2016
Publications and Presentations of the SETI Institute

Carl Sagan Center
For the Study of Life in the Universe
2016 Publications & Presentations of the SETI Institute

Nathalie A. Cabrol
Director, Carl Sagan Center, and the
SETI Institute Scientists and Educators
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Carl Sagan Center for the Study of Life in the Universe
2016: Publications & Presentations of the Carl Sagan Center of the SETI Institute

The Carl Sagan Center at the SETI Institute is at the heart of the scientific research we do that seeks to answer fundamental questions: How many planets exist that might support life? What is required for life to exist? How does life start? How does it evolve? In short, where did we come from and are we alone?

Our team focuses on disciplines including space and planetary exploration, analogs, and observing and modeling the precursors of life in the depths of outer space. Each Carl Sagan Center research project is related to understanding the origins of life or the extent to which life may be present beyond Earth.

2016 was my first full calendar year as head of the Carl Sagan Center at the SETI Institute. I have to say that I am in complete awe of what our scientists are accomplishing. 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 the space and planetary missions, if it’s about searching for life beyond Earth and sharing a passion for knowledge, the SETI Institute team is involved front and center. The body of work presented by the SETI Institute represents more than 500 publications, including peer-reviewed articles, abstracts and proceedings of conferences, and technical reports. Our involvement in education and public outreach is almost as extensive.

2017 will be a year of even more excitement and the SETI Institute will again be at the forefront of new exploration and discovery. We are looking forward to the Great American Eclipse with the Girl Scouts project, a new year of NASA Frontier Development Lab, the Research Experience for Undergraduates program, the continuing down-selection of candidate landing sites for Mars 2020, increased activities of the Biosignature Working Group, and more scientific expeditions in extreme environments. This year will also mark the end of the Cassini mission.

Our quest belongs to all of humanity. We hope you will join us as we continue to tell the story of our work and our Universe.

Nathalie A. Cabrol

Senior Research Scientist and Director of the Carl Sagan Center
SETI Institute
Dear Friends,

The mission of the SETI Institute is to explore, understand, and explain the origin and nature of life in the universe, and to apply the knowledge gained to inform, inspire and guide present and future generations. We have a passion for discovery and for sharing our research and exploration with the world.

The science output of our researchers at the SETI Institute is a source of great pride. This report of the Publications & Presentations of the Carl Sagan Center of the SETI Institute represents the collective work product of our science, education, and research centers during calendar 2016. Their productivity is truly impressive. We are published in such prestigious journals as *Nature* and *Science* as well as the *Astronomical Journal, Astrobiology, Applied Physics, Journal of Chemical Physics, Icarus, Proceedings of the Royal Society, Aeolian Research*, and many more!

Our researchers are referenced in a variety of scientific conference proceedings through hundreds of Abstracts of Conferences. We communicate to the public through dozens of speaking engagements, as well as stories and articles in the popular media.

Telling the story of the SETI Institute, and our wide-ranging research, is an important part of my own personal mission – to let the world know who we are and what we do. The breadth and depth of our science, combined with the impact and reach of our education programs, are truly amazing. I am sure that in surveying this compendium of our work, you will share my admiration for the people who make it all possible.

I have no doubt that our productivity in 2017 will be just as amazing, just as impressive, and just as important to share with the world. Join us on our journey of exploration and discovery and stay on top of the latest developments by visiting us at [www.seti.org](http://www.seti.org).

Sincerely,

Bill Diamond
President and CEO
SETI Institute
1.

Peer-Reviewed Publications


2.

Conferences: 
Abstracts & Proceedings


https://agu.confex.com/agufm16/meetingapp.cgi/Paper/142372


Estrada, P. R., Durisen R. H., and Cuzzi, J. N., (2016). The evolution of Saturn’s rings under the influence of the Edgeworth-Kuiper Belt micrometeoroid flux: tightening the constraints on ring age. 48th DPS/11th EPSC meeting, Pasadena, CA, October 16-21, #114.05. http://adsabs.harvard.edu/abs/2016DPS....48S1140E


322. Hofgartner, Jason Daniel; Buratti, Bonnie J.; Devins, Spencer; Beyer, Ross A.; Ennico, Kimberly; Olkin, Catherine B.; Stern, S. Alan; Weaver, Harold A.; Young, Leslie; and New Horizons Geology, Geophysics and Imaging Science Theme Team. (2016). A Search for Temporal Changes on Pluto and Charon. American Astronomical Society, 48th DPS meeting, Abstract #224.11. http://adsabs.harvard.edu/abs/2016DPS....4822411H


http://adsabs.harvard.edu/abs/2017AAS...22925212O

http://adsabs.harvard.edu/abs/2016DPS...4812320O


http://adsabs.harvard.edu/abs/2017AAS...22924604P


http://adsabs.harvard.edu/abs/2017AAS...2292757.pdf

http://adsabs.harvard.edu/abs/2016LPS...472757.pdf

http://adsabs.harvard.edu/abs/2017LPS...482042.pdf

http://adsabs.harvard.edu/abs/2016LPS...472402P

http://adsabs.harvard.edu/abs/2016LPS...472390P


https://ntrs.nasa.gov/archive/nasa/casi.ntrs.nasa.gov/20160012793.pdf


http://adsabs.harvard.edu/abs/2016EGUGA...184790R

http://adsabs.harvard.edu/abs/2016DPS...4822405R


http://adsabs.harvard.edu/abs/2016DPS...4832611R


4.

Popular Publications, Interviews, Education & Outreach
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.
508. Backman, D. SOFIA Mission presentation at Sunrise Middle School, 70 students, 2 teachers, San Jose, CA, Jan. 22, 2016.
510. Beyer, R. Worked with Astronomy magazine to help them create the first-ever Pluto globe.
512. Bonaccorsi, R. (Media Interview). High Road Documentary (TATA Motors sponsored).
514. Bonaccorsi, R. (TV). aired on RAI GULP (Kid’s network) on December 18, 2016, special on Mars.
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.
519. Cabrol, N.A. Interview by “La Recherche” for the introduction to their special issue on SETI and Astrobiology (November 2016).
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.
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.
531. Cabrol, N. A. Interview, La Tercera, Chile, March 17, 2016.
533. Clark, C. SOFIA exhibit at the Bay Area Science Festival, San Francisco, Nov. 5, 2016.
536. Clark, C. SOFIA presentation to 100 6-8 grade students from Palmdale Learning Plaza visiting NASA AFRIC 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.
539. Coughlin, J. was interviewed and quoted for two Popular Mechanics articles:
   b) How Will We Travel to That Promising New Planet?: http://www.popularmechanics.com/space/deep-space/a22567/interstellar-travel-proxima-b/
543. DeVore, E. A Legacy of Astronomical Discovery, Astrobiology and Searching for ET. Other Life Long Learning (OLLI) Program, March 28, 2016. (Margaret Race as lead instructor.)
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.


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


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


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 Interview on Ronn Owens radio show, KGO, San Francisco

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


609. Shostak, S. Interview about KIC 8462852, Pat Thurston, KGO Radio, San Francisco (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 Visitations,” Scientific American, November 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.


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

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


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

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


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


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.


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

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


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.


656. **Zalucha, A. M.** Spoke about SETI (the science) and Pluto at the Denver Comic Con, June 18, 2016.
Invited Talks
(Professional & Public)
Carl Sagan Center for the Study of Life in the Universe


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


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


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


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


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


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


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

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.

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.

Estrada, P. Micrometeoroid Pollution and Ballistic Transport in Saturn’s Rings, Ring and Satellite Composition Workshop, Cassini PSG meeting, Noordwijk, The Netherlands.

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


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


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


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.


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

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


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


Kamakolanan, 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.


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

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.
750. Marchis, F. Invited at SciFoo, Google HQ, and co-organized two group discussions, July 22-24:
   b. Megastructures and Megacivilizations, with Bruce Macintosh (Stanford University) and Tabetha Boyajian (LSU).
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.
759. Peeters, E. Invited Colloquium, Queen's University, Canada. PAH emission characteristics in Photo-Dissociation Regions, March 14, 2016.
762. Race, M. Death Valley National Park Centennial Celebration, April 8-10, 2016.
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).
    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).
770. Race, M. A Mosaic of Careers: From Marine Biology to Mars, University of PA, Graduate Career Seminar, Biology Department, March 18, 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.
   c. EXPO Hands-on Activities (SETI Table).
774. Race, M. Astrobiology and Planning Human Missions, Burkhalter School, Oakland, CA.
777. Race, M. Astrobiology, Planetary Protection, and Science in the Real World, REU Students Program, the SETI Institute, June 2016.


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


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.


6.

Honors, Awards, & Discoveries


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.


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.
Acknowledgments
Contributors to this annual report include:

- Andersen, D.: Chair, SI Climate and Geoscience Research Group, Astrobiology.
- Bishop, J. Chair, SI Astrobiology Research Group, Astrobiology, Mars, Remote Sensing.
- Bonaccorsi, R. Geosciences, Astrobiology, Analogs.
- Brown, A. Co-Chair, SI Climate & Geoscience Group, Mars, Astrobiology, Remote Sensing.
- Bryson, S. Kepler, Exoplanets.
- Burke, C. Exoplanet, Kepler SO Support Scientist.
- Busch, M. Young Scientists Representative at the SI Science Council, Asteroids, Planetary Exploration.
- Bywaters, K. Mars, Geochemistry, Biosignature Detection, Analogs.
- Cabrol, N. Director, SETI Institute Carl Sagan Center, Planetary Exploration, Astrobiology, Analogs.
- Caldwell, D. Co-Chair, SI Exoplanet Research Group, Exoplanets.
- Cami, J. Astronomy, Fullerenes, Cosmic Carbon, Spitzer.
- Catanzarite, J. Exoplanets, SOC Scientific Programmer, Kepler.
- Chiar, J. Astronomy, IR, REU Program.
- Christiansen, J. Exoplanets, Kepler, Planetary Transits.
- Clark, C. Science Education, Airborne Astronomy Ambassadors (AAA), SOFIA Outreach.
- Clarke, B. Exoplanets, Scientific Programmer, Kepler.
- Coral, C. Education and Public Outreach.
- Dalle Ore, C. Astronomy & Astrophysics, Organic Compounds, Tholins.
- DeVore, E. Director, SI Center for Education, Girl Scouts Program.
- Diamond, W. SETI Institute, President & CEO.
- Doyle, L. Exoplanets, SETI, Animal Communication, Intelligence.
- Estrada, P., Chair, SI Astronomy & Astrophysics Research Group, Formation of Moons around Gas Giants.
- Fenton, L. Co-Chair, SI Planetary Exploration, Planetary Aeolian processes and Modeling.
- Freedman, R. Astronomy, Exoplanet Atmospheres, Model Spectra, Laboratory Spectroscopy.
- French, R. Astronomy, Rings and Moons of Outer Solar System.
- Freund, F. Geosciences, Physics, Preformed Complex Organic Molecules from the Matrix of Magnetic Minerals.
- Gillum, E. Co-Chair SI SETI, OSETI.
- Glines, N. Geology, Geoinformatics, GIS, Astrobiology.
- Gordon, M. Planetary Rings, Planetary Data Systems.
- Gorti, U. Co-Chair, SI Astronomy & Astrophysics Research Group, Star and Planet Formation, Planet-Forming Disks.
- Gulick, V. Chair, SI Planetary Exploration Research Group, Mars, Planetary Exploration, Astrobiology.
- Harman, P. Education and Public Outreach, SOFIA.
- Hollenbach, D. Theoretical Astrophysics, IR Astronomy, Astrochemistry, Astrobiology, Missions.
- Huber, D. Astrophysics, Structure and Evolution of Stars, Space and Ground-Based Telescopes.
- Jenniskens, P. Planetary Astronomy, Meteor Showers, Asteroids.
- Kamoklonu, Gayathri, U. Planetary Habitability, Complex Organics
- Lee, P. Astronomy and Space Sciences, Human Exploration, Mars Analogs.
- Li, J. Exoplanets, Kepler SOC Scientific Programmer.
- Lord, S. Astronomy, Extragalactic Far Infrared Spectroscopy.
- Marchis, F. Chair, SI Exoplanet Research Group, Instrumentation, Outreach.
- Marcu, O. Molecular Adaptation of Cells to Extreme Habitats on Earth, Mars Analogs, Space Biology.
- McGrath, M. Astronomy, Planetary and Satellite Atmospheres and Magnetosphere.
- Michaels, T. Meteorology, Numerical Modeling of Planetary Atmospheres, Surface-Atmosphere Interactions, Data Visualization.
- Morris, R. Methods and Software to Analyze Data, Scientific Programmer, Kepler Mission.
- Mullaly, F. Astronomy, Astrophysics, Exoplanets, Kepler Science Officer.
- Nielsen, E. Exoplanets, GPI, Ground- and Space-Based Telescopes.
- Parenteau, N., Microbial Ecology, Geobiology, Astrobiology.
- Peeters, E. Astrophysics, Astrochemistry, PAHs.
• Quinn, R. Planetary Geochemistry, Astrobiology, Mars, Missions, Ionizing Radiation, Space Environment Viability of Organics.
• Roser, J. Physics, Astrochemistry, Molecular Physics, Condensed Matter Astrophysics of the Interstellar Medium.
• Rummel, J. SI Science Advisory Board Chair, Astrobiology, Life Support Systems Integration, Planetary Protection.
• Ryan, E. Asteroids, K2, Planetary Accretion, Trojan Clouds.
• Sarrazin, P. Planetary Instruments, Mars Missions, Planetary Mineralogy.
• Seader, S. Exoplanets, Kepler SOC Scientific Programmer.
• Shostak, S. Radio Astronomy, SI Senior Astronomer, SETI, Outreach, Big Picture Science.
• Showalter, M. Advisor, SI Science Council, Planetary Astronomy, Planetary Rings, Moons, Planetary Missions.
• Silvestro, S. Mars, Aeolian Processes, Atmospheric Modeling.
• Smith, J. Physics, Data Scientist, Signal Processing, Physics Modeling, Exoplanets, Kepler.
• Sobron, P. Physics, Planetary Science and Instruments, Astrobiology, Mars, Icy Moons, Missions, Analogs.
• Tarter, J. Bernard Oliver Chair, SI Board of Trustees, Radio Astronomy, SETI, Allen Telescope Array.
• Tenenbaum, J. Physics, Colliders (CERN, SLAC), Software, Kepler, Transiting Planets.
• Thompson, S. E. (See S. Mullaly).
• Tiscareno, M. Planetary Science, Solar System Dynamics, Planetary Ring Systems, SI REU Students Program.
• Tregloan-Reed, J. Astrophysics, Exoplanets, Planetary Microlensing, Differential Photometry.
• Twicken, J. Exoplanets, Kepler Lead Scientific Programmer.
• Zalucha, A. Atmospheric Science, Planetary Atmospheres, Planetary Climates, Numerical Models.