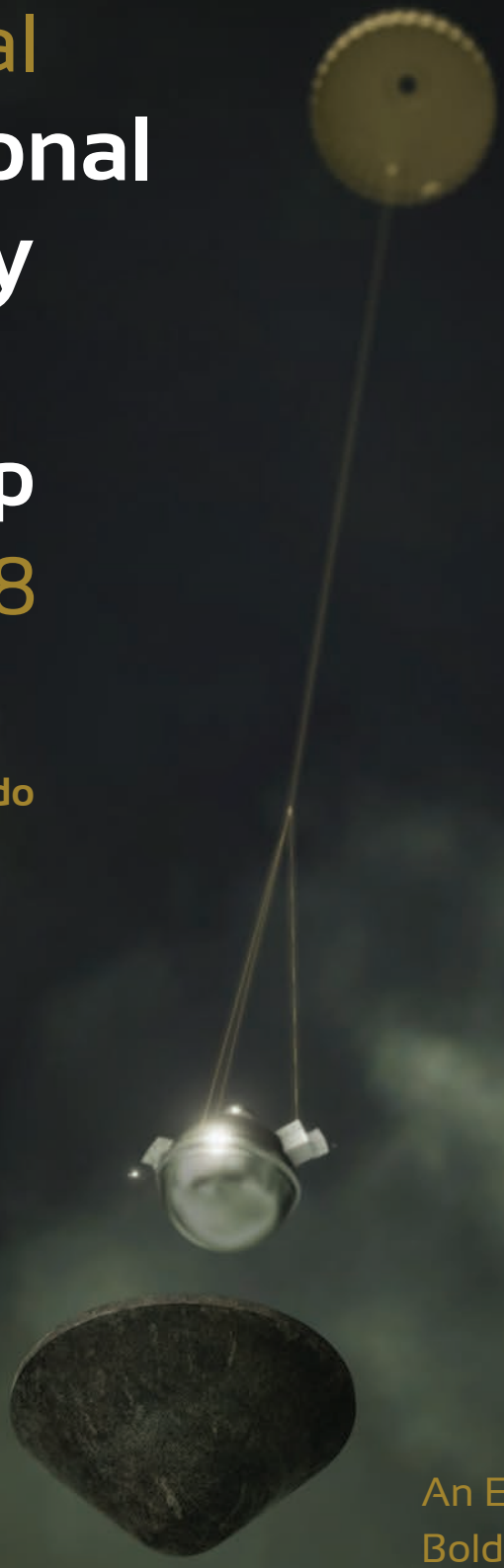
esa

University of Colorado Boulder

NASA

15th Annual International Planetary Probe Workshop

IPPW-2018



June 11-15, 2018

University of Colorado Boulder

Short Course

June 9-10, 2018

Small Satellites:

An Emerging Paradigm for Bold Planetary Exploration

LOCKHEED MARTIN

ANALYTICAL MECHANICS ASSOCIATES

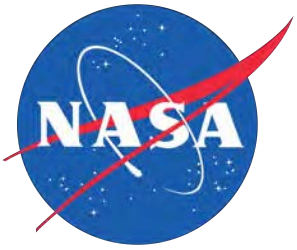
ROCCOR

Advanced SPACE

Virgin ORBIT

IPPW-2018 Sponsors

IPPW-2018 is grateful to the following sponsors for their support, which helped make this Workshop a reality:



IPPW-2018 Welcome

Welcome to Boulder, Colorado and to the 15th meeting of the International Planetary Probe Workshop, hosted by University of Colorado Boulder. Participating in this year's Workshop and Short Course is an outstanding group of international scientists, engineers, technologists, mission designers, and policy makers. We are pleased to be hosting IPPW-2018 in Boulder, Colorado. The city is nestled in the foothills of the Rockies and offers impressive scenery, a rustic feeling with excellent restaurants, and clean air. Colorado is home to 400 aerospace companies employing some 200,000 Coloradans, with many of those companies, large and small, based nearby. Be certain to take the time—not during the workshop of course—to explore Boulder and discover the rugged mountain areas, and see why National Geographic ranked the city #1 in happiness.

IPPW-2018 offers a varied program, as you have already seen from the program agenda, along with ample opportunities for networking. We received a record number of 170 high quality abstracts this year. The Program Organizing Committee worked hard to put together an exciting program with an outstanding set of presentations and posters that you will encounter in the next five days. Per IPPW tradition, the Workshop was preceded this year by a weekend Short Course focusing on Small Satellites for Interplanetary Exploration. In addition, we solicited and evaluated nominees for the Al Seiff Memorial Award. Unfortunately, our IPPW-2018 awardee, Sushil Atreya from the University of Michigan, will be awarded *in absentia* since he cannot attend this year. He sends his best wishes to the community, and plans to deliver a talk at IPPW-2019.

In order to accommodate the number of presenters and posters in a workshop format, we scheduled short presentations for each technical session followed by general Q&A sessions so attendees can further explore the presented concepts. In addition, we are highlighting our posters by scheduling brief Poster Short Talks by each poster presenter, arranged in four groups across Monday and Tuesday. There are no parallel sessions during IPPW-2018, allowing you to attend all sessions of interest.

We encourage you to attend as many oral presentations and poster viewing opportunities as possible. In addition to the technical content, we have planned various social events during the week. A Welcome Reception, sponsored by Lockheed Martin, is scheduled on Monday evening to introduce you to the attendees at this year's workshop. On Tuesday evening, our Poster Reception, sponsored by Advanced Space, will afford all attendees the opportunity for detailed viewing and learning from the varied posters on display. After a half-day of presentations on Wednesday morning, the afternoon is devoted to a visit to various science and engineering institutions in and around Boulder. Following the tour, our annual banquet

will be held at the scenic Folsom Field Rooftop Terrace, which features a spectacular view of the Flatirons, Rockies and a (planned) memorable sunset.

Since IPPW-2018 is indeed a workshop, we invite you to take advantage of the numerous opportunities during coffee breaks, lunches, and social activities to build collaborative partnerships with other workshop participants. We thank our generous IPPW-2018 sponsors, as listed in this program, for supporting our 15th workshop and for providing funding to support a record number of European and US students who are attending to gain a better understanding of their future career options in planetary probes. This year, we have awarded nearly 40 student scholarships and have scheduled events with a student focus, including the Student Social, student networking exercises, and the Student Processional Development luncheon on Tuesday.

On Friday afternoon, 15 June, a presentation on the plans for IPPW-2019, to be hosted at Oxford University in the United Kingdom, is scheduled. We encourage you to attend this talk to learn about your next opportunity to join us. In this time of exciting missions planning for future explorations occurring in our space 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 actively participate, expand your knowledge, and enjoy our 15th International Planetary Probe Workshop.

Let's make it a great week! *Ad Astra.*

Bernie Bienstock
Caltech / Jet Propulsion Laboratory (JPL)
Chair, IPPW-2018 International Organizing Organizing Committee

Bobby Braun and Lewis Groswald
University of Colorado Boulder
Co-Chairs, IPPW-2018 Local Committee

Table of Contents

General Information

This program contains all of the organization and programming information you need for the 2018 International Planetary Probe Workshop (IPPW-2018), held at the Williams Village campus at the University of Colorado Boulder, from 11-15 June 2018.

You can also find information on the Short Course on Small Satellites: An Emerging Paradigm for Bold Planetary Exploration, which precedes the workshop on 9-10 June 2018.

Venue

IPPW-2018 will take place in the Village Center of the Williams Village campus of the University of Colorado Boulder (CU Boulder), nestled at the base of the Flatirons & Foothills, which are the gateway to the Rocky Mountains. "Will Vill," as it is called, is a 15-minute walk from CU Boulder's main campus. See page 8 for the conference center layout at Will Vill.

In addition to the Short Course and Main Workshop occurring in the conference portion of the Village Center, there is ample lounging areas along the Village Center ground floor to work, network, and hold informal meetings.

The Grotto is one such general work/meeting area, while the ASAP Tutor room is intended for quiet, focused work.

Village Center, Williams Village at the University of Colorado Boulder
500 30th Street, Boulder, CO 80303

Parking

The parking lot is located off of 30th Street next to the Village Center. Parking is by virtual permit or credit card pay-to-park machines. Participants are responsible for reading and adhering to all posted parking policies and paying accordingly. Read all signage when entering a lot to ensure you are parking in the correct lot. Individual requirements exist for each lot based on day and time. Information on how to purchase virtual parking permits online can be found at the Registration Desk. The rate is $17 per week.

Meals

Please note that *breakfast and lunch* are included in your registration for each day of the workshop, and will be served on the second floor in the Will Vill Dining Hall, accessible by the main grand staircase or elevator. The Tuesday Student Professional Development Luncheon will also take place in the Will Vill Dining Hall, but will be sectioned off.

Registration

The Registration Desk is located in the main entrance/lobby area of the conference area of the Village Center. The entrance to the Village Center is off of 30th Street across from the entrance driveway to the parking lot. Registration Desk Operating Hours are:

Saturday, June 9th	08:00-11:30
Sunday, June 10th	08:00-10:00
Monday, June 11th	07:30-11:30
Tuesday, June 12th	08:00-10:00
Wednesday, June 13th	08:00-10:00
Thursday, June 14th	08:00-10:00
Friday, June 15th	08:00-09:00

For registration support outside of these hours or any other questions, please contact LOC Co-Chair, Lewis Groswald, at lewis.groswald@colorado.edu.

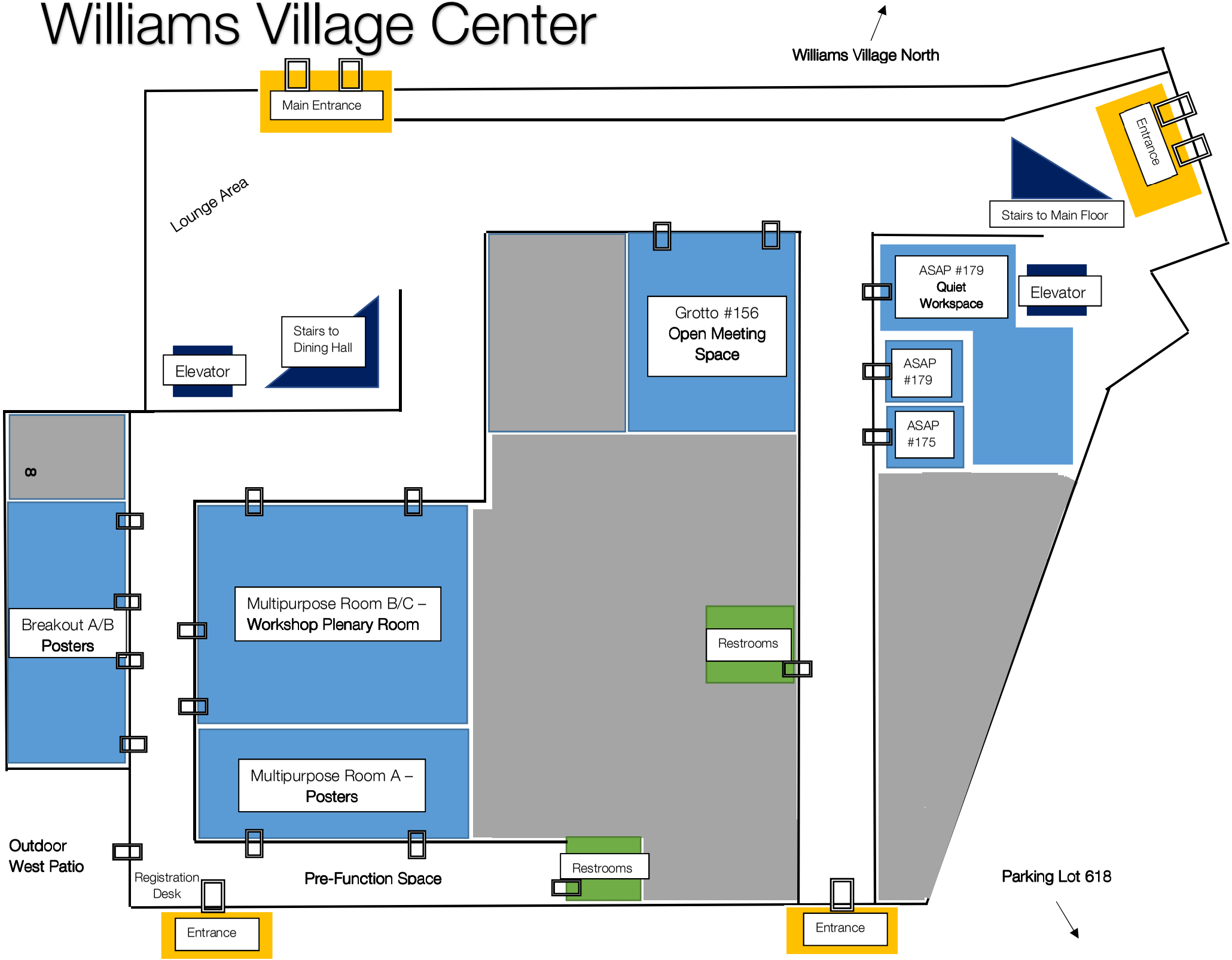
Conference Badges & Official Identification

Please keep your badge on you at all times during the Workshop, as well as for official IPPW activities and social events. Badges will be used for entry to receptions and the Wednesday banquet. International visitors should also keep their passports with them to use for identification for the Wednesday activities and whenever purchasing alcohol, as bartenders will ask for age verification. US citizens should also have official government ID with them for these reasons (Colorado bartenders are stringent in asking for ID).

Wi-Fi & Power

Access wireless service on campus by selecting **UCB Guest Wireless** from your available Wi-Fi network options and accepting the terms and conditions upon opening your web browser (no password required). You will be prompted to re-accept these terms and conditions periodically. If you encounter difficulty accessing the Internet, call 303-735-HELP (4357) or email help@colorado.edu for assistance during their business hours. Check firewalls or security settings on your computer that could possibly complicate accessing the campus Wi-Fi system before you arrive.

Williams Village Center



Welcome to Boulder, Colorado

The following information is provided by the Boulder Convention & Visitors Bureau. Learn more about Boulder and what it has to offer at www.bouldercoloradousa.com.

Boulder, Colorado, is located just 30 minutes northwest of Denver, exactly where the plains meet the Rocky Mountains. The town was founded in 1859 by explorers seeking the riches of gold, and Boulder's history only got more colorful from there.

Today, visitors can enjoy the benefits of a community created by residents that embrace a healthy, culturally-enriched lifestyle. Whether you are an outdoor enthusiast, seeking intellectual stimulation or want a relaxing getaway, Boulder offers a variety of experiences for every type of travel. Catch a glimpse of some of Boulder's furry and feathery residents while strolling, hiking or biking through our 300 miles of trails and 45,000 acres of open space, people-watch at an outdoor café or restaurant on Pearl Street, visit one of our many national lab oratories, or check out a top attraction like Celestial Seasonings tea factory or the Boulder Dushanbe Teahouse.

The City of Boulder sits 5,430 feet above sea level, and Boulder enjoys 300 plus days for sunshine a year and moderate weather. Last we checked, there were 103,166 residents in Boulder, including about 30,000 students who are enrolled at the University of Colorado at Boulder.

Downtown Boulder, Colorado | Source: Boulder Convention & Visitors Bureau

National Geographic and the "Today" show recently recognized Boulder as "The Happiest City in the U.S.." Forbes recently noted Boulder tops the list of an etiquette expert's friendliest cities in the nation. Boulder has earned a spot on Gallup's "Highest Well Being Communities" list for several years running. And even back in 2011, CBS News wrote, "If happiness is a state of mind, then Boulder is its capital."

Things To Do in Boulder

Pearl Street

The brick-paved Pearl Street is Boulder's heart and soul — a central gathering place where locals and visitors alike come to stroll and shop among the historic storefronts, dine at buzzed-about restaurants, sip coffee, throw back a microbrew or simply people-watch. If you do only one thing in Boulder, walking this pedestrian mall should probably be it.

The Flatirons

Boulder's beloved Flatirons — those slanting, massive slabs of sandstone that form Boulder's backdrop from just about any angle — tend to have a slightly mystical effect on visitors. We're willing to bet you'll be drawn to them, and the Open Space Mountain Parks area adjacent to the Chautauqua historic district affords the best way to get a closer look. Gaze up at them from the hiking area's beautiful meadow, where dozens of trails lead off into the foothills, then hike right up into the Flatirons if you are seeking a bit more exercise and adventure.

Celestial Seasonings

Get an up-close look at how the largest tea manufacturer in North America blends ingredients into some of the country's most beloved teas (Sleepytime tea, anyone?). See the production floor, catch of whiff of the famous mint room, taste any of the teas and view tea-box art in the gallery — all for free. Celestial Seasonings was named one of the country's best food factory tours by USA TODAY's Readers' Choice.

Boulder Dushanbe Teahouse

Unless you've been to Tajikistan, you've probably never seen a teahouse like this one. Handcrafted by artisans in Boulder's sister city of Dunshanbe, the structure was shipped piece-by-piece from the Tajikistan city and assembled in Boulder. It is an inviting and peaceful place to enjoy one of dozens of types of teas and a bite to eat while taking in the vibrant carvings and paintings that cover every inch of the interior.

Boulder Creek Path

Miles of paved path meander right through the heart of Boulder and are easily accessible to all. Join locals who bike, jog, skate and walk Boulder Creek Path alongside the babbling creek beneath shady old-growth trees for some fresh air and beautiful Boulder views.

Boulder Theater

The historic Boulder Theater has been a stage for music and film since 1906, though in various incarnations. Today, the theater's art deco facade and neon marquis are almost as iconic to Boulder as the Flatirons. And from big-name musical acts like Shawn Colvin and Sheryl Crow to local faves such as Big Head Todd and the Monsters and The Samples, the Boulder Theater has put on some of the finest shows in Boulder's history.

Banjo Billy's Bus Tour

First of all, if you don't take Banjo Billy's Bus Tour, you'll constantly be wondering what you're missing by the third or fourth time you spot the recognizable school-bus-turned-hillbilly-shack rambling around town. More importantly, you're bound to learn a lot more about Boulder on this unique tour that covers ghost stories, legend and lore while you sit on a saddle, recliner or couch and listen to the entertaining tour guide share fun facts and silly stories.

Boulder Farmers' Market

Named the No. 1 farmers' market in the country by readers of *USA Today*, the Boulder Farmers' Market is the perfect way to experience Boulder like a local. Established in 1986 by a handful of local farmers looking to sell farm-fresh produce directly to the public, the market is a growers-only outlet. Shoppers are guaranteed the best selection of locally grown, seasonal produce, eggs, cheeses, meats, herbs, flowers, wines and gourmet food products available in Boulder County. Open Wednesdays 4pm–8pm, May–October and Saturdays 8 am–2pm, April through November.

General Locale Information

Time Zone
Boulder, Colorado is in the US Mountain Daylight Time Zone (MDT / UTC-07:00).

Climate and Clothing
In June, the average high temperature is 82°F (22.2°C) and the average low is 52°F (11.1°C)—make sure to bring a jacket to the Monday Reception & Wednesday night Banquet. Despite Boulder's semi-arid climate, rain is always a possibility. A light-weight jacket or pullover are recommended, at the least.

Credit Cards
Credit cards are accepted at most businesses including restaurants, shopping centers (malls) and gift stores, gas stations, grocery stores. Major credit cards include Visa, MasterCard, and American Express. ATMs are also located at many areas across town.

Local Transportation, Including Public

Transportation Options from Denver International Airport to Boulder
There are numerous ground transportation options available at Denver International Airport. The Ground Transportation Information Counter is located in the central area on Level 5 of Jeppesen Terminal. Counter hours are 6:30 a.m. to 11:30 p.m. daily.

Public Transport: RTD – Regional Transportation District-Denver
RTD is the regional public transportation provider in the Boulder-Denver region. You can take the RTD AB1 shuttle to and from the airport straight to downtown Denver. A popular option is to take the shuttle to Boulder, and take a ride share or taxi to your final destination in-town. Learn more about routes and rates at www.rtd-denver.com.

Boulder B-Cycle
Boulder has its very own bike share program called Boulder B-Cycle, with rental kiosks arranged around town. Learn more at https://boulder.bcycle.com/.

Rental Cars
All rental car companies at DIA are located on airport property, but are away from the main terminal. Each rental company provides a courtesy shuttle to and from Jeppesen Terminal from its location. All courtesy shuttles pick up and drop off on level five of both the east and west sides of the Jeppesen Terminal. Please follow the overhead signage for the appropriate pick-up location.

Shuttles
GreenRide is a popular local shuttle services with affordable one-way and roundtrip tickets: https://greenrideco.com/

SuperShuttle is another widely used shuttle service: http://supershuttle.com/
You can learn about other commuter shuttles here by entering "Boulder" to bring up a list of transit options:
https://www.flydenver.com/parking_transit/transit/shared-vans

Taxis & Ride Share
Taxis are readily available and service within the eight counties that make up the Denver metro area. Some companies may also provide service to other destinations within the state of Colorado. Check with your cab company of choice (or directly with your driver at the airport) for more information on fares and destinations served.

- Denver Yellow Cab – 303.777.7777
- Freedom cab – 303.444.4444
- Metro Taxi – 303.333.3333
- Union Taxi – 303.922.2222

Uber & Lyft are also widely used and drivers are plentiful, both for airport transportation and for getting around Boulder. Both services allow for the creation of business travel accounts, and make it easy to split when sharing a ride.

Local Printing Shops

If you don't want to put a 4-foot poster in the overhead bin, or transport a heavy stack of papers across the Atlantic, you can request printing services at the following local providers.

Please note that there are no printing facilities in Williams Village. If you need to print something during the workshop, consider doing so at your hotel or at one of the businesses below:

FedEx Office Print & Ship Center
2616 Baseline Rd, Boulder, CO 80305 (south end of Main Campus)
303-494-2622
0.6mi/0.9 km from Village Center – 4-min drive or 10-12-min walk
https://local.fedex.com/co/boulder/office-0414/

The Ink Spot Copy Center (on Main Campus)
1st Floor, University Memorial Center, UMC 130C (in food court), Boulder, CO 80309
303-492-7878 | inkspot@colorado.edu
1.4mi/2.1km from Village Center – 6-min drive or 25-30-min walk
https://www.colorado.edu/auxiliaryservices/imaging-services

The UPS Store (on Main Campus)
2480 Kittredge Loop Drive (north side of Kittredge Central building)
303-442-2601
0.9mi/1.4km from Village Center, 5-min drive or 15-20-min walk
https://boulder-co-6439.theupsstorelocal.com/

IPPW-2018 Committees

International Organizing Committee

Chair: Bernie Bienstock, *Jet Propulsion Laboratory*

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Dayung Koh, *Jet Propulsion Laboratory*
Dean Kontinos, *NASA Ames Research Center*

(International Organizing Committee cont'd)

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Ozgur Karatekin, *Royal Observatory of Belgium*
Siddharth Krisnamoorthy, *Jet Propulsion Laboratory*
Jean-Pierre Lebreton, *CNRS*
David Mimoun, *ISAE*
Michelle Pizzo, *Old Dominion University*
Evan Roelke, *University of Colorado Boulder*
Steve Ruffin, *Georgia Institute of Technology*
Isil Sakraker, *German Aerospace Center (DLR)*
Thomas Voirin, *European Space Agency*
Michael Werner, *University of Colorado Boulder*

Al Seiff Memorial Award Committee

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Jim Arnold, *AMA Inc. (Moffet Field, CA, USA)*
David Atkinson, *Jet Propulsion Laboratory*
Miguel Pérez Ayúcar, *European Space Agency (ESAC, Madrid)*
Olivier Witasse, *European Space Agency (ESTEC, The Netherlands)*

Local Organizing Committee

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Co-Chair: Lewis Groswald, *University of Colorado Boulder*

Erin Smith, *University of Colorado Boulder*

Forward Planning Committee, IPPW-2019

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Athéna Coustenis, *Observatoire de Paris*
Ashley Korzun, *NASA Langley Research Center*
Jean-Pierre Lebreton, *CNRS*
Ralph Lorenz, *Applied Physics Laboratory*
Ethiraj Venkatapathy, *NASA Ames Research Center*

IPPW-2018 Instructions for Oral and Poster Presenters

1. ORAL presenters—Please note the guidelines below for your presentation:

- Presentations and accompanying material (e.g. videos) must be uploaded to the submission website no later than Thursday, June 7th (hard deadline).
    - Go to https://ippw.jpl.nasa.gov/ and sign in with your personal user credentials (same as used for abstract submission).
    - Upload your presentation material into the same "presentation folder" as your abstract. From the drop-down box, select what type of document you are uploading (oral presentation / poster / abstract / 1-slide / other for media files). Note that you may upload multiple files into your presentation folder.
    - Please make certain to delete any obsolete file versions.
    - Note that the system will automatically rename your files with consistent naming and assign them to the relevant session.
- If you submit a paper, a preliminary version shall also be uploaded by June 7th in the same manner as described above. A paper template is available at: https://www.colorado.edu/event/ippw2018/abstracts
- One PC laptop, a projector, and a remote pointer will be available during the workshop sessions for oral talk presentations.
- Ensure that your presentation displays all media files and graphics on a standard Windows laptop equipped with Microsoft Office and PDF reader.
- Due to the large number of contributions, speaker presentation slots are limited to 12 minutes to allow for 1-2 brief questions. The time limit will be strictly enforced.
- Presentation should therefore be limited to 10 slides in order to adhere to the allocated 12-minute presentation time. You will be warned as you approach the 12-minute presentation time and be asked to end your presentation at 12 minutes elapsed presentation time.
- You may include additional "backup" slides to briefly address anticipated questions and for archiving purposes. All presentations, with "backup" slides (if submitted), will be archived.
- In order to facilitate a smooth transition between speakers, we will pre-load all files on the presentation computer. Your contact point for questions will be your session convener. Please preview and verify proper functioning of your files, at the following times on the day of your presentation:
    - AM Presentations: 8:00 AM

- PM Presentations: 1:00 PM
- During breaks the days before your presentation

2. POSTER presenters—Please note the guidelines below for your poster:

- **Poster Setup & Breakdown Times (in Breakout AB & Multipurpose A, see map):**
  - Setup: Monday, June 11, *after* 11:00am
  - Breakdown*:* Friday, June 15, *by* 12:00pm
- Your poster file (as a PDF) and a one-slide introduction presentation must be uploaded to the submission website no later than Thursday, June 7th (hard deadline).
  - Go to https://ippw.jpl.nasa.gov/ and sign in with your personal user credentials (same as used for abstract submission).
  - Upload your poster and your one-slide introduction presentation into the same "presentation folder" as your abstract. From the drop-down box, select what type of document you are uploading (oral presentation / poster / abstract / 1-slide / other for media files). Note that you may upload multiple files into your presentation folder.
  - Please make certain to delete any obsolete file versions.
  - Note that the system will automatically rename your files with consistent naming and assign them to the relevant session.
- Posters must be in portrait orientation, with maximum dimensions of 42" h x 32" w. Poster boards will be provided. Pins will be provided to allow you to affix your poster to the board.
- All posters should include:
  - Poster title
  - Author name(s)
  - Author institution(s)
- In addition, include your institutional logo(s) and the abstract number near the top of your poster.
- Dedicated poster introduction sessions are scheduled on Monday, 11 and Tuesday, 12 June, as indicated in the detailed program. Each poster presenter will be allocated 1 minute to provide a very brief overview of their poster. Presenters may use no more than a single slide, either an explanatory brief narrative or the poster itself, to "advertise" their poster during their 1-minute presentation.
- In order to adhere to the allocated time, we will pre-load the 1-slide poster presentations to the workshop computer. Note, that due to the large number of posters, no last-minute updates to the poster presentations can be accommodated.
- A full poster session is scheduled for the evening of Tuesday, June 12th.
- If additional assistance is needed, please inquire at the registration desk.

Abstracts for Download

Please note that all IPPW-2018 abstracts (for oral presentations and posters) can be downloaded as one integrated PDF file at the following URL (which is also posted on the IPPW-2018 website):

https://www.colorado.edu/event/ippw2018/content/ippw-2018-abstracts-all

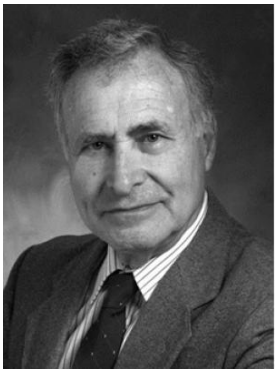
Student Presentation & Poster Competition

The IPPW Student Organizing Committee invites you to cast your vote in the student paper and poster competition! Shortly before 08:00 MDT on Monday, June 11, 2017, you will receive an email (in your conference-registered email inbox) from the IPPW SOC (ippwsoc@gmail.com), which contains a link to an electronic ballot. This ballot will be used to record audience scores for all student presentations and posters during IPPW 2018.

To access the ballot, click the red "Access the Ballot" button in the email. To score the participants, choose either the "Paper Competition" or "Poster Competition" option, and press "Next". On either the paper or poster competition pages, select the name of the contestant from the drop-down menu and enter your score using the buttons provided. When you click "Next", your score will be saved, and you will be returned to the option selection page. Each ballot is unique to your email ID, please do not forward this link to anyone. Further, you are allowed to alter your scores until you submit the ballot. You are allowed to skip participants in the ballot, but must go through the "Submit Your Ballot" option on the option selection page in order to have your scores considered.

Please submit your ballot by 12:25:00 MDT on Friday, June 15, 2018. We thank you for your participation!

Alvin Seiff Memorial Award



The Alvin Seiff Memorial Award, presented annually at the International Planetary Probe Workshop, honors a scientist, engineer, technologist, or mission planner for outstanding career contributions to our field. Each honoree has excelled in aspects of planetary entry probe missions and has served as a mentor for the next generation of solar system explorers. These are the very traits for which Alvin "Al" Seiff was legendary in his pioneering efforts in our field.

Anyone may nominate an exceptional candidate for this award. Members of the IPPW-2018 Al Seiff Award committee evaluated the nominees, and recommended the candidate to the International Organizing Committee (IOC). This year's committee, composed of both an Al Seiff Award recipient and other IPPW IOC members, was chaired by Helen Hwang (NASA Ames) and included Jim Arnold (AMA Inc.), David Atkinson (JPL), Miguel Pérez Ayúcar (ESA), and Olivier Witasse (ESA).

The committee unanimously selected and recommended Dr. Sushil K. Atreya—Professor of Climate and Space Sciences and Engineering, and Director, Planetary Science Laboratory, University of Michigan—to the IOC, whose selection was ratified by the IPPW governing body.

"In recognition of his career achievements in advancing the knowledge of the origin, formation, and evolution of the solar system and solar system atmospheres, planetary atmospheric structure, chemistry, and cloud physics; developing and continued promotion of and advocacy for the concept of multiple probe missions to multiple outer planets; and his significant contributions to developing the future generation of planetary explorers."

Congratulations Professor Atreya!

Past Winners:

Dr. Hasso B. Niemann, NASA Goddard (2007); Professor Jacques Blamont, University of Paris (2008); Mr. Michael Tauber, Eloret Corporation (2010); Dr. Martin Tomasko, University of Arizona (2010); Dr. Jean-Pierre Lebreton, CNRS (2011); Dr. Bobby Braun, Georgia Tech. (2012); Prof. Mikhail Marov, Vernadsky Institute of Geochemistry, and Dr. James Arnold, NASA Ames (2013); Gentry Lee, Jet Propulsion Laboratory (2014); Boris Ragent (2015); Rob Manning, Jet Propulsion Laboratory (2016); and Dr. Benton Clark, Lockheed Martin, and Chul Park, NASA Ames Research Center (2017).

Activities & Social Events

Sunday, 10 June 2017

Student Social (for students only)

Time: 17:00 – 20:00
Location: **Dark Horse**, 2922 Baseline Rd, Boulder, CO 80303
(Short walk across Baseline Road from the Boulder Inn hotel or across 30th Street from Williams Village)

Monday, 11 June 2017

IPPW-2018 Welcome Reception – Sponsored by Lockheed Martin

Time: 18:30-21:00
Location: **Chautauqua Dining Hall**, 900 Baseline Road, Boulder, CO 80302

Note: *All attendees* participating in the Welcome Reception will be bussed to the reception venue because there is severely limited parking. If you choose, you may also walk the 1.5 miles (approx. 30-35 min walking time) from Williams Village to Chautauqua Dining Hall.

Tuesday, 12 June 2017

Student Professional Development Luncheon

Time: 12:30-13:30
Location: Village Center Dining Hall (upstairs and to the left when you enter the dining area; general IPPW attendee seating will be to the right of the dining area)

> **Calling all students!** Please join the Student Organizing Committee on Tuesday, June 12th, during the lunch-hour, for a Professional Development Luncheon. You will sit down with professionals across multiple disciples and work designations, and have the opportunity to "interview" the professionals asking questions such as, *What makes for a great day at work?*, *What motivates (or demotivates) you?*, and *What about your job makes you want jump out of bed in the morning?*. The entire luncheon will be student-led to allow each of you to speak candidly with the professionals. Our goal is for you to learn more about the professionals' work day-to-day so that you can begin focusing your education and career path in the right direction for you.

Tuesday Poster Reception – Sponsored by AdvancedSpace

Time: 18:30-20:30
Location: IPPW Conference Center

Note: Posters are located in Breakout AB across the hall from the main plenary room, and in Multipurpose Room A just off of the conference center lobby area. Heavy hors d'oeuvres and beverages will be served in the lobby of the conference area.

Wednesday, 13 June 2018

Wednesday Afternoon Activities—Visits to:

- Laboratory for Atmospheric & Space Physics (**LASP**) at the University of Colorado Boulder
- National Center for Atmospheric Research (**NCAR**)
- National Institute of Standards and Technology (**NIST**) Boulder Laboratories
- National Oceanic and Atmospheric Administration (**NOAA**) Boulder

See descriptions of the different institutions below.

Notes on Transportation to Activities: *All activity transportation* (round-trip) will be provided by buses that will depart from the Williams Village bus loop off of 30th Street; signage will be made available. Some activity attendees will have slightly less than 30 minutes to have lunch in the upstairs dining hall, so plan accordingly. Buses are scheduled to leave at the following times:

1. 14:00 – 1 bus departs for NOAA & NIST (shared bus)
2. 14:00 – 1 bus departs for NCAR
3. 14:15 – 1 bus departs for LASP
4. In the event of high activity demand, we will add additional tours and buses

About These Organizations:

LASP: The Laboratory for Atmospheric and Space Physics (LASP) at the University of Colorado Boulder (CU Boulder) began in 1948, a decade before NASA. We are the world's only research institute to have sent instruments to all eight planets and Pluto. LASP combines all aspects of space exploration through our expertise in science, engineering, mission operations, and scientific data analysis. As part of CU Boulder, LASP also works to educate and train the next generation of space scientists, engineers and mission operators by integrating undergraduate and

graduate students into working teams. Our students take their unique experiences with them into government or industry, or remain in academia to continue the cycle of exploration. Learn more at http://lasp.colorado.edu.

NCAR: The National Center for Atmospheric Research (NCAR) is a federally funded research and development center devoted to service, research and education in the atmospheric and related sciences. NCAR's mission is to understand the behavior of the atmosphere and related Earth and geospace systems; to support, enhance, and extend the capabilities of the university community and the broader scientific community, nationally and internationally; to foster the transfer of knowledge and technology for the betterment of life on Earth. The National Science Foundation is NCAR's sponsor, with significant additional support provided by other U.S. government agencies, other national governments and the private sector. Learn more at https://ncar.ucar.edu.

NIST: A world leader in the physical sciences and precision measurement for more than 60 years**,** NIST Boulder Laboratories provide research, measurements, technology, tools, data, and services that enable innovation and improve the quality of our lives. NIST Boulder develops and supplies measurement tools, test methods, and scientific data that businesses need to invent, innovate, and produce high-quality products for electronics, communications, optics, nanotechnology, public safety, biosciences, forensics, defense, and environmental applications. NIST Boulder makes possible many commonplace technologies—such as accurate wristwatches and GPS navigation systems, advanced communications networks, safe laser surgery, and reliable gas pipelines. NIST Boulder generates spin-off companies and jobs and provides industry, academia, and other federal agencies with cutting-edge technologies. Commercial products influenced by NIST Boulder-pioneered technologies include closed captioning and chip-scale atomic clocks. NIST technologies used by other labs include frequency combs, quantum sensors, laser power meters, single-photon detectors, and magnetometers. Learn more at https://www.nist.gov/director/pao/nist-boulder-laboratories-precision-measurements-support-innovation.

NOAA: NOAA Boulder is home to the Earth System Research Laboratory, National Centers for Environmental Information (including Paleoclimatology Branch), and the National Weather Service and Space Weather Prediction Center. Learn more at www.boulder.noaa.gov.

University of Colorado Boulder New Aerospace Building "Topping Out" Ceremony

Time: 17:00-18:45

Location: New Aerospace Building Site, CU Boulder East Campus, next to the Sustainability, Energy, and Environment Complex (SEEC).

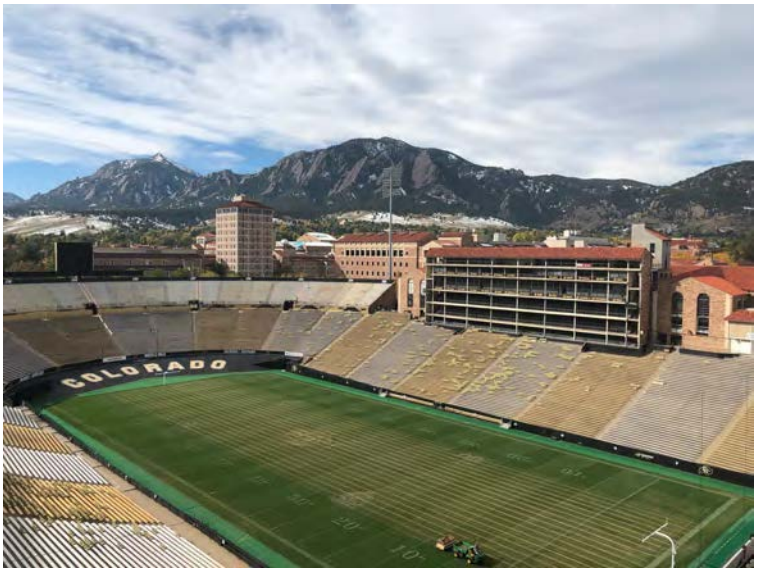
What: IPPW-2018 attendees are invited to a special reception for the Topping Out of the future home of the Smead Aerospace Engineering Sciences Dept. at CU Boulder. This new, dedicated 176,000 sqft facility will be completed in late Spring 2019. The Topping Out Ceremony commemorates the completion of the steel frame of the building, and you can even sign the final beam that will be placed atop the building. Bus transportation will be provided for those who want to go straight to the IPPW-2018 Banquet at 19:00 at Folsom Field on the main campus. Transportation will not be provided back, though. If you attend, please plan accordingly. You may RSVP at https://bit.ly/2J9FxEk.

Wednesday IPPW-2018 Banquet

Time: 19:00-22:00

Location: Folsom Field Rooftop Terrace, 2400 Colorado Ave, Boulder, CO 80302

How to get there: Participants are expected to make their own way to the banquet. It is recommended that you walk or ride share/cab over to Folsom Field. However, if you decide to drive, you can park in the paid parking area of the Folsom Field Garage. You may not park in designated permit-only areas. If you drive, it is recommended that you download the Parkmobile app which will allow you to pay easily and quickly on your phone, though you can of course pay at the garage kiosk. Parking is $2/hr before 7pm, and $1hr after 7pm.



View from the Folsom Field Rooftop Terrace

Thursday, 14 June 2018

IPPW IOC Dinner (*by personal invitation only*)

Time: 19:30-22:00

Note: If you are an IOC member who wants to attend but has not yet RSVP'd, please contact LOC Co-Chair, Lewis Groswald: lewis.groswald@colorado.edu.

Short Course – Small Satellites: An Emerging Paradigm for Bold Planetary Exploration

Over the past decade, the emerging Small Satellite (SmallSat) paradigm has been transforming the space industry. While small spacecraft have been developed for many years, the arrival of the CubeSat form factor and subsequent international efforts have dramatically accelerated the proliferation of small, low-cost, and risk-tolerant space missions. Where the "traditional" model centers on exceptionally high-reliability and low-risk spacecraft development, the Small Satellite mentality encourages a willingness to take more calculated risks in order to accelerate technology development and explore new corners of our solar system.

Early efforts in the SmallSat area concentrated in low-Earth orbit, as access to space opened up for organizations and universities who were previously unable to afford to participate. As the scope and capability of Small Satellite hardware has progressed, even national space agencies are beginning to explore the potential of this platform for bold and ambitious exploration of deep space. The scientific possibilities for planetary SmallSats, particularly in network or constellation configurations or as sacrificial elements that brave the harsh environments of challenging destinations, are especially compelling and worthy of pursuit.

There are important technical challenges facing the community of SmallSat developers as they engage in deep space planetary science and exploration. For example, many scientific payloads and common spacecraft components are simply less productive when less surface area or volume is available to them. Another obstacle is access to space: the demands and costs of launch, navigation, and orbit insertion do not inherently scale down with size. Other key concerns are radiation tolerance and data return capability.

Despite these challenges, the rapid pace at which new hardware is being developed, space-qualified, and improved suggests that the full capability of the SmallSat platform has yet to be realized. As technologies advance, mission architects are just beginning to unveil the multitude of ways in which small, focused spacecraft can contribute to our understanding of the solar system.

This short course will examine the brief history and trends associated with Small Satellites, and will explore their growing potential for planetary probe exploration. Special consideration will be given to SmallSat developments that are relevant to planetary entry, descent, and landing and *in situ* planetary science.

Day 1 will summarize the state-of-the-art for Small Spacecraft, provide an overview of SmallSat subsystem capabilities and constraints, and examine the international efforts that are ongoing in this area in both commercial and governmental applications.

Day 2 will look forward, toward planetary missions and technologies that are emerging around the world to enable bold planetary science and exploration. Below, please find the Short Course Agenda:

Saturday, 09 June 2018

****08:00: Registration Desk Opens****

Welcome and Introductions

- 09:00: Introduction, Short Course Overview, and Goals – Adam Nelessen (Jet Propulsion Laboratory)
- 09:20: Small Satellite Paradigm – Adam Nelessen (Jet Propulsion Laboratory)
- 09:45: Educational Benefits of the SmallSat Standard – Scott Palo (University of Colorado Boulder)
- 10:05: *Coffee Break*

Summary of International Efforts

- 10:25: NASA – Charles Norton (NASA/Jet Propulsion Laboratory)
- 10:45: ESA – Philipp Hager (European Space Agency)
- 11:05: JAXA – Kazuhiko Yamada (Japan Aerospace Exploration Agency)
- 11:25: CU Boulder – Scott Palo (University of Colorado Boulder)
- 11:45: *Lunch*

(Short Course Agenda Cont'd)

Small Spacecraft Subsystem State-of-the-Art, Part I

- 13:15: Data, Energy, and Aperture – Ralph Lorenz (Applied Physics Laboratory)
- 13:35: Payloads – Andrew Ball (European Space Agency)
- 13:55: Telecommunications – M. Michael Kobayashi (Jet Propulsion Laboratory)
- 14:15: Power and Avionics – Brent Abbott (Clyde Space)
- 14:35: *Coffee Break*

Small Spacecraft Subsystem State-of-the-Art, Part II

- 14:50: Small Entry Probe Trajectories for Mars and Venus – Bart van Hove (Royal Observatory of Belgium)
- 15:10: Reentry Technology – John Dec (Terminal Velocity Aerospace)
- 15:30: Access to Space: Launch, Propulsion, and Deploy – Alan Didion (Jet Propulsion Laboratory)
- 15:50: *Coffee Break*

Small Spacecraft Subsystem State-of-the-Art, Part III

- 16:05: Propulsion - Bruce Yost (Ames Research Center & Small Satellite Systems Virtual Institute)
- 16:25: Attitude Determination and Control - Dan Hegel (Blue Canyon Technology)
- 16:45: Industry Bus Solutions - Jan Thoemel (GomSpace)
- 17:05: *Wrap Up*

Sunday, 10 June 2018

Past and Present Small Probe Missions

- 09:00: New Millennium DS-2 Mars Microprobes – Ralph Lorenz (Applied Physics Laboratory)
- 09:20: MarCO – Andrew Klesh (Jet Propulsion Laboratory)
- 09:40: MINERVA and MINERVA-2 – Tetsuo Yoshimitsu (Japan Aerospace Exploration Agency)
- 10:00: Mobile Asteroid Surface Scout (MASCOT) – Jens Biele (DLR)
- 10:20: QB50 Mission Overview – Davide Masutti (Von Karman Institute)
- 10:40: *Coffee Break*

Next-Generation Mission Concepts: Small Bodies and Landers

- 11:00: Miniaturised Asteroid Remote Geophysical Observer (M-ARGO) – Philipp Hager (European Space Agency)
- 11:20: Planetary Object Geophysical Observer (POGO) – Elena Adams (Applied Physics Laboratory)
- 11:40: Asteroid Touring Nanosat Fleet – Mihkel Pajusalu (Massachusetts Institute of Technology)
- 12:00: *Lunch*

Next-Generation Mission Concepts: Atmospheric Probes

- 13:30: Small Next-Generation Atmospheric Probe – Robert Dillman (Langley Research Center)
- 13:50: Cupid's Arrow – Christophe Sotin (Jet Propulsion Laboratory)
- 14:10: Chariot to the Moons of Mars – Zach Putnam (University of Illinois at Urbana-Champaign)
- 14:30: *Coffee Break*

Emerging Technologies

- 14:50: Drag Modulation Aerocapture for SmallSats - Adam Nelessen (Jet Propulsion Laboratory)
- 15:10: Nano-ADEPT - Paul Wercinski (Ames Research Center)
- 15:30: QARMAN Aeroheating Technologies - Davide Masutti (Von Karman Institute)
- 15:50: Summary and Key Takeaways - Gilles Bailet (CentraleSupélec)
- 16:15: *Wrap Up*

IPPW-2018 Detailed Technical Program

Below please find the 9 Technical Session descriptions, followed by the detailed technical program, which is followed by the list of Posters and the Poster Short Talk groupings.

1. **Inner Solar System Exploration -- Monday, June 13, 13:30:**
   The Inner Solar System Exploration Session will focus on past, present, and future exploration of Venus, Earth, and Mars. Topics may include missions, science, technology, and systems dealing with the in-situ exploration of the rocky planets, such as landers or entry probes. Contributions to this session can address aspects such as atmospheric science and environment characterization, robotic and human EDL, and sample return.

2. **Demonstration and Flight Testing -- Tuesday, June 12, 08:30:**
   Ground demonstration and flight testing in relevant environments are critical to the development of technologies for planetary probe missions. Specific topics sought include testing that demonstrates technology capability in aerodynamic performance; aerothermodynamic survivability; material response; propulsion; and guidance, navigation, and control. Other desired topics include demonstrations of manufacturing and assembly of probe technologies, novel testing techniques, new instrumentation approaches, and new ground test capabilities. Emphasis should be placed on technologies and flight systems that enable current and future missions and mission concepts.

3. **Aerosciences and Entry Technology -- Tuesday, June 12, 13:30:**
   Probe missions to a planetary body with an atmosphere involve aerodynamically decelerating the probe using entry technologies to successfully complete the entry phase and to prepare for descent and landing. For example, heatshields must be designed to withstand severe heating environments as the vehicle is decelerated via hypersonic aerobraking or entry through the atmosphere. This session will cover current engineering techniques, physics, and technologies that enhance and enable atmospheric aerobraking or entry

missions, such as: entry vehicle and thermal protection system design; methods for assessing aerothermal environments, thermal and structural response, and aerodynamic performance; specific implementation concepts such as supersonic retropropulsion, inflatable/deployable heatshields, and systems/methods that improve entry control/guidance. Cross-cutting/multidisciplinary topics related to this theme are also encouraged.

4. **Descent and Landing Technology -- Wednesday, June 13, 08:30:**
   The objective of various technologies used during descent and landing phases of EDL are to dissipate the kinetic energy of a spacecraft that remains from the entry phase of flight, while also directing the vehicle to its target landing conditions and making final preparations for landing. This session is focused on the engineering and technology of these EDL phases and will cover topic areas that include, but are not limited to, aerodynamic decelerators, supersonic retropropulsion, GN&C strategies, navigation sensors, terrain relative sensing and characterization, autonomous targeting, propulsion and touchdown systems, architecture transitions, and instrumentation.

5. **Instrumentation and Experiments -- Wednesday, June 13, 11:15:**
   In-situ planetary science measurements are fundamental to our understanding of the solar system. This session covers the development and implementation of past, present and future science and engineering instrumentation for probes exploring planets, moons and other small bodies. Engineering and science are brought together in this session to discuss the fundamental goals, requirements and challenges of instruments and experiments, understand the practical limitations of data collection from in situ or remote sensing techniques and share lessons learned from instrument development or implementation activities.

6. **Modeling, Simulation, and Validation -- Thursday, June 14, 08:30:**
   This session will focus on modeling and simulation advancements for planetary probes including: entry, descent and landing (EDL), computational fluid dynamics (CFD), guidance, navigation and control (GNC), materials and thermal protection systems (TPS) modeling, decelerator systems, surface operations, integrated/optimized capabilities, and related disciplines. Current work in testing and demonstration techniques, model validation, and diagnostics, are also a major component of this session. Work that is advancing the state-of-the-art of the current capabilities or technologies, or comparing or leveraging both

testing and computational models including data-driven modeling, is especially relevant.

7. **Lunar and Small Body Exploration -- Thursday, June 14, 13:30:**
   Lunar and small body exploration has the potential to provide insight into our own planet and the evolution of our solar system. This session will focus on current and future missions, descent and landing architectures, and science and instrumentation related to this mission class.

   Lunar exploration has had a regain of interest in the recent years both from agencies and private businesses. It is expected to continue and even increase in the coming years. Specific aspects of enabling descent and landing technologies in support of future missions and architectures (including polar exploration, rover deployment, human surface activity preparation and exploration) shall be discussed. In addition, discussions on scientific data return, commercial applications and enablers as well as international collaboration and framework are also welcome to the session.

   Small body exploration is a growing mission class that has unique scientific potential. Small airless bodies are being targeted for learning about the solar system's origin, evolutionary processes that led to the formation of the planets, as well as the search of primitive classes of organics that can shed light on the origin of life. The large number of future mission concepts, planned missions, and missions under way to their respective targets emphasize the continued great interest in airless bodies and promise to unveil many mysteries.

8. **Small and CubeSat Probes -- Thursday, June 14, 16:15:**
   This session invites abstracts on mission concepts, scientific instruments and new technologies for small spacecraft or CubeSat probes. Small probes can augment a primary spacecraft's science mission. They may also stand alone as their own mission by reducing life-cycle costs or by increasing spacecraft quantity. They can perform remote sensing and/or in-situ measurements, be used as landing platforms for technological demonstrations.

9. **Outer Solar System Exploration -- Friday, June 15, 08:30:**
   The outer solar system comprises the gas and ice giant planets and a multitude of icy worlds. The giant planets represent time capsules from the epoch of solar system formation. Within the atmospheres and interiors of the giant planets, fingerprints of the chemical and physical conditions existing at the time and

location at which each planet formed and the processes by which the giant planets and the solar system formed can be found. In situ measurements of giant planet atmospheric composition and processes help constrain models of solar system formation and evolution, the origin and evolution of atmospheres, and the large-scale structure of the solar system including the Earth.

Icy worlds in the outer solar system include the satellites of the giant planets, comets, asteroids, KBOs, and the Pluto system. The icy worlds represent laboratories for understanding surface geochemistries, and geophysical and atmospheric chemistries and processes including atmospheric thermal and energy structure and dynamics, as well as having compositions that help constrain models of solar system formation and evolution. The prospect of subsurface oceans on a number of the icy worlds as potentially habitable environments has exciting implications for astrobiology. The in-situ exploration of these ocean worlds such as Europa, Titan, and Enceladus could offer important clues to answer the fundamental question of whether life exists elsewhere in the universe.

The Outer Solar System Exploration session solicits presentations addressing concepts for possible future outer solar system atmospheric and/or surface contact missions (incl. the outer planets, their moons, and other icy worlds), and technologies and instrumentation designed to enable exploration of the extreme environments found in the outer solar system.

IPPW-2018 - Monday (11th June)

Opening Session

Convener: Pat Beauchamp (JPL)

9:00 - 9:05		LOC welcome	Bobby	Braun	University of Colorado - Boulder
9:05 - 9:20		IOC welcome and opening	Bernie	Bienstock	Jet Propulsion Laboratory
9:20 - 9:30		POC intro of schedule and workshop guidelines	POC	chairs	
9:30 - 9:45		Al Seiff award presentation to Sushil Atreya	Helen	Hwang	NASA Ames Research Center
9:45 - 10:30		**Keynote talk: NASA's planetary programs and technology**	**David**	**Schurr**	**Deputy Director, Planetary Science Division, NASA HQ**
10:30 - 11:00		**Coffee Break - Sponsored by Roccor**			
11:00 - 11:30		**Keynote talk: Advancing Technology for NASA Science with Small Spacecraft**	**Mike**	**Seablom**	**Chief Technologist, Science Mission Directorate, NASA HQ**
11:30 - 12:00		**Keynote talk: Spores, viable organisms, and other tribulations in planetary protection requirements for Mars and Europa.**	**Lisa**	**Pratt**	**Planetary Protection Officer, NASA HQ**
12:00 - 12:30		**Keynote talk: IPPW Enabled International Collaborations in EDL – Lessons Learned and Recommendations**	**Ethiraj Venkatapathy**	**Ali Guelhan**	**NASA Ames / DLR**
12:30 - 13:30		**Lunch Break**			

Session 1: Inner Solar System Exploration

Conveners: Brooke Harper (JPL), David Mimoun (ISAE), Ashley Korzun (NASA LaRC), Ingo Gerth (OHB)

13:30 - 14:00		**Invited talk: Human Mars architecture**	**Tara**	**Polsgrove**	**Human Mars Study Team, NASA Marshall Space Flight Center**
14:00 - 14:14		Status of the InSight entry, descent, and landing system	Brooke	Harper	Jet Propulsion Laboratory
14:14 - 14:28		Venus aerial platform studies	James	Cutts	Jet Propulsion Laboratory
14:28 - 14:42		Aerial platform options for Venus	Jeffery	Hall	Jet Propulsion Laboratory
14:42 - 14:56		Balloon-borne infrasound as a remote sensing tool for Venus - Progress in 2017	Siddharth	Krishnamoorthy	Jet Propulsion Laboratory
14:56 - 15:10	(Student)	Analysis for Lithium-combustion power systems for extreme environment spacecraft	Christopher	Greer	The Pennsylvania State University
15:10 - 15:24		Post flight analysis of the radio Doppler shifts of the ExoMars Schiaparelli lander	Ozgur	Karatekin	Royal Observatory of Belgium
15:24 - 15:45		**Poster Short Talks - Group I**			
15:45 - 16:15		**Coffee Break - Sponsored by Virgin Orbit**			
16:15 - 16:29		MARS 2020 entry, descent, and landing update	Erisa	Stilley	Jet Propulsion Laboratory
16:29 - 16:43		Recent developments for an orbiting sample container for potential Mars sample return	Aaron	Siddens	Jet Propulsion Laboratory
16:43 - 16:57		Changing entry, descent, and landing paradigms for human Mars landers	Alicia	Dwyer Cianciolo	NASA Langley Research Center
16:57 - 17:10		**Q&A inner solar system exploration**			
17:10 - 17:15		We need your help - The planetary probe blue book refresh	Todd	White	NASA Ames Research Center
17:15 - 17:50		**Poster Short Talks - Group II**			
17:50 - 18:30		**Bus Transfer to Welcome Reception at Chautaqua Dining Hall**			
18:30 - 21:00		**IPPW-2018 Welcome Reception (Chautauqua Dining Hall)**			

IPPW-2018 - Tuesday (12th June)

Session 2: Demonstration and Flight Testing

Conveners: Robert Dillman (NASA LaRC), Brandon Smith (NASA ARC), Alan Cassell (NASA ARC)

8:30 - 8:44		'More honoured in the breach?' - Test as You Fly Environments for Planetary In-Situ Missions	Ralph	Lorenz	APL
8:44 - 8:58	(Student)	ExoMars Schiaparelli flight trajectory and atmospheric reconstruction	Bart	Van Hove	Royal Observatory of Belgium
8:58 - 9:26		Overview of Orion aerodynamics: Database development and flight test comparisons	Karen	Bibb	NASA Langley Research Center
9:26 - 9:40		Overview of the first two flights of the ASPIRE supersonic parachute test program	Bryan	Sonneveldt	Jet Propulsion Laboratory
9:40 - 9:54		The modulated exo-brake flight testing: modeling and test results	Marcus	Murbach	NASA Ames Research Center
9:54 - 10:08		Computed tomography scanning of a 1-meter demonstration heatshield for extreme entry environments	Cole	Kazemba	NASA Ames Research Center
10:08 - 10:22		Flight testing a vision-based navigation and hazard detection and avoidance (VN&HDA) experiment over a Mars-representative terrain	Tiago	Hormigo	Spin.Works S.A.
10:22 - 10:52		**Coffee Break - Sponsored by AMA Inc.**			
10:52 - 11:06		ADEPT SR-1 development and testing	Brandon	Smith	NASA Ames Research Center
11:06 - 11:20		Planned orbital flight test of a 6-meter HIAD	Robert	Dillman	NASA Langley
11:20 - 11:34		The HIAD orbital flight demonstration instrumentation suite	Greg	Swanson	AMA Inc @ NASA ARC
11:34 - 11:48		Mars 2020 entry, descent, and landing verification and validation overview	Gregorio	Villar	Jet Propulsion Laboratory
11:48 - 12:02		Mars 2020 entry, descent, and landing flight system verification and validation	Cj	Giovingo	Jet Propulsion Laboratory
12:02 - 12:16		DLR explorer-initiatives: Enabling technologies for future robotic space exploration	Oliver	Funke	DLR German Aerospace Center, Space Administration
12:16 - 12:30		**Q&A Demonstration and Flight Testing**			
12:30 - 13:30		**Lunch Break + Student Professional Development Luncheon (Will Vill Dining Hall)**			

Session 3: Aeroscience and Entry Technology

Conveners: Karl Edquist (NASA LaRC), Andrew Brune (NASA LaRC), Mike Barnhardt (NASA ARC)

13:30 - 13:44		Future development plan of sample return capsule evolved on the basis of HAYABUSA SRC heritage	Kazuhiko	Yamada	Japan Aerospace Exploration Agency
13:44 - 13:58		A new era and a new trade space: Evaluating Earth entry vehicle concepts for a potential 2026 Mars sample return	Scott	Perino	Jet Propulsion Laboratory
13:58 - 14:12		Hot-structure Earth entry vehicle concept for robotic Mars sample return	Marcus	Lobbia	Jet Propulsion Laboratory
14:12 - 14:26		Post flight analysis of the COMARS+ data and backcover heating of the ExoMars Schiaparelli lander	Ali	Guelhan	German Aerospace Center - DLR
14:26 - 14:40		Pterodactyl: Integrated control design for precision targeting of deployable entry vehicles	Sarah	D'Souza	NASA Ames Research Center
14:40 - 14:54	(Student)	Aerobraking at Mars: A machine learning implementation	Giusy	Falcone	University of Illinois at Urbana-Champaign
14:54 - 15:08		Overview of heatshield for extreme entry environment technology (HEEET) project	Donald	Ellerby	NASA Ames Research Center
15:08 - 15:22		Highly reliable 3-dimensional woven thermal protection system for Mars sample return	Keith	Peterson	NASA Ames Research Center
15:22 - 15:45		**Poster Short Talks - Group III**			
15:45 - 16:15		**Coffee Break**			
16:15 - 16:29		Sizing and margin methodology for dual-layer thermal protection systems	Milad	Mahzari	NASA Ames Research Center
16:29 - 16:43		Studies in support of Venus aerocapture utilizing drag modulation	Robin	Beck	NASA Ames Research Center
16:43 - 16:57		A common probe design for multiple planetary destinations	Helen	Hwang	NASA Ames Research Center
16:57 - 17:11		Science goals and payloads for common probe missions to Venus and the giant planets	David	Atkinson	Jet Propulsion Laboratory
17:11 - 17:25		Evaluation of common probe trajectories at multiple solar system destinations	Alicia	Dwyer Cianciolo	NASA Langley Research Center
17:25 - 17:39		Aerothermodynamics for Dragonfly's Titan entry	Aaron	Brandis	AMA at NASA Ames Research Center
17:39 - 17:53		**Q&A Aeroscience and entry technology**			
17:53 - 18:15		**Poster Short Talks - Group IV**			
18:30 - 20:30		**Poster Reception (IPPW-2018 Williams Village Venue)**			

IPPW-2018 - Wednesday (13th June)

Session 4: Descent and Landing Technology

Conveners: Svenja Woicke (DLR), Steve Lingard (Vorticity Systems), Al Witkowski (Katabasis Engineering), Som Dutta (NASA LaRC)

8:30 - 8:44		Development and testing of precision landing GN&C technologies within NASA	John	Carson	NASA Johnson Space Center
8:44 - 8:58		End-to-end GN&C for the powered descent and landing of reusable lunar landers	Tiago	Hormigo	Spin.Works S.A.
8:58 - 9:12		Making an onboard reference map from MRO/CTX imagery for Mars 2020 lander vision system	Yang	Cheng	Jet Propulsion Laboratory
9:12 - 9:26		Aerosciences considerations in the design of a powered descent phase for human-scale Mars lander vehicles	Ashley	Korzun	NASA Langley Research Center
9:26 - 9:40		Planning for a supersonic retropropulsion test in the NASA Langley unitary plan wind tunnel	Karl	Edquist	NASA Langley
9:40 - 9:54		Detailed investigations of the Huygens spin anomaly in a subsonic wind tunnel	Jean-Pierre	Lebreton	LPC2E
9:54 - 10:08		A brief history of InSight parachute development and acceptance for flight	Devin	Kipp	Jet Propulsion Laboratory
10:08 - 10:22		Reconstructed disk-gap-band parachute performance during the first two ASPIRE supersonic flight tests	Clara	O'Farrell	Jet Propulsion Laboratory
10:22 - 10:30		Q&A descent and landing technology			
10:30 - 11:00		**Coffee break**			

Session 5: Instrumentation and Experiments

Conveners: Todd White (NASA ARC), Manuel Dominguez (Univ. Politecnica de Catalunya), Javier Gomez-Elvira (INTA/CAB)

11:00 - 11:14		The Mars microphone onboard supercam for the Mars 2020 rover	David	Mimoun	ISAE-SUPAERO, University Toulouse
11:14 - 11:28		InMARS: a comprehensive program for the development of key-technologies for miniature martian probes	Ignacio	Arruego	INTA
11:28 - 11:42		Testing campaign of a martian spherical wind sensor at the AWTSII wind tunnel facility	Manuel	Dominguez-Pumar	Technical University of Catalonia
11:42 - 11:56	(Student)	Mars sample return to subglacial polar science on Earth	Ryan	Timoney	University of Glasgow
11:56 - 12:10		Silicon carbide, vacuum tube nanoelectronics: Application for exploration missions requiring category III/IV planetary protection	James	Arnold	NASA Ames Research Center
12:10 - 12:24		Silicon carbide pressure sensors for Venus environment	Robert	Okojie	NASA Glenn Research Center
12:24 - 12:38		Development of a pneumatic sample transport system for ocean worlds	Joseph	Sparta	Honeybee Robotics
12:38 - 12:52		Ion selective electrodes for soluble salt measurements on icy worlds	Aaron	Noell	Jet Propulsion Laboratory
12:52 - 13:06		Development of a double hemispherical probe (DHP) for improved space plasma measurements	Xu	Wang	University of Colorado
13:06 - 13:15		Q&A instrumentation and experiments			
13:15 - 14:00		**Lunch break and bus boarding for field trip**			
14:00 - 18:00		**Field Trip to LASP, NCAR, NIST, and NOAA - See "Activities & Social Events" section of the Printed Program for more information; Round-trip bus transportation from Williams Village 30th Street Bus Loop (look for signs)**			
19:00 - 22:00		**IPPW-2018 Banquet (Folsom Field Rooftop Terrace)**			

IPPW-2018 - Thursday (14th June)

Session 6: Modeling, Simulation, and Validation

Conveners: Doug Adams (JHU-APL), Eric Stern (NASA ARC), Aaron Stehura (JPL), Julia Kowalski (RWTH-Aachen)

8:30 - 8:44		EDL modeling challenges for past and present planetary missions	Michael	Wright	NASA Ames
8:44 - 8:58		ExoMars 2016: A preliminary post-flight study of the entry module heat shield interactions with the martian atmosphere	Gregory	Pinaud	Industry
8:58 - 9:12		DSENDS simulation of Mars 2020 entry, descent, and landing	Paul	Burkhart	Jet Propulsion Laboratory/Caltech
9:12 - 9:26	(Student)	Blackout analysis of martian reentry missions	Sahadeo	Ramjatan	University of Minnesota
9:26 - 9:40		Design and characteristics of the suborbital expansion tube HEK-X for afterbody heating of sample return capsule	Kohei	Shimamura	University of Tsukuba
9:40 - 9:54		Overview of global reference atmospheric model (GRAM) upgrades	Hilary	Justh	NASA Marshall Space Flight Center
9:54 - 10:08		Mars 2020 atmospheric modeling for flight mechanics simulation	Soumyo	Dutta	NASA Langley Research Center
10:08 - 10:22		Progress on free-flight CFD simulation for blunt bodies in the supersonic regime	Joseph	Brock	NASA Ames Research Center
10:22 - 10:52		**Coffee Break**			
10:52 - 11:06	(Student)	Dynamic propagation of discrete-event drag modulation for Venus aerocapture	Michael	Werner	University of Colorado Boulder
11:06 - 11:20	(Student)	Coupled aero-structural modelling and optimisation of deployable Mars aero-decelerators	Lisa	Peacocke	Imperial College London
11:20 - 11:34		The Case for High-fidelity Material Response Modeling	Michael	Barnhardt	NASA Ames Research Center
11:34 - 11:48		In situ Characterization of Ablation Processes by High-speed X-ray Imaging	Isil	Sakraker Ozmen	German Aerospace Center - DLR
11:48 - 12:02	(Student)	CFD analysis of the cork-phenolic heat shield of a reentry Qubesat in arc-jet conditions including ablation and pyrolysis	Ata Onur	Baskaya	Middle East Technical University
12:02 - 12:16		How gravity and temperature affect the performance of thermal melting probes	Julia	Kowalski	RWTH Aachen University
12:16 - 12:30		Q&A modeling, simulation, and validation			
12:30 - 13:30		**Lunch Break**			

Session 7: Lunar and Small Body Exploration

Conveners: Erisa Stilley (JPL), Ravi Prakash (JPL), Andy Frick (Blue Origin), Benoit Pigneur (University College London)

13:30 - 13:44		The comet astrobiology exploration sample return (CAESAR) new frontiers mission	Michael	Amato	NASA GSFC
13:44 - 13:58		Key challenges in capturing a boulder for the asteroid redirect robotic mission	Benjamin	Cichy	NASA/GSFC
13:58 - 14:12		Probing Psyche: Mission overview and operations concept	Carol	Polanskey	Jet Propulsion Laboratory
14:12 - 14:26		A modular ascender concept for sample return missions	Robert	Buchwald	Airbus Defence and Space
14:26 - 14:40		PROSPECT - thermal design challenges for lunar volatile extraction	Philipp	Hager	European Space Agency - ESTEC
14:40 - 14:54	(Student)	SIRONA1-a selenocentric platform hosting international payloads	Gilles	BAILET	CentraleSupélec, Université Paris Saclay
14:54 - 15:08		Initial results of shell lander impact tests for the exploration of medium-sized airless bodies	Christian	Grimm	German Aerospace Center (DLR)
15:08 - 15:22		Cubesat electrostatic dust analyser (CEDA) for measuring electrostatic dust transport on airless bodies	Xu	Wang	University of Colorado
15:22 - 15:36		Effects of probe shape and surface topography in deployment to small bodies	Dan	Scheeres	University of Colorado Boulder
15:36 - 15:45		Q&A lunar and small body exploration			
15:45 - 16:15		**Coffee break**			

Session 8: Small and CubeSat Probes

Conveners: Ozgur Karatekin (Royal Observatory of Belgium), Isil Sakraker (DLR)

16:15 - 16:29		Drag modulation aerocapture for SmallSat science missions to Venus	Adam	Nelessen	Jet Propulsion Laboratory
16:29 - 16:43		Minimum-mass limits for streamlined Venus atmospheric probes	Jacob	Izraelevitz	NASA Jet Propulsion Laboratory
16:43 - 16:57	(Student)	Mission design of small deployable cameras for the close investigation of Phobos	Onur	Celik	The Graduate University for Advanced Studies (SOKENDAI)
16:57 - 17:11		Miniaturised asteroid remote geophysical observer (M-ARGO)	Philipp	Hager	European Space Agency - ESTEC
17:11 - 17:25	(Student)	Multiprobe mission design with applications to the outer planets	Archit	Arora	Purdue University
17:25 - 17:39	(Student)	Assessment of magnetohydrodynamic (MHD) effects on CubeSat sized re-entry capsule	Robin	Müller	University of Stuttgart Institute of Space Systems
17:39 - 17:53		Venus airglow measurements and orbiter for seismicity (VAMOS): A mission concept study	Attila	Komjathy	Jet Propulsion Laboratory
17:53 - 18:00		Q&A Small and CubeSat probes			
18:00 - 18:30		**Invited Talk: Bill Willcockson - 37 years of aeroentry vehicles with Martin Marietta and Lockheed Martin**			
		Free evening			
		IOC Dinner (by invitation only)			

IPPW-2018 - Friday (15th June)

Session 9: Outer Solar System Exploration

Conveners: David Atkinson (JPL), Aline Zimmer (JPL), Olivier Mousis (Aix-Marseille Université)

8:30 - 8:44		Europa lander mission overview and update	Steven	Sell	Jet Propulsion Laboratory
8:44 - 8:58		Overview of the Europa lander descent stage flight system concept.	Tejas	Kulkarni	Jet Propulsion Laboratory
8:58 - 9:12		Landing on Europa: Key challenges and architecture concept	Aline	Zimmer	Jet Propulsion Laboratory
9:12 - 9:26		Concepts on maximizing data return for a potential Europa lander using direct to Earth communications	Grace	Tan-Wang	Jet Propulsion Laboratory
9:26 - 9:40		Surface and subsurface sampling drills for life detection on ocean worlds	Fredrik	Rehnmark	Honeybee Robotics
9:40 - 9:54		Key technology needs for accessing the ocean of an icy moon	Thomas	Cwik	Jet Propulsion Laboratory
9:54 - 10:08	(Student)	Exploring icy worlds: Accessing the subsurface voids of Titan through autonomous collaborative hybrid robots	Pradyumna	Vyshnav	NASA Jet Propulsion Laboratory
10:08 - 10:22		Sample acquisition and transfer for a Titan lander	Ralph	Lorenz	APL
10:22 - 10:52		**Coffee Break**			
10:52 - 11:06		New technologies for powering a surface mission on Titan: Capturing energy from Titan's winds for science exploration (CETIWISE)	William	O'Hara	Sierra Nevada Corporation
11:06 - 11:20		Dragonfly: Rotorcraft landing on Titan	Douglas	Adams	Johns Hopkins Applied Physics Lab
11:20 - 11:34	(Student)	Enceladus probe mission design using Titan aerogravity-assist	Ye	Lu	Purdue University
11:34 - 11:48		Scientific rational for Uranus and Neptune in situ explorations	Olivier	Mousis	Laboratoire d'Astrophysique de Marseille
11:48 - 12:02		A concept for a joint NASA/ESA mission for in situ exploration of an ice giant planet	David	Atkinson	Jet Propulsion Laboratory
12:02 - 12:16	(Student)	Hybrid aerocapture using low L/D aeroshells for icy giant missions	Athul	Pradeepkumar Girija	School of Aeronautics and Astronautics, Purdue University
12:16 - 12:30		Q&A outer solar system exploration			
12:30 - 13:30		**Lunch Break**			

Closing Session

Convener: Bernie Bienstock(JPL)

13:30 - 13:35		Introduction	Bernie	Bienstock	Jet Propulsion Laboratory
13:35 - 15:05		Session findings	POC &	Session Conveners	Each session limited to 10 minute discussion
15:05 - 15:15		Student award presentations	Svenja Woicke	/ Gregory Villar	Svenja Woicke (DLR) / Jet Propulsion Laboratory
15:15 - 15:25		Plan for IPPW-16	Steve	Lingard	Vorticity Systems
15:25 - 15:30		Farewell	Bernie	Bienstock	Jet Propulsion Laboratory

IPPW 2018 - Posters

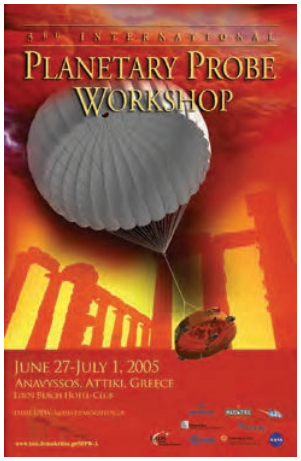
Opening		We need your help! The planetary probe Blue Book refresh	Todd	White	NASA Ames Research Center
Group I					
Inner Solar System Exploration		Exploring impact attenuating interfaces for a potential Mars sample return Earth entry vehicle	Cameron	Grace	University at Buffalo (SUNY)
Inner Solar System Exploration	(Student)	Altitude control for Venus balloons using phase change and loop heat pipes	Varun	Patel	San Jose State University
Inner Solar System Exploration	(Student)	3d printed liquid rocket engine design for Mars sample return missions	Tyler	Saunders	San Jose State University
Instrumentation and Experiments		Shock layer radiation measurements for planetary probes	Susan	White	NASA Ames Research Center
Instrumentation and Experiments	(Student)	High-temperature, anti-fouling coatings for Venus exploration	Ruiqi	Chen	Stanford University
Instrumentation and Experiments	(Student)	Gas barrier thermal testing for convective heating improvement for emergency fire shelters (CHIEFS)	Jonathan	Cheatwood	Virginia Tech
Instrumentation and Experiments	(Student)	Investigation of coatings for Langmuir probes in an oxygen-rich space environment	Joseph	Samaniego	Univeristy of Colorado - Boulder
Instrumentation and Experiments	(Student)	A double hemispherical probe (DHP) for interpreting probe measurements in the spacecraft sheath	Joseph	Samaniego	Univeristy of Colorado - Boulder
Lunar and Small Body Exploration	(Student)	A design for repeatable NEO flyby missions	Oscar	Fuentes-Munoz	CU Boulder
Lunar and Small Body Exploration	(Student)	Estimation evaluation of the radio science phase of the OSIRIS-REx mission	Daniel	Brack	University of Colorado Boulder
Lunar and Small Body Exploration	(Student)	Analysis of structural effects on seismic instruments on-board space exploration landers	Vikram	Krishnaswamy	ISAE-SUPAERO
Lunar and Small Body Exploration	(Student)	Current and future researches at ISAE-SUPAERO in autonomous operations orbiting an unknown asteroid through imagery	Paolo	Panicucci	ISAE-Supaero
Lunar and Small Body Exploration	(Student)	Orbit determination using Markov chain Monte Carlo	Andrew	French	University of Colorado
Lunar and Small Body Exploration		Simulations of a gas concentrator for mass spectrometry of tenuous atmospheres	Savio	Poovathingal	Montana State University
Group II					
Modeling, Simulation, and Validation	(Student)	Design exploration, optimization and model-based engineering for nano-satellite mission design	Justin	Ancheta	San Jose State University - Aerospace Engineering
Modeling, Simulation, and Validation	(Student)	Using Bezier triangles for modeling small body shapes and their inertia properties in the presence of uncertainty	Benjamin	Bercovici	University of Colorado Boulder
Modeling, Simulation, and Validation		Full-scale MSL heatshield material response using DSMC and CFD to compute the aerothermal environments	Arnaud	Borner	NASA Ames Research Center
Modeling, Simulation, and Validation	(Student)	Development of a thermo-elastic solver for modeling woven thermal protection systems	David	Dang	University of Michigan
Modeling, Simulation, and Validation		CFD code validation for Mars entry simulation	Luigi	Cutrone	Italian Aerospace Research Center
Modeling, Simulation, and Validation		Common-probe: Interplanetary trajectory design	Marcus	Lobbia	Jet Propulsion Laboratory
Modeling, Simulation, and Validation		Inverse determination of aeroheating and charring ablator response	Jeremie	Meurisse	STC at NASA Ames Research Center
Modeling, Simulation, and Validation	(Student)	Planetary probe entry models for concurrent and integrated interplanetary mission design	Alec	Mudek	Purdue University
Modeling, Simulation, and Validation		6-DoF CFD simulations of Cobra mid-L/D rigid vehicle ballistic range test	Ben	Nikaido	NASA Ames
Modeling, Simulation, and Validation		Dynamics of FiberForm oxidation	Savio	Poovathingal	Montana State University
Modeling, Simulation, and Validation	(Student)	Aerogravity assist maneuver variability analysis using global reference atmospheric models	Swapnil	Pujari	Georgia Institute of Technology / Space Systems Design Laboratory
Modeling, Simulation, and Validation	(Student)	A comparison of different filtering techniques applied to autonomous navigation using X-ray pulsars	Vishal	Ray	CU Boulder
Modeling, Simulation, and Validation	(Student)	Multi-fidelity modeling for efficient aerothermal prediction of hypersonic inflatable aerodynamic decelerators	Mario	Santos	Missouri University of Science and Technology
Modeling, Simulation, and Validation	(Student)	Validation of the KATS material response code with arc jet data	Olivia	Schroeder	University of Kentucky
Modeling, Simulation, and Validation	(Student)	Post-flight reconciliation modeling for the advanced supersonic parachute inflation research and experiment (ASPIRE) program `	Michelle	Pizzo	Old Dominion University
Modeling, Simulation, and Validation		Development of the ICARUS material response solver	Eric	Stern	NASA Ames Research Center
Modeling, Simulation, and Validation	(Student)	Satellite and payload simulator of EntrySat 3U CubeSat	Adriaen	Van Camp	ISAE-SUPAERO
Modeling, Simulation, and Validation		Mars 2020 second chance flight software	Aaron	Stehura	Jet Propulsion Laboratory
Modeling, Simulation, and Validation		Shock shape transition on spherically blunted cones in hypersonic flows	Jan	Martinez Schramm	German Aerospace Center
Modeling, Simulation, and Validation	(Student)	Aerodynamic stability analysis of a cubesat in rarefied flow	James	Williams	University of Illinois at Urbana-Champaign
Group III					
Aerosciences and Entry Technology	(Student)	Study on EDL sequence of martian penetrator	Tomoya	Kazama	Tokyo University of Science
Aerosciences and Entry Technology	(Student)	Mission design optimization for consecutive aerocapture-entry systems at Mars	Evan	Zinner	University of Illinois at Urbana-Champaign
Aerosciences and Entry Technology	(Student)	Investigation of DPG properties as a material in a self-healing thermal protection system	Nate	Skolnik	University of Illinois at Urbana-Champaign

Aerosciences and Entry Technology	(Student)	Fast design technique for conceptual hypersonic entry vehicle	Kevin	Bonnet	University of Colorado Boulder
Aerosciences and Entry Technology	(Student)	Drag-modulation aerocapture on Mars: Independent capability insertion for small satellites	Giusy	Falcone	University of Illinois at Urbana-Champaign
Aerosciences and Entry Technology		Aerothermal design of a common probe for multiple planetary destinations	Gary	Allen	NASA Ames Research Center
Aerosciences and Entry Technology		Reduced lift-to-drag vehicle concepts for Neptune aerocapture	Casey	Heidrich	University of Colorado Boulder
Aerosciences and Entry Technology	(Student)	Single-stage drag-modulation GNC for Venus aerocapture demonstration	Evan	Roelke	University of Colorado Boulder
Aerosciences and Entry Technology		Sustaining phenolic impregnated carbon ablator (PICA) TPS for future NASA needs	Mairead	Stackpoole	NASA Ames Research Center
Demonstration and Flight Testing	(Student)	Kentucky re-entry universal payload system (KRUPS): Sub-orbital flights	James	Sparks	University of Kentucky
Demonstration and Flight Testing		Demonstration of a modular ascender for sample return missions	Florian	Ebert	Airbus Defence and Space
Demonstration and Flight Testing	(Student)	Design of a single wheel test rig for ocean worlds rovers	Ye	Lu	Purdue University
Descent and Landing Technology	(Student)	Analysis of supersonic, ejected debris far-field flight envelope	David	Blette	Georgia Tech
Descent and Landing Technology	(Student)	Adaptive attitude control system designed for NASAs ADEPT entry probes	Johnathon	Hicks	San Jose State University
Descent and Landing Technology		Integrated mission and Earth reentry capsule design for a sample return from the moons of Mars	Tiago	Hormigo	Spin.Works S.A.
Descent and Landing Technology		Aerodynamic instability measurement with free-flight capsule model in vertical wind tunnel	Hideyuki	Tanno	JAXA Kakuda
Descent and Landing Technology	(Student)	Minimum-fuel powered descent in the presence of uncertainty	Jack	Ridderhof	Georgia Institute of Technology
Descent and Landing Technology	(Student)	Testing of an instrumented Huygens mock-up in a subsonic wind tunnel: 1st campaign and preliminary results	Guillaume	Thebault	Polytech Orleans
Group IV					
Outer Solar System Exploration		Exploration of Pluto with a new-frontiers-class lander or orbiter mission	Benjamin	Goldman	Global Aerospace Corporation
Outer Solar System Exploration		Nuclear thermal propulsion: Enabling robust missions to the outer solar system	Mitchell	Rodriguez	NASA George C. Marshall Space Flight Center
Outer Solar System Exploration	(Student)	A surface mobility system with large deployable and conformal tire for ocean worlds exploration	Rachana	Agrawal	Purdue University
Outer Solar System Exploration		Dragonfly: Navigating Titan's surface	Douglas	Adams	Johns Hopkins Applied Physics Laboratory
Outer Solar System Exploration		Using radiation sails to transport interplanetary and interstellar probes	Ronald	Bennett	Business
Outer Solar System Exploration	(Student)	Simulating cavitation on the Titan seas	Damon	Chen	New York University
Outer Solar System Exploration	(Student)	Modeling exospheric escape and transfer processes in the Pluto-Charon system using a hybrid SPH-ballistic method	Shane	Carberry Mogan	New York University
Outer Solar System Exploration		The proposed HERA Saturn entry probe mission concept	David	Atkinson	Jet Propulsion Laboratory
Small and CubeSat Probes		Doppler wind retrievals of planetary zonal and meridional winds using constellations of SmallSats	David	Atkinson	Jet Propulsion Laboratory
Small and CubeSat Probes	(Student)	Radio occultations using CubeSats on martian atmosphere.	Ahmed	El Fadhel	University of Nice Sophia Antipolis
Small and CubeSat Probes	(Student)	Gallium nitride magnetic field sensor payload for suborbital flight	Karen	Dowling	Stanford University
Small and CubeSat Probes	(Student)	Recovering time and state for autonomous navigation used for small satellites	Andrew	Dahir	University of Colorado Boulder
Small and CubeSat Probes		High performance deployable photovoltaic systems for planetary exploration - MMA HaWK series	Mark	Bailey	MMA Design LLC
Small and CubeSat Probes	(Student)	Active control for mission extension (ACME) for CubeSat probes	Martin	Costa	San Jose State University
Small and CubeSat Probes	(Student)	Innovative deployable telescope enabling drastic remote-sensing enhancement capabilities of CubeSats with minimal platform impact	Tarik	Errabih	CentraleSupelec
Small and CubeSat Probes		Virtual reality in space: The next frontier for space exploration	Robert	Bruce	San Jose State University
Small and CubeSat Probes	(Student)	Spartan imaging satellite	Irvin	Quintero	San Jose State University
Small and CubeSat Probes		The CU-E^3 CubeSat: An entry in NASA's cube quest challenge's deep space derby	John	Sobtzak	University of Colorado - Boulder
Small and CubeSat Probes	(Student)	Innovative compact solar and antenna array drive assembly enabling deep space CubeSat missions	Marcus	Hott	Ecole CentraleSupelec Paris

Notes

Lisbon · Portugal · 2003

Moffett Field · California · USA · 2004



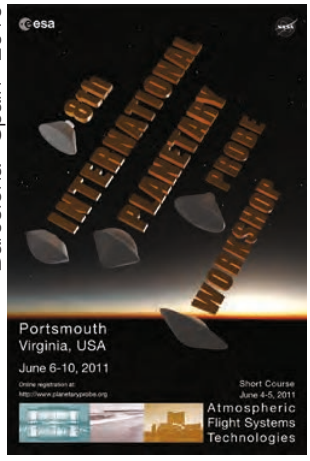
Anavyssos · Attiki · Greece · 2005

Pasadena · California · USA · 2006

Bordeaux · France · 2007

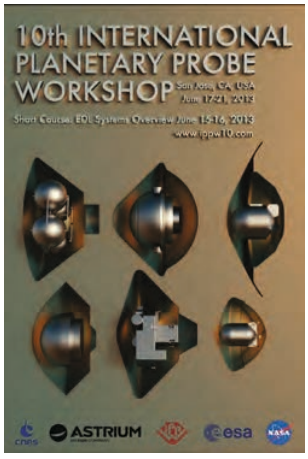
Atlanta · Georgia · USA · 2008

Barcelona · Spain · 2010

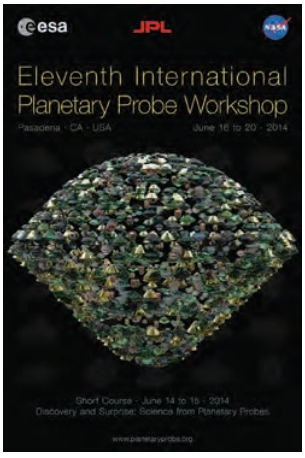


Portsmouth · Virginia · USA · 2011

Toulouse · France · 2012



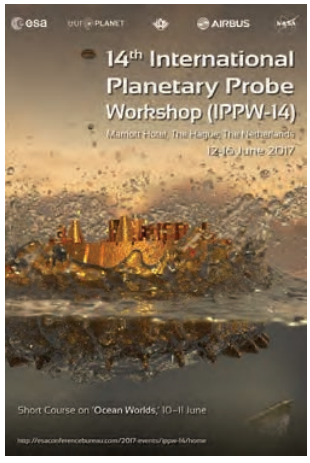
San Jose · California · USA · 2013



Pasadena · California · USA · 2014

Cologne · Germany · 2015

Laurel · Maryland · USA · 2016



The Hague · The Netherlands · 2017

History of the

International Planetary Probe Workshop

2003–2017