CARL SAGAN CENTER

Annual Report 2016

Dr. Nathalie A. Cabrol, Director

Carl Sagan Center Annual Report

2016

Publications, Education & Public Outreach

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and the
SETI Institute Scientists and Educators

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CARL SAGAN CENTER

FOR THE STUDY OF LIFE IN THE UNIVERSE

ANNUAL REPORT OF PUBLICATIONS AND EDUCATION & PUBLIC OUTREACH ACTIVITY

A YEAR IN REVIEW…

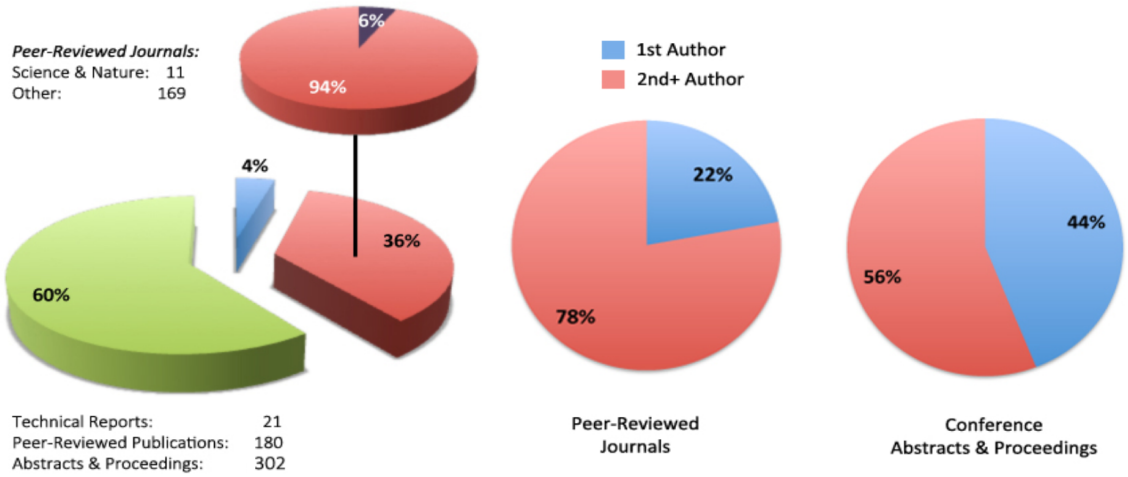
This has been my first full calendar year as head of the Carl Sagan Center. In that timeframe, I have come to know all of you better, and I have to say that I am in complete awe. What you are accomplishing every day is simply extraordinary, especially in the currently difficult budgetary landscape.

*Whether in the lab, from space- or ground-based observations, in terrestrial extreme environments, in the classroom with children and students, or as part of space and planetary missions, if it is about **searching for life beyond Earth and sharing a passion for knowledge**, you are involved front and center. Through your work, you are making the SETI Institute a highly respected, world leading research institution.*

The compilation of scientific publications and activities in Education & Public Outreach that follows is just one expression of your dedication, but it is also a statement – your statement of excellence. As I gathered this information to assemble the report, I could only marvel at the seemingly endless list because, as a scientist, I know exactly what it takes to achieve all that you do. That speaks volumes about who you are, and where your passion resides. For that, you have all my respect and support.

In 2016 alone, your body of work represents over 500 publications, including peer-reviewed articles, abstracts and proceedings of conferences, and technical reports. One could say that this is what scientists do, that this is part of our job. Yet those numbers are staggering…and you don't stop there! The record of your involvement in education and public outreach is almost as extensive! You ought to be proud of what you are achieving. I know I am, and I am striving every day to find solutions that will make accomplishing all of these things easier for you.

Indeed, change is happening at the Carl Sagan Center, some of it already visible, some of it will require more time, but the wheels have been set in motion with one goal in mind: to provide you with more support and more funding opportunities. Here are a few examples of what is already available:



***The James J. Kay Bequest**, which provides a directed, internal source of funds accessible to those working on asteroids and comets. Proposals may be submitted to me at any time, and they are being evaluated by the Science Council. So far, the Science Council has approved funds to support the preparation of a proposal, travel to a conference, and a small project to develop instrumentation that will help us better understand Earth-crossing comets and primitive asteroids. I am planning to release an official call for internal proposals sometime during the second quarter of 2017.*

***Sponsors**. The hard work of the SETI Research Group is already paying off. Through tireless effort, the SETI RG wrote a number of proposals this year and one of them grabbed the attention of Franklin Antonio who is now generously supporting the development of new feeds for the ATA!*

***The Science Council**. With Chairs, Co-Chairs, and Advisers, the Science Council represents the scientists of the six Research Groups (RG) at the SETI Institute. Until now, your interaction with your RG representatives has been mostly through the monthly activity reports. You see the results here today, with this extensive collection of publications and work that represents our collective memory for the past year. However, the Science Council is a lot more. In the coming months, your representatives will take on a key role in the organization of proposal strategy, common activities that will focus on your research centers of interest, and hopefully will lead to the development of science and technology proposals together. Your presence at the All Hands Meetings and group activities is, in that respect (and many others), essential for you to understand the bigger picture, and realize that you are not isolated, but part of a team of scientists, where the whole is greater than the sum of its parts. The Science Council and I are always available to answer your questions, and my door is always open.*

***Support for Grant Writing**. For the first time, the CSC PIs now benefit from internal funding to support their grant writing time, and for the 2017 proposal season, we will also provide quality control for proposals (e.g., editing, structure, relevance, internal review) before they are submitted.*

There is a lot more to be accomplished, but this is where we chose to start because grant writing and proposal strategy is how we make a living. This is our number one priority, and I hope the decision we are making now will bear fruit in the upcoming proposal season.

Beyond the programmatic direction and sources of funding provided by government agencies, it is clear that the SETI Institute is a mature research institution, and a leader in the field of the search for life in the Universe. This is why, with the support of the Senior Management Staff, the Board of Trustees, and the Science Advisory Board, we are actively pursuing and developing ties with companies in Silicon Valley and beyond to allow you, the CSC scientists, in a not too distant future, to design, develop, and implement your own projects and missions.

This is the road ahead. Meanwhile, I am looking forward to sharing more exploration and discoveries in 2017. This year promises to be, once again, rich in scientific and outreach events where the SETI Institute scientists and educators will take center stage, including: The Great American Eclipse with the Girl Scouts Project, a new year of NASA Frontier Development Lab at the Institute, the Research Experience for Undergraduates program, the continuing down-selection of candidate landing-sites for Mars 2020, increased activities of the Biosignature Detection Working Group led by our NAI team, and sadly too, the end of the Cassini mission. These are only a few examples. There will be a lot more going on, and you will not only be part of the exploration, you will lead it!

In closing, I would like to express my deepest gratitude to all of those who, with endless dedication, support the SETI Institute scientists and educators in all capacities, and facilitate their work day in and day out:

The Center for Communication, Development, Finances and Accounting, the Grants Office and Contracts, Human Resources, and IT and Facilities.

I wish you all a successful year 2017!

Nathalie A. Cabrol

February 14, 2017

From the SETI Institute President & CEO

Dear colleagues,

It is with great pride that I received the first "Annual Report of the SETI Institute" representing the collective output of our science, education and outreach centers. The productivity is immensely impressive, with nearly 200 articles appearing in peer-reviewed journals, and over 300 abstracts of conferences representing original research. We are published in "Nature" and "Science" as well as in the "Astronomical Journal," "Astrobiology," "Applied Physics," "Journal of Chemical Physics," "Icarus," "Proceedings of the Royal Society," "Aeolian Research," and many more!

Part of our mission as a research organization is to share our work with the public through published articles, abstracts of conferences, speaking engagements, and even mainstream media. Part of my own personal mission is to tell the story of the SETI Institute to the outside world, and to give the public a comprehensive understanding of who we are and what we do. When we set out to start compiling monthly reports from the Carl Sagan Center one year ago, I was not expecting an eleven-page document, just to cover February! I was completely amazed at our output, and could well imagine that many of you are also unaware of just how prolific and productive you and your colleagues are across the multidisciplinary sciences of the SETI Institute!

Not only is this compilation impressive, but it is also important. It is important to let the world, and our followers and donors know what we are up to, and to let our colleagues at NASA know just how productive we are. The "product" of the SETI Institute that is represented in these pages is a compelling record of achievement. In addition to recognizing your hard work, I also want to thank Nathalie in particular for her tireless efforts to collect your publication information and assemble this report. I also thank those of you who have been regularly submitting your publications and abstracts to Nathalie and the Science Council Chairs. And for those who have not, I hope that the record of your colleague's achievements captured here, will compel you to participate this year!

I have no doubt that our output in 2017 will be just as amazing, just as impressive, and just as important to share with the world.

Many thanks!

Bill Diamond

February 14, 2017

1.

Peer-Reviewed Publications

1. Abdul-Masih, M., Prsa, A., Conroy, K., Bloemen, S., Boyajian, T., **Doyle, L. R.**, et al. (2016). Kepler Eclipsing Binary Stars. VIII. Identification of False Positive Eclipsing Binaries and Re-extraction of New Light Curves. *Astron. J.* https://arxiv.org/abs/1602.05932

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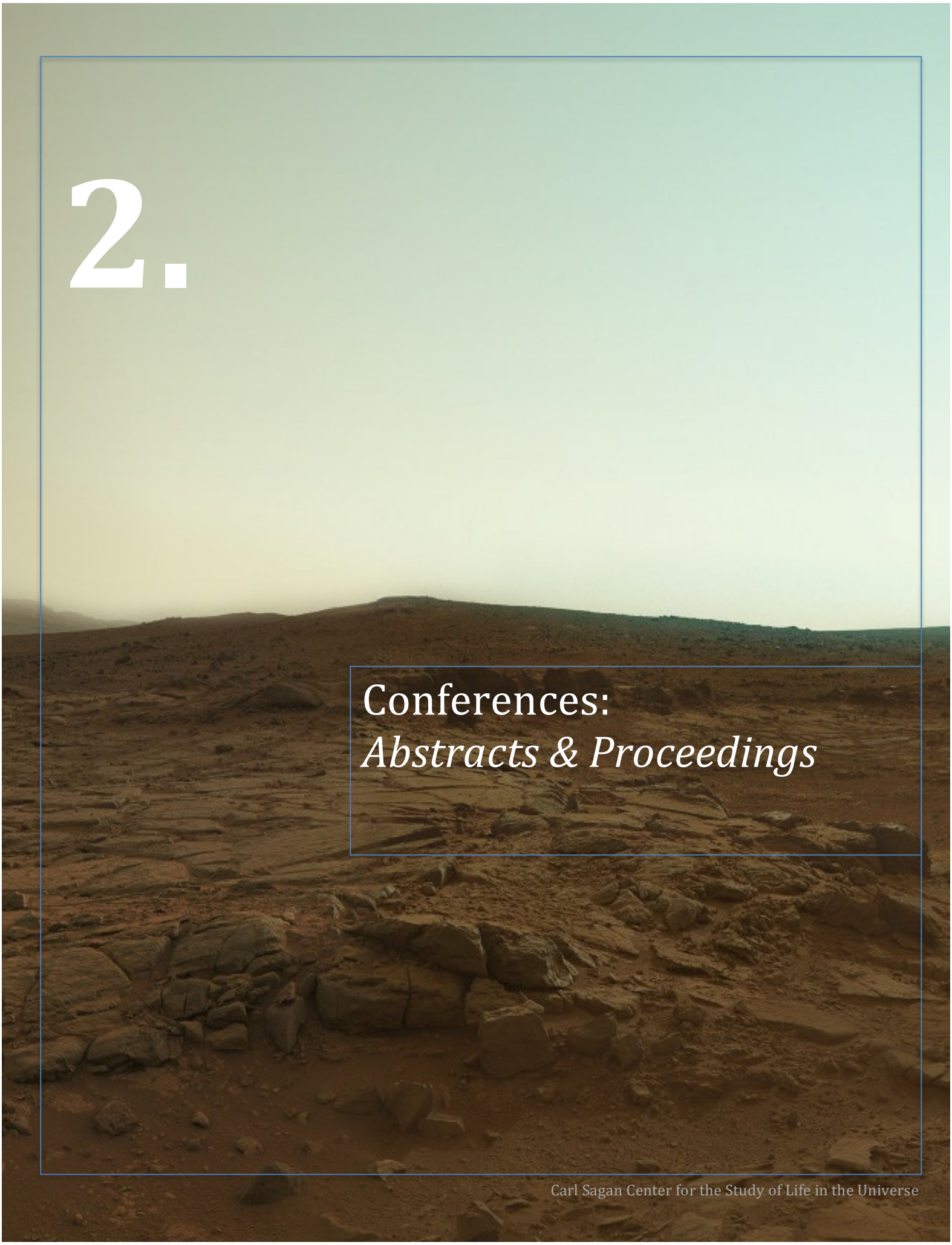

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497. Slavney, S., Joyner, R., **Gordon, M. K.**, and Simpson, R., Eds. (2016). *Planetary Data System Standards Reference, Version 1.7.0*. September, 2016.

498. **Tarter, J.** Report from Subcommittee B – New Approaches to SETI (August 19-20, 2016 workshop) submitted to the Breakthrough Foundation, for the Breakthrough Listen Initiative, Oct 5.

499. **TESS:** The TESS Science Processing Operation Center successfully completed Verification & Validation (V&V) of the science algorithm software for the front end of the science pipeline for the software version 2 release. This includes calibration of raw pixel data (CAL), generation of photometric light curves (PA) and conditioning of the light curves for preparation for the planet search (PDC). Work continues completing the data handling infrastructure for the front end in preparation for the imminent TESS-mission-wide Ground Segment Integration Test 2 (GSIT 2) which should occur very soon. In parallel to the GSIT preparation work, the SETI Data Scientists are moving forward beginning development work for the pipeline back-end, which includes the Transiting Planet Search (TPS), Data Validation (DV) and Photometer Performance Assessment (PPA). We are on schedule to finish development of the pipeline back-end algorithms by the end of summer 2017.

500. **Thompson, S. E., D. A. Caldwell**, eds. (2016). *Kepler Data Release 25 Notes Q0–Q17*, Technical Report KSCI-19065-002 [Final Kepler data release], NASA Ames Research Center Kepler Mission, Aug 2016.

501. **Thompson, S. E.,** D. Fraquelli, J. E. van Cleve, and **D. A. Caldwell** (2016). *Kepler Archive Manual, Technical Report KDMC-10008-006*, NASA Ames Research Center Kepler Mission, May 2016.

502. Van Cleve, J. E. & **D. A. Caldwell**, (2016). *Kepler Instrument Handbook, Technical Report KSCI-19033-002*, NASA Ames Research Center Kepler Mission, April 2016.

503. Van Cleve, J. E., J. L. Christiansen, J. M. Jenkins, **D. A. Caldwell,** T. Barclay**, S. T. Bryson, C. J. Burke, J. Campbell, J. Catanzarite, B. D. Clarke, J. L. Coughlin,** F. Girouard, M. R. Haas, T. C. Klaus, J. J. Kolodziejczak, J. Li, S. D. McCauliff, **R. L. Morris, F. Mullally**, E. V. Quintana, J. Rowe, A. Sabale, S. Seader, **J. C. Smith,** M. D. Still, **P. G. Tenenbaum**, **S. E. Thompson, J. D. Twicken**, A. K. Uddin, and K. Zamudio, (2016). *Kepler Data Characteristics Handbook*, Technical Report KSCI - 19040 - 005, NASA Ames Research Center, Dec 2016

4.

Popular Publications, Interviews, Education & Outreach

504. **Backman, D.** SOFIA presentation to NASA Ames college interns, Moffett Field, CA, Nov. 4, 2016.

505. **Backman, D.** Participation in NASA panel for 50 high school science students from Idaho visiting NASA Ames, Moffett Field, July 26, 2016.

506. **Backman, D.** *NASA SOFIA and IR Astronomy*, Infrared astronomy inquiry based presentations to 6 groups of middle school children, teachers, and parents (total about 100) visiting the AAS Exhibit Hall, San Diego, CA, June 14, 2016.

507. **Backman, D.** *NASA's SOFIA and IR Astronomy*, California Associated for the Gifted (CAG) education conference, invited plenary SOFIA talk to 138 teachers, Palm Springs, Feb. 28, 2016.

508. **Backman, D.** SOFIA Mission presentation at Sunrise Middle School, 70 students, 2 teachers, San Jose, CA, Jan. 22, 2016.

509. **Beyer, R.** Participated in DPS New Horizons Press, Oct. 2016, including: http://aasnova.org/2016/10/19/48th-dps11th-epsc-meeting-day-2/ http://www.space.com/34443-landslides-on-pluto-moon-charon.html http://www.natureworldnews.com/articles/30447/20161021/scientists-discover-landslides-pluto-s-moon-charon.htm http://www.universetoday.com/131492/latest-results-new-horizons-clouds-pluto-landslides-charon/

510. **Beyer, R.** Worked with Astronomy magazine to help them create the first-ever Pluto globe.

511. **Bishop, J.** Contributed to *Microbes living on Mars*. The article was published on Jan. 30, 2017. http://www.seeker.com/mars-microbes-rocks-biology-life-astrobiology-iron-sunscreen-2225424742.html

512. **Bonaccorsi, R.** (Media Interview). High Road Documentary (TATA Motors sponsored).

513. **Bonaccorsi, R.** (Media Interview). Rajya Sabha Television (India Govt. TV channel). Science monitor 08-14-16 news.

514. **Bonaccorsi, R.** (TV). aired on RAI GULP (Kid's network) on December 18, 2016, special on Mars.

515. **Busch, M.** Overview of asteroid radar astronomy for the NASA Frontier Development Lab (Web Story), July 2016.

516. **Busch, M.** Lectures for Margaret Race's class at the Osher Lifelong Learning Institute (OLLI), Santa Clara University, April 14 and 21, 2016.

517. **Busch, M.** Public outreach session and star party, Pasadena, during the DPS and EPSC.

518. **Cabrol, N. A.** *Searching for life on Mars through a new lens --- Ancient life organized around oases"*, http://www.dailygalaxy.com/my_weblog/2016/12/the-search-for-life-on-mars-needs-a-new-approach-ancient-life-organized-around-oasis.html#more

519. **Cabrol, N. A.** Interview by "La Recherche" for the introduction to their special issue on SETI and Astrobiology (November 2016).

520. **Cabrol, N. A.** Interview by Mark Kauffman. *SETI reconceived and broadened: A call for community proposal*. http://www.manyworlds.space/index.php/2016/11/21/seti-reconceived-and-broadened/

521. **Cabrol, N. A.** Helen Macdonald participate in the field expedition to the Andes for 3 weeks to write a story about Cabrol for the New York Times (to be published in the first quarter of 2017).

522. **Cabrol, N. A.** Interview with *La Recherche* magazine (France) about the Search for Extraterrestrial Intelligence, Aug. 31, 2016.

523. **Cabrol, N. A**. Phone interview with a Canadian radio about the article *Alien Mindscapes* published in Astrobiology, Aug. 23, 2016.

524. **Cabrol, N**. A. Interview by Joseph Brean, *National Post*, about the article *Alien Mindscapes*, Aug. 12, 2016.

525. **Cabrol, N. A.**: Abundant coverage (PR and interviews from July to December) of the *Astrobiology* article *Alien Mindscapes*. On the high-impact list since publication on Open Access.

526. **Cabrol, N.** A. Interview with Mark Kauffman about the article published by Astrobiology: *Alien Mindscapes.*

527. **Cabrol, N. A.** Interview with Irish radio about the article published by Astrobiology: *Alien Mindscapes* and SETI.

528. **Cabrol, N. A**. *SETI calls for new tools in the search for extraterrestrial intelligence*, https://phys.org/news/2016-07-seti-tools-extraterrestrial-intelligence.html

529. **Cabrol, N. A.:** From Viking to Mars 2020 – Searching for Habitability and Life on Mars (40th anniversary of Viking landing on Mars, Web Story).

530. **Cabrol, N. A.** Pre-field season, phone interview with Helen Macdonald, writer, New York Times, May 4, 2016.

531. **Cabrol, N. A.** Interview, La Tercera, Chile, March 17, 2016.

532. **Cabrol, N. A.** Interview, CCTV, Los Angeles, March 2, 2016.

533. **Clark, C.** SOFIA exhibit at the Bay Area Science Festival, San Francisco, Nov. 5, 2016.

534. **Clark, C.** Presentation at NASA Ames fir 24 pre-service teachers, Moffett Field, July 28, 2016.

535. **Clark, C.** Presentation on space sciences & NGSS during the ASP's Summer Astronomy Institute, San Francisco. Jul. 25, 2016.

536. **Clark, C.** SOFIA presentation to 100 6-8 grade students from Palmdale Learning Plaza visiting NASA AFRC SOFIA Facility, Palmdale, CA, March 11, 2016.

537. **Clark, C.,** and **D. Backman**. SOFIA Exhibit at NASA Ames, *Take your Child to Work Day Street Fair*, ~300 visitors to booth, Moffett Field, April 28, 2016.

538. **Clark, C.** NASA Ames Space Science Jamboree, SOFIA Exhibit, over 500 attendance, Moffett Field, March 8, 2016. https://spacescience.arc.nasa.gov/media/SS%202016%20JAMBOREE%20BOOKLET_0.pdf

539. **Coughlin, J.** was interviewed and quoted for two *Popular Mechanics* articles:
    a) Earth-Like Planet Found Orbiting the Nearest Star to the Sun: http://www.popularmechanics.com/space/deep-space/news/a22522/nearest-planet-proxima-b/
    b) How Will We Travel to That Promising New Planet?: http://www.popularmechanics.com/space/deep-space/a22567/interstellar-travel-proxima-b/

540. **DeVore, E.** *Panel presentation regarding STEM Careers at Girl Scout Career Day,* Mountain View, Nov. 5, 2016.

541. **DeVore, E.,** and **P. Harman**. *When I Grow Up!* Girl Scout Day at NASA Ames, Hands-on activity for Girl Scouts, Nov. 5.

542. **DeVore, E.,** and **P. Harman**. Girl Scout Bridging Day-Ling Event, Crissy Field, San Francisco. Hands-on activities for Girl Scouts, April 30.

543. **DeVore, E.** A Legacy of Astronomical Discovery, *Astrobiology and Searching for ET,* Osher Life Long Learning (OLLI) Program, March 28, 2016. (Margaret Race as lead instructor.)

544. **DeVore, E.**, and **P. Harman**. *Girls Go to Mars* Workshop for Girl Scout Representatives, Alameda, Feb. 23-24, 2016. http://nautil.us/blog/dolphins-are-helping-us-hunt-for-aliens

545. **Doyle, L.** Invited article about animal communication and SETI, *Nautilus* magazine, April 17, 2016.

546. **Estrada, P.:** *Life in Outer Space*, a 2-episode documentary to be aired soon on Discovery USA, and featuring interviews with a number of SETI Institute scientists.

547. **Estrada, P.** Interviewed by Christopher Crockett of *Science News* about his DPS presentation on the new constraints on the age of Saturn's rings. The article appeared on Oct. 20, 2016, at: https://www.sciencenews.org/article/experts-dont-agree-age-saturn-rings?tgt=nr)

548. **Fenton, L.** mentored high school student Helen Carson on a project using the NASA Ames Mars Global Climate Model to simulate wind patterns in Meridiani Planum over the past ~200 ka, Oct. 2016.

549. **Gulick, V., and N. Glines.** Organized and hosted the yearly visit of 7th and 8th graders and their teacher Mr. Dennis Mitchell from Evergreen Middle School, Cottonwood, CA.

550. **Harp, G**. Interview and significant article, El Diario, http://www.eldiario.es/hojaderouter/ciencia/vida_inteligente-extraterrestres-ciencia-descubrimiento-protocolo_0_528797334.html, June 20, 2016.

551. **Jenniskens, P.** CAMS detection of P-R evolved cm-sized meteoroids (Web Stories, February 2016).

552. **Harman, P.** *NASA SOFIA and IR Astronomy*, Infrared astronomy inquiry based presentation during the AAS Student event, 113 attendance, San Diego, CA, June 14, 2016.

553. **Harman, P.** *NASA SOFIA and IR Astronomy*, SOFIA presentation to 35 5th graders and 2 teachers, Lafayette Elementary School, San Francisco, CA, April 29, 2016.

554. **Harman, P.** *NASA SOFIA and IR Astronomy*, inquiry based presentation during the AAS Student event, 118 attendance, Kissime, Florida, Jan 5, 2016.

555. **Lee, P.** Interview, CCTV, Los Angeles, March 2016.

556. **Lee, P.** *Passage to Mars*. Before humans make it to Mars, he must conquer the Arctic. Passage to Mars is the incredible true story of Pascal's team who embarks on a treacherous, 2,000-mile journey across the forbidding tundra of the Northwest Passage-an alien voyage on planet Earth designed to prepare NASA astronauts for an eventual mission to Mars. Sept. 30, 2016. The documentary was co-written by **P. Lee**. https://vimeo.com/133185152

    a. 31 May – 5 June 2016: Advance screening in Los Angeles.

    b. 30 Sept. 2016: Premiere in NYC, NY, and select theaters nationwide.

    c. 10 Dec 2016: Awarded *Best Non-Fiction Feature Film* at RAW Science Film Festival in Hollywood. Pascal present to accept the award on behalf of the film team.

    d. Jan 24, 2017: DVD Release.

    e. Jan 29, 2017: Nominated for Golden Reel Award for Best Sound Editing in Documentary Feature Film Category.

557. **Lee, P.** Talk, Bishop Elementary School, Sunnyvale, CA, Dec. 5., 2016.

558. **Lee, P.** National Geographic's MARS, Bookstore, Corte Madera, CA, Oct. 30, 2016.

559. **Lee, P.** Talk, Marymount School – Santa Barbara, Oct. 4, 2016.

560. **Lee, P.** Talk, Ocean Innovation Conference Youth Center – Iqaluit, Canada, Oct. 3, 2016.

561. **Lee, P.** (TV) NASA's Unexplained Files – Season 5 episode filming, Oct. 1, 2016.

562. **Lee, P.** (Interview) Voice of America Radio Interview, Sept. 6, 2016.

563. **Lee, P.** NASA Ames STEM talk, June 24, 2016.

564. **Lee, P.** Talk, Innovation Norway Students, Moffett Field, June 23, 2016.

565. **Lee, P.** Talk, REU Students Program, the SETI Institute, Mountain, CA, June 22, 2016.

566. **Lee, P.** Talk, Cupertino Middle School, Cupertino, CA, May 20, 2016.

567. **Lee, P.** NASA's Unexplained Files – Season 3 episode filming, May 17, 2016.

568. **Lee, P.** Talk, MESA- NASA Ames, N245, CA, May 16, 2016.

569. **Lee, P.** Talk, Bishop Elementary School, Sunnyvale, CA, May 13, 2016.

570. **Lee, P.** The Space Show Radio Interview, May 5, 2016.

571. **Lee, P.** Ames Child Care Center, Moffett Field, CA, April 20.

572. **Lee, P.** Academy Antics, talk, San Jose, CA, April 16, 2016.

573. **Lee, P.** Talk, Riverview Middle School, Bay Point, CA, March 10, 2016.

574. **Lee, P.** Talk, Monta Loma Elementary School, Mountain View, CA, March 4, 2016.

575. **Lee, P.** NASA's Unexplained Files – Season 4 episode filming, Feb. 21, 2016.

576. **Lee, P.** Talk, Princeton Elementary School, Delano, CA, Feb. 2, 2016.

577. **Lee, P.** CCTV Interview – Jan. 27, Aired/Released May 28, 2016.

578. **Lee, P.** IHMC STEM-Talk Interview, Jan. 22 – Aired/Released Aug. 17, 2016.

579. **Lee, P.** Stanford Hispanic Broadcasting radio interview, Jan. 19. 2016.

580. **Marchis, F.** (Interview): La Recherche, special issue on SETI and Astrobiology (November 2016).

581. **Marchis, F.** *Une Nouvelle Terre Proche de Nous?* La Recherche, 519, (L'Année de la Physique, p. 58).

582. **Marchis, F.** (Interview): *SETI is hopeful yet skeptical that Russians found aliens*, Venture Beat http://venturebeat.com/2016/08/30/seti-is-hopeful-yet-skeptical-that-we-found-aliens/

583. **Marchis, F.** (Interview): *Did SETI scientists discover aliens? Not so fast* - Daily Dot http://www.dailydot.com/parsec/astronomer-seti-signal/

584. **Marchis, F.** (Interview): *Non, SETI n'a pas encore détecté de signal E.T* - Ciel et Espace https://www.cieletespace.fr/actualites/non-seti-n-a-pas-encore-detecte-de-signal-e-t

585. **Marchis, F.** (Interview): *In The Search For Alien Life, An All-Too-Human Communication Failure* - Fast Company by Cale Wissman

586. **Marchis, F.** Worked with the California Academy of Sciences on a documentary called "Incoming!", and a 10-min. documentary for the Hohfeld Hall Program on Extrasolar Planet Formation.

587. **Race, M.** Course Lead and Lecturer – *Astrobiology & Searching for ET*, Osher Life Long Learning (OLLI) Program, March 28, April 7, 14, 21, and 28, 2016).

588. **Race, M.** Interview (Spanish) on *Response to Discoveries of ET Signals or Phenomena*. http://www.eldiario.es/hojaderouter/ciencia/vida_inteligente-extraterrestres-ciencia-descubrimiento-protocolo_0_528797334.htm

589. **Richards, J.** Interview, KXLR Radio, Redding, CA., Oct. 22, 2016. YouTube video using the audio and pictures: https://youtu.be/uX0Cpvp2utk

590. **Richards, J.** Story published in: https://www.amazon.com/Science-Fiction-Scientists-Anthology-Stories/dp/3319411012

591. **Richards, J.** KIXE Public TV interview, Nov. 24/26, 2016: https://youtu.be/XXKDKXEWCXY

592. **Richards, J.** Interview at the ATA for Durbania. https://youtu.be/VUmVz3Bw4LY

593. **Shostak, S.** Radio Interview, Radio 5, BBC, *Hillary Clinton and Area 51*. March 2016.

594. **Shostak, S.:** Radio Interview, SETI and SETI Science, *Midnight in the Desert*. March 2016.

595. **Shostak, S.** Radio Interview, SETI, *Dark Thirty Radio*, March 2016.

596. **Shostak, S.** TV Interview at the ATA for Prometheus Productions, March 2016.

597. **Shostak, S.** "Drone's Eye View of Mars," *Huffington Post*, May 16, 2016. http://www.huffingtonpost.com/seth-shostak/drones-eye-view-of-mars_b_9990872.html

598. **Shostak, S.** How to Take Stellar Night Shots of Stars," *Shutterbug*, June 2016, p. 30.

599. **Shostak, S.** Looking for ET, *Sky's Up*, Summer 2016. https://www.joomag.com/magazine/skys-up-summer-2016/0694333001461966596

600. **Shostak, S.** The Other Way to Find Life Out There, *Huffington Post*, June 3, 2016. http://www.huffingtonpost.com/seth-shostak/the-other-way-to-find-lif_b_10283870.html

601. **Shostak, S.** Seth Shostak, July 5, Independence Day: Core Values, *Huffington Post*, http://www.huffingtonpost.com/seth-shostak/independence-day-core-val_b_10813464.html

602. **Shostak, S.** 9/8 Host of two episodes of Neil deGrasse Tyson's radio show.

603. **Shostak, S.** 9/10 Panelist on life in space, Northeast Fall Astronomy Festival, Durham, NH.

604. **Shostak, S.** 9/12 Video interview by Joel Achenbach, Washington Post, in Washington, DC.

605. **Shostak, S.** 9/15 Inverview on Ronn Owens radio show, KGO, San Francis

606. **Shostak, S.** Interview on "Science Friday" (NPR radio) 10/7/2016.

607. **Shostak, S.** Interviews radio and TV CBC, Edmonton, Canada 10/17 and 18/2016

608. **Shostak, S.** Interview by Czech science radio show, Aug. 4, 2016.

609. **Shostak, S.** Interview about KIC 8462852, Pat Thurston, KGO Radio, San Franscisco (ISDN).

610. **Shostak, S.** Interview by "Amy on the Radio" (Skype).

611. **Shostak, S.** Interview by BBC5 on Schiaparelli lander (radio) 10/19/16.

612. **Shostak, S.** Guest on "Coast to Coast AM", two hours (radio) 10/25/16.

613. **Shostak, S.** 5 Things We Know to be True: No Credible Evidence of Alien Visitation Exists," *Scientific American*, November 2016.

614. **Shostak, S.** Arrival: Squid Pro Quo," *Huffington Post*, November 10, 2016. http://www.huffingtonpost.com/seth-shostak/arrival-squid-pro-quo_b_12897656.html

615. **Shostak, S.** "If ET Exists, We'll Find Him in the Next 20 Years," *Nautilus|Cosmos*, November 2016. http://cosmos.nautil.us/short/56/if-et-exists-well-find-him-in-the-next-20-years

616. **Shostak, S.:** Drake Equation: 55 Years Old," *SETI Institute*, November 16, 2016. http://www.seti.org/seti-insititute/Drake-Equation-55-Years-Old

617. **Shostak, S.** "John Glenn 1921-2016," *SETI Institute*, November 9, 2016. http://www.seti.org/seti-institute/john-glenn-1921-2016

618. **Shostak, S.** "Are Humans the Real Ancient Aliens?" NBC News, December 13, 2016. http://www.nbcnews.com/mach/space/are-we-ancient-aliens-n695456

619. **Shostak, S.** Guest (one hour) on "Dark Thirty Radio", April 1, 2016.

620. **Shostak, S.** Guest on the BBC World Service Television on *Breakthrough Starshot*, 12 minutes, April 12, 2016.

621. **Shostak, S.** Guest for news segment (*Breakthrough Starshot*) on "Coast to Coast AM" radio, 10 minutes, April 12, 2016.

622. **Shostak, S.** Guest on "Coast to Coast AM" radio, two hours, April 14, 2016.

623. **Shostak, S.** Interview about SETI by KHOI radio, Ames Iowa, May 13, 2016.

624. **Shostak, S.** Interview about SETI by Dr. J. Radio, May 16, 2016.

625. **Shostak, S.** SETI on "On Point", NPR radio show out of WBUR (Boston), May 19, 2016.

626. **Shostak, S.** Interview, Wolfgang Radio (London), May 23, 2016.

627. **Shostak, S.** Interview, Australian Radio, May 24, 2016.

628. **Shostak, S.** Interview, Packman Show (television), 2016.

629. **Shostak, S.** Weekly Space Hangout (web TV show), May 27, 2016.

630. **Shostak, S.** *SETI Update*, BayCon, San Mateo, CA, May 28, 2016.

631. **Shostak, S.** *SETI*, Mythic Internet Radio, May 31, 2016.

632. **Shostak, S.** "Dark Thirty" radio show, May 31, 2016.

633. **Shostak, S.** *Independence Day: Core Values*, Huffington Post, July 5, 2016. http://www.huffingtonpost.com/seth-shostak/independence-day-core-val_b_10813464.html

634. **Shostak. S.** Interview in studio, *In Depth*, KCBS radio, San Francisco, Sept. 1, 2016.

635. **Shostak, S.** Interview in studio for *Business Insider*, New York, Sept. 6, 2016.

636. **Shostak, S.** Interviewed by Michio Kaku for his radio show, Sept. 6, 2016.

637. **Shostak, S.** Interviewed by Neil deGrasse Tyson for his TV show, Sept. 7, 2016.

638. **Shostak, S.** Interview for the National Geographic Channel at the ATA, Nov, 12, 2016.

639. **Shostak, S.** Interview about SETI by Radio 2U3, Sydney Australia, Nov. 23, 2016.

640. **Shostak, S.** Interview about SETI, Irish Radio Dublin, Dec. 09, 2016.

641. **Shostak, S.** Interview about SETI, WBAI radio, New York, Dec. 23, 2016.

642. **Shostak, S.** Weekly *Big Picture Science*, Radio Show, the SETI Institute.

643. **Tarter, J.** OLLI at Santa Clara, *SETI Lectures*, April 7, 2016.

644. **Tarter, J.** Media interviews and press conference to promote the Starmus 3 Festival in Tenerife, May 9-13.

645. **Tarter, J.** Filming with Neil de Grasse Tyson for an episode of StarTalk on Nat Geo., May 27, 2016.

646. **Tarter, J.** Submitted new foreword for Murmurs of Earth that is being translated into Chinese by editor Alexei LU Fei, May 2016.

647. **Tarter, J.** Film video for the Asteroid Day website, Aug. 3, 2016.

648. **Tarter, J.** Film with California Humanities, Aug. 22, 2016.

649. **Tarter, J.** Phone interview with Tommy Schnurmacher on CJAD800, Montreal. Aug. 25, 2016.

650. **Tarter, J.** Phone interview with Leonard David.

651. **Tiscareno, M.** Media/Interview - Close Views Show Saturn's Rings in Unprecedented Detail. http://www.jpl.nasa.gov/news/news.php?feature=6729

652. **Tiscareno, M.** *Life in Outer Space*, a 2-episode documentary to be aired soon on Discovery USA, and featuring interviews with a number of SETI Institute scientists.

653. **Tiscareno, M.** Interview by Emily Benson of *New Scientist* for comments on a new article on the origins of Saturn's rings, Sept. 16, 2016. https://www.newscientist.com/article/2106108-saturns-rings-may-be-from-the-whirl-of-a-passing-icy-rock).

654. **Tiscareno, M.** Interviewed by PBS Nova on the Cassini Grand Finale, Dec. 2016.

655. **Zalucha, A.** Quora: Most Viewed Writer: Meteorology, Weather Forecasts; Answer published in Forbes: What Do We Know About Pluto's Atmosphere? May 2016. http://www.forbes.com/sites/quora/2016/04/04/what-do-we-know-about-plutos-atmosphere/#507aec651e0d

656. **Zalucha, A. M.** Spoke about SETI (the science) and Pluto at the Denver Comic Con, June 18, 2016.

5.

Invited Talks
(Professional & Public)

657. **Ballard, L.** *How To Play with Deep Space Data*, invited speaker at Dent:Space, San Francisco, September 2016.

658. **Ballard, L.** *Postcards from the Outer Planets,* invited speaker at Science Hack Day, San Francisco, Nov. 12-13, 2016.

659. **Ballard, K.** *Space Hacks with WordPress and Python*, invited speaker at DotAstronomy 8 Conference, Oxford, UK.

660. **Beyer**, **R**. *Charon: Pluto's Fascinating Moon from New Horizons.* SETI Weekly Lecture Series, May 17, 2016.

661. **Beyer, R.** Talk to two 3rd grade classes about planetary exploration, Nov. 4, 2016.

662. **Beyer, R.** *New Horizons*, public talk, San Mateo Astronomy Club, Nov, 4, 2016.

663. **Beyer, R.** Keynote speaker at Stanford;s GISday, Nov. 16, 2016.

664. Bishop, R. Invited speaker at the GSA Gilbert Session, Denver, Sept. 27, 2016.

665. **Bishop, J.** *History of Clays on Mars: How we Found them and their Astrobiological Importance.* SETI Weekly Lecture Series, Nov. 8, 2016.

666. **Bonaccorsi, R.** MarsFest Symposium Guided Talks, March 2016.

667. **Bonaccorsi, R**. *Analog Field Research in Extreme Desert Environments*. Osher Lifelong Learning Institute, Santa Clara University, April 21, 2016.

668. **Bonaccorsi, R**. Invited to speak (public talk) at the Visual Performing Arts (VPA) theater, Evergreen College, Nov. 2, 2016.

669. **Bonaccorsi, R.** *Summary Activities of the Lipid Biomarker Detection Group*. Opening event for Spaceward Bound India, Lemon Tree Delhi, Aug. 8. 2016.

670. **Bonaccorsi, R**. *International Seminar and Space Forum*, Amity Institute of Aerospace Engineering (AIAE), New Dehli, Aug. 21, 2016.

671. **Bonaccorsi, R.** *Searching Life Elsewhere: Life Detection in Planetary Analog Materials*. Seeker's Interaction Forum, Lucknow (India), Aug. 31, 2016.

672. **Bonaccorsi, R**. Invited talk: *Science Expeditions to Planetary-Like Environments and the Search for Life in the Solar System*, Evergreen College's Performing Arts (VPA) Theater, San Jose, Dec. 2, 2016,

673. **Brown, A.** Invited talk: *Volatiles and Ices in the Polar Regions of Mars - the future is LIDAR*, NASA Goddard Science Colloquium, April 5, 2016.

674. **Busch, M.** Outreach at the California Academy of Sciences evening event, March 10, 2016.

675. **Busch, M.** Seminar at the University of Central Arkansas (via videoconference), March 15, 2016.

676. **Busch, M.** *Strange New Worlds* – Panel discussion on recent planetary science results at the BayCon Science Fiction Convention, San Mateo, CA, May 29, 2016. https://sites.grenadine.co/sites/baycon/en/2016/items/104/Strange+New+Worlds

677. **Busch, M.** *Small Bodies in the Solar System*, REU Program, the SETI Institute, June 15, 2016.

678. **Busch, M.** *Asteroid Impact Response*, talk series for the NASA Frontier Development Lab (FDL), June 27-29, 2016.

679. **Busch, M.** *Near-Earth Asteroid Spacecraft Missions and the Impact Hazard*, Evergreen Community College. Sponsored by the College's Astronomy Club, Aug. 2, 2016.

680. **Cabrol, N. A.** *Decoding a Changing Planet*, Rolex Prize, Finalist, Geneva, Switzerland, April 2016.

681. **Cabrol, N. A.** *Comparison of Environmental Habitability: Evolution and Preservation in Time*, Invited talk, Biosignature Preservation and Detection in Mars Analogues Conference, Tahoe, May 16-18, 2016).

682. **Cabrol, N. A**. *Searching for Life Beyond Earth*, REU Program, the SETI Institute, June 23, 2016.

683. **Cabrol, N. A**. *Searching for Habitability and Life Beyond Earth*, Mount Tam Astronomy Nights, CA, July 9, 2016.

684. **Cabrol, N. A.,** Invited seminar: *Biosignature Detection on Mars*, Universidad Católica del Norte, Antofagastam Chile. Nov. 9, 2016.

685. **Cabrol, N. A.** *The Coevolution of Life & Environment and the Astrobiological Quest*, Invited Sagan Lecture, AGU Fall Conference, Biogeoscience and Planetary Science Section, Dec. 14, 2016.

686. **Cami J.** *Fullerenes in the PAH Universe*, invited review talk at the "The Past and Future of AstroPAH Research" conference, Noordwijk, the Netherlands, Oct 30—Nov 1, 2016.

687. **Cami J.** *The formation of fullerenes in planetary nebulae*, invited talk at the "Energetic Processing of Large Molecules II" meeting, Stockholm, Sweden, April 11—13, 2016**Cuk, M.** *Tidal Evolution of the Moon from a High-Obliquity High-Angular Momentum Earth*, CITA Colloquium, Toronto, Canada, March 31, 2016.

688. **Cami J.** *Fullerenes and PAHs in planetary nebulae*, invited review talk at the "Workshop for Planetary Nebula observations (WorkPlaNS)", Leiden, The Netherlands, Jan 25—29, 2016.

689. **Cuk, M.** *Orbital Dynamics Suggests a Recent Formation of Saturn's Moons.* SETI Institute Weekly Lecture Series, April 12, 2016.

690. **Cuk, M.** *Orbital Evolution of the Moon from a High-Obliquity High-Angular-Momentum Earth*. LPL colloquium series, May 17th, 2016.

691. **Cuk, M**. *Past Dynamics of Saturn's Moons and Earth's* Moon**,** Seminar at Petnica Science Center in Serbia, Oct. 7, 2016.

692. **Cuk, M**. Invited Talk: *Dynamical Evidence for a Recent Formation of Saturn's Moons.* Presented at the Young Moons and Rings Workshop, Monrovia, CA, Oct. 14, 2016.

693. **Dalle Ore, C.** Presented a **TEDx** talk in Bergamo, Italy: *The challenges behind the mission to Pluto*. July 25, 2016.

694. **Davila, A.** MarsFest talks, Death Valley, April 9-11, 2016.

695. **Davila, A.** *Enceladus and the Icy Moons of Saturn*, July 26-29, 2016, Boulder, Colorado.

696. **Davila, A.** Invited to speak at the SPINDLE Project Workshop, (Bill Stone, PI), Sept. 2016.

697. **DeVore, E.** Searching for ET's Home, **TED-x**, Amador Valley High School, Pleasanton, CA Sept. 8.

698. **DeVore, E., Harman, P.** When I Grow Up! Girl Scout Day at NASA ARC, Hands-on activities for Girl Scouts, Nov. 5.

699. **DeVore, E., Harman, P.** Girl Scout Bridging Day-Long Event, Crissy Field, San Francisco. Hands-on activities for Girl Scouts. April 30.

700. **Diamond, W.** *QUEST! The Search for Life Beyond Earth and Science at the SETI Institute*, SETI Institute Weekly Lecture Series, June 21, 2016.

701. **Doyle, L.** All day seminar: *Science and Spirituality*, Pasadena, July 2016.

702. **Doyle, L.** Invited talk, *Quantum Astronomy*, Foundational Questions in Physics) FQXI Institute, Banff, Canada, Aug. 2016.

703. **Estrada, P.** *How can we solve the mystery of the plateaus? The role of ballistic transport in Saturn's rings*. Presented at the 68th Cassini PSG Meeting, Feb. 8-12, 2016, JPL, Pasadena, CA.

704. **Estrada, P**. *Fractal Growth and Radial Migration of Solids: The Role of Porosity and Compaction in an Evolving Nebula*, presented at the SADL weekly talk series, the SETI Institute, April 27, 2016.

705. **Estrada, P.** *Micrometeroid Pollution and Ballistic Transport in Saturn's Rings*, Ring and Satellite Composition Workshop, Cassini PSG meeting, Noordwijk, The Netherlands.

706. **Fenton L**. Presentation to the SOFIA educators at the SETI Institute (via Zoom), March 27, 2016.

707. **French, R.** *Saturn's Rings: New results from Cassini*. Public talk to the Peninsula Astronomical Society, Sept. 9, 2016.

708. **French, R.** *Saturn's Rings: New results from Cassini*. Public talk to the Mount Diablo Astronomical Society, Feb. 23, 2016.

709. **French, R.** *Saturn's Rings: New results from Cassini*. Public talk to the Civil Air Patrol Squadron 10, Palo Alto Airport, Feb. 16, 2016.

710. **Freund, F.** Invited talk at the GNS, NZ center of seismology in Lower Hutt, near Wellington, Dec. 2016.

711. **Freund, F.** Earthquakes – no Surprise, Keynote Address, International Conference Aula Magna, PUCP, Lima, Peru, Nov. 14-15, 2016.

712. **Freund, F. TEDx** Christchurch 2016, Christchurch New Zealand, Oct. 29, 2016 https://www.youtube.com/watch?v=B1yno8RjaFE

713. **Freund, F.T**. (2016). Mystery of the Missing Water on the Moon. Friends of Lunar Volatiles John Hopkins University, Baltimore, MD. Sep. 8, 2016.

714. **Freund, F.T**. (2016). Global Earthquake Forecast System, Singularity University Grand Challenge Awards, San Francisco, CA, Aug. 28-30, 2016.

715. **Freund, F.T.** (2016). Satellite Technology to Capture Pre-Earthquake Signals from Above NASA Ames Mission Design Center presentation, Aug. 18, 2016.

716. **Freund, F**. *Protonic Semiconductor Approach to Proton Translocation through Membranes*, Physikalisch-Technische Bundesanstalt, Berlin, Germany, Apr. 15, 2016.

717. **Gillum, E.** *OSETI: All Sky, All the Time*, at the Breakthrough Discuss Event, April 15, 2016.

718. **Gillum, E.** *A Novel Approach to OSETI*, SETI Institute Weekly Lecture Series, Oct. 4, 2016.

719. **Glines, N., and V. Gulick.** *Indications of meltwater-driven gully formation in Moni Crater, Mars*. In: HiRISE Instrument Team Meeting. Desert Studies Center, Zzyzx, CA, Feb. 17, 2016. Presented by N. Glines.

720. **Glines, N., and V. Gulick.** *The Gullies of Mars*, In: NASA Ames Early Career Mars Science Seminar, Feb. 26, 2016. Presented by N. Glines.

721. **Gorti, U.** *Evolution of gas in protoplanetary disks*. Invited talk at the Solar System Exploration Seminar Series, NASA Goddard, Feb. 3, 2016.

722. **Gorti, U.** *Resolving planet formation in the era of ALMA and extreme AO*, ESO, Santiago, Chile, May 16-20, 2016. Invited review on Photoevaporation.

723. **Gorti, U.** *Gas and Dust Evolution in Disks and Implications for Planet Formation*. Invited talk presented at the "Linking Exoplanet and Disk Compositions STScI Workshop", John Hopkins, Baltimore, MD, Sept. 12-14, 2016.

724. **Gorti, U**. Invited Review Talk on *Protoplanetary Disks*, SOFIA: The Local Truth Conference, Asilomar, CA, Oct. 11-14, 2016.

725. **Gulick, V.** *Fluvial and Hydrothermal Processes Science Theme Updates and Gully Analysis Studies Update*. MRO HiRISE Team Meeting, Desert Studies Center, ZZyzx, CA, Feb. 15, 2016.

726. **Gulick, V.** *Understanding Mars: A new era of exploration.* Invited talk, GS 122/222 Planetary Systems: Dynamics and Origins class, Stanford University, Stanford, CA, Feb. 25, 2016.

727. **Gulick, V**. *New Evidence for Water Activity on Mars as seen by the Mars Reconnaissance Orbiter*, SJSU Astronomy and Physics Department Seminar, Nov. 3, 2016.

728. **Gulick V.** *What Makes a Habitable Planet*, Stanford Undergrad/grad. Geological Sciences 121 class, Nov. 17, 2016.

729. **Hargitai, H., V. Gulick, and N. Glines** (presented by Hargitai). *Discontinuous Drainage Systems in Navua Valles, Mars*. NASA Ames Early Career Network Series, Feb. 26, 2016, NASA Ames, Moffett field, CA.

730. **Hargitai, H., and V. Gulick** (presented by Hargitai). *Mapping Navua Valles*. Invited talk, Stanford University, in Planetary Systems: Dynamics and Origins, Class, Feb. 25, 2016, Stanford, CA.

731. **Hargitai, H.** *400 Years of Planetary Cartography – Mapping Channels on Mars*. SETI Institute Weekly Lecture Series, May 24, 2016.

732. **Harp, G.** *The Radio Search for Extraterrestrial Intelligence at the SETI Institute*, SETI Institute Weekly Lecture Series, Oct. 18, 2016.

733. **Harp, G.** *NASA STEM Day*, Hartnell Community College, Salinas, CA.

734. **Harp, G.**, and **S. Shotask.** *Humans need Alien Life*, Breakthrough Radio.

735. **Harp, G.** *The Search for Extraterrestrial Intelligence at the SETI Institute*, American Association of Physics Teachers, Sacramento, CA, July 7, 2016.

736. **Huang, X.** *Computing Highly Accurate Spectroscopic Line Lists for Characterization of Exoplanet Atmospheres and Assignment of Astronomical Observations*. Invited talk presented at the ASA-HITRAN 2016 Congress, Reims, France, Aug. 25, 2016.

737. **Jenniskens, P.** *Observing the Re-Entry of Space Debris WT1190F*. SETI Institute Weekly Lecture Series, Jan. 19, 2016.

738. **Kamakolanu, Gayathri, U.** Webcast participant in a workshop on *Searching for Life Across Space and Time*, Space Studies Board, held Dec. 5-6, 2016, Beckman Conference Center, Irvine, CA.

739. **Lee, P.** (Theater). Commonwealth Club SV - Wonderfest Event w/ A. Weir+M. Roach - 19 Oct 2016

740. **Lee, P.** (Theater). Christopher B. Smith Rafael Film Center – Science On Screen – 16 Jun 2016

741. **Lee, P.** gave a presentation about planning and preparing for the first human mission to Mars and discussed our progress, from the Arctic to Antarctica, from basement labs to the International

Space Station, to achieve the first human voyage to Mars. San Rafael, June 16, 2016.

742. **Lee, P.** Talk, Space Center Houston, Houston, TX, March 23, 2016.

743. **Lee, P.** Talk, Chabot Space and Science Center, Wonderfest – Oakland, March 18, 2016.

744. **Lee, P.** Speaker at School Library, Contra Costa, March 2016. http://www.contracostatimes.com/news/ci_29641820/bay-point:-spacedout-scientist-make-big-impact-on-kids

745. **Lee, P.** Library Talk: San Rafael Library, Feb. 24, 2016

746. **Lee, P.** Library Talk: Corte Madera Library, Feb. 24, 2016

747. **Lee, P.** Library Talk: Point Reyes Library, Feb. 23, 2016

748. **Lee, P.** Library Talk: Mill Valley Public Library, Jan. 8, 2016.

749. **Marchis, F.** *Tiny Moons around Asteroids*. California Academy of Sciences, April 4, 2016). http://buff.ly/21kBw6J.

750. **Marchis, F**. Invited at SciFOO, Google HQ, and co-organized two group discussions, July 22-24:

    a. *Life in Space. The Future of Humanity?* with Sanjoy Som (Blue Marble Institute).

    b. *Megastructures and Megacivilizations*, with Bruce Macintosh (Stanford University) and Tabetha Boyajian (LSU).

751. **Marchis, F.** *Life in Space: From Europa to Aliens*, invited talk, Yerba Buena Center for Arts, Nov. 9, 2016.

752. **Marchis, F.** Public talk: *Comètes et Astéroïdes: L'Exploration de Cérès & Tchouri*, Stella Matutina, and Saint-Paul, La Réunion Island, Nov. 29-30, 2016.

753. **Marchis, F.** Schools: *SETI et l'Exploration du Système Solaire*, NORDEV, La Réunion Island, Dec. 1, 2016.

754. **Marchis, F.** *La Recherche d'une Nouvelle Terre: Science ou Fiction?*, Makes Observatory, La Réunion Island, Dec. 3, 2016.

755. **Marchis, F.** presented the MapX instrument at the SSRL SLAC user meeting since we used one of the Synchrotron lines to calibrate it, Oct. 2016.

756. **Marcu. O.** *NASA's GeneLab Project*, NASA Jet Propulsion Laboratory, Pasadena July 28, 2016, hosted by Kasthuri Venkateswaran.

757. **Nielsen, E.** *The Gemini Planet Imager (GPI): Discovering Young Jupiter Around Other Stars*, San Mateo County Astronomical Society.

758. **Peeters, E.** Invited review talk on *An observational perspective on astronomical PAHs* at "The past and future of AstroPAH research", Noordwijk, The Netherlands, Oct 30-Nov 5, 2016.

759. **Peeters, E.** Invited Colloquium, Queen's University, Canada. *PAH emission characteristics in Photo-Dissociation Regions*, March 14, 2016.

760. **Race, M.** *Acting Ethically on the Red Planet*. Panel on issues in human exploration on Mars. Santa Clara University, Seminar at Markula Center for Applied Ethics, Feb. 17, 2016. https://scu.edu/ethics/focus-areas/more/resources/martian-morals/

761. **Race, M.** participated in the STAR_Net Webinar Series *NASA's Solar System Ambassador's: Nationwide Support for Libraries Webinar*, March 16t, 2017 10PT/11MT/12CT/1ET.

762. **Race, M.** *Death Valley National Park Centennial Celebration*, April 8-10, 2016.

763. **Race, M.** *Aliens, Astronauts, and Astrobiology: Bringing Space Exploration to your Library.* National Webinars with JPL Solar System Ambassadors and STAR-net (for Librarians), March 16, 2016.

764. **Race, M.** *Life and Career as an Interdisciplinary Mosaic – From Mudflat Ecology to Mars*. Careers in Life Sciences Graduate Seminar Series. University of Pennsylvania.

765. **Race, M.** March 13, 2016:

    a. *Acalanes High School Career Day - two presentations on STEM careers and Astrobiology* "Astrobiology: Basic Science, Technology and Teamwork"
    b. *Pittsburg Public Library: "*All about Space: Searching for ET and Understanding our Place in the Universe"
    c. *Bay Point Public Library & Riverside Middle School:* Astrobiology and STEM

766. **Race, M.** Two co-authored papers at the IEEE Conference, Big Sky MT (presented by Andy Spry, SETI Co-I).

    a. *Unanswered Questions in the Development of Planetary Protection Policy & Implementation for the Human Exploration of Mars. (Spry, J. A., M. S. Race, J. D. Rummel, and C. A. Conley)*.

    b. *NASA's Path to Planetary Protection Requirements for Human Exploration Missions*: *Update on Recent Progress. (Johnson, J. E., J. A. Spry, M. S. Race, B. Siegel, and C. A. Conley)*.

767. **Race, M.** *Astrobiology*. Career Fair, Acalanes High School, Lafayette, CA, March 10, 2016.

768. **Race, M**. *Astrobiology & Searches for ET Life*. Bay Point and Pittsburgh Libraries, Contra Costa County, March 10, 2016.

769. **Race, M**. *Panel Presentation and Webcast with JPL Solar System Ambassadors for STEM & Libraries*, March 16, 2016.

770. **Race, M**. *A Mosaic of Careers: From Marine Biology to Mars*, University of PA, Graduate Career Seminar, Biology Department, March 18, 2016.

771. **Race, M**. *Astrobiology and STEM: Searches for ET.* Novato Library, April 6, 2016.

772. **Race, M**. Death Valley National Park Centennial and MarsFest (April 8-9, 2016).

    a. Safeguarding Special Places on Earth & Beyond: How to preserve, protect and study environmentally and culturally important places.
    b. Panelist- Unimpaired for Future Generations - Preservation & Protection of sites.
    c. EXPO Hands-on Activities (SETI Table).

773. **Race, M.** *The Process of Change in Science*. Lectures on Planetary Protection & Astrobiology; and Planetary Defense and Decision Making, USC Senior Honors Program, April 18-19, 2016.

774. **Race, M**. *Astrobiology and Planning Human Missions*, Burkhalter School, Oakland, CA.

775. **Race, M.** Invited Planetary Protection and Icy Moons – Talk: *Enceladus Focus Group Meeting*, UC Berkeley. June 2016.

776. **Race, M.** Invited Talk. *Risk Communication and Hazardous Asteroids*, NASA Frontier Development (FDL), June 21-23, 2016.

777. **Race, M.** *Astrobiology, Planetary Protection, and Science in the Real World*, REU Students Program, the SETI Institute, June 2016.

778. **Race, M.** Three Invited Talks and Q&A for science-space camp students: *Planning a Trip to Mars* – Children's Fairyland, Oakland, CA. June 2016.

779. **Race, M.** *Thanksgiving on Mars? Planning a **Really** Long Space Mission*. El Cerrito Library, Nov. 19, 2016.

780. **Race, M**. *Workshop on Social & Conceptual Issues in Astrobiology*, Clemson University, Sept. 24-25, 2016.

781. **Race, M**. *Planetary Protection Policies & Practices*, NASA Kennedy Space Center, course instructor, Sept. 27-29.

782. **Race, M**. *Astrobiology, Planetary Protection, and Missions in the Solar System*, Los Altos Library, Oct. 19, 2016.

783. **Race, M.** *Searching for ET and Understanding Life --- Past, Present, Future*, Los Altos Library, Oct. 19, 2016.

784. **Race, M.** Menlo-Atherton High School, College and Career Day Speaker, Oct. 19, 2016.

785. **Race, M.** New Space Conference, Austin Texas, Nov. 4-5, 2016.

786. **Race, M.** Springhill School, Lafayette, CA, Nov. 7.

787. **Richards, J.** Public talk, Sacramento Astronomical Society, Dec. 16, 2016.

788. **SETI SCIENCE ADVISORY BOARD MEETING – Tarter, J., S. Shostak,** and **G. Harp** participated in the meeting, Sept. 27-28, 2016, at the SETI Institute.

789. **SETI Institute PANEL** – Nathalie Cabrol, Seth Shostak, Mark Showalter, Fergal Mullaly. Moderator: Bill Diamond. *When Will We Find Life Beyond Earth?* SETI Weekly Lecture Series, May 3, 2016.

790. **SETI Institute PANEL – The Exoplanet Group and Colloquium Series of the SETI Institute** organized a panel on Proxima Centauri b with Natalie Batalha, Chris Burkhart, Eduardo Bendek, Tom Barclay on Aug. 30, 2016.

791. **Shostak, S.** Panelist at the Conference on World Affairs – Science and Technology, Nine panels between April 4-8, 2016.

792. **Shostak, S.** Nueva School, Hillsboroughm CA., March 2016.

793. **Shostak, S.** Presentation for a Russian class on entrepreneurialism, Menlo Park, CA, March 2016.

794. **Shostak, S.** Five talks during the eclipse tour MWT Associates, Indonesia.

795. **Shostak, S.** *Fermi Paradox* (via Skype). Class in New York arranged by Vladimir Butkov, Ultimate Risk Solutions, April 15, 2016.

796. **Shostak, S.** *The Future is Here*, Smithsonian Event, Invited SETI Talk, April 24, 2016.

797. **Shostak, S.** *The Search for Extraterrestrial Intelligence*, Institute of High Energy Physics, Frascati, Italy, May 5, 2016.

798. **Shostak, S.** *When will we Find ET?* Santa Barbara, CA, May 18, 2016.

799. **Shostak, S.** *SETI,* Colloquium at Las Cumbres Observatory, Goleta, CA, May 19, 2016.

800. **Shostak, S.** Astrobiology Class Lecture on SETI, Santa Clara University, May 25, 2016.

801. **Shostak, S.** *Searching for Non-Biological Intelligence*, Starquest Conference, Green Bank, WV, July 9, 2016.

802. **Shostak, S.** Talk for the University of New Hampshire Students, Durham, NH, Sept. 9, 216.

803. **Shostak, S.** Keynote talk, Northeast Fall Astronomy Festival, Durham, NH, Sept. 9, 2016.

804. **Shostak, S.** Brief SETI talk for a business event in Palo Alto, CA, Sept. 19, 2016.

805. **Shostak, S.** Talk on *The Real Aliens*, DENT: Space Conference, San Francisco, Sept. 22, 2016.

806. **Shostak, S.** Keynote presentation on the 21st Century, for NASA, Oct. 1, 2016.

807. **Shostak, S.** *SETI Update*, Science Adventures (Phil Plait), Sonoma, CA, Oct. 1, 2016.

808. **Shostak, S.** Lecture: *New Developments in SETI*, Mount Tam Astronomy Lectures, Oct. 8, 2016.

809. **Shostak, S.** *Science of Star Wars*, Silicon Valley Lecture Series, Oct. 12, 2016.

810. **Shostak, S.** Physics Colloquium, San Jose State University, Oct. 13, 2016.

811. **Shostak, S.** Presentation to the Physics Department, McKuen University, Edmonton, Canada, Oct. 17, 2016.

812. **Shostak, S.** Public presentation at the Space and Science Center, Edmonton, Canada, Oct. 17, 2016.

813. **Shostak, S.** Presentation for the Mt. Diablo Astronomical Society, Walnut Creek, CA, Oct. 25, 2016.

814. **Shostak, S.** Panels for *Alien Con*, Santa Clara, CA, Oct. 29. 2016.

815. **Shostak, S.** Participating in the Bay Area Science Festival, San Francisco, CA, Oct. 30, 2016.

816. **Showalter, M. R**. *The New Horizons Flyby of Pluto: An Insider's View*. The Space Station Museum, Novato, January 9, 2016

817. **Showalter, M**. *Pluto Flyby*, Lockheed, Feb. 18, 2016.

818. **Showalter, M.** *Orbital and Rotational Dynamics of Pluto's Small Moons*, Invited Talk, *EGU Meeting*, Vienna, week of April 2016 (presented by Showalter, and co-authored by: Harold Weaver, John Spencer, Simon Porter, Douglas Hamilton, Richard Binzel, Marc Buie, William Grundy, Francis Nimmo, Robert Jacobson, Marina Brozovic, S. Alan Stern, Cathy Olkin, Leslie Young, Kimberly Ennico, and The New Horizons Science Team.

819. **Showalter, M.** Public Talk: *The New Horizons Flyby of Pluto: An Insider's View*, San Francisco Amateur Astronomers, May 17, 2016. http://www.sfaa-astronomy.org/lecture-17-may-the-new-horizons-flyby-of-pluto-insiders-view-by-mark-showalter-phd/

820. **Showalter, M.** Public Talk: *The New Horizons Flyby of Pluto: An Insider's View*, Geological Society of Nevada, May 17, 2016.

821. **Showalter, M.** *Orbital and Rotational Dynamics of Pluto's Small Moons*, Division for Dynamical Astronomy Meeting of the AAS, Nashville, May 25, 2016. http://adsabs.harvard.edu/abs/2016DDA....4730302S

822. **Showalter, M.** *Pluto Up Close*. Modesto Area Partners in Science lecture series, Modesto Junion College, November 18, 2016.

823. **Showalter, M.** *The Solar System*. Skype presentation to the seventh grade students of Pennridge Middle School, Perkasie, PA, December 20, 2016.

824. **Sobron, P.** *In Situ Chemistry, Mineralogy, and Organic/Biomarker Content on Phobos and Deimos: A New Instrument Concept.* Presented at the Tohoku Forum for Creativity: International Workshop: Planetary Science and Space Exploration, Sendai University, Japan, July 5, 2016.

825. **Sobron, P.** *Robotic Missions to Explore the Solar System – And How We Prepare for Them*. Presented at the 2016 South American Space Generation Workshop, Lima, Peru, Aug. 5, 2016.

826. **Tarter, J**. Keynote: Northern Arizona Planetary Science Alliance Workshop, Lowell Observatory, March 2016.

827. **Tarter, J.** Keynote: MarsFest in Death Valley – *A Cosmic Perspective: Searching for Aliens, Finding Ourselves*, April 8, 2016.

828. **Tarter, J.** California Academy of Sciences – Yuri's Night at NightLife: *Life Beyond Earth?* April 14, 2016.

829. **Tarter, J.** Session Chair at the "Breakthrough Discuss Meeting" at Stanford University: *OSETI and Directed Energy Propulsion Systems*, April 15, 2016.

830. **Tarter, J.** Brown University, President's Thinking Out Loud Lecture Series: *The 21st Century: The Century of Biology on Earth and Beyond"*, April 20, 2016.

831. **Tarter, J.** Mills College Noon Lecture: *Life Beyond Earth?*, April 27, 2016.

832. **Tarter, J.** Moderated a discussion with Neil de Grasse Tyson on the theme of Intelligent Life in the Universe during the Starmus III Festival in Tenerife, Beyond the Horizon, Tribute to Stephen Hawking. June 28, 2016.

833. **Tarter, J.** Narrated *Contact*, for NASA FDL participants, Aug. 2, 2016.

834. **Tarter, J.** Talk for Early Career Network group, NASA Ames, Aug. 12, 2016.

835. **Tarter, J.** Presentation and interview with school students (via Skype), Princeton, NJ. Aug. 2016.

836. **Tarter, J.** Talk at the Singularity University Summit, Aug. 30, 2016. https://exponential.singularityu.org/summit/2016presenters/

837. **Tarter, J.** Attended *Curiosity Retreat*, Gateway Canyon, CO, conducting a precept session with Allen, Oct. 2016.

838. **Tarter, J.** Attended the celebration for the 25th Anniversary of Ira Flatow's Science Friday in New York, Oct. 2016.

839. **Tarter, J.** *SETI Futures*, North American Breakthrough Listen Workshop, Green Bank, WV, Oct. 6, 2016.

840. **Tarter, J.** *Life Beyond Earth?* Los Altos High School STEM celebration week, Oct. 25, 2016.

841. **Tarter, J.** *SETI: An Alternate Reality*, Celebration of Marvel Cinematic Universe and Dr. Strange, Oct. 27, 2016.

842. **Tarter, J.** *Life Beyond Earth?*, CSIcon, Las Vegasm Oct. 29, 2016.

843. **Tiscareno, M**. *Rotational and Interior Models for Enceladus*, University of California Berkeley, Weekly Colloquium, March 2016.

844. **Tiscareno, M**. *Propellor peregrinations: Ongoing Observations of Disk-embedded Migration in Saturn's Rings* (SADL SEMINAR, SETI Institute).

845. **Tiscareno, M**. *Propellor peregrinations: Ongoing Observations of Disk-embedded Migration in Saturn's Rings* (DDA Meeting, Nashville, TN).

846. **Tiscareno, M**. *Saturn's Rings: A Nearby Astrophysical Disk.* REU Students Program, the SETI Institute.

847. **Tiscareno, M**. *Rings Science Update.* Cassini Project Science Group Meeting, (subgroup: Imaging Team), Noordwijk, Netherlands, June 20, 2016.

848. **Tiscareno, M.** *Propeller and Wisp Science Update*, Cassini Project Science Group Meeting, (subgroup: Imaging Team), Noordwijk, Netherlands, June 22, 2016.

849. **Tiscareno, M.** *Saturn's Rings Update. Cassini-Huygens Analysis and Results from the Mission (charm)*. Public telecom, Oct. 2016. https://saturn.jpl.nasa.gov/cassinicharm/

850. **Tregloan-Reed, J.** *A broadband transmission spectrum of HAT-P-32b from Ground-Based Simulatenous Multi-Band Photometry*, presented at the Bay Exoplanet Meeting, March 2016.

851. **Zalucha, A.** *But What About the Stellar Occultation Data of Pluto's Atmosphere?* SETI Weekly Lecture Series, May 10, 2016.

852. **Zalucha, A.** Invitation to speak at a panel about mental health for students, faculty, and researchers, American Physical Society, (scheduled March 13, 2017).

6.

Honors, Awards, & Discoveries

Ballard, L. Named to "100 Awesome Women in Open Source", Oct. 2016, and appointed to NASA Datanauts 2016 Class.

Cabrol, N. A. AGU Sagan Lecture, Dec. 14, 2016.

Coughlin, J. and **C. Burke**: NASA Exceptional Achievement Medal, July 2016. http://nasapeople.nasa.gov/awards/nasamedals.htm

Gordon, M. participated in the releases of versions 1.6 (March 31) and 1.7 (September 28) of the archiving standards for NASA's Planetary Data System.

Lee, P. The movie "*Passage to Mars"* is awarded *Best Non-Fiction Feature Film* at RAW Science Film Festival in Hollywood. Pascal present to accept the award on behalf of the film team, Dec 10, 2016.

Marchis, F., and his group discovered a triple asteroid (107) Camilla using the VLT/SPHERE instrument. The announcement was made via a IAU circular, Aug. 2016.

NASA Kepler and K2 Team is the winner of the *National Space Society's 2017 Space Pioneer Award* in the ScEngineering category. http://www.seti.org/seti-institute/news/kepler-k2-team-wins-national-space-society's-2017-space-pioneer-award-science

Pilorz, S. received a NASA Group Achievement Award for his contribution to the VIMS Thermal Modeling Team. Stu developed and implemented the models that predict the heating that two instruments on the Cassini spacecraft will receive as a result of close flybys of Saturn and the rings. June 2016.

Pilorz, S., received NASA RHG Exceptional Achievement Award for Mission & Enabling Support to Cassini CIRS Operations Team, March 2016.

Rowe, J. NASA's Exceptional Scientific Achievement Medal for Exoplanet Research.

Showalter, M. was selected in January to serve on NASA's Science Definition Team for a proposed future mission to Uranus and/or Neptune.

7.

Acknowledgments

Contributors to this annual report include:

- Andersen, D.: *Chair, SI Climate and Geoscience Research Group, Astrobiology*.
- Backman, D.: *Education and Public Outreach, SOFIA, IR Astronomy.*
- Ballard, L. *Planetary Science Web. Developer.*
- Beyer, R. *Planetary Exploration, Remote Sensing.*
- Bishop, J. *Chair, SI Astrobiology Research Group, Astrobiology, Mars, Remote Sensing.*
- Bonaccorsi, R. *Geosciences, Astrobiology, Analogs.*
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