



THE CARINA NEBULA

IMAGE CREDIT: NASA, ESA/STSCI

Space Science Institute

Newsletter



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NCIL News...

Big News in Astronomy

Conference Highlights: DPS, AGU and AAS

By Dr. Karly Pitman, Executive Director

While the rest of the world is slowing down around the holidays, our scientists kick into high gear in the winter months submitting grant proposals, judging others' proposals at review panels, and traveling to present results at national and international conferences. This year, conference season kicked off with the American Astronomical Society's Division for Planetary Sciences (DPS) held Nov. 8-13, 2015 at the Gaylord National Resort and Convention Center in National Harbor, MD. [More on Page 10](#)



Karly Pitman and Carl Wuth at AAS
Picture Credit: Lynne Valencic (JHU)

Clouds Over Martian Low Latitudes!

Submitted by Dr. Todd Clancy – SSI NC

Over the past two decades, the importance of clouds in Mars' atmosphere has been established through new observations and modeling. A variety of cloud forms reflects the variety in saturation conditions (e.g. atmospheric temperatures) and dynamical forcing ranging from local to global conditions. This range of behaviors spans narrow vertical pipes of uplift that force high altitude perihelion (nearest to the Sun) cloud trails in the warm orbital phase of the Mars atmosphere, to the global low latitude gird of the aphelion (farthest from the Sun) cloud belt in the cold orbital phase of the Mars atmosphere.

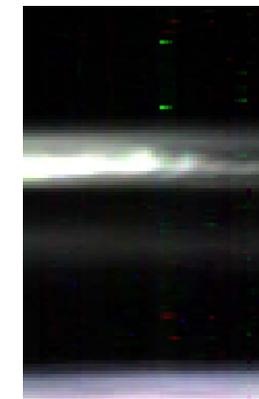
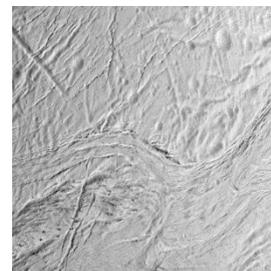


Figure 1. CRISM color limb image of CO₂ clouds – credit page 3.

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Cassini Completes Final Close Enceladus Flyby!



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Covering science news around Boulder!

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Cassini Completes Final Close Enceladus Flyby

By Preston Dyches/CICLOPS Team

NASA's *Cassini* spacecraft has begun transmitting data and images from the mission's final close flyby of Saturn's active moon Enceladus. *Cassini* passed Enceladus at a distance of 3,106 miles (4,999 kilometers) on Saturday, Dec. 19, at 9:49 a.m. PST (12:49 p.m. EST).

"This final Enceladus flyby elicits feelings of both sadness and triumph," said Earl Maize, *Cassini* project manager at JPL. "While we're sad to have the close flybys behind us, we've placed the capstone on an incredible decade of investigating one of the most intriguing bodies in the solar system."

Cassini will continue to monitor activity on Enceladus from a distance, through the end of its mission in Sep. 2017. Future encounters will be much farther away -- at closest, more than four times farther than this latest encounter.

This was the 22nd Enceladus encounter of *Cassini*'s mission. The spacecraft's discovery of geologic activity there, not long after arriving at Saturn, prompted changes to the mission's flight plan to maximize the number and quality of flybys of the icy moon.

"We bid a poignant goodbye to our close views of this amazing icy world," said Linda Spilker, the mission's project scientist at NASA's Jet Propulsion Laboratory in Pasadena, California. "*Cassini* has made so many breathtaking discoveries about Enceladus, yet so much more remains to be done to answer that pivotal question, 'Does this tiny ocean world harbor life?'"

After revealing Enceladus'

surprising geologic activity in 2005, *Cassini* made a series of discoveries about the material gushing from warm fractures near its south pole. Scientists announced strong evidence for a regional subsurface sea in 2014, revising their understanding in 2015 to confirm that the moon hosts a global ocean beneath its icy crust.

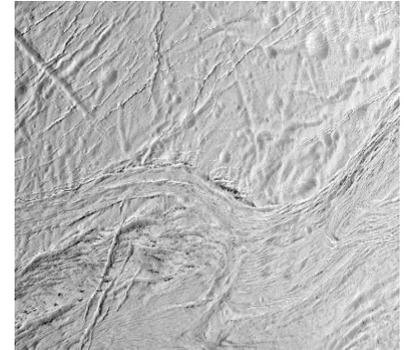
The new views are available at

http://www.ciclops.org/view_event/229

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The *Cassini-Huygens* mission is a cooperative project of NASA, the European Space Agency and the Italian Space Agency. The Jet Propulsion Laboratory (JPL), a division of the California Institute of Technology in Pasadena, manages the *Cassini-Huygens* mission for NASA's Science Mission Directorate, Washington. The *Cassini* orbiter and its two onboard cameras were designed, developed and assembled at JPL. The imaging team consists of scientists from the U.S., England, France, and Germany. The imaging operations center and team leader (Dr. C. Porco) are based at the Space Science Institute in Boulder, Colo. For more info see <http://saturn.jpl.nasa.gov> and <http://www.nasa.gov/cassini>.

Frozen Fractures - During its final close flyby of Saturn's moon Enceladus, NASA's *Cassini* spacecraft captured this view featuring the nearly parallel furrows and ridges of the feature named Samarkand Sulci. Credits: NASA/JPL-Caltech/Space Science Institute.



Ice and Atmosphere - NASA's *Cassini* spacecraft paused during its final close flyby of Enceladus to focus on the icy moon's craggy, dimly lit limb, with the planet Saturn beyond. NASA/JPL/SSI.



Features of the North - NASA's *Cassini* spacecraft peered out over the northern territory on Saturn's moon Enceladus, capturing this view of two different terrain types. Credits: NASA/JPL-Caltech/Space Science Institute.



CASSINI ISS INSTRUMENT OPERATIONS AT SSI

For more about what the SSI Cassini ISS team members are up to on a regular basis, and Dr. Carolyn Porco's Captain's Log, please check out: www.ciclops.org

High Altitude CO₂ Clouds Over Martian Low Latitudes

By: Dr. Todd Clancy – SSI North Carolina
(Continued from Page 1)

In all cases, visible (i.e., sun-lighted as opposed to polar night) Mars clouds are composed of fine H₂O ice particles, as water vapor is most likely to condense under typical (non-polar winter) Mars atmospheric temperatures. However, a new style of Mars cloud associated with condensation of the bulk CO₂ atmosphere (i.e., “dry ice”) at equatorial high altitudes was first proposed in 1998 and subsequently observed from a range of Mars spacecraft beginning in 2004. These mesospheric (50-100 km altitudes) CO₂ clouds form within extremely cold atmospheric temperature minima (-270°F) generated by upper level thermal tides and gravity waves. They are perhaps the most seasonally and spatially specific of Mars clouds, but their specific saturation and physical properties are only recently becoming apparent.

Figure 1. CRISM color limb image of CO₂ clouds observed on May 27, 2014; at 60 km, 10°S, 75°W. The top of the aphelion H₂O ice cloud belt is apparent at the bottom of the figure. The full CRISM spectra (figure 3) distinguish these distinct H₂O and CO₂ cloud compositions.
Credits: APL/JHU.



Since December of 2013, the CRISM imaging spectrometer (visible-to-near infrared wavelengths, 0.4-4.0 μm) on board the *Mars Reconnaissance Orbiter (MRO)* spacecraft has obtained diagnostic limb scans of these mesospheric CO₂ clouds. Figure 1 presents a visible color image of

these clouds at the Mars atmospheric limb, as observed in May 2014.

In early September 2014, a remarkably bright set of these mesospheric CO₂ ice clouds spanning 20°S to 10°N was simultaneously observed by CRISM on the limb and in color nadir (down-looking) images with the *MRO* MARCI ultraviolet/visible global camera. Figure 2 presents CRISM visible-to-near-infrared spectra of these clouds, which determines both the CO₂ ice composition and variable particle sizes for these 50-70 km altitude clouds.

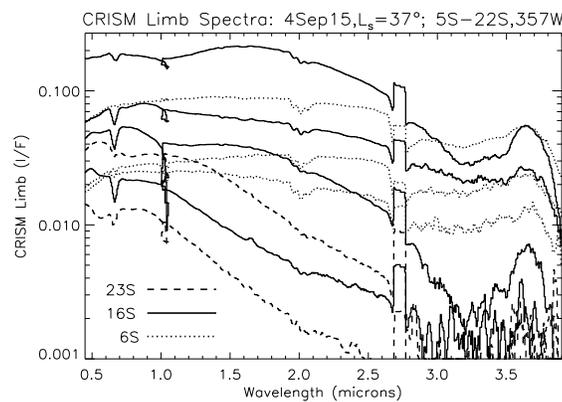


Figure 2. CRISM limb spectra of mesospheric CO₂ clouds observed on September 4, 2015. The lack of H₂O and dust spectral absorptions indicates a cloud CO₂ composition. Variations in spectral shapes indicate cloud particle radii ranging from 0.7 to 1.5 μm.
Credits: APL/JHU.

Figure 3 presents the MARCI image strip, spanning a 20°S-10°N, 15°E-15°W region, incorporating the CRISM field-of-view, and indicating the extended horizontal distribution of these clouds. The MARCI image demonstrates the cirrus-like morphology and distinct wave structures that characterize the dynamical forcing of these mesospheric, equatorial CO₂ clouds. In concert with the microphysical constraints provided by the coincident CRISM spectra (figure 2), these unique *MRO* combined limb-nadir measurements of Mars mesospheric CO₂ clouds supports the most diagnostic study of cloud formation to date.



Figure 3. Wispy mesospheric (65 km) CO₂ ice clouds on Mars, as imaged by MARCI on September 4, 2015 (and as observed by CRISM in figure 2). The image color registration is set at the altitude of these clouds, such that the individual RGB color images are offset for the Mars surface.
Credit: Malin Space Science Systems.

Amazon Smile!

Want to help SSI earn extra funding while you are doing your 2016 shopping? Use the link below to get to AmazonSmile and select Space Science Institute

as your charity of choice! As a result, SSI will earn an extra 0.5% from each purchase you make.

smile.amazon.com



Be sure to tell your family and friends as well...the more we earn, the more flexibility we have to continue the great work you have all come to know and love.

Mars and Pluto are not so different after all.

By: Dr. Alexey Pankine – SSI California

Despite huge differences between Mars and Pluto (the latter is not even considered to be a planet by the IAU...), there are also some striking similarities between these two members of our Solar System. In the figure below on the left is the image of the Martian southern polar cap. The intricate “fingerprint” pattern of small ~100 meter wide depressions in carbon dioxide ice (called “dry ice” here on Earth) is thought to have formed by collapse and widening by sublimation of ice. During Martian summer, the polar cap warms up and the ice can sublimate (melt and immediately turn into vapor). In Martian winter, the temperatures at the pole drop low enough for the carbon dioxide to turn into ice again. The image on the right shows similar “fingerprint” pattern of depressions - but this time we see them on Pluto!

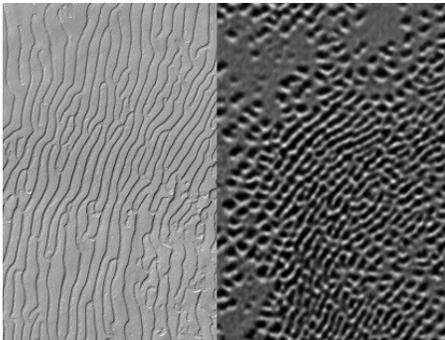


Figure 1. “Fingerprint” patterns on the surface ices on Mars (left) and on Pluto (right). The image on the left was taken by Mars Orbiter Camera (MOC) on Mars Global Surveyor spacecraft. Image credit: NASA/JPL/Malin Space Science Systems. The image on the right is by Long Range Reconnaissance Imager (LORRI) on New Horizons spacecraft. Credit: NASA/JHUAPL/SwRI

On Pluto these depressions form in a mixture of nitrogen and methane ices at a very low temperature that cover the surface of Pluto. However, the process by which they have formed is likely to be the same, as on Mars. Pluto experiences the change of seasons not unlike Mars and Earth, but on a very long scale – one year on

Pluto is equal to 248 Earth years. Similar to Mars, Pluto’s polar ice caps may be losing ice and completely disappearing during summer and reappearing again in winter. Thus, the depressions that we see on Pluto have likely formed by sublimating ices.

Two Faces of Science: Research and Outreach

By: Dr. Padma A. Yanamandra-Fisher, SSI - California



Image Credit: Dr. Padma Yanamandra-Fisher

If a picture is worth a thousand words, then this picture encompasses the various aspects of my research: scientific results, with complementary outreach and citizen science. At the recent annual American Geophysical Union (AGU) meeting held in San Francisco, CA, in December 2015, it was very edifying to be able to chat with James Green (Dir., Planetary Science Division, NASA), John Grunsfeld (Assoc. Administrator, SMD, NASA) and Kristen Erickson (Dir., Science Engagement and Partnerships, NASA HQ), Carol Grunsfeld (Dep. Project Manager, DSCOVR Team), and Kevin Baines (JPL), at the end of a busy weekend of workshops,

team meetings and caucuses. The emerging theme resonating amongst us was how exciting the year 2015 was in planetary science, especially for small worlds and fresh new education partnerships – that we were seeing two sides of the scientific research and exploration, with new results; and outreach/citizen science to share the results with both informal and formal audiences. Luckily, I happened to be in a sweet spot, being involved in both aspects of science.

Colorado Gives Day: Update

We would like to extend a great big THANK YOU to all of the donors who helped support SSI on Colorado Gives Day (Dec. 8)!! Sixteen generous donors helped us raise almost \$7,000 for SSI’s Science Enhancement Fund, outreach, and unrestricted use. We cannot say enough how much we appreciate your support in working toward our mission and we’re proud to call you partners.

For those of you who missed this year’s drive, please use the link to our Colorado Gives page below to learn more about our programs and consider participation in next year’s big event (or sooner if desired!).

<https://www.coloradogives.org/SpaceScienceInstitute/overview>

COLORADOGIVES.ORG

A program of Community First Foundation



SSI's Dr. Thanasis Boudouridis with R2D2 at the 2015 Winter AGU Meeting in San Francisco, CA. Credit: Thanasis Boudouridis

A Physics-based Automated Technique for the Detection of Field Line Resonance Frequency in Ground Magnetometer Data

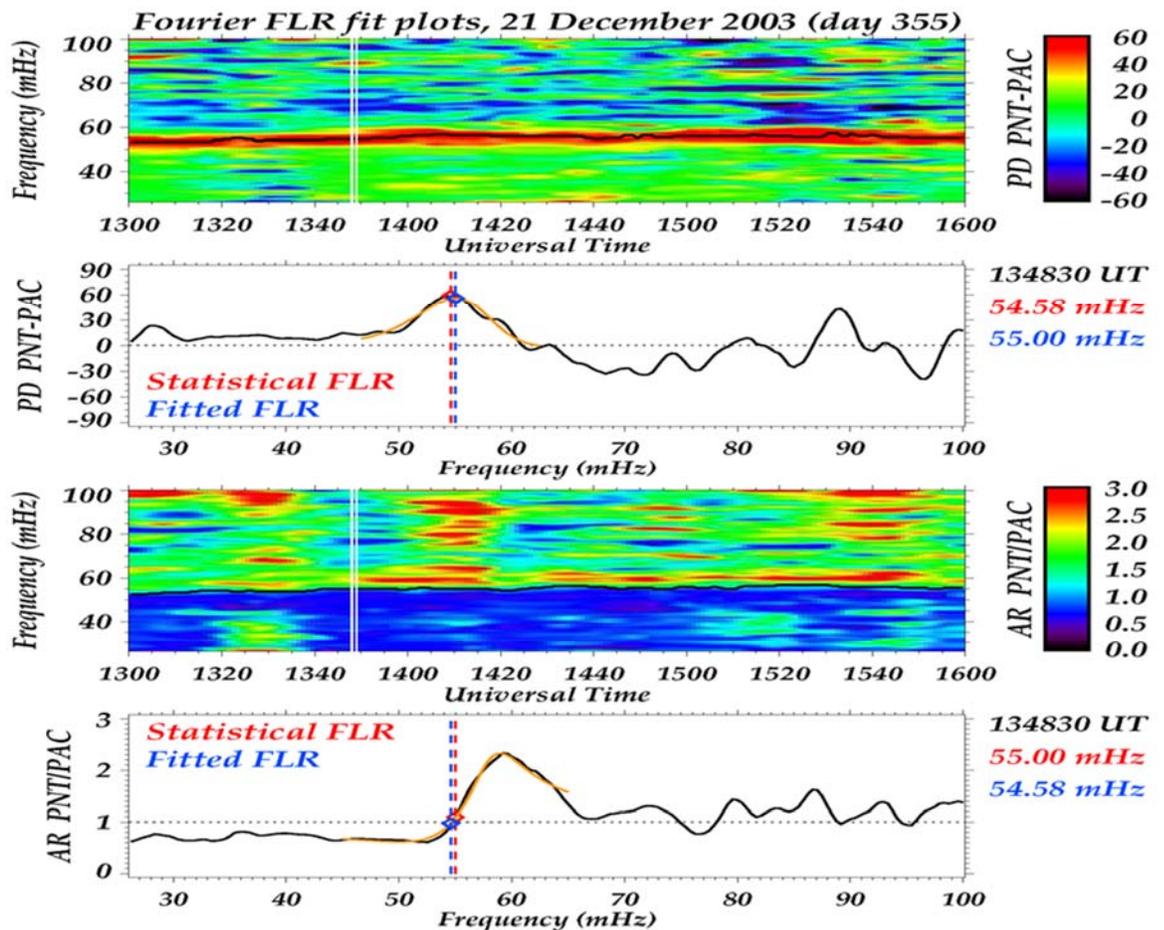
By: A. Boudouridis (SSI - CO), E. Zesta, and M. B. Moldwin

The accurate determination of the Field Line Resonance (FLR) frequency of a resonating geomagnetic field line is necessary for the remote monitoring of the plasmaspheric mass density during geomagnetic storms and quiet times alike. Under certain assumptions the plasmaspheric mass density at

the equator is inversely proportional to the square of the FLR frequency. The most common techniques to determine the FLR frequency from ground magnetometer measurements are the amplitude ratio and phase difference techniques, both based on geomagnetic field measurements at two latitudinally separated ground stations. Previously developed automated techniques have used statistical methods to pinpoint the FLR frequency using the amplitude ratio and phase difference calculations. We now introduce a physics-based automated technique that can reproduce the resonant wave characteristics from the two ground station data, and from those determine the FLR frequency. The advantage of the new technique, besides moving away from ambiguous statistical manipulations of the ground data,

is the estimation of physically determined errors of the FLR frequency, which can yield physically determined errors of the equatorial plasmaspheric mass density. We present preliminary results of the new technique calculations, and test it using data from the new Inner-Magnetospheric Array for Geospace Science (iMAGS) ground magnetometer chain along the coast of Chile and the east coast of the United States. We compare the results with the results of previously published statistical automated techniques

"An example of the curve fitting techniques for both the phase difference (PD, top two panels) and the amplitude ratio (AR, bottom two panels) methods for the determination of the Field Line Resonant (FLR) frequency."



Covering Science News In Boulder

By Dr. Travis Metcalfe – SSI Boulder, adapted from his article in the Boulder Weekly.



Since the end of World War II, Boulder has been transformed from a sleepy college town to a Mecca for scientists from around the world. With four government labs around Boulder, many of the scientific discoveries that make the news have some connection to local researchers. Harvard astrophysicist Walter Orr Roberts brought the High Altitude Observatory to Boulder in the late 1940s, expanding in 1960 to establish the National Center for Atmospheric Research (NCAR). The National Oceanic and Atmospheric Administration (NOAA) was created in 1970 by Richard Nixon, but its predecessor (the Central Radio Propagation Laboratory) had been operating here since the early 1950s. The National Bureau of Standards was also in town back then, but it wasn't renamed the National Institute for Standards and Technology (NIST) until 1988. Jimmy Carter established the Solar Energy Research Institute in 1974, which became the National Renewable Energy Laboratory (NREL) in 1991 under George H.W. Bush.

The labs have been like a magnet for scientists, who were attracted to Boulder and quickly discovered that they couldn't leave. As this army of Ph.D.s piled higher and deeper over the decades, new research institutes and non-profit organizations were

established to absorb them. The Joint Institute for Laboratory Astrophysics (JILA) was formed in 1962 by NIST and CU. The National Snow and Ice Data Center (NSIDC) came to town in 1976 and began operating with support from NOAA and CU in 1982. Grant-funded researchers at CU created the Center for Astrophysics and Space Astronomy (CASA) in 1985, while several non-profit organizations sprouted up in the 1990s around similar concepts: Space Science Institute (SSI) in 1992, a division of Southwest Research Institute (SWRI) in 1994, and a branch of Northwest Research Associates (NWRA) in 1998. Boulder now boasts the largest number of Ph.D.s per capita of any city in the nation, at 8.2 percent in 2012.

I am one of the many scientists who came to Boulder and decided to stay. I arrived in 2004 to work at NCAR with a fellowship from the National Science Foundation. I was hired as a staff scientist two years later, and I spent the next six years working to understand the structure and dynamics of the Sun using observations of other nearby stars. In 2012, when the full impact of the Great Recession finally hit the government, I lost my dream job to federal budget cuts. As local scientists have been doing for decades, I stayed in town and supported my research by writing grant proposals — in my case primarily to NASA. In the past few years, I have been using the Kepler space telescope to study planetary systems around other stars.

One of my responsibilities as a staff scientist at a federally-funded laboratory was to share my enthusiasm for science with the

general public. I took this obligation seriously, writing a monthly column on starstuff.blogspot.com to explain the latest scientific discoveries in the simplest terms, and to provide more context and background than is typically offered in the news. Over the next year I hope to do something similar for the monthly articles in the Lab Notes series, with a special focus on the cutting-edge research that is being done right here in Boulder.

Science journalism is on the decline across the media landscape, and even where it persists the reporters have very little background in science. Some of the labs around town have offices to issue press releases and to connect their scientists to journalists. For the government labs these offices are sometimes headquartered in Washington D.C., while the smaller local research institutes may not have the resources to support media outreach. Only the largest news organizations have staff assigned specifically to cover science, so even these limited efforts tend to be directed at national outlets. Local connections can be lost in the shuffle. Even in the best cases, many scientists have a hard time articulating their research at a level that the public can appreciate, and journalists have difficulty translating complex results into simple language. Boulder is home to a wealth of scientific expertise, and it would be a shame not to make it more accessible to everyone in our community.

Travis Metcalfe, Ph.D., is a SSI researcher and science communicator based in Boulder. Read previous columns and support the future of the Lab Notes series at labnotes.whitedwarf.org

The National Center for Interactive Learning (NCIL) leverages SSI's successful experience in research, museum, science center and library educational programs, public outreach, and digital technologies into accessible and inspiring learning opportunities.

The Broomfielder Magazine included *Discover Tech: Engineers Make a World of Difference* in its December 2015 issue! The article quoted Roberta Depp, Library Director, as saying, "We are proud that the Mamie Doud Eisenhower Public Library was selected to be one of nine sites nationwide to host the Discover Tech exhibition." She went on to say, "We think people of all ages and backgrounds will find that the exhibition explores engineering and technology in a way that is understandable, inspiring, and relevant."

SSI's own Anne Holland was also quoted when she stated, "The Broomfield Library has been collaborating with science and technology partners for over a decade and seemed an appropriate institution to highlight the positive connections made between libraries and STEM organizations."

If you'd like to read more, you can pick up a copy or follow the link below:

http://issuu.com/loudmouthmediallc/docs/de_c15_broomfielder_issuu?e=16506336%2F31563830

2016 Exhibition Itinerary Discover Tech

Submitted by Naomi Carlson, SSI Headquarters

Tour

Dates/Locations:

October 7, 2015 –
January 22, 2016
Rolling Hills
Consolidated
Library, St. Joseph,
MO

February 3, 2016 –
April 29, 2016
Blount County
Public Library,
Maryville, TN

May 11, 2016 – August 5, 2016
Boone County Public Library,
Burlington, KY

August 17, 2016 – November
11, 2016
Bertha Voyer Memorial Library,
Honey Grove, TX

November 30, 2016 – March 10,
2017
Marion Public Library, Marion,
IN

March 22, 2017 – June 16, 2017
Grand Forks Public Library,
Grand Forks, ND

June 28, 2017 – September 22,
2017
Salt Lake County Library
Services, West Jordan, UT

October 4, 2017 – January 19,
2018
Mountain Home Public Library,
Mountain Home, ID



SSI Comet Making Image Credit:
NCIL at SSI

Discover NASA: From Our Town to Outer

Space 2016-2017 Tour:

10/12/2015 - 1/4/2016
Louisville Public Library
Louisville, Colorado

1/5/2016 - 4/1/2016
Centennial Park Library
Greeley, Colorado

4/13/2016 - 7/8/2016
Auburn Public Library
Auburn, Maine

7/20/2016 - 10/14/2016
East Meadow Public Library
East Meadow, New York

10/26/2016 - 1/20/2017
Slover Library
Norfolk, Virginia

2/1/2017 - 4/19/2017
Winfield Public Library
Winfield, Kansas

5/3/2017 - 7/28/2017
Camp Verde Community Library
Camp Verde, Arizona

2016 Exhibition Discover Earth:

Tour Dates/Locations:

October 7, 2015 – January 22, 2016
Rolling Hills Consolidated Library,
St. Joseph, MO

February 3, 2016 – April 29, 2016
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Salt Lake County Library Services,
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October 4, 2017 – January 19, 2018
Mountain Home Public Library,
Mountain Home, ID

2016 Outreach Events

By Anne Holland – SSI Boulder

NCIL has ramped up its outreach efforts in the local Boulder community, and has started partnerships with the Louisville and Broomfield Public Libraries to host "Science Fact or Fiction Movie Nights". These events are preceded by hands on activities for younger patrons (like comet making for Armageddon), and include a "Mystery Science Theatre" style viewing of popular movies (Jurassic Park, Star Wars, Armageddon, etc), followed by a panel discussion of the science presented in the films. Stay tuned as we finalize our 2016 schedule of events!



Image Credits: SSI



Image Credit: Anne Holland

“Discover Space” exhibition announced!

Community members invited to explore exhibit at Anythink Huron Street

THORNTON, Colo.—Jan. 25, 2016—

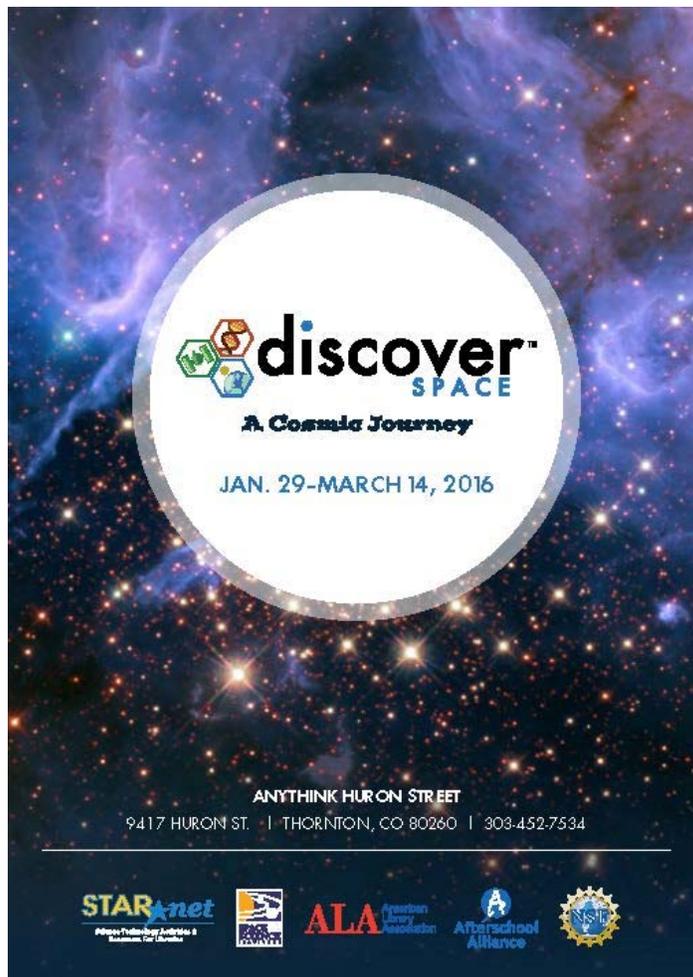
Anythink announced that Friday, Jan. 29-Monday, March 14, Anythink Huron Street will host *Discover Space: A Cosmic Journey*, an interactive exhibition produced by the Space Science Institute. *Discover Space* is an opportunity for community members of all ages to explore the cosmos from space storms to asteroids and the universe beyond. On Friday, Feb. 5, Anythink Huron Street celebrated this unique exhibition with an opening reception from 5-7 pm, free and was open to the public.

“The Discover Space exhibition takes visitors on an exciting cosmic journey from planet Earth, through the Solar System and into the universe beyond,” says Paul B. Dusenbery, Director of the Space Science Institute’s National Center for Interactive Learning. “Lots of fun and hands-on activities will inspire both young and old alike.”

Discover Space is presented in conjunction with Anythink’s upcoming Space Month, a district-wide celebration of all things space. Throughout the month of March, customers will have the opportunity to participate in a variety of space-

related programs, crafts and special events. More detailed information on Space Month is forthcoming.

“We’re excited to host *Discover Space* and share this exhibition with our community,” says Anythink Huron Street manager Sandra Sebbas. “It provides great opportunities for kids, adults and families to be



inspired by space science.”

The Space Science Institute is a Boulder-based nonprofit that creates new and far-reaching models for earth and space science research and STEM (science, technology, engineering, mathematics) education. *Discover Space* is funded by the National Science Foundation and will travel to libraries across the country.

Event Details

Discover Space: A Cosmic Journey

Exhibition Opening Reception

Was Friday, Feb. 5, 5-7 pm
Anythink Huron Street
9417 Huron St.
Thornton, CO 80260
303-452-7534

See the universe in a new light with Anythink and the Space Science Institute during the opening reception of *Discover Space: A Cosmic Journey*. Explore everything from space storms to asteroids and the universe beyond in this interactive exhibition, on display through March 14. All ages welcome. Light refreshments will be served.

This event was free and open to the public.

About Anythink™

Anythink is a new style of library – a place of unlimited imagination, where play inspires creativity and lifelong learning. Rangeview Library District serves the residents of Adams County with seven Anythink libraries and

Anythink in Motion – the district’s mobile library – and is one of the recipients of the 2010 National Medal of Museum and Library Service from the Institute of Museum and Library Services. For more information, go to anythinklibraries.org.

Conference Highlights

By: Dr. Karly Pitman, Executive Director
(Continued from Page 1)

At DPS, SSI was the corporate sponsor for the Women in Planetary Science lunch, a networking event that drew 100+ attendees. Executive Director Karly Pitman led the DPS Professional Development subcommittee's workshop "Working Through Adversity: Strategies For Success" and proudly represented the soft money industry at the AAS DPS Student/Postdoc Reception. SSI researchers presenting first-author work at DPS in addition to Karly included Brad Sandor, Todd Clancy, Julie Moses, Padma Yanamandra-Fisher, and Gordon Videen; their work spanned the entire Solar System, with an emphasis on planetary atmospheres, outer Solar System moons, and comets.

The "big science" highlight of DPS was an entire day devoted to New Horizons Pluto discoveries; you can watch the recorded talks from the Pluto and other plenary sessions online at <http://aas.org/dps-47th-meeting/dps-47-meeting-videos>

or read Emily Lakdawalla's recap at <http://www.planetary.org/blogs/emily-lakdawalla/2015/12211538-pluto-updates-from-agu.html>

SSI made its next appearance at the American Geophysical Union (AGU) fall meeting in San Francisco, CA on Dec. 14-18, 2015, with Carl Wuth, Mike Wolff, Karly Pitman, and Jaime Harold holding down the fort at the SSI booth. The Fall AGU meeting attracts a slightly different crowd, mostly geologists, planetary scientists, and solar physicists. Several of SSI's scientists presented science and

education talks and posters on Mars, Cassini, solar plasma physics, and small bodies topics (Padma Yanamandra-Fisher, Vadim Roytershteyn, Phil James, Mick Denton, Mike Wolff, Thanasis Boudouridis, Peter Gary, Karly Pitman, Carolyn Porco, Colin Mitchell, and Jaime Harold). The AGU offers a wide array of programming, including general sessions that have a broad application to all fields of Earth and space science; the Tuesday talk by Elon Musk was heavily attended. The SpaceX group even brought a tricked-out \$150K Tesla that was for sale in front of the exhibit hall.

The 227th American Astronomical Society (AAS) winter meeting was held Jan. 4-8, 2016 at the Gaylord Palms Resort and Convention Center in Kissimmee, FL. The Gaylord Palms is effectively a biodome with live alligators that are only fed twice a week living in the center of it. Karly Pitman, Carl Wuth, and Mike Wolff stayed safely at the SSI booth; thanks to Dayton Jones, Matt Haffner, and Franz Bauer for helping out and stopping by. Once again, SSI was part of the free-to-the-public education event that AAS hosts every year. This year, the folks stopping by our booth ranged from homeschooling consortia, private schools, and middle through high school aged public school groups. Debbie Kovalsky from AAS logistics sent thanks to SSI's Business and Education groups for participating in this year's event on short notice. AAS placed a special emphasis on career skills and development, as the winter meetings in general are the place for job seekers and doing onsite interviews. Karly was a featured scientist at the "Leadership

and Team-building For Astronomers" workshop hosted by Alaina Levine and Dr. Margaret Hanson. See also AAS Nova and Astrobites for quick recaps of the entire meeting and exoplanets talks: <https://aas.org/posts/news/2016/01/highlights-aas-nova-recap-227th-aas-meeting>

Hot Topics in HR

By: Dr. Rick Delacastro, SSI HR

The Colorado minimum wage increased January 1, 2016. This increase represents a modest increase of 1.0% above the 2015 State minimum wage.

| Colorado Minimum Wage History | |
|-------------------------------|--------------|
| EFFECTIVE DATE | MINIMUM WAGE |
| January 1, 2016 | \$8.31 |
| January 1, 2015 | \$8.23 |
| January 1, 2014 | \$8.00 |
| January 1, 2013 | \$7.78 |
| January 1, 2012 | \$7.64 |
| January 1, 2011 | \$7.36 |
| January 1, 2010 | \$7.24 |
| January 1, 2009 | \$7.28 |
| January 1, 2008 | \$7.02 |
| January 1, 2007 | \$6.85 |
| August 8, 1998 | \$5.15 |

SSI is also completing a market wage survey with Mountain States Employment Council, in conjunction with 2016 raise requests. Stay tuned for more details!

SSI IT Bytes

Microsoft Office Licenses

As part of the migration to Office 365, SSI will now be providing licenses for the Microsoft Office suite as part of its overhead support for SSI employees. For more information contact Jaime (harold@spacescience.org)

IDL 8.5 Is Here!

IDL (v8.5) is now installed on gemelli.colorado.edu for general use by SSI staff. If you do not have an account on gemelli, please submit an IT request to Jaime Harold for one.

SSI Facebook Roundup

Top stories for SSI from November – February 2015 on SSI's Facebook page:
<https://www.facebook.com/spacescienceinstitute>

November 3: Captivating Science – Acid Fog Likely Dissolved Rocks on Mars: Discover News.

November 4: Dr. Luca Montabone, had a great time with future scientists (at their nursery school), showing vortices, and using food dye colors.



Image Credit: Dr. Luca Montabone

November 5: Taurid Meteor Showers peak November 5, 6, 11 & 12th.

November 5: Anne Holland at NCAR for Super Science Saturday, she was making comets and showcasing meteorites as part of the fun!

November 5: The Louisville Public Library's new Makerspace, opens November 7th!

November 9: Dr. Carolyn Porco and her team press on – Cassini Seeks Insights to Life in Plumes of Enceladus, Saturn's Icy Moon.

November 10: SSI's National Center for Interactive Learning (NCIL) staff participated in the Discover Tech workshop at the Mamie Doud Eisenhower Public Library in Broomfield, CO on November 3-4.

November 11: Curiosity Rover Sees Earth from Mars for the 1st Time!

November 11: Veterans Day - To all those who have served, have sacrificed, or are serving still - we thank you (including SSI's own).

November 17: Leonid Meteor Shower Peaks Overnight Tonight: What to Expect...

November 18: Curiosity Rover is about to mark another major milestone... Curiosity headed to Dark Sand Dunes on Mars.

December 1: Giving Tuesday – Amazon Smile, help support SSI by using AmazonSmile's SSI Link.

December 2: Reminder SSI Holiday Party December 9th, in Boulder Office.

December 6: Our Highest Resolution Views Yet of Pluto's Surface by the New Horizons spacecraft.

December 7: Anne Holland was quoted in the December 2015 issue of The Broomfielder magazine.

December 8: Reminder SSI will be attending AGU in San Francisco Remember to come by our booth 640 and see what's new!

December 8: Colorado Gives Day!

December 9: Thank you to all the donors who helped support SSI!

December 10: Remember to look up – Geminid Meteor Shower Puts on a Dazzling Display This Week!

December 15: Due to Weather, SSI was officially closed due to the weather and road conditions.

January 5: SSI at AAS in Kissimmee, FL, Great picture of the Booth, Karly and Carl, at the 215th meeting AAS.

January 13: Volunteer Fair at CU Boulder, Courtney was recruiting volunteer help for SSI!

January 14: NASA's Juno Spacecraft Breaks Solar Power Distance Record to become humanity's most distant solar-powered emissary.

January 15: The Space Science Institute will be exhibiting at the 32nd Space Symposium in Colorado Springs, CO in April!

January 15: For anyone who missed Nerd Nite in Denver, Dr. Bill Farrand's interview held afterward is now online!

January 25: SSI's newest NCIL exhibition, Discover Space, is opening at the Huron Street Anything Library Jan. 29th – Mar. 14th, 2016!

SSI Is a Finalist for the When Work Works Award!

By Dr. Karly Pitman, Executive Director

The When Work Works Award is a prestigious award recognizing employers that successfully use workplace flexibility to meet both organizational and employee goals. This year, SSI has been selected as a finalist, meaning that we've scored in the top 20% for flexible work programs/policies and workplace culture nationwide.

Starting on Feb. 1, the Families and Work Institute will be sending out survey questions to SSI employees coming from the e-mail address [noreply@qemailserver.com] with a subject line of "When Work Works Award Survey." Please help SSI advance in the rankings by completing this survey. Employee feedback counts for two-thirds of the final score and will also give us some nice general feedback on what is working vs. not at SSI.

- Estimated time to complete the survey is 25 minutes.
- Participation is confidential; responses will be summarized but not linked to individuals.
- Everyone will receive a unique survey link.

If you have any questions, please contact Karly or Courtney.



CU's Volunteer Fair: January 2015

By Courtney Stanton, SSI Headquarters

On Wednesday, January 13, 2016, SSI participated in the CU Boulder Winter Volunteer Fair. Located in the Glenn Miller Ballroom on campus, SSI set up a table and spent approximately four hours talking to students of all ages about SSI and our projects, work, mission, and goals. There were a fairly large number of students who showed interest in volunteering for SSI for several hours each week. The areas where students were most interested in assisting were research (assisting the scientists with their projects), technology (assisting with game/app development and testing), communication and advertising (assisting with newsletters, social media, branding, and one-off write-ups for articles), and

education & public outreach (assisting with outreach activities as they come up, assisting with video work and editing for E/PO materials, and other related E/PO activities).

Overall, it was a highly successful endeavor and we are looking forward to participating in the even bigger Volunteer Fair being held in August 2016, when the new school year begins. For anyone interested in working with a volunteer, please contact Karly, Ralph, Jaime, or Anne.

The picture on the right is of space and what SSI supporter Eliana V. (age 3) thinks is out there in our galaxy. Eliana donated 1/3 of her life savings to SSI to help space discovery. For her support, her interest, and her artwork, SSI thanks Eliana very much! Keep up the great work, Eliana!



Space Science Institute



4750 Walnut
St., Ste. 205
Boulder, CO
80301-2532

Welcome to SSI:

New Employees - Channon Visscher and Keliann LaConte

We say Hello and Welcome to:

Our newest Board Member: Larry Satkowiak



Larry Satkowiak came to The Cable Center as its CFO in late 2003 and served as its President and CEO from 2005-2015. The Cable Center is the nonprofit educational arm of the cable industry devoted to preserving the rich history of the cable industry, building bridges between the cable industry and higher education, and bringing together industry participants to share ways to better serve customers. The Cable Center works with the higher education community, sponsors the Cable Hall of Fame, and preserves the rich history of the cable industry. In 2015,

Larry published his first book titled: *The Cable Industry: A Short History Through Three Generations*.

Larry was born in Detroit, Michigan and his early education was shaped by the Jesuits and the Oblates of St. Francis De Sales until he graduated from high school in 1971. Having a strong obligation to serve his country, he entered military service and was stationed at Fort Carson, Colorado where he was in the Signal Corps and the Fourth Infantry Division. After military service, he stayed in Colorado, attended the University of Colorado in Colorado Springs and started a family.

His career began in banking, where he entered the bank's management training program and learned bank operations. Larry worked at the bank during the day and attended classes at night to complete his BS in Business in 1980, with an emphasis in Organizational Management. As he rotated through the various banking departments as part of his training, he found that he particularly enjoyed accounting and financial analysis, so he returned to the university to complete the accounting major.

He left banking to take a position as an accounting instructor and shortly afterward, became the Executive Director of the Pueblo College of Business in 1981. In 1984, he accepted a position as Chief Business Officer at the Biological Sciences Curriculum Study (BSCS), located on the Colorado College campus in Colorado Springs. (BSCS is a 501(c)(3) nonprofit organization dedicated to improving K-College education through curriculum development, professional development, and research). Larry specialized in nonprofit accounting and managed grants and contracts from the National Science Foundation, National Institutes of Health, and the Department of Energy. He completed his MBA in Finance and Accounting from Regis University in 1990, while working full time. *More on Page 14 ...*

Welcome to our newest Board Member: Larry Satkowiak (continued)...

Larry accepted a position as the Director of Finance and Administration at The Denver Foundation in 1999, which at the time, was a \$200 million community foundation. The foundation enjoyed tremendous growth during his tenure, and though he enjoyed the position, he returned to BSCS in 2001 to help the organization recover after the tragic death of its Associate Director. He worked three years at BSCS as Associate Director and Chief Operating Officer, and then received an offer in 2003 to return to Denver as Chief Financial Officer of The Cable Center. Before accepting this position with The Cable Center, he also taught accounting and finance as an adjunct faculty member for most of his career (his last position was at Regis University). In addition, he has been an organizational consultant to numerous nonprofit organizations over the past 20 years. He has also served on various nonprofit boards throughout his career and has written for multiple cable publications.

Larry is married to Linda Satkowiak, ND, RN, a pediatric nurse who works for Children's Hospital. Linda received her doctorate at the University of Colorado Health Sciences Center. They have four daughters who have all graduated from college and are enjoying professional careers of their own. In addition, they have six grandchildren. Larry and Linda enjoy hiking, traveling, and reading – Larry's favorite pastime is amateur photography, and though he enjoys travel photography, his favorite subject remains his grandchildren.

Channon Visscher, PI

Dr. Channon Visscher is an Assistant Professor of Chemistry & Planetary Sciences at Dordt College in Sioux Center, IA. A graduate of Dordt College, he completed his Ph.D. in Earth and Planetary Sciences in 2006 from Washington University in St. Louis, where he worked in the laboratory of Dr. Bruce Fegley, Jr., with a research emphasis on thermochemical equilibrium models of planetary atmospheres. In 2008 he began working as a postdoc under the direction of Julianne Moses at the Lunar and Planetary Institute in Houston, TX, with a research focus on developing chemical models of planetary atmospheres. In 2011 he joined Southwest Research Institute in Boulder, CO in 2011, working with Robin Canup to develop combined accretion models of lunar formation, until returning to teaching at Dordt College in 2013. His current research generally involves modeling physical and chemical processes in planetary and astrophysical environments. The goal of this work is to better understand the underlying chemistry responsible for the observed properties of planetary atmospheres, and to provide clues about the formation and evolution of planetary systems. Channon and his wife have three children and live in Sioux Center, IA.

Keliann LaConte, Professional Development Manager

Keliann comes to SSI from a similar position at the Lunar & Planetary Institute in Houston Texas, where she spent over 6 years as their Informal Education Lead. She has been a key partner with NCIL on the Phase 1 and Phase 2 *STAR_Net* Awards, leading the development and implementation of the training programs for the public library staff (online and in-person). She is well versed in training for informal educators, with an emphasis on those who serve rural communities and girls. She has also had a strong role in the *Explore* program and community of practice. We are pleased to welcome her to the NCIL team and look forward to seeing her in action!

We say *Congratulations* to:

Savita Mathur, our new Director of the Center for Extrasolar Planetary Systems at SSI, as of September 2015.

We say *Goodbye* to:

Naomi Carlson, Project Coordinator NCIL. Congratulations on the new job at Zillow and best wishes going forward!

SSI Participation at DPS 2015:

Mon. 11/09:

107. Mercury and the Moon

107.08. Transitional lava flows as potential analogues for lunar impact melts

Catherine Neish; Scott Hughes; Christopher Hamilton; Shannon Kobs Nawotniak; William B. Garry; John R. Skok; Richard Elphic; Lynn Carter; Joshua Bandfield; Gordon Osinski; Darlene Lim; Jennifer Heldmann

Tue. 11/10:

201. ³Venus / Asteroid Dynamics

201.04. Observations of Altitude Dependence and Temporal Variation of CIO in the Venus Mesosphere

Brad J. Sandor; R. T. Clancy

219. EPO - Scientist's Showcase, Programs, and Best Practices

219.03. PACA_Rosetta67P: Global Amateur Observing Support for ESA/Rosetta Mission

Padma A. Yanamandra-Fisher; Claudia Alexander; Efrain Morales; Christiana Feliciano-Rivera

Wed. 11/11:

311. Jovian Planets Atmospheres and Interiors

311.01. Uranus' Persistent Patterns and Features from High-SNR Imaging in 2012-2014

Patrick M. Fry; Lawrence A. Sromovsky; Imke de Pater; Heidi B. Hammel; Phillip Marcus

311.30. Evaluation of Data Used for Modelling the Stratosphere of Saturn

Eleanor S. Armstrong; Patrick G. Irwin ; Julianne I. Moses

311.35. Probing the Depths of Jupiter and Saturn at Five-Microns

Padma A. Yanamandra-Fisher; Sara M. Gutierrez; Anna Payne; Glenn S. Orton; James Sinclair

Thu. 11/12:

413. 67P/Churyumov-Gerasimenko

413.13. Hubble Space Telescope Imaging Polarimetry of Comet 67P/Churyumov-Gerasimenko Obtained During the Rosetta Mission

Dean C. Hines; Anny-Chantal Levasseur-Regourd ; Edith Hadamcik; Vadym Kaydash; Matthew M. Knight ; Ludmilla Kolokolova; Jian-Yang Li; Carey M. Lisse; Karri Muinonen; Max Mutchler; Yuriy Shkuratov; Colin Snodgrass; Michael L. Sitko; Matt G. Taylor; Gorden Videen; Padmavati A. Yanamandra-Fisher; Evgenij Zubko

415. Comets: Physical Characteristics, Dynamics, and Composition

415.13. Coma in Comet C/2012 S1 (ISON) at ~4 au

Gorden Videen; Evgenij Zubko; Dean C. Hines; Yuriy Shkuratov; Vadym Kaydash; Karri Muinonen; Matthew W. Knight; Michael L. Sitko; Carrey M. Lisse; Max Mutchler; Diane H. Wooden; Jian-Yang Li; Hiroshi Kobayashi

420. Mars: Surface and Interior

420.03. ChemCam at Gale Crater: Highlights and Discoveries from Three Years of Chemical Measurements on Mars

Diana L. Blaney; Roger Wiens; Sylvestre Maurice; Olivier Gasnault; Ryan Anderson; John Bridges; Nathan Bridges; Samuel Clegg; Benton Clark; Bethany Ehlmann; Melinda D. Dyar; Martin Fisk; Raymond Francis; Cecile Fabre; Olivier Forni; Jens Frydenvang; Jeffery Johnson; Nina Lanza; Richard Leveille; Jeremie Lasue; Laetitia Le Deit; Nicholas Mangold; Noureddine Melikechi; Marion Nachon; Horton Newsom; Valerie Payre; William Rapin; Violane Sautter; David Vaniman; John Grotzinger; Ashwin Vasavad; Joy Crisp

Fri. 11/13:

502. Jovian Planet Magnetospheres, Aurorae, and Atmospheres

502.04. Are Brown Barges the Deserts of the Upper Jovian Atmosphere?

Glenn S. Orton; James Sinclair; Leigh Fletcher; Takuya Fujiyoshi; Padma Yanamandra-Fisher; John Rogers; Patrick Irwin; Thomas Greathouse; Raiyan Seede; Jason Simon; Marian Nguyen; Matthew La

504. Extrasolar Planets: Giant Planet Atmospheres

504.05. The Effect of Photochemistry and Quenching on the Atmospheric Composition of Young Directly Imaged Giant Planets

Julianne I. Moses; Michael R. Line; Channon Visscher; Mark S. Marley; Jonathan J. Fortney; Nikole K. Lewis; Michael J. Wolff

508. Icy Satellites

508.05. Coherent Backscattering Effect in Saturnian vs. Uranian Satellites: Effects on Band Depths and Shapes

Karly M. Pitman; Ludmilla Kolokolova; Anne J. Verbiscer; Charles Gulotta; Emily C. Joseph; Daniel W. Mackowski; Bonnie J. Buratti; Thomas W. Momary

SSI Participation at AGU Fall 2015:

Padma Yanamandra-Fisher

- ED51E-06: “Student-to-Scientist (S2S) via the PACA Project: Connecting Astronomers, Educators and Students”
- P41D-2090: “Polarimetric Study of Atmospheric Phenomena and Its Applications”

Vadim Roytershteyn

- SH11E-2417: "Turbulence dissipation challenge: particle-in-cell simulations"
and co-author on:
- SM43A-04: “A Rosetta Stone for in situ Observations of Magnetic Reconnection”
- SH11E-2418: “Coherent structures, dissipation and intermittency in plasma turbulence”
- SH44A-03: “Kinetic Simulation of the Dissipation of a Turbulent Cascade (Invited)”
- SM51A-2547: “Laboratory study of ion and electron dynamics during asymmetric magnetic reconnection”
- SH51D-07: “Transition Region Near the Heliopause: Modeling Results from the Voyager Mission Perspective”

Phil James

- P23B-2127: Albedo of Carbon Dioxide Ice in Mars' Residual South Polar Cap

Mick Denton

- Invited Talk, SM32A-04: “Long-lived plasmaspheric plumes: What is the source of the plasma?” Denton, et al.
- Poster SM41A-2467: “Flux predictions at geosynchronous orbit (1 eV to 40 keV) based on solar wind conditions at 1 AU” Denton, et al.
- Chair, Session SM41G: “Refilling of the Plasmasphere: Theory versus Observations” Convenors: Denton and Gallagher

Karly Pitman

- P31A-2043: Improving Estimated Optical Constants With MSTM and DDSCAT Modeling

Mike Wolff

- P23B-2138: Limb Retrievals of the martian atmosphere: Mapping with optical observations from MGS/TES and MRO/MCS.

Peter Gary

- SH53B-2511: Ion-Driven Instabilities in the Solar Wind: Wind Observations of 19 March 2005
- SH11D-2405: Solar Wind Electron Scattering by Kinetic Instabilities and Whistler Turbulence

Carolyn Porco

- Poster “ENCELADUS' 101 GEYSERS: PHANTOMS? HARDLY” Porco, C., DiNino, D., and Nimmo, F.

Joe Borovsky

- SM52A-06: “Superposed Epoch Analysis Comparing the Reaction of the Proton Radiation Belt and the Electron Radiation Belt during High-Speed-Stream-Driven Storms”, Borovsky, J., et al.
- SM31E-04: “Overview of the SHIELDS Project at LANL” Jordanova, V., et al.
- SM41H-2584: “Comparison of Energetic Electron Distribution Functions Derived from CXDs (L~4.2), CPAs and SOPAs (L~6.6), and Model AE8 at or near the Magnetic Equator” Cayton, T., et al.

Colin Mitchell

- Talk titled “Icy Tendrils from Enceladus”

Bill Farrand (not in attendance)

- NH43A-1853: “Mineralogical Composition and Potential Dust Source of Playas in the Western U.S. and Australia as Remotely Identified through Imaging Spectroscopy” Authors: L. W. Raming, W.H. Farrand, and B. B. Bowen.

Also in attendance, Dr. Gorden Videen and Carl Wuth.

Congratulations to SSI PIs on the following New Awards:

NSF/OSU Subaward, “Stellar Rotation and the Chronology of the Galaxy” to Dr. Savita Mathur

STScI award, “HST/COS FUV Spectrophotometry of the Key Binary Solar Twins 16 Cyg A&B: Astrophysical Laboratories for the Future Sun and Older Solar Analogs” to Dr. Travis Metcalfe

NASA award, “Analyzing the Web of Correlations and Time Lags Between the Solar Wind and the Inner Magnetosphere: Systems Science with CCA” to Dr. Joe Borovsky

IMLS/COS award, “A Guide for State Library Agencies - Enabling public libraries to become STEM community learning centers” to Dr. Paul Dusenbery

University of Michigan/NSF Subaward, “Collaborative Research: Inner-Magnetospheric Array for Geospace Science: iMAGS” to Dr. Thanasis Boudouridis

NASA award, “Development of a Stellar Model-Fitting Pipeline for Asteroseismic Data from the TESS Mission” to Dr. Travis Metcalfe

STScI award, “Improving the UV Continuous Opacities and Model Spectra for Cool Stars” to Dr. Julianne Moses

JPL award, “Spectral Characterization of Planetary Surface Materials” to Dr. Karly Pitman

NASA award, “Atmospheric Chemistry and Aerosol Formation on Exoplanets” to Dr. Julianne Moses

Smithsonian Astrophysical Observatory, “The Rotation/Activity Relation of M Dwarfs” to Dr. Dawn Peterson from the Chandra General Observer Program.

UPCOMING SSI MEETINGS:

- ❖ **The next SSI Board of Directors Meeting will be held on-site on February 19, 2016.**
- ❖ **SSI will be presenting and exhibiting at the 47th Lunar and Planetary Conference in Woodlands, Texas the week of March 21st – 25th, 2016.**
- ❖ **SSI will be exhibiting at the 32nd annual Space Symposium in Colorado Springs, CO, April 11th – 14th, 2016.**
- ❖ **SSI will also be exhibiting at the 2016 GSA annual meeting in Denver, CO, September 25th – 28th, 2016.**
- ❖ **SSI’s own NCIL will also be exhibiting at the Association of Science-Technology Centers (ASTC) Conference in Tampa, Florida, September 24th – 27th, 2016.**

Do you have something you’d like to see in the next SSI Newsletter?

If so, please contact Barbi or Courtney with your details!

bshepley@spacescience.org or cstanton@spacescience.org
