SSI NEWS
A Bi-Monthly Company Newsletter
March 20, 2015 Volume 8, Number 9

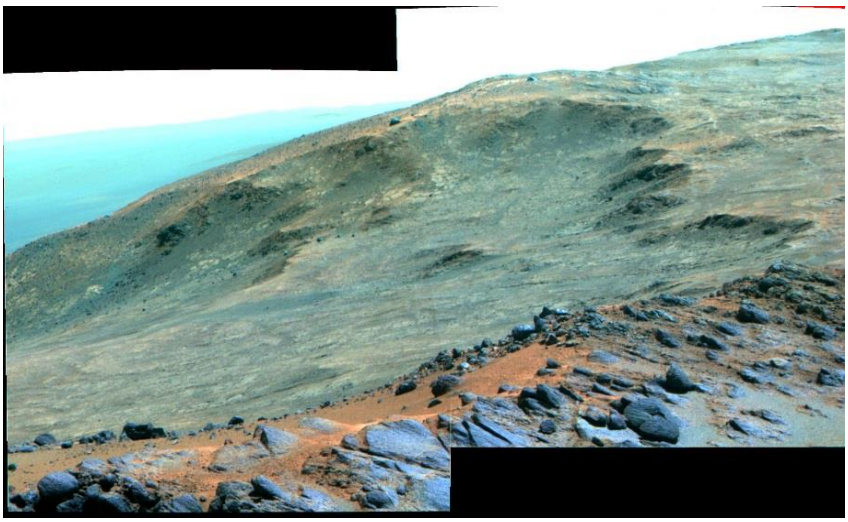
"Expanding the frontiers of knowledge & understanding"

In this issue:

I. Research

"Marathon Valley" ~ Mars

(Submitted by Dr. Bill Farrand, Boulder, CO)



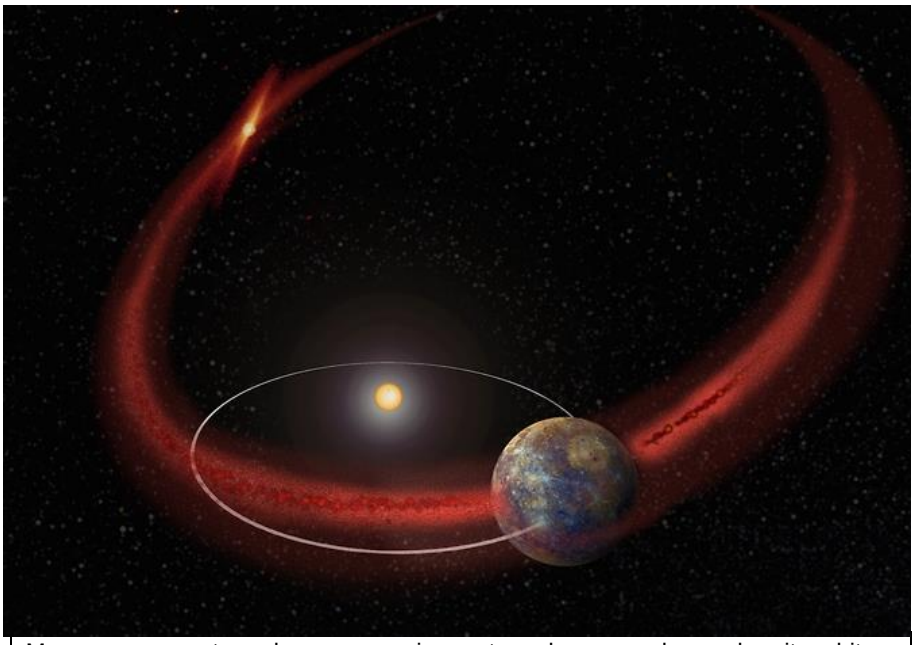
NASA's Mars Exploration Rover, Opportunity acquired this two frame false color mosaic from the rim of Endeavour Crater looking into the feature dubbed, "Marathon Valley" by the science team. Orbital hyperspectral data has indicated that Marathon Valley hosts exposures of clay minerals that were formed in the presence of abundant water. The exploration of Marathon Valley represents an exciting new stage of Opportunity's mission, now in its 11th year.
Credit: NASA/JPL-Caltech

Impact Vaporization as a Possible Source of Mercury's Calcium Exosphere

(Submitted by Dr. Joseph Hahn, Austin, Texas Office)

Mercury's calcium exosphere varies in a periodic way with that planet's true anomaly. We show that this pattern can be explained by impact vaporization from interplanetary dust with variations being due to Mercury's radial and vertical excursions through an interplanetary

dust disk having an inclination within 5 degrees of the plane of Mercury's orbit. Both a highly inclined dust disk and a two-disk model (where the two disks have a mutual inclination) fail to reproduce the observed variation in calcium exospheric abundance with Mercury true anomaly angle.



Mercury appears to undergo a recurring meteor shower, perhaps when its orbit crosses the debris trail left by comet Encke. (Artist's concept.)
Image Credit: NASA's Goddard Space Flight Center
http://www.nasa.gov/press/goddard/2014/december/messenger-data-suggest-recurring-meteor-shower-on-mercury/

However, an additional source of impacting dust beyond the nominal dust disk is required near Mercury's true anomaly (v) 25° ± 5°. This is close to, but not coincident with, Mercury's true anomaly (v = 45°) when it crosses Comet 2P/Encke's present day orbital plane. Interestingly, the Taurid meteor storms at Earth, which are also due to Comet Encke, are observed to occur when Earth's true anomaly is ±20 or so degrees before and after the position where Earth and Encke orbital planes cross. The lack of exact correspondence with the present day orbit of Encke may indicate the width of the potential stream along Mercury's orbit or a previous cometary orbit. The extreme energy of the escaping calcium, estimated to have a temperature >50,000 K if the source is thermal, cannot be due to the impact process itself but must be imparted by an additional mechanism such as dissociation of a calcium-bearing molecule or ionization followed by recombination.

Highlights

- We show that Mercury's calcium exosphere, which is observed to vary seasonally about that planet's orbit, can be attributed to impact vaporization by interplanetary dust.
- A comparison of models to MESSENGER mission observations shows that the seasonal variations in that calcium (Ca) signal result from the planet's sizable orbital eccentricity and inclination which cause that planet to experience significant radial and vertical excursions through the interplanetary dust cloud.
- The model developed here also requires an additional source localized at 25 ± 5° degrees after Mercury's perihelion, and that may be due to a meteor stream possibly associated with the nearby Comet Encke.
- Impact vaporization can explain the source rate and true anomaly angle variations in the calcium exosphere but an additional mechanism must be invoked to explain the extreme temperature.

See Related Links:
http://www.nasa.gov/press/goddard/2014/december/messenger-data-suggest-recurring-meteor-shower-on-mercury/
http://www.sciencedirect.com/science/article/pii/S0019103514006745

Bringing Systems Science into Magnetospheric Research

(Submitted by Dr. Joe Borovsky, Los Alamos, NM)

SSI is working to introduce systems science and its techniques into magnetospheric research via the NSF GEM (Geospace Environment Modeling) Program. The magnetosphere-ionosphere system (geospace) is complex and highly coupled. The expansive and uncontrolled nature of geospace presents formidable challenges to understanding this coupling. Many physical processes act simultaneously across vast interconnected regions of geospace and diverse experts are needed to study its aspects. These are classic characteristics of a system ripe for systems science.

The National Research Council Decadal Survey for Solar and Space Physics [2013] recommends: "the committee emphasizes the necessity of adopting a systems approach to achieve appropriately balanced progress in understanding an interconnected solar-heliospheric-terrestrial and planetary system." The Survey is explicit in pointing out that the "coupled magnetosphere-ionosphere … system exhibits characteristic non-linear, chaotic dynamics, or 'emergent' behavior that could never have been predicted without knowledge of the coupling physics."

Joe Borovsky, with inputs from other members of the SSI Center for Space Plasma Physics (Joachim Birn, Thanasis Boudouridis, and Mick Denton), led a proposal team to establish a 5-year focus group called "Geospace Systems Science" in the NSF GEM program. That proposal was accepted: systems science sessions began in 2014 at the NSF GEM Workshop and NSF money will be directed to support work on this topic.

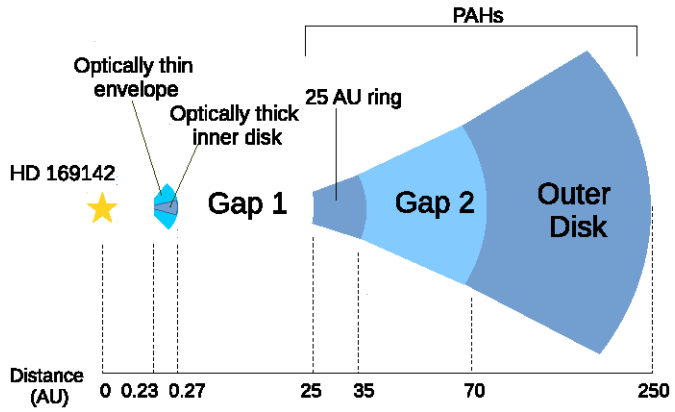
We define "systems science" as follows: (1) system-level (global) thinking that engages a broad range of expertise to reveal the underlying system interactions controlling observed phenomena, and (2) the investigation of collective system behaviors often via the application of techniques developed for analyzing dynamical complex systems. The first goal of the Geospace Systems Science focus group is to advance knowledge of the system interactions underlying geospace phenomena by coordinating research on key systems-level questions. A second goal of the Geospace Systems Science focus group is to evaluate and incorporate systems-science methodologies into GEM. A third goal of the focus group is the development of data-analysis tools that will enable accurate characterization of multiscale processes and transient events in observations and in numerical simulations.

Along with SSI, the coordinators of the GSS focus group are from Dartmouth College, Catholic University, and University of Chile.

Determining the Structure & Variations of the Gapped Planet-Building Disk around the Young Star HD 169142

(Submitted by Dr. Mike Sitko, Cincinnati, Ohio Office)

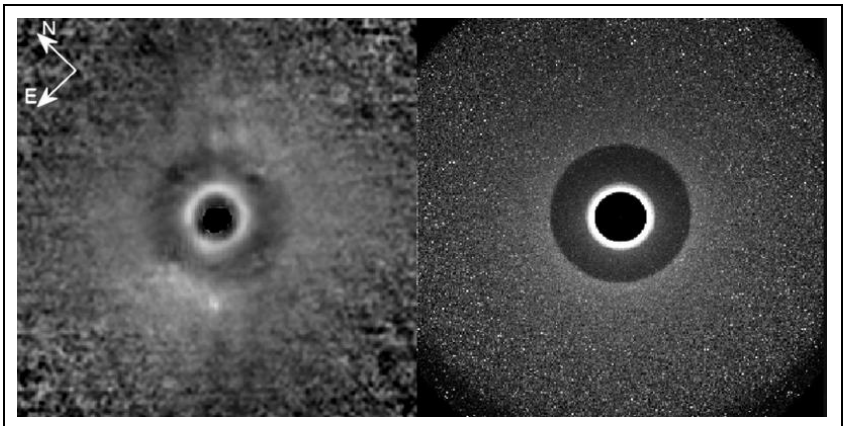
Two years ago, Kevin Wagner, an undergraduate student at the University of Cincinnati, began his research career in astrophysics working with SSI scientist Mike Sitko by studying the properties of young stars surrounded by planet-building disks of gas and dust. Most stars in the sky are now thought to have planets, and as the planets form they sweep up material from the disk they are forming from, opening up one or more gaps in the disk. These



Schematic side view of the structure of the disk of HD 169142. The disk includes two gaps – an inner one nearly devoid of material, and an outer one with a drop in density from its surroundings, and partially shadowed by the middle ring of material. Credit: The Astrophysical Journal

"gapped" disks are prime targets for studying the way that young planets, and the disks they form from, interact.

Kevin spent the past 2 years investigating the structure of the disks in young stars with evidence of such gaps, in particular the star HD 169142, about 470 light- years from the Earth, in the constellation of Sagittarius. His work on this star began in July 2013 when, with Sitko and his colleague Ray Russell (The Aerospace Corporation), he helped obtain near-infrared spectra of the star using NASA's Infrared Telescope Facility on the summit of Mauna Kea, Hawaii. After carefully calibrating the spectra, he combined them with data obtained by a vast array of astronomical facilities, such as the *Hubble* and *Spitzer Space Telescopes*, the *Infrared Space Observatory*, and the *Wide-field Infrared Survey Explorer,* to construct the spectral energy distribution of the star+disk system, one of the key input parameters needed to determine the structure of the disk. The other set of input data were high spatial resolution images of the disk. These were obtained by other investigators using state-of-the-art instruments that combined coronagraphs and adaptive optics to produce the most detailed images of the disks available, and were provided to Kevin for the modeling effort that was to follow.



Left: The polarized intensity image of the disk of HD 169142, obtained in the H-band with the VLT/NACO instrument by Quanz et al. (2013, ApJL, 766, L2). Right: Kevin's model of the H-band polarized flux. Both images have had their intensities scaled by the square of the angular distance from the center of the system. The spatial extent of the innermost ring of material is too small to be visible in these images. Credit: The Astrophysical Journal

The modeling made use of the Monte Carlo radiative transfer code developed by SSI scientist Barb Whitney. In these simulations, individual "photons" are followed as they leave the star and interact with the disk. With enough of these photons, both the spectrum and an image of the star+disk syatem can be gradually built up. For high-quality images, over a billion such calculations are required. The case of HD 169142 was chosen for this work because data obtained over the past decade showed that the structure of the disk had *changed* during that time. Kevin's work determined *how* the structure must have changed to explain this difference. Most of the changes seen were consistent with loss of disk material in the innermost ring, between ~0.025 and ~0.030 AU from the central star.

Whether these changes are due to the gravitational influence of the planets that are likely present is not yet known. But such dynamical effects are likely present in all young planetary systems, and that includes our own when it was only a few million years old.

The results of Kevin's work appeared in the January 10, 2015, issue of The Astrophysical Journal, with Kevin, an undergraduate student (supported in part by an SSI grant in the summer of 2014), as lead author. ***Image Credits:*** *Quanz et al. 2013, The Astrophysical Journal Letters, 766, L2. Link:* http://iopscience.iop.org/0004-637X/798/2/94/article

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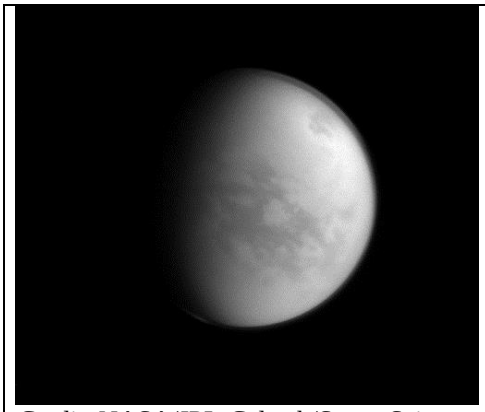
II. Cassini ISS Operations

(The Latest View from the Cassini Imaging Science Subsystem (ISS) Instrument)

Named after a Japanese paradise, the Senkyo region of Saturn's largest moon, Titan (the dark area below and to the right of center) is a bit less welcoming than its namesake.



Credit: NASA/JPL-Caltech/Space Science Institute
Released: March 9, 2015 (PIA 18307)

With a very inhospitable average temperature of approximately 290 degrees below zero Fahrenheit (-180 degrees Celsius), water on Titan (3200 miles or 5150 kilometers across) freezes hard enough to be essentially considered rock. Even if you enjoy cold temperatures, Titan's dense nitrogen-rich atmosphere contains no oxygen.

This view looks toward the Saturn-facing side of Titan. North on Titan is up and rotated 33 degrees to the right. The image was taken with the Cassini spacecraft narrow-angle camera on January 8, 2015 using a spectral filter which preferentially admits wavelengths of near-infrared/ultraviolet light centered at 938 nanometers.

The view was acquired at a distance of approximately 1.2 million miles (1.9 million kilometers) from Titan. Image scale is 7 miles (11 kilometers) per pixel.
Source: http://www.ciclops.org/view/7984/Frozen-Paradise

Cassini Imaging Leader Looks to UC Berkeley and California Academy of Sciences for Mind-Expanding Inspiration

Dr. Carolyn Porco, Director of Flight Operations, and leader of the imaging team on NASA's Cassini mission at Saturn, has accepted dual invitations to be a Fellow of the California Academy of Sciences in Golden Gate Park, San Francisco, and a Distinguished Scholar within the Department of Astronomy at the University of California at Berkeley. These are visiting appointments and she will continue in her paid role working for SSI on her projects throughout the year.

"I am so looking forward to this opportunity to work alongside my colleagues at Berkeley and the Academy", said Porco. "I'm anticipating a great, mind-expanding rush to come from placing what we have found on Enceladus in the broader context of life within our solar system and beyond, and finding new ways to bring these connections to the public."

Porco is known for her work on the Voyager and Cassini missions to the outer solar system and her award-winning efforts to engage the public in appreciation for the scientific enterprise.
For full article click link: http://www.ciclops.org/news/special_news_2015Mar12.php?js=1

III. National Center for Interactive Learning (NCIL)

(Submitted by Anne Holland, Boulder, CO Office)

Phase 2 of STAR_NET Program Underway…

- Refurbishment has begun on the *Discover Earth: Our Changing Planet* exhibit and the *Discover Tech: Engineers Make a World of Change exhibit*. These will arrive in Denver for refurbishment at the end of April 2015.

- 4 New Exhibits to launch - *Discover Space* and 3 *Explore* exhibits. The *Explore* exhibits are mini versions of the 3 large exhibition programs under STAR_NET.

- Project partner ALA has begun soliciting applications for the programs.

Soliciting Survey Responses

NCIL is currently soliciting survey responses from both librarians and STEM professionals for use of front-end evaluation of the program. Your responses to the STEM survey would be greatly appreciated! This survey seeks to determine how Communities of Practice differ in the library and STEM communities. The survey will take approximately 7 to 10 minutes and can be accessed here: https://cuboulder.qualtrics.com/SE/?SID=SV_a3RoGibMjnWD9Ax

NCIL Exhibition Schedule

Large *Great Balls of Fire* exhibit

Spring 2015	National Corvette Museum	Bowling Green, KY
Summer 2015	OPEN	

***Discover Tech* Library exhibition**

Spring 2015	Central Rappahannock Public Library	Fredericksburg, VA
Summer 2015	TBD	

VIII. New Employees

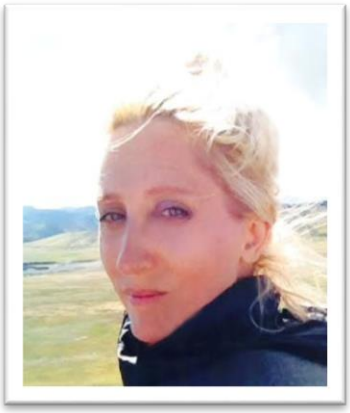
Dr. Karly M. Pitman, Executive Director/Senior Research Scientist (February 2015)

Karly is an astrophysicist/planetary scientist whose areas of expertise include computational radiative transfer modeling, remote sensing and hyperspectral analysis, and spectroscopy and refractive index determination at ultraviolet to far-infrared wavelengths. She specializes in interpreting surface and atmospheric spectral signatures for Mars, outer Solar System moons, and asteroids and in performing laboratory astrophysics experiments to infer the makeup of interstellar dust in support of NASA and NSF. She holds a Ph.D. in Physics from Louisiana State University and an A.B. in Astronomy and Geology from Vassar College in New York. Previously she worked at Planetary Science Institute, Washington University – St. Louis in the Department of Earth & Planetary Sciences, as a NASA Postdoctoral Program fellow and affiliate contractor at the Jet Propulsion Laboratory, California Institute of Technology, and as a graduate research assistant at SSI where her career began. Karly serves on various committees for the American Astronomical Society, the American Geophysical Union, and the American Physical Society, with a focus on professional development, demographics, and the science, technology, engineering, and mathematics (STEM) employment pipeline, and is a scientific consultant for children's books and K-24 STEM curriculum materials. For more about Karly's interests, hobbies, and backstory, check out her profile on the NASA Solar System Exploration website http://solarsystem.nasa.gov/people/profile.cfm?Code=PitmanK1

Myron McCallum, Senior IT Administrator – Cassini ISS Group (October 2014)

Myron is the Senior IT Administrator for the Cassini ISS group. He has worked with computers since he was 14, when his high school physics teacher had a 300 baud dial up connection to the local university along with providing on-campus programming experience using card-punch and paper-tape storage systems. (The "original" dangling chads that caused huge amounts of frustration). He's been a manager of computer systems in support of aerosol, aerospace and geophysics related research groups for most of his career, while squeezing in some start-up business support and consulting ranging from a private space exploration company to medical software database and dental-imaging companies.
Hobbies include coaching youth hockey, playing adult hockey, Nordic-skiing, biking, hiking and trail running... while getting the last of 3 kids out of high school and off to college this year.

Rita Hurst-Thomas, NCIL-Education Project Coordinator (November 2014)



My name is Rita. I am a self-appointed planet spokesperson. Earth and space literacy are my mission. Last year I moved to Colorado from a rural town in Nebraska. While there I held a position at the University of Nebraska in Lincoln for the Science Management Office of a climate research organization--doing work in the United States Antarctic Program.
In my new role at SSI, I hope to be an advocate for STEM learning in communities both large and small. The icing on the cake for me is having the opportunity to work with a group of extremely talented people. When I have free time I enjoy: kicking back at home, exploring with my partner, Brian and my dog Einstein, hiking, xx country skiing, sky watching, cooking stuff, painting, photos, blogging, Yerdling (not to be confused with yodeling), and I am currently growing heirloom beans in a jar.

Richard (Rick) J. DelaCastro, Ph.D., HR Consultant (February 2015)
Mountain States Employers Council

Rick has over twenty years' experience as human resources professional. Working in both the private and public sectors, Rick has focused his efforts on helping organizations maximize their human capital. He has an extensive background in human resource change management, organizational development, management development, staffing, human resources planning, and labor relations. He has served in corporate management and external consulting roles, where he focuses on common sense solutions from a strong technical background.

Debby Leite, Administrative Assistant (February 2015)

Debby was born in Hamburg, Germany and lived there until the age of 10 years, when her family immigrated to San Diego, CA. Over the years, she has traveled worldwide with her family to fun and exotic places such as India, Thailand, Philippines, Egypt, Kenya, Switzerland, Austria, Mexico, Japan and lived in Hawaii for 2 years. She speaks German and a little bit of Spanish. Debby graduated with a Dual Bachelor's degree in Business Management & Psychology from National University of San Diego. She moved from San Diego, CA almost 5 years ago and considers Boulder her home. She has over 25 years experience working for an International Fortune 500 Company, the Ken Blanchard Company (Author of "Who Moved My Cheese" & "One Minute Manager") and recently ran her own company. She has served on the Board of Directors for both the Boulder Climbing Community (BCC) and Harmonious Earth Community Foundation (HECF) in Belen, NM and volunteered for Boulder International Film Festival (BIFF). She brings an entrepreneurial spirit and strong background in organizational management, Human Resources, Accounting and Administrative experience supporting Executive Leadership teams of both national and international business organizations.

She stays active and in tune with nature through hiking (with her dog, Cairo), biking, rock climbing, camping, going to the gym, yoga, and gardening. She enjoys trying out new restaurants, her favorites are Sushi and Mexican food. She has one daughter, Anastasia (11), who loves to dance and sign, so music and movement is a huge part of both of their lives.

Appreciation…

SSI would like to thank Mark Eggleston for his service as a Board member and also as SSI's Treasurer on the Board of Directors. Mark served on the Board from February 2012 until March 2015, lending his financial expertise to SSI's continued development and success. He was involved in the creation of the SSI Audit Committee and helped with the successful recruitment of SSI's new Executive Director. We would like to wish Mark all the best!

Mark Eggleston
Treasurer, Board of Directors
Board Service: February, 2012 through March, 2015

SSI would like to wish our outgoing Development officer, Carol Nickell, all the best and Good Luck in her future endeavors.

In closing, we want to thank the whole SSI community for their help and efforts in 2014-2015, especially Paul and Mike for their guidance of the company from its beginning through the past year. We're looking forward to a continued bright future.

Future Submissions: Please send submissions for the next newsletter to Debby Leite at: **dleite@SpaceScience.org**