



Three Kansas research universities collaborate on future space technology

“The first important thing for people to know is that all three universities are working together—it takes a lot of teamwork in engineering,” according to Melanie Derby, assistant professor of mechanical and nuclear engineering at Kansas State University.

Derby is part of the teamwork awarded a \$750,000 NASA EPSCoR research grant last spring to Wichita State University, along with Kansas State University and the University of Kansas. The goal is to develop smaller and more efficient heat and water management systems for use in space. The three universities also provided a \$380,000 grant match, including faculty and student research time and lab use.

Increased electronic demands in small, closed spacecraft systems necessitate development of better technologies for efficient and compact cooling and water recycling systems. NASA has used liquid-

vapor, phase-change-based systems (based on the cycle of evaporation and condensation) but these systems can be bulky, limited, expensive and complex.

Developing a better system relies on expertise in several fields—thermofluid sciences, advanced manufacturing and image-based diagnostics, according to project lead Gisuk Hwang, WSU assistant professor of mechanical engineering. Along with colleague Rajeev Nair, assistant professor of mechanical engineering, they are developing a new capillary structure manufactured with a process called laser-based adaptive sintering. This is a type of 3-D printing that uses computer-generated drawings to produce parts in minute detail.

The aim is to use the principle of capillary action to produce next-generation results.

An illustration of capillary action is when one touches a water spill

with the edge of a paper towel—the textured, porous surface wicks away the moisture. Similarly, wiping with a rough towel after a shower dries and cools the body much quicker than a smooth towel would.

Using this principle in a loop heat pipe (typically used in microgravity for cooling) which is lined with bimodal wicks (complex, textured, porous micro particles combined into larger structures) would give larger evaporative areas compared to typical heat pipes. The wick provides capillary action to circulate the working fluid. Copper is the metal used as it conducts heat quickly to enhance heat removal.

“One thing that makes this project special is the tailoring of the wick to the circumstance. You need a different size if you want to bring liquid to a boil than if you want to condense it,” said Derby. They

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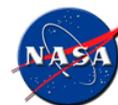
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Interstellar symposium and propulsion workshop to come to Wichita in 2019

A long-held dream of our Ad Astra Kansas Foundation is coming to pass—Kansas will be the site of an interstellar symposium and propulsion workshop.

In collaboration with the National Aeronautics and Space Administration (NASA), the Tennessee Valley Interstellar Workshop (TVIW) will hold its 6th Interstellar Symposium and Interstellar Propulsion Workshop—hosted by Wichita State University (WSU) and Ad Astra Kansas



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Galaxy Forum goes to both ends of solar system



The 2018 Galaxy Forum on August 11 at the Cosmosphere attracted attendees of all ages. They came to listen to three presentations. Dr. Tom Cravens and Stephen Houston of KU spoke on “From the Cosmos to the Solar System and Outer Planets.” Caleb Gimar of WSU gave a presentation “Exploring the Sun: Inside and Out.”

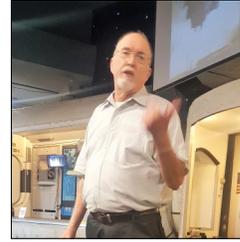


Photo credits:
Steve Durst

Ad Astra Kansas Space Celebration soars



A sunny October 13 afternoon and an only-partly-cloudy evening at Stoffer Science Hall on the Washburn campus in Topeka laid the groundwork for over 200 to enjoy almost 20 STEM activities and view Mars in the Crane Observatory. Attendees also received a surprise visit from Luke Skywalker and friends. Winners of two family passes to the Kansas Children’s Discovery Center in Topeka were Alexander Derobles and Rachel McDonald.



This fun and educational event was possible through the generous cooperation of:

- Washburn U Dept. of Physics and Astronomy
- Washburn U. Chemistry Dept. / Chemistry Club
- Washburn U. Dept. of Education,
- Northeast Kansas Amateur Astronomy League
- Kansas Children’s Discovery Center
- K-State Department of Food Science
- KS-DOT / American Society of Civil Engineers
- Foundation for Aeronautic Education
- Dr. Jerry Manweiler
- Madison Sargent
- Space Age Publishing Company,
- Star Wars Imperial Costuming Group / 501st Legion
- Wichita Society of Women Engineers
- and many others.

Photo credits, Kevin Boatright, Hadeel Al-Nammari, and Jodi Spindler

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Foundation from Sunday, November 10 through Friday, November 15, 2019 in Wichita.

In addition to a plethora of professionals, the event is expected to attract others such as space enthusiasts, educators and science fiction writers, according to Nick Solomey, head of the symposium organizing committee, professor of physics at WSU and Ad Astra board member.

Other WSU organizers include professors Atri Dutta and James Schwartz. Local Ad Astra Kansas Foundation board members Vicki Johnson and Jeanette Steinert are also on the organizing committee.

“This will bring a national focus on space science to the Ad Astra State and is an op-

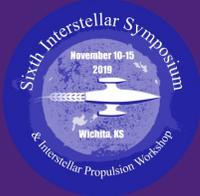
portunity to bring Kansas research and innovative thinking to a national, even international audience,” said Steinert.

Abstracts are now being requested for presentation in either of two categories:

The NASA Workshop on Interstellar Propulsion will focus solely on physics-based propulsion technologies that have the potential to meet the goal of launching an interstellar probe within the next century.

The Interstellar Symposium will focus on all other aspects of interstellar travel except advanced propulsion technologies covered in NASA’s workshop.

The link for abstract submission is below:



The 6th Interstellar Symposium and Advanced Interstellar Propulsion Workshop, presented by the Tennessee Valley Interstellar Workshop (TVIW) in collaboration with the National Aeronautics and Space Administration (NASA) and hosted jointly by Wichita State University and Ad Astra Kansas Foundation, will be held in Wichita, KS on November 10-15, 2019. There will be more information on the content of this symposium as it becomes available, but we are now opening a call for papers to be presented at this symposium. To submit an abstract for consideration, please do so [here](#).






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hope to customize the results for various circumstances. There are challenges.

An important one is no gravity in space. “We can’t use gravity in testing—we have to be smart in how we design the tests; one way is to go horizontal in designing them. This can be used to make space systems more compact and lightweight, since capillary action gets stronger as size goes down,” said Derby.

Derby, along with K-State associate professor of mechanical and nuclear engineering Amy Betz, K-State lead on this project, will be trying to figure out how can they use these textured structures to cool electronics and harvest water from the air. How can they make water evaporate more efficiently and how can water be captured more efficiently to be recycled?

Another challenge is that these opaque structures do not allow visualization of water behavior, according to Hwang. To handle that, Xianglin Li, assistant professor of mechanical engineering at KU, will do image-based diagnostic work using x-ray microtomography to do math and computer-based modeling of the process.

Research is being done in conjunction with NASA Jet Propulsion Laboratory and Glenn Research Centers and two Kansas companies, WireCo, Inc. and Cargill, Inc.

Uses for this technology on earth include sustainable energy, environmental systems, and food production fields.

Not only is this new research collaboration of the three universities in Kansas important for this project, “it will stimulate research activities and empower a future STEM workforce to resolve research challenges for NASA over the next 30 years,” said Hwang in his proposal abstract.

The grant will also support engineering outreach activities with the partner universities and the Cosmosphere. This combination of research-based outreach and educational programs will have an impact far beyond its allotted three years.



“I imagined my first trip to outer space would be memorable. I just didn’t expect it would be this memorable...it was one wild ride—”

Kansas astronaut Nick Hague about the failed rocket launch to the ISS on October 11.

To view a video of his NASA media conference on October 16, go to [NBC interview](#)

INTERSTELLAR R & D

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**We're on the web!
and
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This "Interstellar R&D" thirty-fourth feature in the Ad Astra Kansas News these past 17 years continues an enterprise to research and gather information on important developments preparatory to humanity's greatest adventure—voyaging to the stars. Now, at the millennium's turn, is an appropriate time for grand vision and forward thinking, and there are strong signs of a renaissance in interstellar travel thought and activity. This feature and newsletter, thus, now set forth to develop a national / international / global clearing center and storehouse of knowledge and know-how for travel to the stars: Ad Astra—Galactically, Steve Durst

Observation

New Hubble-Lemaître Law IAU 2018 Resolution B4

The newly-proclaimed Hubble-Lemaître law is the result of intense discussion at the International Astronomical Union 30th General Assembly in Vienna, 20-31 August 2018. Resolution B4 was proposed to rename the Hubble law as the "Hubble-Lemaître law" to recognize Lemaître's research on the expansion of the Universe, and to pay tribute to both Georges Lemaître and Edwin Hubble for their most fundamental contributions to modern cosmology. A non-binding poll at the concluding session of the IAU GA indicated 74% of the 385 attending individual Members agreed with Resolution B4. Given the importance of the Hubble law, the IAU Executive Committee decided to put Resolution B4 to an electronic vote of all IAU Members, with voting to conclude 26 October 2018.

According to historical sources, Lemaître and Hubble both attended the IAU 3rd General Assembly in Leiden in 1928, where they exchanged ideas on the perceived correlation between the distance and radial velocity of extragalactic nebulae. This developing realization led to the scientific theory of the expansion of the Universe and the then-named Hubble law ($V = H_0 D$) and Hubble constant (H_0), with galaxy redshift / recession of 71 km/s per megaparsec (as now determined with WMAP data).

The IAU B4 Resolution is a significant precedent for revising century

-old conventions when both science and society require updating to advance astronomical accuracy and social betterment, as should be the updating of the Precession-advanced Aquarius equinox epoch.

Communication

In their paper, Interstellar Mission Communications Low Background Regime, Philip Lubin, David Messerschmitt, and Ian Morrison discussed interstellar communications using low-pass probes accelerated to relativistic speed by a ground-based beam that would have wavelengths designed to work with varying probe speeds. Data would be transmitted back to Earth via optical communication downlink. For data to be transmitted from Proxima Centauri which is 4.243 light years away, we would need to design Earth-based large-area aperture receivers and build highly selective optical bandpass filters to reduce radiation from target star.

Authors suggested using spread spectrum modulation to design these receivers. Spread spectrum is used in digital wireless terrestrial radio systems. Due to its wider bandwidth, spread spectrum would reduce ambiguity in interstellar communication, and parameters like bandwidth and carrier frequency will be easily determined. The authors believe that using spread spectrum modulation techniques for interstellar communication suggests a promising new direction in this field.

Transportation

In "Roadmap to Interstellar Transportation", UC Santa Barbara Professor Philip Lubin discussed some of the challenges for propulsion systems for interstellar transportation. We need to achieve relativistic speeds and design systems to transport varying masses from sub grams to scalable, larger weights. Factors that would moderately help design better systems include improving laser efficiencies; these are now above 50% - increasing efficiencies to 80% or more would help design more reliable systems. However, factors that would revolutionize transport include free space phase control over big distances and reflector stability during acceleration.

Transportation in space requires reducing the weight and improving efficiency of radiators; current radiators have a mass to radiated power of 25 kg/kw, for radiated temperatures near 300K. Improving these efficiencies over the next 5 years would help design better systems for space deployment. Lubin works with NASA Innovative Advanced Concepts (NIAC) on Directed Energy for Interstellar Missions. His paper, Interstellar WaferSats, outlined sending several wafer scale craft with a range of sizes and instrumentation to Alpha Centauri; sizes would vary from 1 gm to 1 kg and would be designed to reach destination in about 100 years.