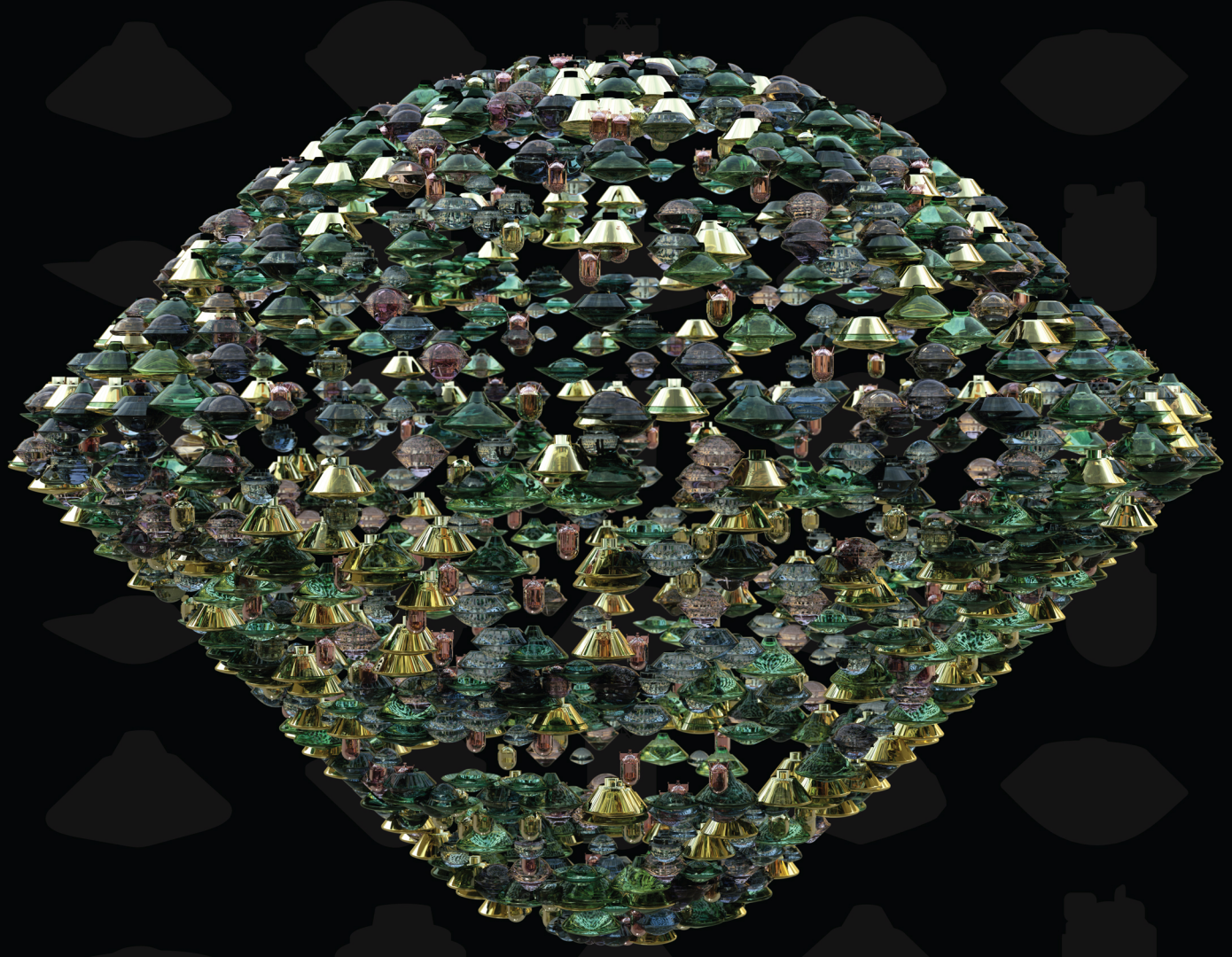
Eleventh International Planetary Probe Workshop

Pasadena · CA · USA

June 16 to 20 · 2014



Short Course · June 14 to 15 · 2014

Discovery and Surprise: Science from Planetary Probes

http://www.hou.usra.edu/meetings/ippw2014/

IPPW-11 Welcome

Welcome to Pasadena, California, and the 11th International Planetary Probe Workshop. Participating is an outstanding group of international scientists, technologists, engineers, mission designers, and policy makers. We elected to hold this year's workshop on the historic California Institute of Technology (Caltech) campus, home to many of the world's legendary physicists and solar system explorers. In addition, Caltech operates NASA's Jet Propulsion Laboratory (JPL), located a few freeway miles from the campus.

IPPW-11 offers an abundance of participants, a varied program, and ample opportunities for networking. This year, we have elected to emphasize the collaborative nature of our workshop. That's why we are offering short presentations followed by panel discussions that feature session presenters fielding questions from the audience. To encourage full attendance in each session, we have avoided parallel sessions. Our community has been very busy over the past year, selecting; an outstanding set of presentations and posters that you will encounter in the next four and a half days. In addition, we have solicited and evaluated nominees for the Al Seiff Award, conducted the Short Course, and coordinated opportunities for student participation.

We encourage you to attend as many oral and poster sessions as possible. We have scheduled a welcome reception and poster session on Monday. In keeping with our IPPW tradition, we have slated exciting tour options on Wednesday. As you registered, you were offered the choice of visiting JPL for an in-depth tour of facilities there, or the California Science Center for an expert-led tour of the Space Shuttle Endeavor and other exhibits that benefit from the presence of Southern California's aerospace industry. After a brief respite from the tours, you will be bussed to the scenic Griffith Observatory for a brief tour and dramatic view of the Los Angeles basin. Then you will be transported to the IPPW-11 Banquet, at the Castaway Restaurant in the Burbank hills, with still more spectacular views of Los Angeles and environs.

Since IPPW-11 is indeed a workshop, we also urge you to take advantage of the numerous opportunities during coffee breaks, lunches and social activities to build collaborative partnerships with other workshop participants. The IPPW-11 sponsors have generously funded a large number of students who want to gain a better understanding of how to build a future career in this exciting field. We are very encouraged to have a sizeable student population with us!

On Friday, 20 June, there will be a presentation on the plans for 2015's IPPW-12 in Cologne, Germany, near DLR. We encourage you to attend this talk to learn about your next opportunity to join us. In this time of transition for many of our agencies, it is all the more valuable for us to reconnect with our colleagues and celebrate our strong planetary probe community. We encourage you to enjoy our 11th International Planetary Probe Workshop.

Let's make it a great week!

Bernie Bienstock
NASA Jet Propulsion Laboratory
IPPW-11 International Organizing
Committee Chair

Anita Sengupta
NASA Jet Propulsion Laboratory
IPPW-11 Local Organizing
Committee Chair

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Kamal Oudrhiri, *Jet Propulsion Laboratory*
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Mikhail Marov, *Vernadsky Institute*

Short Course

Discovery and Surprise: Science from Planetary Probes

Saturday, June 14, 2014

Time	Topic	Presenter(s)
9:00 AM	Welcome, Introductions	Ralph Lorenz, Matt Sorgenfrei
9:15 AM	Discovery and Surprise - Expected and Unexpected Science from Planetary Probes	Ralph Lorenz
9:35AM	Science Objectives and Priorities in NASA missions	Christophe Sotin
10:25 PM	Coffee Break	
10:55 PM	Science Highlights, Experience and Future Goals: Venus	Kevin Baines
11:45 PM	Science Highlights, Experience and Future Goals: Giant Planets	Tom Spilker
12:35 PM	Lunch	
2:00 PM	Science Highlights, Experience and Future Goals: Mars	Matt Golombek
2:50 PM	Science Highlights, Experience and Future Goals: Titan	Ralph Lorenz
3:40 PM	Coffee Break	
4:10 PM	The process - We got Selected, now we have to build it, show it	David Mimoun
4:50 PM	Mystery Data Exercise (Part 1 ; Distribute data, investigate an example)	Matt Sorgenfrei, Ralph Lorenz
5:30 PM	Adjourn	
7:00 PM	Dinner / Social	

Sunday, June 15, 2014

Time	Topic	Presenter(s)
9:00 AM	Welcome / recap	Ralph Lorenz, Matt Sorgenfrei
9:10 AM	The process - Writing an Instrument Proposal	Kamal Oudhiri
9:55 AM	Science goals and Payload selection in Europe	Marcello Coradini
10:35 AM	The process - Flight : getting, analyzing and archiving the data	Ralph Lorenz
11:15 AM	Coffee Break	
11:45 AM	Science for "free" - Temperatures, Accelerometers, Radio Science	Matt Sorgenfrei, Ralph Lorenz
12:25 PM	Mystery Data Exercise (Part 2)	Ralph Lorenz, Matt Sorgenfrei
1:05 PM	Wrap-Up	Ralph Lorenz, Matt Sorgenfrei
1:15 PM	Lunch	
2:00 PM	Caltech lab visit	

Workshop Overview

Monday, June 16, 2014

9:00 AM	Beckman Institute Auditorium	Opening Session
1:15 PM	Beckman Institute Auditorium	Missions
6:30 PM	Dabney Lounge	Poster Session/Welcome Reception

Tuesday, June 17, 2014

9:00 AM	Beckman Institute Auditorium	Radio Science and Science Instrumentation
1:00 PM	Beckman Institute Auditorium	EDL Technologies
7:00 PM	Il Fornaio Pasadena	IOC Dinner

Wednesday, June 18, 2014

8:45 AM	Beckman Institute Auditorium	Inflatable and Deployable Technology
11:30 AM	Tour Options	JPL and California Science Center Tour (including Box Lunch)
7:00 PM	IPPW-11 Banquet	The Castaway, Burbank

Thursday, June 19, 2014

9:00 AM	Beckman Institute Auditorium	Sustained Flight
12:00 PM		Student Professional Development
1:30 PM	Beckman Institute Auditorium	Modeling, Simulation, and Testing
5:00 PM		Downtown LA Tour

Friday, June 20, 2014

9:00 AM	Beckman Institute Auditorium	Cross Cutting Technologies
1:00 PM	Beckman Institute Auditorium	Closing Session

Opening Session

Monday, June 16, 2014
9:00 AM
Beckman Institute Auditorium

Chairs: Pat Beauchamp
Bernie Bienstock

9:00 AM Bienstock, B. *
IPPW-11 Welcome

9:10 AM Sengupta, A. *
IPPW-11 Program Review

9:20 AM Beauchamp, P. *
Introduction of Charles Elachi

Elachi C. *
IPPW-11 Jet Propulsion Laboratory Welcome

9:40 AM Wright, M. *
Al Seiff Award Presentation

9:45 AM Lee, G. *
Al Seiff Award Acceptance: The Viking Legacy

10:25 AM COFFEE BREAK

10:50 AM Miller, D. *
Finding Balance Between Science, Engineering and Technology

11:15 AM Coradini, M. *
From Giotto to Juice, 40 Years of Space Exploration in Europe

11:40 AM Park, C. Arnold, J. O. * Green, M. Witkowski, A.
Conjecture on the Appearance of the Galileo Probe's Entry and Descent in to the Jovian Atmosphere

12:00 PM LUNCH

Missions Session

Monday, June 16, 2014
1:15 PM
Beckman Institute Auditorium

Chairs: Michael Amato
David Mimoun

1:15 PM Kipp, K. A. * Hines, E. K. Chen, A.
Future Landing Capabilities of the Mars 2020 Entry, Descent, and Landing System **[#8026]**
This study examines landing site elevation capability as a function of landing season, for a future mission using the heritage MSL/Mars 2020 EDL system. Results are presented for a 1200 kg landed mass with different parachute technology assumptions.

1:30 PM Agrawal, P. * Allen, G. A. Jr. Hwang, H. H. Marley, M. S. McGuire, M. K. Garcia, J. A. Sklyanskiy, E. Huynh, L. C. Moses, R. W.
Atmospheric Entry Studies for Uranus **[#8028]**
To better understand the technology requirements for a Uranus atmospheric entry probe, an internal NASA study funded by ISPT program was conducted. The talk describes two different approaches to the planet: 1) direct ballistic entry and 2) Aerocapture.

1:45 PM Barraclough, S. Ratcliffe, A. * Buchwald, R. Scheer, H. Chapuy, M. Garland, M. Rebuffat, D.
Phootprint: A European Phobos Sample Return Mission **[#8030]**
Phootprint is an ESA funded feasibility study for a European Phobos Sample Return Mission. A complete system design has been performed including ERC, Landing Leg, Sample Acquisition System and GNC Proximity Operations.

2:00 PM Saikia, S. J. * Daubar, I. J. Jens, E. Bruck Syal, M. Bunte, M. Cook, C. Decrossas, E. Dove, A. Farnocchia, D. Jonsson, J. Mihaly, J. M. Ollila, A. Palucis, M. C. Poston, M. J. Vardaxis, G. Veto, M. S. Budney, C. J. Mitchell, K. Orton, G. S.
MUSEings on Uranus: Exploration of the Ice-Giant **[#8074]**
A new conceptual orbiter and a probe mission — MUSE (Mission to Uranus for Science and Exploration) — to explore the uranian system is presented.

2:15 PM Lorenz, R. D. *
Twilight on Kraken: The Lost Opportunity to Explore Titan's Seas Until 2040 **[#8014]**
No RTG now / DTE window closing / Dark times on Kraken.

2:30 PM COFFEE BREAK

2:55 PM Voirin, T. * Larranaga, J. Taylor, G. Sanchez Perez, J. M. Prost, J. P. Cavel, C. Falkner, P.
Inspire: A Mars Network Science Mission **[#8040]**
INSPIRE is a Mars Network Science mission which is been studied by ESA in the frame of its Mars Robotic Exploration Program. It consists of three probes performing a direct entry on Mars for geophysics and meteorology science over one full martian year.

3:10 PM Saranathan, H. * Saikia, S. Grant, M. J. Longuski, J. M.
Trajectory Optimization with Adaptive Deployable Entry and Placement Technology Architecture. **[#8072]**
This paper compares the results of trajectory optimization for Adaptive Deployable Entry and Placement Technology (ADEPT) using different control methods. ADEPT addresses the limitations of current EDL technology in delivering heavy payloads to Mars.

3:25 PM Perkinson, M. Waugh, L. Ratcliffe, A. * Vijendran, S. Kennedy, T. Church, P. Fielding, J. Taylor, N.
Europa Penetrator and Full Scale Survivability Testing **[#8031]**
A successful test campaign has been performed on a penetrator for a mission to Europa. The paper will discuss both the mission and system definition as well as review the results of the recent full scale survivability tests into sand and ice.

3:40 PM Lee, G. * Sokol, D. Polidan, R. Bolisay, L. Barnes, N.
Long-Lived, Maneuverable, Semi-Buoyant Platform for Venus Upper Atmosphere Exploration **[#8022]**
This presentation discusses the continued development of the Northrop Grumman/L'GARDE team's long-lived, maneuverable platform to explore the Venus upper atmosphere. It focuses on the overall mission architecture and concept of operations.

3:55 PM Frampton, R. V. * Ball, J. M. Pellz, L.
Design of Landing PODS for Near Earth Asteroids **[#8077]**
Boeing has been developing design for a set of small landing PODS that could be deployed from a spacecraft bus orbiting a NEA to address the set of SKGs for investigation prior to crewed missions to Near Earth Asteroids or the moons of Mars.

4:10 p.m. Collins S. M. * Oh D. Y. Randolph T. M.
Spiral Thrusting for Momentum Control of Planetary Solar Electric Missions **[#8032]**
This paper presents results of a detailed dynamic simulation that applies spiral thrusting momentum control to a hypothetical 2500 kg (wet mass) asteroid rendezvous mission.

4:25 p.m. COFFEE BREAK

4:50 p.m. PANEL DISCUSSION

Poster Session/ Welcome Reception

Monday, June 16, 2014
6:30 PM
Dabney Lounge

MISSIONS

Atkinson, D. H. Lunine, J. I. Simon-Miller, A. A. Atreya, S. K. Brinckerhoff, W. Colaprete, A. Coustenis, A. Fletcher, L. N. Guillot, T. Lebreton, J. -P. Mahaffy, P. Mousis, O. Orton, G. S. Reh, K. Spilker, L. J. Spilker, T. R. Webster, C.
In Situ Probe Science at Saturn **[#8005]**
Key to understanding solar system formation and evolution is the origin and evolution of the giant planets. A small shallow Saturn probe can serve to test competing theories of solar system and giant planet origin, chemical, and dynamical evolution.

Bergsrud, C. M. Straub, J.
A Mission to Create a Constellation of Space Solar Power Satellites as an Enabler for Martian Exploration Activities **[#8007]**
The planetary science community has identified numerous prospective targets of exploration on Mars. To support martian exploration endeavors it is proposed to deploy a constellation of space solar power satellites. This paper discusses this concept.

Bergsrud, C. M. Straub, J.
A Lunar Mission to Create a Constellation of Space Solar Power Satellites as a Precursor to Industrial Establishment, Resource Extraction, and Colonization **[#8008]**
This paper provides an overview of a system of space solar power satellites (SSPSs) to service lunar science, mining and manufacturing operations. The SSPS system will provide power to enable a new paradigm of lunar and Moon-based exploration.

Li, L. Jain, N. Noevere, A. T. Raghunandan, P. Walsh C.
SPAS: Saturn Probe for Atmospheric Science **[#8011]**
A parametric study was performed to design an atmospheric entry probe to Saturn in order to determine the gas giant's composition and structure at depths greater than previous missions. Vehicle and trajectory parameters were chosen.

Gonyea, K. Dendinger, T. Fernandez, J. Jaunzemis, A.
SPLAT: The Sample Probe for Landing And Testing **[#8016]**
A sample return mission from the ISS or low Earth orbit is developed. Vehicle can safely return small biological payloads with consideration of heating, aerodynamics and structural integrity of the vehicle.

Solomonidou, A. Coustenis, A. Lopes, R. M. C. Malaska, M. J. Hirtzig, M. Sotin, C. Drossart, P.
Mid-Latitude Regions on Titan as Promising Landing Sites for Future In Situ Missions **[#8019]**
The Cassini mission revealed Titan's surface including the presence of some 'exotic' features such as areas that appear to change with time. Titan is a fascinating target for future exploration and our study examines the needs for a return mission.

Sokol, D. Lee, G. Polidan, R. Bolisay, L. Barnes, N.
Venus Atmospheric Maneuverable Platform (VAMP) — Air Vehicle Concept and Entry CONOPs **[#8021]**
This presentation discusses the continued development of the Northrop Grumman/L'GARDE team's long-lived, maneuverable platform to explore the Venus upper atmosphere. It focuses on the air vehicle design and entry CONOPs and their interdependencies.

Holstein-Rathlou, C. Withers, P.
Atmospheric Properties Reconstruction from the Mars Science Laboratory Entry, Descent and Landing **[#8034]**
We will present an overview of our atmospheric reconstruction process using MSL EDL data, the derived atmospheric profiles for density, pressure and temperature, and preliminary scientific interpretation of the atmospheric results.

Blette, D. J. Currey, S. R. Singh, L. A. Strain, M. E.
Mars Active Hydrology Exploration Mission **[#8045]**
This project looks at an impactor mission to Mars that could reveal the presence of subterranean water reservoirs. Concept analysis is performed for entry and descent trajectory, heating, and cratering models.

Barton, A. C.
Progress and Status of Google Lunar XPRIZE Mission Preparations **[#8054]**
Update on the technical progress of the teams being monitored as part of the Milestone Prizes and general descriptions of the mission plans of the other Google Lunar XPRIZE competitors.

Creech, S. C. Krezel, J. K.
SLS and Planetary Exploration **[#8057]**
The Space Launch System is on track for first flight in 2017. With an initial lift capability of 70 tons, SLS will provide over twice the performance of any current launch system; the scientific potential of this unique capability are tantalizing.

Saikia, S. J. Das, A. Laipert, F. E. Dapkus, C. Kendall, J. Bowling, T. Steckloff, J. Holbert, S. Graves, K. Antony, T. Bobick, R. Huang, Y. Stuart, J. Minton, D. A. Longuski, J. M.
Marching Towards Troy: Exploration of Jupiter Trojan Asteroids **[#8076]**
A new mission concept for the exploration of the Jupiter Trojan Asteroids using Solar Electric Propulsion is presented. The mission is designed within the constraints of NASA New Frontiers Mission class.

Rajguru, A. Faler, A. C.
Operations cost Reduction for a Jovian Science Mission Using CubeSats **[#8088]**
This paper proposes the operation of a mission architecture for jovian satellite tour, that uses small orbiter 6U CubeSats, airless body landers of the same order of 6U size and a mothership carrier that will act as a communication hub to DSN.

Mousis, O. Coustenis, A. Lebreton, J.-P. Atkinson, D. H. Lunine, J. I. Rey, K. Fletcher, L. N. Simon-Miller, A. Atreya, S. Brinckerhoff, W. Cavalié, T. Colaprete, A. Gautier, D. Guillot, T. Hueso, R. Mahaffy, P. Marty, B. Morse, A. D. Sims, J. Spilker, T. Spilker, L. Webster, C. Waite, J. H. Wurz, P.
Scientific Rationale and Concepts for an In Situ Saturn Probe **[#8094]**
We summarize the science case for in situ measurements at Saturn and discuss the possible mission concepts that would be consistent with the constraints of ESA M-class missions.

Baskaran, G. B. Bonthalapati, A. B. Lyne, J. L. Lewis, J. L. Malone, K. M. Ved, H. V.
Potential Orbital Capture Missions to Trans-Neptunian Objects **[#8097]**
In this abstract our group discusses the planning of missions to trans-neptunian objects with potential to capture into orbit. The abstract contains the methods by which the missions are planned and the tools used to generate results.

Miller C. Chanover N. J. Strycker P. D. Hamilton R. T. Hermalyn B. Suggs R. M.
Planned Lunar Impacts: Scientific Value and Ground-Based Observation Limits **[#8100]**
We detected the signal from the ejecta plume of the directed LCROSS lunar impact from Earth-based observations. We discuss the observational limits to detecting a lunar plume and the implications for plans to impact other spacecraft onto the Moon.

Amato, M. J. Jones, A. L. Robinson, D. W. Jabola, A.
Planetary Atmosphere Probe Descent Modules for Gas and Ice Giant Missions **[#8103]**
Probe missions enabling in-situ measurements at gas and ice giants enable critical and needed science measurements. And lend themselves to probe decent modules using achievable approaches and technology. We discuss work on updated and new designs.

Yakut, E. Çilden, D. Oran, C. Erdo,an E.
Meteorological Observations and Establishing a Base for Future Mars Missions **[#8110]**
According to our study, data indicating the characteristic of Mars' atmosphere and entry conditions will be collected more detailed up to date via CanSAT mission. This data will be used as a guide for design of future missions to the Mars exploration.

Straub, J.
Deep Space Orbital Service Model for Virtual Planetary Science Missions **[#8116]**
An extension of the orbital service model, a technique for coordinating mission services between multiple spacecraft, is presented. This facilitates the creation of virtual uploadable 'app' missions to deep space probes.

Murbach, M. Papadopoulos, P. Atkinson, D. Reuter, A. Mojica, J. Guarneros-Lun, A. Scales, M. Benson, J. Seneris, J. Sok, K. Bodmer, M.
The TechEdSat NanoSatellites and Exo-Brake De-orbit Mechanism: Recent Flight Experience **[#8120]**
The development and initial flight experiments of the Exo-Brake-a simple drag-based de-orbit mechanism, is described. The initial version was successfully flown on the TechEdSat-3 nano-satellite in 2013, and an evolved version is to be flown in 2014.

CROSS CUTTING TECHNOLOGIES

Nyago, J. J. Jr.
Enhancement of Knowledge and Skills of University Educators, Research and Application Scientists in Both the Physical and Natural Sciences as Well as in Analytical Disciplines **[#8003]**
In Uganda, due to the information gap created by the current education curricula and the lack of interest in research, interest and practicability in this Space Technological areas of study.

Kuznetsova, D. Bouquet, A. Gritsevich, M. Baratoux, D. Vaubaillon, J. Mimoun, D. Mousis, O. Bouley, S.
A Model for Meteoroid Atmospheric Entry and its Application to Simulate the Capabilities of an Orbiter for Meteors Monitoring **[#8049]**
We evaluate performance of an orbiting system for monitoring the meteor events in the atmosphere. A numerical tool has been created which uses a theoretical model of meteoroid entry developed by the authors and simulates the rates of meteor detection.

Sunday, C. M. Murdoch, N. Mimoun, D.
Surface-Lander Interactions on Small Bodies **[#8069]**
The objective of this work is to present an experiment on low-velocity, low-gravity collisions into granular asteroid surfaces. The experiment measures the amount of energy lost during impact via a projectile's coefficient of restitution.

Gonzales, G.
Thermal Testing of Woven TPS Materials in Extreme Entry Environments **[#8089]**
Some recent thermal tests of woven TPS have been used to help develop and qualify the capabilities of the NASA's IHF and AEDC's H3 arcjet facilities and this woven material. These tests have benefited both the facilities and woven teams.

Straub, J.
Autonomous Control for Space Solar Power for a Planetary Science Mission **[#8115]**
This paper presents an overview of an autonomous control (decision making) algorithm for a space solar power transmitting spacecraft suitable for use for a deep space planetary science mission.

Straub, J.
Towards Autonomy for Planetary Science: Scientist Characteristics and Autonomy Acceptance **[#8117]**
Attitudes of planetary scientists towards mission autonomy technologies have been previously characterized. This paper presents a characterization segmented by research focus area, assessing where autonomy may be more and less likely to be accepted.

RADIO, RADAR, AND TRACKING

Atkinson, D. H. Oudrhiri, K. Asmar, S. Wayne, S.
Future Planetary Probe Doppler Wind Experiment Techniques Utilizing Advanced Tracking and Ranging Subsystems **[#8084]**
Utilizing tracking and ranging techniques to enhance future entry probe Doppler wind measurements of planetary atmospheric dynamics.

Wayne, S. Kitchen, A. Perry, R. Petersen, P. Slater, J. Oudrhiri, K. Asmar, S. Atkinson, D.
Balloon Measurements of Winds in Planetary Atmospheres **[#8095]**
Atmospheric dynamics can be better measured if data is recorded from many spatially separated capsules. One method under study is to use a planetary lander that releases multiple balloon-bourne transceivers that can be Doppler tracked by the lander.

Castillo-Rogez, J. Boland, J. Chien, S. Frick, A. Kahn, C. Kahn, P. Klesh, A. Nesnas, I. Pavone, M. Staehle, R. Thompson, D
Decadal and SKG Science with Next Generation Low Cost Small Platforms
A review of the state of the art in small instruments and science operations in the context of reconnaissance mission concepts for Human exploration of near earth asteroids and Mars' moons and environment.

SCIENCE AND INSTRUMENTATION

Rafkin, S. Banfield, D. Andrews, J. Soto, A. Nowicki, K. Case, T. Dissly, R. Dwyer-Cianciolo, A. Fenton, L. Genzer, M. Karatekin, O. Lange, C. F. Merrison, J. Neal, K.
The Atmospheric Characterization for Exploration and Science (ACES) Instrument Suite for Mars **[#8079]**
The ACES instrument suite is designed to address the highest priority lower atmosphere goals identified by MEPAG, and to address both Strategic Knowledge Gaps (SKGs) and science goals identified for the Mars 2020 mission.

Omaly, P. O. Hebert, P. H.
ICOTOM: Narrow Band Infrared Radiometer **[#8080]**
On Mars space vehicle back-shield, the radiative heat flux can represent up to 100% of the total heat flux. This flux is mainly due to the infra-red CO_2 radiation.

Zacny, K. Chu, P. Paulsen, G. Indyk, S.
Comet Surface Sampling Technologies **[#8024]**
The goal of the Comet Surface Sample Return (CSSR) is to acquire and return to Earth a ≥500 cc) sample. Honeybee developed several sampling technologies including a standalone CSSR Probe (CSSRP) and Pyramid Comet Sampler (PyCoS).

INFLATABLE AND DEPLOYABLE TECHNOLOGY

Bolisay, L. B. Barnes, N. C. Sokol, D. H. Lee, G. J. Polidan, R. S.
Venus Atmospheric Maneuverable Platform (VAMP) — Stowage/Deployment Concepts and Materials Investigation **[#8048]**
This presentation discusses the continued development of the Northrop Grumman/L'GARDE team's long-lived, maneuverable platform to explore the Venus upper atmosphere. It focuses on vehicle stowage and deployment concepts, and materials investigation.

SUSTAINED FLIGHT

Matthies, L. Cutts, J. Tokumaru, P. Pauken, M.
Venus Guided Aerosonde (VGA) for Landing Site Reconnaissance **[#8085]**
The VGA concept extends previous Venus dropsonde concepts by adding a precise terrain-relative navigation capability, followed by a low-altitude, shallow glide to obtain high-resolution images and 3-D mapping data to scout potential landing sights.

MODELING, SIMULATION AND TESTING

Pauken, M. T. Fernandez, C. J. Jeter, S. M.
Expendable Cooling for a One-Day Venus Lander **[#8012]**
A thermal architecture of a Venus lander mission using an expendable coolant system has been developed to enable a day-long surface mission. The system uses an aqua-ammonia mixture to provide cooling of the electronics and the pressure vessel.

Perino, S. V. Bayandor, J.
A Structural Concept Study for Future Planetary Probes and Sample Return Vehicles **[#8059]**
Atmospheric entry vehicle concepts for future planetary probes and sample return vehicles were parametrically investigated. Key aspects of the analysis methodology and important discoveries about the AEV design and tradespace are discussed.

Allen, G. A. Jr. Marley, M. A. Agrawal, P.
Uranus Atmospheric Model for Engineering Application **[#8023]**
The poster/paper describes an atmospheric model for the planet Uranus constructed from published data based upon the Voyager-2 flyby of Uranus in 24 January 1986. This new model is designed for use in atmospheric probe trajectory simulation.

Pinaud, G. Barcena, J. Bouilly, J.-M. Leroy, V. Fischer, Wpp. Massuti, T.
HYDRA: Macroscopic 3D Approach of Light Weight Ablator **[#8002]**
The HYDRA project is an European funded program that aims at developing novel solution in term of TPS associated to a demonstration of Technology Readiness Level (TRL) 4. We describe modelling activities (radiation/ablation) compared to plasma test.

Ramirez, F. M.
Position Analysis of a Pico-Satellite for Optimum Solar Illumination **[#8098]**
This study characterizes the attitude of a satellite in order to obtain the optimum solar illumination on the face of a solar panel. While taking into consideration times of eclipse, a curve for the area exposed to the sun is derived.

Arthur, D. Senatore, C. Iagnemma, K. Andrade, J. Anderson, R. C.
Fundamental Characterisation of Planetary Surface Material in Microgravity Environments **[#8111]**
We present the aspect of xTerramechanics concerned with design of experimental hardware and protocols for characterization of granular planetary surface material, and early testing aboard the Zero Gravity Corporation hyperbolic research flight.

Gasch, M. J.
Thermal Testing of Planetary Probe Thermal Protection System Materials in Extreme Entry Environments **[#8062]**
The present talk provides an overview of recent updates to NASA's IHF and AEDC's H3 high temperature arcjet test facilities that to enable higher heatflux (>2000 W/cm2) and high pressure (>5 atm) testing of TPS.

EDL TECHNOLOGY

Boghozian, T. B. Stackpool, M. S. Gonzales, G. G.
Alternative High Performance Polymers for Ablative Thermal Protection Systems **[#8020]**
Comparing four ablation polymers with phenolic resin using different techniques, such as FTIR, TGA, DSC, and mechanical properties.

Fisher, T.
Preliminary EDL Aeroshell Design Performance from a Newtonian Theory Simulation Tool **[#8042]**
This paper explores the potential of commercial software to support preliminary mission entry vehicle designs and flight performance metrics using Newtonian Impact theory within Matlab.

Beck, R. A. S. Arnold, J. O. Gasch, M. J. Stackpoole, M. M. Venkatapathy, E.
Update on Conformal Ablative Thermal Protection System for Planetary and Human Exploration Missions **[#8065]**
In FY13, more advanced testing and modeling of the new NASA conformal ablative TPS material was performed. Most notable were the 3- and 4-point bending tests and the aerothermal testing on seams and joints in shear. The material outperformed PICA.

Bombelli, A. Soler, L. Mease, K.
Entry Trajectory Planner for High Elevation Mars Landing **[#8070]**
Achieving high elevation landing sites requires parachute deployment altitude control. A planner is proposed that yields trajectories with near-optimal performance, where control profiles are obtained as solutions of non-linear programming problems.

Luque Ribas, S. Zenou, E. Hernandez, D.
Guided Descent to Mars. Vision-Based Navigation System for a Mars Probe **[#8071]**
The Vision-based navigation system designed during this project uses database images of Mars and a camera on the probe to obtain the position and provide a feedback to the control systems, in order to increase the landing precision of the probes.

Saikia, S. J. Saranathan, H. Grant, M. J. Longuski, J. M.
Enabling Venus In Situ Missions Using Mechanically Deployed Aerodynamic Decelerator **[#8073]**
Trade study and optimal solutions for guided entry and aerocapture for Venus in situ missions using Mechanically Deployed Aerodynamic Decelerator to reduce peak deceleration loads, as well as peak heat fluxes.

Mignot, Y. M. Pisseloup, A. P.
Exomars Heatshield: From Design to Manufacturing **[#8102]**
Awarded a contract in 2007 for ExoMars Heatshield subsystem, Airbus DS is now close to deliver the Proto-Flight model for integration on the ExoMars Entry Demonstrator. The 11th IPPW is obvioulsy a good opportunity to share this enriching experience.

Heilimo, J. Harri, A.-M. Aleksashkin, S. Koryanov, V. Arruego, I. Schmidt, W. Haukka, H. Finchenko, V. Martynov, M. Ostresko, B. Ponomarenko, A. Kazakovtsev, V. Martin, S. Siili, T.
RITD — Adapting Mars Entry, Descent and Landing System for Earth **[#8039]**
The EDLS applicability to Earth's atmosphere is studied by the EU/RITD project. Project focuses to the analysis and tests of the transonic behaviour of this compact and light weight payload entry system at the Earth re-entry.

Ali, H. K. Braun, R. D.
In Situ Magnetohydrodynamic Energy Generation for Planetary Entry Vehicles **[#8046]**
This work aims to study the suitability of multi-pass entry trajectories for harnessing of vehicle kinetic energy through magnetohydrodynamic power generation from the high temperature entry plasma. Potential mission configurations are analyzed.

Morse, K. J. Milam, S. C. Ackerman, A. J. Clyde, N. W. Hoffman, W. M. Kaschmitter, B. F. Yovanoff, M. A. SunSpiral, V. Atkinson, D. H.
Validation of a Model for the Impact Landing of a Tensegrity Landing System **[#8056]**
In this project impact tests were performed on an instrumented spherical tensegrity with a payload to determine the accuracy of current simulations for impact events.

Murphy, M. K.
Depressed Aeroshell Forebody Geometries for the Generation of Lift **[#8075]**
Various depressed conic aeroshell forebody geometries are analyzed using a modified Newtonian method for their efficiency at generating lift during the entry and descent hypersonic flight regime.

Buchwald, R.
A Landing Platform with Robotic Self-Leveling Capability **[#8093]**
A robotic concept for the autonomous touchdown, self-leveling and lowering of the landing platform to the ground for a simplified rover egress has been developed and tested using a terrestrial demonstrator of a full scale Mars landing platform.

Rodriguez, E D. Santos, J. A. Bose, D. Vander Kam, J.
AVCOAT Density Characterization for Orion Multi-Purpose Crew Vehicle (MPCV) **[#8109]**
Post flight TPS analysis will be conducted on the Orion Multi-Purpose Crew Vehicle. The material characterization includes density profiling through the AVCOAT TPS thickness. Results help to further development more accurate TPS response models.

Sepka, S. A. Samareh, J. A.
Development of FIAT-Based Parametric Thermal Protection System Mass Estimating Relationships for NASA's Multi-Mission Earth Entry Concept **[#8114]**
Mass estimating relationships have been formulated to determine a vehicle's Thermal Protection System material and required thickness for safe Earth entry. We focus on developing MERs, the resulting equations, model limitations, and model accuracy.

Park, C. Arnold, J. O. Green, M. Witkowski, A.
Conjecture on the Appearance of the Galileo Probe's Entry and Descent in to the Jovian Atmosphere **[#8044]**
This paper gives the technical background for depiction of the Galileo Probes appearance during jovian entry. A clip from the planetarium show "Dark Universe" will be shown during the opening.session.

Foster, J. C. Le, M. N.
Where's Your EDL Data? **[#8050]**
Entry, Descent, Landing (EDL) represents a critical capability in our exploration of the solar system. Data from past technologies may need to be reviewed or may be reused. Where should this data reside? Why archive the data that is being created?

Ksanfomality, L. V.
Possible Life Found at a Wrong Place **[#8001]**
A re-examination of images of venusian surface returned from the VENERA landers 32 years ago has been undertaken using a modern processing technique. It allowed the detection of some new interesting entities that hypothetically may be related to fauna and flora of the planet.

Radio Science and Science Instrumentation Session

Tuesday, June 17, 2014
9:00 AM
Beckman Institute Auditorium

Chairs: Bernie Bienstock
Sami Asmar
Hannes Griebel

9:00 AM Mahaffy, P. R. * Atreya, S. K. Cartwright, J. A. Conrad, P. C. Farley, K. A. Franz, H. B. Garvin, J. B. Glaze, L. S. Malespin, C. Trainer, M. G. Wong, M. H.
In Situ Techniques for Measurements of Noble Gas and Nitrogen Isotopes in Planetary Environments: Recent Advances **[#8064]**
Advances in measurement techniques for measurements of noble gas and nitrogen isotopes are described and their relevance for a variety of in situ investigations of planetary atmospheres and surfaces.

9:15 AM Bailet, G. B. * Bourgoing, A. B. Magin, T. M. Laux, C. O. L.
Re-Entry Platform for Radiation Studies **[#8061]**
Based on an emission spectrometer, the payload developed by ECP and VKI will permit through newly developed methodology to characterize the reentry plasma and some ablation behaviors including recession rate in a plug concept to be flown by 2015.

9:30 AM Zacny, K. * Chu, P. Paulsen, G. Davis, K.
Sample Acquisition and Caching Architectures for the Mars 2020 Mission **[#8025]**
The goal of the Mars 2020 mission is to acquire 37 samples for future return. We present technologies to capture cores and regolith, to abrade rocks, and to inspect cores prior to caching. We also present three caching architectures.

9:45 AM Conte, L. Trifoni, E. * De Filippis, F. Marraffa, L.
Concept of an Innovative Photoluminescent Sensor for Radiative Heat Flux Measurement During Super-Orbital Re-Entry **[#8018]**
In this work is presented the idea, the physical principle, and a first layout of an innovative sensor capable to collect the VUV contribution to radiative heat flux both for onboard flight measurements and plasma wind tunnel tests.

10:00 AM Guelhan, A. * Siebe, F. Thiele, T.
Combined Sensor Package COMARS+ for Measuring Aerothermal and Radiation Loads on the Exomars EDM Capsule Back Cover **[#8013]**
Based on the former flight instrumentation experience combined aerothermal sensor package COMARS+ has been developed to perform radiative and convective heat flux measurements on the EDM back cover TPS of ExoMars EDM flight in 2016.

10:15 AM Asmar, S. W. * Folkner, W. M. Dehant, V. Banerdt, W. B. Smrekar, S. E.
The Martian Interior Structure from Landed Probe Doppler Tracking **[#8096]**
InSight carries a seismometer and other instruments including the Rotation and Interior Structure Experiment for precision Doppler tracking. It will constrain interior models by measuring the change in the spin axis direction as a function of time.

10:30 AM Liu, J. J. Yan, W. * Li, C. L. Ren, X.
Trajectory Reconstruction of CE-3 Soft Landing by Landing Camera Images **[#8078]**
In this paper, a method of trajectory reconstruction by space resection of landing camera is proposed. The process of avoidance obstacle at orbital altitude of about 100 meters is carefully studied, finally some useful results are given.

10:45 AM COFFEE BREAK

11:00 AM PANEL DISCUSSION

12:00 PM LUNCH

EDL Technologies Session

Tuesday, June 17, 2014
1:00 PM
Beckman Institute Auditorium

Chair: Aaron Morris

1:00 PM Chen, A. Hines, E. Otero, R. Stehura, A. Villar, G. *
Mars 2020 Entry, Descent, and Landing System Overview **[#8015]**
This paper presents an overview of the Mars 2020 entry, descent and landing system design and summarizes the status on a series of trade studies investigating proposed changes from the MSL baseline.

1:15 PM Munk, M. M. *
Entry, Descent and Landing (EDL) Technology Investments Within NASA's Space Technology Mission Directorate (STMD) **[#8060]**
NASA's Space Technology Mission Directorate has several investments in entry, descent and landing technologies, across its nine programs. This presentation will give a top-level view of the various investments.

1:30 PM Bose, D. * White, T. R. Schoenenberger, M. Munk, M. Hwang, H. H. Wright, H. S.
MSL Entry, Descent, and Landing Instrumentation: Return on Investment **[#8099]**
The presentation will describe benefits from MEDLI thermal and pressure instrumentation flown on MSL forebody TPS. The presentation will also introduce an enhanced MEDLI2 instrumentation for Mars-2020 mission.

1:45 PM Hughes, S. J. * Cheatwood, F. M. Dillman, R. A. DiNonno, J. M. Bodkin, R. J. White, J. P. Del Corso, J. A.
Terrestrial HIAD Orbital Reentry (THOR) Flight Test Opportunity **[#8113]**
Discussion of the environments achievable for the THOR opportunity and applicability to future missions using HIADs for atmospheric entry, as well as recent HIAD technical developments that make the THOR mission feasible.

2:00 PM Yamada, T. Y. * Yoshihara, K. Y. Yamada, K. Y.
Hayabusa-2 Reentry Capsule and its Verification Tests **[#8043]**
Hayabysa-2 is planned to be launched in 2014 and return in 2020. Hayabusa-2 SRC passes through the severe aerodynamic heating environment at velocity of 12 km/s. The present paper describes the design review and verification tests of the Hayabusa-2.

2:15 PM Kazemba, C. D. * Arnold, J. O. Chen, Y. K. Venkatapathy, E.
A Versatile 3D-Woven Carbon Fabric for Broad Mission Application of ADEPT **[#8017]**
This work seeks to identify a fabric architecture that is well suited to a wide array of various mission applications using 1D material response models and 3DOF trajectory analyses. This expands the potential mission infusion opportunities for ADEPT.

2:30 PM COFFEE BREAK

2:45 PM Woicke, S. * Mooij, E.
A Stereo-Vision Based Hazard-Detection Algorithm for Future Planetary Landers **[#8038]**
A hazard detection algorithm based on the stereo-vision principle is presented. A sensitivity analysis concerning the minimum baseline and the maximum altitude is discussed, based on which the limitations of this algorithm are investigated.

3:00 PM Gullotta, W. S. * Kirchner, C. G. Yuengert, A. P.
Resettable Landing Gear for Mars Hopper **[#8055]**
Researches using passive electromagnetic damper for repeated landing attenuation on Mars Hopper.

3:15 PM Lingard, J. S. * Underwood, J. C. Darley, M. G. Marraffa, L. Ferracina, L.
Supersonic Parachute Aerodynamic Testing and Fluid Structure Interaction Simulation **[#8082]**
The ESA Supersonic Parachute program expands the knowledge of parachute inflation and flying characteristics in supersonic flows using wind tunnel testing and fluid structure interaction to develop new inflation algorithms and aerodynamic databases.

3:30 PM Rajguru, A. * Faler, A. C. Franz, B.
Amphibious Quadcopter Swarm for the Exploration of Titan **[#8086]**
This is a proposal for a low mass and cost effective mission architecture consisting of an amphibious quadcopter swarm flight vehicle system for the exploration of Titan's liquid methane lake, Ligeia Mare. The paper focuses on the EDL and operations.

3:45 PM COFFEE BREAK

4:00 PM PANEL DISCUSSION

7:00 PM IOC Dinner Il Fornaio Restaurant, Pasadena

Inflatable and Deployable Technology Session

Wednesday, June 18, 2014
8:45 AM
Beckman Institute Auditorium

Chairs: Julian Nott
Hannes Griebel

8:45 AM Dillman, R. A. * Hughes, S. J. DiNonno, J. M. Bodkin, R. J. White, J. P. Del Corso, J. A. Cheatwood, F. M.
Planned Flight of the Terrestrial HIAD Orbital Reentry (THOR) **[#8091]**
This paper discusses the mission concept for the Terrestrial HIAD Orbital Reentry (THOR), planned for flight in 2016 as a secondary payload on an orbital sciences commercial resupply mission to the International Space Station.

9:00 AM Arnold, J. O. * de Jong, M. Prabhu, D. K. Boghozian, T. Kruger, C. Cassell, A. M.
Arcjet Testing of Woven Carbon Fabric Seams for Adapative Deployable Placement Technology **[#8035]**
The joining of gores of woven carbon fabric, robust to loading experienced during atmospheric entry is enabling for Advanced Deployable Entry Placement Technology. This paper demonstrates the viability stitched seams for use in ADEPT vehicles.

9:15 AM. Swanson, G. T. * Kazemba, C. D. Johnson, R. K. Hughes, S. J. Calomino, A. M. Cheatwood, F. M. Cassell, A. M.
Overview of the 6 Meter HIAD Inflatable Structure and Flexible TPS Static Load Test Series **[#8047]**
This overview will discuss the January 2014 static load test series of the six meter HIAD inflatable structure with integrated flexible TPS in detail.

9:30 AM Yount, B. C. * Kruger, C. E. Cassell, A. M. Kazemba, C. D.
Deployment Testing of the ADEPT Ground Test Article **[#8106]**
The ADEPT concept provides a low ballistic coefficient for planetary entry by employing an umbrella-like deployable aerodynamic decelerator. Findings from the development and deployment testing of a ground test article are presented.

9:45 AM Smith, B. * Cassell, A. Venkatapathy, E.
ADEPT for Secondary Payloads **[#8027]**
This presentation will inform the EDL community of the capability of ADEPT for delivery of small (sub 1 m diameter) secondary payloads as well as provide status of on-going technology development activities.

10:00 AM Diaz-Silva, R. A. * Sarigul-Klijn, N.
Standalone Simulations of SIAD Aeroelastic Response Using LS-DYNA **[#8108]**
Aeroelastic, 3D simulations of a Supersonic Inflatable Aerodynamic Decelerator (SIAD) featuring a tension cone geometry are showcased in this presentation. Partial inflation and buckling behavior results are presented.

10:15 AM COFFEE BREAK

10:30 AM PANEL DISCUSSION

11:30 AM Box lunch pick-up

11:45 AM NASA Jet Propulsion Laboratory Tour
-or-
California Science Center Tour
Depart Caltech

4:30 PM Griffith Observatory Tour — Griffith Park
followed by
IPPW-11 Banquet — Castaway
Depart Pasadena Hilton

NASA Jet Propulsion Laboratory Tour

Wednesday, June 18, 2014
Depart Caltech: 11:45 AM
Return Caltech: 2: 30 PM

Jet Propulsion Laboratory (JPL) is a federally funded research and development center and NASA field center located in Pasadena, California. JPL is managed by the nearby California Institute of Technology (Caltech) for the National Aeronautics and Space Administration. The laboratory's primary function is the development and operation of robotic planetary spacecraft, Earth-orbiting and astronomy missions. It is also responsible for operating NASA's Deep Space Network.

Among the laboratory's current major active projects are the Mars Science Laboratory mission (Curiosity rover), the Cassini–Huygens mission orbiting Saturn, the Mars Exploration Rover Opportunity, the Mars Reconnaissance Orbiter, the Dawn mission to the dwarf planet Ceres and asteroid Vesta, the Juno spacecraft en route to Jupiter, the Nuclear Spectroscopic Telescope Array (NuSTAR) X-ray telescope, and the Spitzer Space Telescope. JPL's Space Flight Operations Facility and Twenty-Five-Foot Space Simulator are designated National Historic Landmarks. (*courtesy wikipedia*)

California Science Center
Space Shuttle Endeavor Tour

Wednesday, June 18, 2014
Depart Caltech: 11:45 AM
Return Caltech: 3:30 PM

The California Science Center is open to the public seven days a week, 362 days per year, with free general admission to its permanent exhibit galleries. The facility, which opened in February 1998, spans more than 400,000 sq. feet and includes four major exhibit areas. World of Life probes the commonalities of the living world; Creative World examines the ways people employ technology to meet their needs; and Ecosystems, features an unprecedented blend of nearly 400 species of live plants and animals, and hands-on exhibits in 11 immersive environments.

On October 30, 2012, Space Shuttle Endeavour opened to the public in the Science Center's newly built Samuel Oschin Pavilion, where guests are able to see Endeavour up close and discover some of the science behind this amazing space vehicle. Also featured is SPACEHAB, a workshop for astronauts while in space, and a space shuttle main engine (SSME) which helped push the shuttle into orbit. Before entering the Pavilion, guests will be able to enjoy an introductory experience, Endeavour: The California Story, which celebrates Endeavour's many scientific achievements and its strong connection to California where all the orbiters were built. In addition to the orbiter, our unique collection of Air and Space Exhibits explores the design of aircraft, spacecraft, and space probes for specific tasks by applying the principles of air, space, and flight. *(courtesy http://www.californiasciencecenter.org/)*
Transportation will be via bus from Caltech, and tour is free of charge.

IPPW-11 Banquet

Wednesday, June 18, 2014

Castaway Restaurant
1250 E. Harvard Road
Burbank, CA 91501-1096
818.848.6691

Depart Pasadena Hilton 4:30 PM for Griffith Observatory followed by bus transportation to Castaway Restaurant
Return Pasadena Hilton: 10:00 PM

The Castaway Restaurant is located high in the Burbank hills overlooking De Bell Golf Course with a breathtaking view that is spectacular day or night. It is appropriately nicknamed "The Jewel on the Hill" and has been a landmark in the Burbank area for over 50 years. The IPPW-11 banquet will be held on the outdoor patio featuring views of Los Angeles. Bus transportation will be provided from the Pasadena Hilton.

Sustained Flight Session

Thursday, June 19, 2014
9:00 AM
Beckman Institute Auditorium

Chair: Jim Cutts
Jean-Pierre Lebreton

9:00 AM Tokumaru, P. T. * Balaram, J. Cutts, J. A. Matthies, L. H.
Fixed and Rotary Wing Flight of Small Air Vehicles on Mars, Venus, and Titan **[#8081]**
This presentation discusses air vehicle concepts from three recently proposed missions to Mars, Venus and Titan with an emphasis on air vehicle performance considerations.

9:30 AM Matthies, L. * Tokumaru, P. Sherrit, S. Beauchamp, P.
Titan Aerial Daughtercraft (TAD) for Surface Studies from a Lander or Balloon **[#8083]**
Recent rapid progress on autonomous navigation of micro air vehicles for terrestrial applications opens new possibilities for a small aerial vehicle that could deploy from a Titan lander or balloon to acquire samples for analysis on the mothership.

9:45 AM Balaram, J. * Tokumaru, P. T.
Rotorcrafts for Mars Exploration **[#8087]**
Rotorcraft mobility provides a number of useful capabilities to potential Mars missions. We present some recent results relating to the design and test of Mars rotorcraft mobility elements, and aspects of rotorcraft system and mission design.

10:00 AM Voss, P. B. * Nott, J. Cutts, J. A. Hall, J. L. Beauchamp, P. M. Limaye, S. S. Baynes, K. H. Bennett, B. Hole, L. R.
Altitude-Controlled Balloons for Long-Duration Flights on Venus **[#8092]**
Balloons provide a relatively simple and well-proven platform for accessing the upper atmosphere of Venus. We analyze several types of altitude-controlled balloons and assess their suitability for an extended mission on Venus.

10:15 AM Pauken, M. T. * Hall, J. L.
Development and Testing of a Titan Superpressure Balloon Prototype **[#8006]**
We discuss the technical developments of a superpressure balloon designed to operate in Titan's cryogenic environment. A 1.5-m diameter spherical balloon was constructed from a hexalaminate mylar film plus polyester fabric for this research.

10:30 AM Mimoun, D. * Garcia, R. F.
A Venus Interior Structure Explorer Mission Using Balloons **[#8063]**
Although very similar to Earth, Venus remains a mystery. One key to the understanding this is the understanding of its interior structure. We propose a mission concept using balloons, based on solid/atmosphere coupling processes understanding.

10:45 AM COFFEE BREAK

11:00 AM PANEL DISCUSSION

12:00 p.m. LUNCH

Modeling, Simulation and Testing Session

Thursday, June 19, 2014
1:45 PM
Beckman Institute Auditorium

Chair: Carrie Zumwaldt
Kerry Zarchi
Christian Mundt

1:45 PM Kohlman, L. W. * Li, B. Prakash, V. Pereira, J. M. Carney, K. S. Revilock, D. M. Ruggeri, C. R. Lawrence, C. Wu X.
High Rate, Low Temperature Testing and Modeling of Water Ice for High Speed Ballistic Probes **[#8052]**
High rate, low temperature testing and modeling of water ice is important in design of ballistic probes for in-situ evaluation of icy moon composition. The results of coupon and impact testing will be presented, as well as a new modeling approach.

2:00 PM Buchwald, R. *
Simulation Based Landing System Verification — About the Challenges of Non-Linear Error Estimation **[#8053]**
Simulation based verification of non-linear events comes with additional risks. Special focus has to be set on software validation and error estimation. A dedicated uncertainty factor has been derived and evaluated on the basis of terrestrial tests.

2:15 PM Jaramillo-Botero, A. J. B. * Beegle, L. W. B. Hodyss, R. P. H. Goddard, W. A. G. III Darrach, M. R.
Hypervelocity Impact Effects on Space Mission Instrumentation **[#8051]**
Understanding the physics and chemistry of hypervelocity collisions of small impactors on spacescrafts and their instruments is critical to their survival and operational accuracy, as well as for the design of future mission instrumentation.

2:30 PM Sengupta, A. * Mehta, M. Vizcaino, J. Metzger, P.
Plume Impingement Induced Surface Erosion During Retro-Propulsive Landings on Mars **[#8118]**
The quantification of the environment that occurs as a result of the engine plumes impinging the soil during landings on Mars is critical forrobotic and human landed mission architectures.

2:45 PM Tardivel, S. * Scheeres, D. J. Michel, P. Van wal, S.
Modelling of Asteroid Surfaces to Understand Landing Operations **[#8104]**
A model of asteroid surface using faceted high-resolution shape, stochastic rock distribution and regolith contact dynamics is presented, with application to mission Hayabusa 2. It highlights new opportunities for in-situ exploration of small bodies.

3:00 PM Witte, L. *
A Stochastic Model for the Landing Dispersion of Hazard Detection and Avoidance Capable Flight Systems **[#8033]**
To support landing site assessments for HDA-capable flight systems and to facilitate trade studies between the potential HDA architectures versus the yielded probability of safe landing a stochastic landing dispersion model has been developed.

3:15 PM Glaab, L. J. * Fremaux, C. M.
Vertical Spin Tunnel Testing and Stability Analyses of Earth Entry Vehicles **[#8010]**
This report presents results from dynamic stability testing in the NASA LaRC Vertical Spin Tunnel of a series of Multi-Mission Earth Entry Vehicles and subsequent data analysis. Evaluation of a proposed dynamic stability criteria is also performed.

3:30 PM Van Hove, B. * Karatekin, O.
Observing the Martian Atmosphere Using Flight Data: Stochastic Filtering Methods **[#8068]**
Application of novel Kalman filtering method to Mars flight data records, focus on reconstruction of atmospheric environment, in preparation for the ExoMars 2016 demonstrator mission.

3:45 PM COFFEE BREAK

4:00 PM PANEL DISCUSSION

5:30 PM Downtown Los Angeles Walking Tour
Depart Caltech

Downtown Los Angeles Walking Tour

Thursday, June 19, 2014

Depart: Beckman Courtyard, Caltech: 5:30 PM
Return Caltech: 10:00 PM

Downtown Los Angeles is home to the financial district of the city and also features many iconic destinations including Grand Central Market, Angels flight, Pershing square, the Bradbury Building, and Olivera Street. Participants will be taken on a walking tour with stops at historically interesting sites, distinct hotels and eateries. The tour will utilize public transportation (Gold Line Metro) and is free of charge.

Convene in Beckman Courtyard at 5:00 PM for group departure.

Cross Cutting Technologies Session

Friday, June 20, 2014
9:00 AM
Beckman Institute Auditorium

Chairs: Michelle Munk
Karl Edquist

9:00 AM Bouilly, J.-M. * Scheer, H. Pisseloup, A.
Sample Return Challenges and Technologies **[#8037]**
During the last ten years, Airbus Defence and Space contributed to several Earth Return Capsules projects. The scope of this paper is to present an overview of main results and achievements obtained through mission studies and technology maturation.

9:15 AM Venkatapathy, E. * Ellerby, D.
Heat Shield for Extreme Entry Environment Technology for Near-Term Robotic Science Missions and Longer Term Human Missions **[#8101]**
Heat shield for Extreme Entry Environment is currently funded for technology development for mission infusion into Discovery-13 and New Frontier-4 completed missions. We will describe the technology and the approach to TRL 6 to meet infusion challenges.

9:30 AM Greenlaw, R J. * Arthur, D. T. Anderson, R. C. Andrade, J. E.
Direct Write Sensors for Space and Probe Applications **[#8107]**
This presentation will summarize the latest advances in Direct Write Thermal Spray technology related to probe applications including temperature sensors, heat flux sensors, recession sensors, integrated wiring, antennas, and heaters.

9:45 AM Hemmati, H. Sengupta, A. * Castillo, J. McElrath, T. Roberts, T. Willis, P.
Two-Dimensional Planetary Surface Lander **[#8119]**
A systems engineering study was conducted to leverage a new two-dimensional (2D) lander concept with a low per unit cost to enable scientific study at multiple locations with a single entry system as the delivery vehicle.

10:00 AM Samareh, J. * Armand, S.
Pressure Vessel Design Concepts for Planetary Probe Missions **[#8121]**
Materials and systems for extreme environments have been identified by the Outer Planets Assessment Group (OPAG) as technology needs for future planetary probe missions.

10:15 AM Sakraker, I. * Umit, E. van der Haegen, V. Chazot, O.
Atmospheric Entry Aerothermodynamics Flight Test on CubeSat Platform **[#8041]**
The challenging aerothermochemistry of atmospheric entry is aimed to be experimented on a triple CubeSat platform having ablative TPS in the front unit and ceramic TPS on the side panels. Five aerothermodynamics payloads are presented in this paper.

10:30 AM Pigneur, B. * Ariyur, K. B.
Multiple Sensors for Absolute Measurement of Aerobraking Spacecraft State Estimation **[#8105]**
Prior methods to determine the spacecraft state estimation for aerobraking have been radiometric tracking data and IMU measurement. We propose a novel method for real-time absolute measurement of full state estimation based on multiple sensors.

10:45 AM COFFEE BREAK

11:00 AM PANEL DISCUSSION

12:00 p.m. LUNCH

Closing Session

Friday, June 20, 2014
1:00 PM
Beckman Institute Auditorium

Chairs: Jim Cutts
Bernie Bienstock

1:00 PM Cutts, J. * and Panelists
Panel Discussion: Highlights and Key Issues at IPPW-11

1:30 PM O'Toole, R. *
The U.S. Space Program: Budgets and Politics

2:00 PM Ruffin, S. *
Student Awards

2:15 PM Guelhan, A. *
Plan for IPPW-12

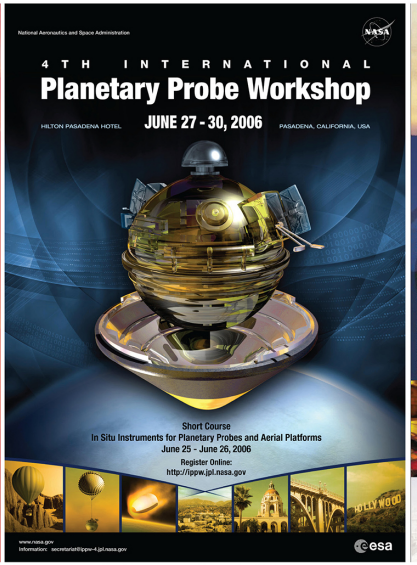
2:30 PM Sengupta, A. * and Bienstock, B. *
Closing and Farewell

3:00 PM MEETING ADJOURNED

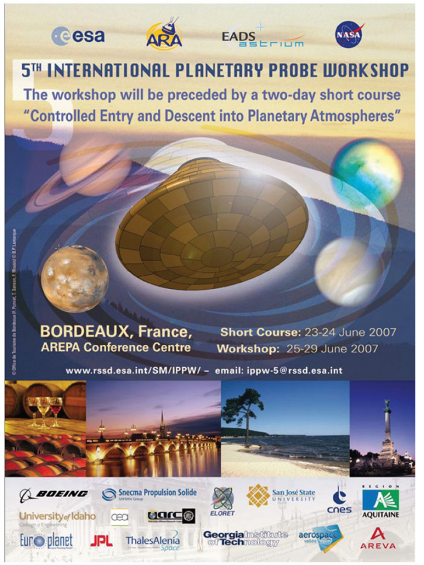
Lisbon · Portugal · 2003

Moffett Field · California · USA · 2004

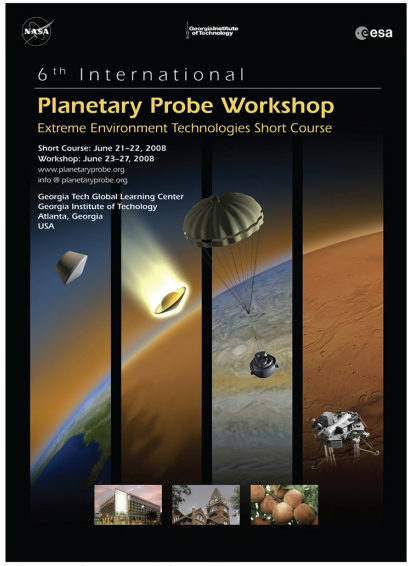
Anavyssos · Attiki · Greece · 2005



Pasadena · California · USA · 2006

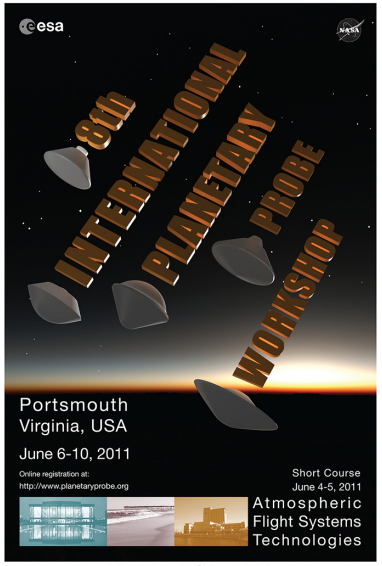


Bordeaux · France · 2007



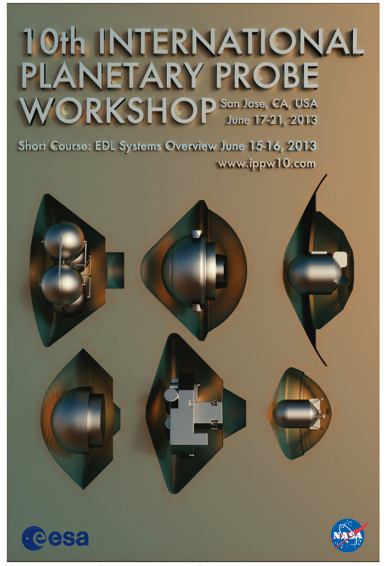
Atlanta · Georgia · USA · 2008

Barcelona · Spain · 2010



Portsmouth · Virginia · USA · 2011

Toulouse · France · 2012



San Jose · California · USA · 2013

IPPW Ten-Year History