architecture **[#4227]**
The University of Houston's SICSA program featured a group working on a case study for martian mission concepts. The study ran from January 2012 to August 2012. Several technology gaps were addressed, along with innovations to old technologies.

Trebi-Ollennu A. Manohara H.
Sail Mobile Mini Landers for Opportunistic Mars Sample Return Mission **[#4077]**
We propose a Sail Mobile Mini Lander based system for opportunistic Mars sample return mission. The proposed mission concept uses the heritage and experience from over a decade of surface operations on Mars, from MER rovers to the Phoenix Lander.

Trinh H. P.
Lightweight, High Performance, Low Cost Propulsion Systems for Mars Exploration Missions to Maximize Science Payload **[#4348]**
Utilization of new cold hypergolic propellants and leverage Missile Defense Agency technology for propulsion systems on Mars explorations will provide an increase of science payload and have significant payoffs and benefits for NASA missions.

Vandendriessche S. Valev V. K. Verbiest T.
Detecting and Analyzing Molecular Chirality on Mars **[#4048]**
We propose to detect and analyze molecular chirality on Mars. The presence of homochirality is a necessity for biological activity, and the quantization of chirality yields information on when this activity would have occurred.

Venkatapathy E. Stackpoole M. Feldman J. Kowal J. Munk M.
Woven TPS — An Enabling Technology for Mars Sample Return, In-Situ Science and Human Exploration Missions **[#4149]**
Woven TPS, an innovative new concept, an exploratory effort funded by OCT under game changing technology, has the potential to enable MSR (longer term) and *in situ* science missions to Venus, outer planets, and high-speed sample return (near/mid term).

Voelker M.
In-Situ Exploration of Recent and Liquid Water Resources on Mars by Investigating Youngest Gully Features — A Scientific and Engineering Approach **[#4141]**
The abstract evaluate possible missions to recently formed martian gullies, considering scientific and engineering problems and opportunities.

Voelker M.
Monetary Optimization of Martian Exploration by Reutilization of Existing Designs or Modularized Systems **[#4197]**
The abstract assess possibilities to lowering costs by using existant technologies or so-called modularized systems. Thus, development- and poduction costs could be decreased significantly.

van Amerom F. H. W. Chaudhary A. Short R. T.
Low-Cost Micro Mass Spectrometers for Handheld Chemical Analysis and Distributed Networks for Space Flight Missions **[#4281]**
Distributed networks of low-cost micro mass spectrometers, far smaller than presently available, will be powerful tools for safety of astronauts, enabling chemical monitoring throughout spacecrafts/habitats, surface vehicles and Mars deployments.

Wallace K. S.
Wireless Power and Data Transfers for Autonamous Mobile Systems **[#4182]**
The goal of this initiative is to mature and integrate the technologies for remote power transfer, and optical communication links, allowing he autonomous remote units to perform independent short-term operations, and then return for power and data transfers.

Weber R. C. Nall M. E. Law E. S.
The Lunar Mapping and Modeling Portal: An Application of Lunar Landing Support Tools to Mars **[#4218]**
The Lunar Mapping and Modeling Portal led by MSFC, has created a suite of interactive visualization and analysis tools to enable scientists and mission planners to access mapped lunar data products. This tool can be modified to support Mars landings.

Wertz J. R. Van Allen R. E. Sarzi-Amade N. Shao A. Taylor C.
Hummingbird: Dramatically Reducing Interplanetary Mission Cost **[#4146]**
The Hummingbird interplanetary spacecraft has an available delta V of 2 to 4 km/sec and a recurring cost of $2 to $3 million, depending on the payload and configuration. The baseline telescope has a resolution of 30 cm at a distance of 100 km.

Whitehead J. C.
A Perspective on Mars Ascent for Scientists **[#4290]**
This presentation raises awareness of the Mars ascent challenge for the science community. Miniature launch vehicles have never existed, so solving Mars ascent can benefit from a broad understanding of the prospects with a long-term perspective.

Willson D.
ISRU: Automated Water Extraction Ffrom Mars Surface Soils for Sample Return Missions **[#4191]**
An ISRU option for Mars sample return vehicles is to employ a Sojourner/MER sized bucket excavation rover that mines and extracts water from the top 5 cm of surface soils and delivers it to an ISRU on the lander. The option is mass competitive.

Wolf A. A. Freeman A. Kedar S. Webb F. H. Matousek S.
Impactor Science at Mars **[#4110]**
A Mars impactor mission could accomplish multiple science objectives: (1) reveal subsurface composition; (2) explore areas with potential liquid flows; (3) conduct an active seismic study. It could also facilitate sample return from Mars or from Phobos.

Wyatt E. J. Burleigh S. C. Clare L. P. Torgerson J. L. Wagstaff K. L.
Exploring Mars via Autonomously Networked Spacecraft **[#4310]**
Enabling multiple assets to coordinate their activities autonomously via space networking techniques can significantly improve the way we explore Mars by enabling collaborative observations to improve science return and flexibility to reduce risk.

Ximenes S. W.
Intelligent Zipline Deployment For Martian Cave Exploration **[#4362]**
Accessibility to planetary cave approaches requires ingress/egress technology solutions for robots and eventual human explorers. A deployment architecture for an intelligent zipline to meet planetary protection protocols is discussed.

Youngbull C. Shkolyar S. Hatch A. C. Shock E. L. Anbar A. D.
Isothermal Heat Conduction Calorimetry for In Situ Detection of Extant Life **[#4250]**
We present a generic minimal-assumption approach to extant life detection using isothermal nanocalorimetry. A thermodynamic fingerprint is used to definitively locate and characterize extant chemotrophic or organotrophic life with high sensitivity.

Zubrin R. M. Berggren M. H. Rose H. A.
The Mars Enabling Technology System **[#4101]**
The Mars Enabling Technology System produces unlimited CH_4, oxygen, and water using regolith water and atmospheric CO_2. Water is outgassed from soil in a closed chamber using hot CO_2. H_2 from electrolyzed water is reacted with Mars CO_2 to make CH_4.