Orbiter

April 2017

Brane Craft Proposal Wins 2017 NASA Innovative Advanced Concepts Phase II Award

by **Eric Cheevers**
April 07, 2017

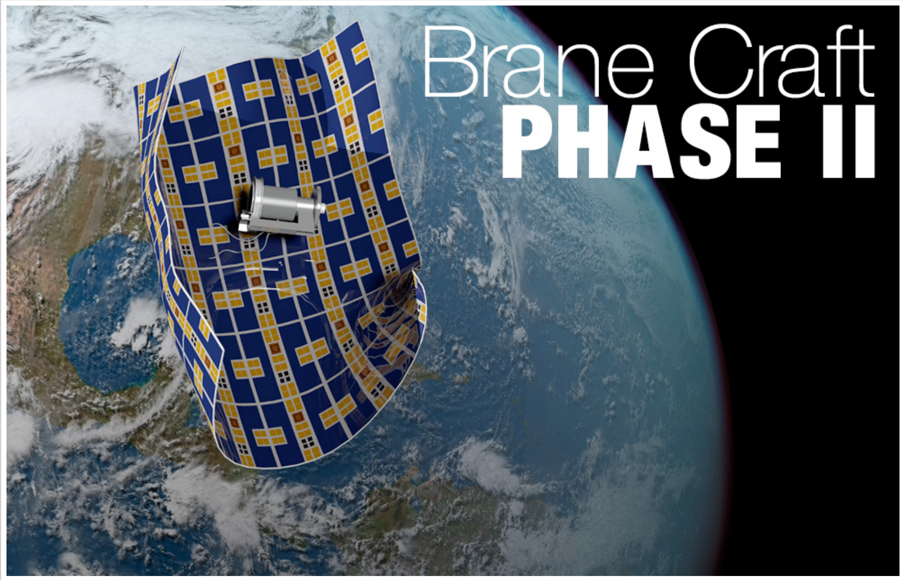


Illustration: Joseph Hidalgo

The term "space debris" is one of several terms used to describe an assortment of man-made objects in space, such as spent rocket stages, defunct satellites as well as the fragments created from the disintegration and collisions of the debris itself. While the United States Strategic Command has tracked approximately 18,000 artificial objects in low-earth orbit as of July 2016, orbiting debris poses an existential threat to active spacecraft, prompting increasing interest in space debris removal.

NASA has awarded Aerospace a 2017 NASA Innovative Advanced Concepts (NIAC) Phase II award for a revolutionary proposal that addresses this very issue. Specifically, this proposal, which was preceded by a Phase I grant last year, investigates the possibility of developing a small, flexible spacecraft that envelops and removes space debris from Earth's orbit.

Dr. Siegfried Janson's concept, known as the Brane Craft, is a flat 3-foot x 3-foot spacecraft that is less than half the thickness of a human hair. Exceptionally light, maneuverable, and fuel-efficient, the Brane Craft can be deployed to collect orbiting space debris by wrapping itself around the item, then lowering it into the atmosphere for incineration. The concept can best be compared to an automated spot cleaner in space, whose mission is limited only by its fuel payload.

While NIAC Phase I awards support the initial definition and analysis of a concept, more time and resources are required for award recipients to refine their designs and explore various methods of implementing the new technology. Phase I grants are generally $100,000; researchers who go on to qualify for Phase II awards receive $500,000 for another two years of work.

"The 2017 NIAC Phase II studies are exciting, and it is wonderful to be able to welcome these innovators back into the program. Hopefully, they will all go on to do what NIAC does best — change the possible", said Jason Derleth, NIAC program executive. "We look forward to seeing how each new study will expand how we explore the universe."

Weighing under 3 ounces, Janson's brain (or Brane) child currently includes an experimental ionic liquid thruster system developed by NASA, endowing the 30-micron-thick spacecraft with a very high thrust-to-weight ratio. It would also be able to travel long distances, allowing for missions in which multiple space debris fragments can be contained and disposed of at once. These features also lend themselves to applications far beyond the removal of space debris.

"Brane Craft prospectors could land on any near-Earth asteroid, Phobos, Deimos, a wide variety of main belt asteroids, or orbit Mars or Venus, and return," Janson said. "Brane Craft could access just about any orbit within cis-lunar space [between Earth and the moon] several times, with propellant to spare."

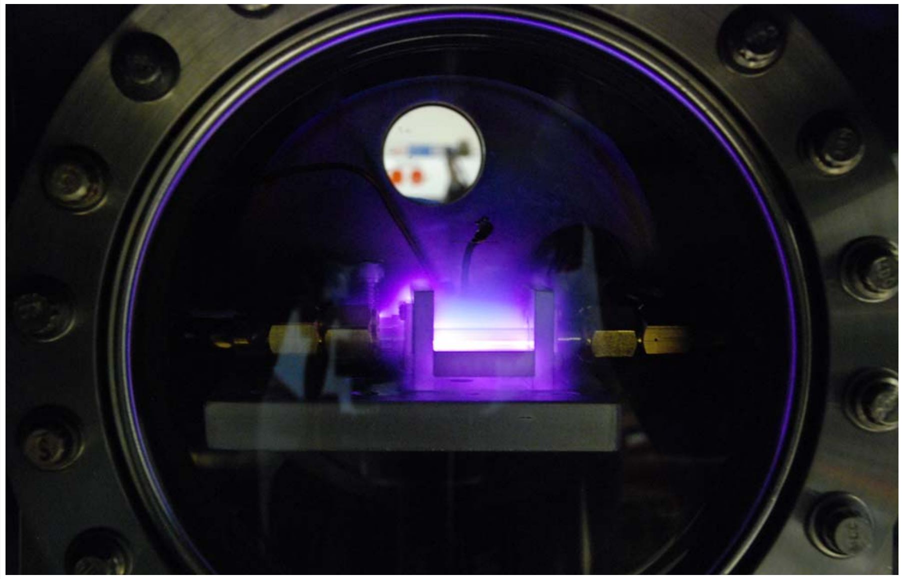
Janson said the Phase II effort will analyze and document the benefits, limitations, mission operations, and size-scaling of Brane Craft for removal of orbital debris, and will also attempt laboratory demonstrations of thin-film electronics for communications, command and control, power conditioning, sensing, and shape control.

“We will identify the most promising fabrication technologies, develop a technology roadmap, and provide recommendations for further development,” he said.

Janson’s Brane Craft concept is at once cutting edge and anticipatory. In keeping with Aerospace tradition, the Brane Craft presents a visionary concept that stands to dramatically transform space missions by way of ingenuity, economy and heretofore unexplored ideas.

Industry Adopts Aerospace Standard on RF Breakdown

by **Gabriel A Spera**
April 24, 2017



This long-exposure photo shows plasma breakdown in a parallel-plate device used to study multipactor breakdown. (Photo: Aerospace)

Advances in solar cell and power system technology have been a double-edged sword for space systems. On the one hand, the increase in available power has enhanced the capabilities of satellites using radio frequency (RF) transmissions; on the other hand, the high voltages that form in the presence of these RF fields can give rise to a destructive phenomenon known as RF breakdown, which can melt, short, or degrade sensitive components.

As explained by Preston Partridge of the Antenna Systems Department and Aimee Hubble of the Propulsion Systems Department, RF breakdown refers to two related phenomena: multipactor breakdown and ionization breakdown. “Multipactor is a resonant electron breakdown that requires a vacuum (or near vacuum) inside the RF component, whereas ionization refers to a plasma breakdown created from gas or other vaporized material internal to the component,” Partridge said.

Multipactor breakdown is a function of the frequency, geometry, and intensity of an electric field. When free electrons within an electrode gap are accelerated in the presence of an alternating RF field, the subsequent collisions can release more electrons in a cascade reaction, which can form a plasma. “The components most often affected are those that see high-power RF,” said Partridge. “This includes high-power amplifiers and all the components downstream — isolators and circulators used to protect amplifier outputs, switches and combining/dividing networks used to route the signals, filters and multiplexers used for managing the frequencies of operation, and antennas used to radiate or receive the RF signals.”

Difficult Choices

To avoid permanent damage, space system designers and operators face difficult choices. “One solution is to completely fill the device with a dielectric (insulating material), but this often comes with performance tradeoffs, and either cannot be done or results in reduced capability,” Partridge said. “Another solution is to reduce the power level used on the spacecraft — again, this results in reduced capability.”

As one of the few organizations in the country with lab facilities dedicated to studying RF breakdown, Aerospace has a unique understanding of both the phenomenon itself and its engineering impacts. In 2014, Aerospace convened a special panel at the Mission Assurance Improvement Workshop to address the issue. This meeting brought together industry and government to generate consensus for a comprehensive standard that incorporates best practices. “The MAIW process involves gathering representatives and subject matter experts from across the industry and meeting several times over the year to produce a final document,” Partridge said. “The committee members were drawn from suppliers, prime contractors, FFRDCs, and academic institutions.”

The standard delineates a variety of new tests that can identify problems early, preventing expensive failures late in production or on orbit. “The best way to mitigate RF breakdown is to address the risk in the design phase. If a component is found to be susceptible to breakdown late in the development phase, it can be difficult to mitigate," Partridge said. The standard also establishes new bounding test cases that enable programs to confidently remove excessive margin from their designs, which can result in large cost savings. The standard also accounts for new numerical analysis techniques that can, in certain cases, eliminate the need for expensive qualification and acceptance testing.

AIAA Adopts Standard

The American Institute of Aeronautics and Astronautics (AIAA) recently adopted "Standard/Handbook for Multipactor Breakdown Prevention in Spacecraft Components" as ANSI/AIAA S-142-2016. The document covers worst-case conditions, margin requirements, and verification of those requirements using state-of-the-art methodologies. It also recommends methods, with examples, to ensure proper requirement verification for all satellite components susceptible to RF breakdown. "The standard is intended to provide a baseline of minimum requirements for component verification," said Partridge. "It is meant to take into account known system-level uncertainties and the application of modern test and analysis techniques when considering margin and verification requirements." A second standard, which focuses on ionization breakdown, is also under development.

Programs are already seeing improvements. For example, JPL's Surface Water and Ocean Topography (SWOT) program recently caught a design issue in one of its prototypes, enabling the problem to be corrected before building the actual flight hardware. "For programs adopting the standard in the beginning, the risk of RF breakdown may be addressed with minimal impact to cost and schedule," Partridge said.

Aerospace Plays Key Role in CYGNSS Mission That Uses GPS Technology to Improve Hurricane Forecasting

by **Gail Kellner**
April 05, 2017

CYGNSS microsatellite (Illustration: Southwest Research Institute)

Commonly used GPS technology that many people have in their cars is being used in space to improve hurricane forecasting, with Aerospace playing a key role in testing a critical subsystem of the eight-satellite constellation at the heart of the mission.

GPS technology is a key capability in the NASA mission called the Cyclone Global Navigation Satellite System (CYGNSS), part of the NASA Earth System Science Pathfinder Program. The satellites were launched in December and are expected to be fully operational before this year's hurricane season.

The CYGNSS mission uses eight microsatellites developed by the Southwest Research Institute (SwRI) under contract to the University of Michigan, the institution of the principal investigator. Aerospace provided support to Southwest from mid-2013 through the launch last December, primarily in developing a Spacecraft Dynamics Simulator (SDS) for use in end-to-end testing of the microsatellite attitude determination and control subsystem.

CYGNSS is using a novel mission architecture to calculate wind speeds that both reduces the mission's cost and gathers more data.

The measurement of wind speed over the oceans from space typically uses a technique called scatterometry. A radar instrument aboard a satellite transmits a signal to the surface, and receives the signal reflected back to it.

The CYGNSS satellites don't transmit; they receive only. They make use of signals broadcast from GPS satellites already orbiting the Earth that reflect off the ocean in addition to reaching the satellites directly. Consequently, CYGNSS microsatellites are smaller and less complex compared to satellites that transmit and receive, resulting in significant cost savings for the mission. Each CYGNSS microsatellite is roughly the size of a small suitcase when its solar arrays are stowed.

In building the SDS units, Aerospace's Civil Systems Group and Engineering and Technology Group (ETG) staff utilized their extensive expertise for developing and delivering similar hardware-in-the-loop and software-in-the-loop simulators used by traditional launch and satellite programs as part of the mission assurance process. A total of eleven SDS units were integrated and tested at Aerospace before delivery to SwRI.

A key benefit of using a constellation of microsatellites is that they will pass over a given location on the Earth's surface more frequently than a single satellite would, resulting in a more detailed view of changes in the ocean winds.

The added quality and quantity of surface wind data, combined with precipitation fields produced by NASA's Global Precipitation Measurement (GPM) mission, will provide data that will allow the hurricane forecasters to improve weather forecast models used to predict both the track and intensity of land-falling hurricanes. This data also will enable more accurate weather forecasts of wind speeds and storm surges — the walls of water that do the most damage when hurricanes make landfall.

Key Aerospace personnel who supported CYGNSS include: Dr. Robert Kinsey, Dr. Margaret Abraham, and Gary Boggan from Civil Systems Group; Andrew Hsu from the Systems Engineering Division; Pat Doyle, Nicholas Lin, Barry Pataky, Constantine Solomos, James Cowan, and Chris Reed from the Vehicle Systems Division; Robert Wallsgrove from the Computers and Software Division; and Dr. Richard Briet and Jeff Sokol from the Electronics and Sensors Division.

Awards and Recognitions, April 2017

by **Gail Kellner**
April 17, 2017

Aerospace employees frequently earn recognition for their professional accomplishments. This Orbiter feature acknowledges those honors and awards, including the publication of books. To nominate someone for consideration in this section, send details of the award in a timely fashion to orbiter@aero.org, or contact Gail Kellner at gail.d.kellner@aero.org.

Bruce Arnheim, Dr. Yontha Ath, Donald Gardner, Bonnie Keillor-Slaten, and Dr. James Womack

An Aerospace team received certificates of appreciation from the Office of the Secretary of Defense in recognition of their outstanding contributions to the advancement of developmental test and evaluation. The group included Bruce Arnheim, senior project leader, Systems and Software Engineering; Dr. Yontha Ath, member of the technical staff, Reliability and Statistics Department; Donald Gardner, senior project engineer, and Bonnie Keillor-Slaten, engineering specialist, both of System Security Engineering Integration and Test Office; and Dr. James Womack, department director, Reliability and Statistics Department.

The group was recognized for its leadership within the Military Global Positioning System User Equipment Design of Experiments Working Group, which led to an exceptional test strategy that reduced the overall test cycle time by 60 percent, while producing the highest quality decision information for senior leadership. Their contributions have been widely recognized within the Department of Defense.

Patricia Maloney

Patricia Maloney, principal director, Systems Development Ops and Protection Directorate, will be honored by California State University, Northridge (CSUN) on April 29 at the CSUN 2017 Distinguished Alumni Awards. The awards will recognize three individuals in different fields who personify the university's tradition of excellence and who bring distinction to themselves and to CSUN through their outstanding achievements.

Maloney is being honored for being "a dynamic leader, having directed the business, economic, and marketing side of science and technology worldwide."

April 2017 Obituaries

by **Christine T Kato**
April 01, 2017

Sincere sympathy is extended to the families of:

Lila Heidbrink, member of administrative staff, hired Oct. 11, 1960, retired Sept. 1, 1988, died March 26, 2016
Nicholas Kfoury, member of technical staff, hired April 18, 1977, retired Oct. 1, 1994, died Dec. 26, 2016
Geraldine Madison, office of technical support, hired Aug. 1, 1961, retired April 1, 1995, died Dec. 26, 2016
Joann Oestreich, office of technical support, hired Feb. 17, 1981, retired Feb. 1, 1995, died March 17, 2017
John O'Leary, member of administrative staff, hired Jan. 9, 1961, retired July 1, 1987, died March 2, 2017
Donald Schacker, member of technical staff, hired Sept. 8, 1970, retired May 1, 2001, died March 2, 2017
Norman Stahlberg, member of technical staff, hired Nov. 5, 1973, retired Sept. 1, 2014, died Nov. 16, 2016
Theodore Taylor, member of technical staff, hired Dec. 2, 1965, retired Jan. 1, 1989, died Feb. 16, 2017
Helene Uno, office of technical support, hired Aug. 30, 1979, retired May 1, 1989, died Aug. 2, 2016
Richard Van Vranken, member of technical staff, hired April 6, 1962, retired Jan. 1, 1990, died March 7, 2017
Hillard Wachowski, member of technical staff, hired July 9, 1962, retired Aug. 1, 1987, died Nov. 25, 2016
Donald Young, member of technical staff, hired Aug. 17, 1981, retired March 1, 1986, died Feb. 24, 2017

To notify Aerospace of a death and have it included in the Orbiter, please contact Human Resources at 310-336-5107.

April 2017 Notes

by **Christine T Kato**
April 01, 2017

Notes of appreciation to fellow employees and Aerospace for thoughtfulness and sympathy have been received from:

Virginia and Tim Bixler (parents) and **Damon Rogers** (uncle) on the recent passing of Brian Bixler.
Carole Mulchinski on the recent passing of her mother, Carol Mulchinski.
Jess Rivera on the recent passing of his father, Caferino Rivera, Sr.
Bernard Vecerek on the recent passing of his mother-in-law, Ara Terlecky.

To submit a note of appreciation to Aerospace, please contact Valerie Jackson in People Operations at 310-336-0891.

April 2017 Anniversaries

by **Christine T Kato**
April 01, 2017

40 Years

Defense Systems Group

Reinhold Bauer

Engineering and Technology Group

Ana Rubio, Richard Casten

Space Systems Group

Jay Bernard

35 Years

Engineering and Technology Group

Thomas Hayhurst

Operations and Support Group

Jeffery Bolton

30 Years

Defense Systems Group

Mark Hopkins, Robert Davis

Engineering and Technology Group

Inki Min, Joseph Bagamery

Enterprise Information Services

Luz Blurfrushan

National Systems Group

Gwendolyn Rogers

Space Systems Group

David Truong, Travis Lemle

25 Years

Engineering and Technology Group

Donald Rudy

20 Years

Engineering and Technology Group

Brandon Wong, Isha Browne, Yenyih Ni

Enterprise Information Services

Lauresa Stillwell

National Systems Group

Jason Feig

Operations and Support Group

Krista Drew

Space Systems Group

David Crilly, Harn Chen, John Cadou

15 Years

Engineering and Technology Group

Jerome Fuller, Jonas Racys, Lee Steffeney, Rachael Galvan, Thomas O’Brien

National Systems Group

Frank Pisano

Space Systems Group

Charles Donahue, Kamran Aslam

Vaeros

Violet Barghe-Sharghi

10 Years

Defense Systems Group

Craig Mahan

Engineering and Technology Group

Benjamin Hayes, Harriet Mizuno-Moyer, James Hoffman, Kalyani Rengarajan, Michael Benson, Nicholas Cohen, Richard Deigan

Executive Offices

Marcus George

National Systems Group

David Wangerin, James Harrell, Leif Aamot, Rhett Breeden, Sara Thomas

Space Systems Group

Clifford Harris, Douglas Rothnie, Katie Feistel, Stephen Huibregtse, Trina Galloway

Vaeros

Douglas Daniels

5 Years

Operations and Support Group

Melissa Parsons, Wayne Clevenger

Space Systems Group

Angie Wang

Vaeros

James Rosenbauer, Russell Brucker

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