AD ASTRA KANSAS FOUNDATION

AD ASTRA KANSAS

Volume 16, Issue 1 Spring 2017

Points of Interest about Science Festivals

- They are NOT science fairs. They showcase science/tech in fresh, relatable ways.
- The key ingredient to a successful event is the presence of scientists, engineers or other STEM practitioners to engage with festival attendees.
- Results of a recent study showed that from 22-39% of attendees had never asked a question of a STEM practitioner before the festival.
- Afterwards, 69% looked up info on what they had learned.
- Also, 64% reported taking part in activities related to what they had learned.
- Source: Journal of Science Communication

Inside this issue:

From the editor	2
TRAPPIST-1: ultra cool and ultra complicated	2
KSU public lecture geared towards solar eclipse	2
Astrobiology research at GSFC engages WSU student	3
Interstellar R & D	4

The Ad Astra Kansas Foundation is co-recipient of science festival grant

TOPEKA—The Science Festival Alliance has awarded the partnership of the Ad Astra Kansas Foundation, the Visit Topeka! and 712 Innovations organizations up to $10,000 in matching funds to expand science festival learning in Topeka in 2017.

Awarded as an accelerator grant in December by the SFA, this is one of only nine such awards for 2017. The award also includes $3000 in professional development resources plus attending and learning from other science festivals.

In October 2016, Ad Astra scheduled its eighth annual evening space celebration to coordinate with the daytime first-ever Topeka Science & Technology Festival, providing a double-barreled day of fun and learning for attendees.

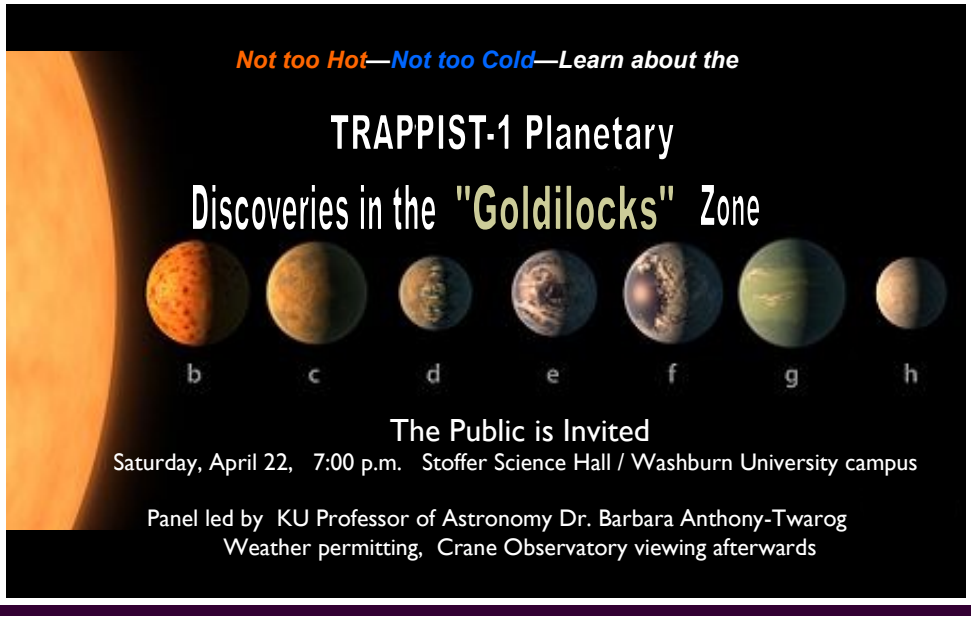
The success of this event prompted a request from the SFA, headquartered at the Massachusetts Institute of Technology Museum, for an accelerator grant application. The grant is funded by the Alfred P. Sloan Foundation.

In 2017, the Topeka Science & Tech Festival in conjunction with the Ad Astra Space Celebration will be held on the weekend of October 14 in downtown Topeka and at Washburn University.

The mission of the Ad Astra Kansas Foundation is to promote and encourage youthful interest in STEM (science, technology, engineering and math) in Kansas by highlighting the space sciences.

Funds donated or pledged for this

Cont. "Science" page 3



FROM the Editor:

Hello all:

In performing our mission of outreach in STEM through the space sciences, and in looking for resources, we find there are more educational activities of that type going on in Kansas than one realizes—from astronomy outreach events throughout the state to Winfield Public Library's recent massive and amazing DISCOVER NASA "From Our Town to Outer Space" agenda of programs and events from February thru April. (Still a few events left. Click on Discover NASA).

And often, we find out about it when it is too late to help spread the word.

Of course, our main focus is our organization and mission, but in doing so we are also glad to pass on info about an upcoming event. If you have an outreach event, we will be glad to post on our website, include in our newsletter or other outreach avenues as we can. So, please include us in your press releases. Send to contact@adastra-ks.org

Ad Astra,
Jeanette Steinert

Trappist -1 system is ultra cool and ultra complicated

To whet readers' appetites for the upcoming Ad Astra Kansas public lecture on the Trappist-1 system, we asked a few questions of one of the expert presenters, KU physics and astronomy major Daniel Brossard

What is an ultra cool star?

It is a star just barely large enough to sustain hydrogen fusion in its core. It is right on the edge between an actual star and a brown dwarf, which is the intermediate state between a planet and a star. The bottom limit for actual stars is about 8% the mass of the sun. For a size comparison, that's a little more than 80 times more massive than Jupiter. Despite being more massive than Jupiter, it is a lot denser than any gas giant would be. Since they are so small and cool this star will have one of the longest lives in the universe—up to 1 trillion years.

Is this an unusual star / sun to have at the center of a solar system?

Not really. There are many examples of red dwarfs having planetary systems. One thing nearly every red dwarf has in common is that their planetary systems tend to be compact, raising the chances of their planets being in the habitable zone.

There are challenges to the planets around such stars though. Being so small and cool, in order for them to be in a habitable zone the planets themselves have to orbit well inside the orbit of Mercury. So their years would be a matter of a few Earth days up to a few tens of Earth days. And being so close to their parent star makes them vulnerable to being blasted if their star is a flare star.

These close orbits also likely mean the planets are tidally locked; so only one side ever faces its star. One side would be constantly baked and the other shrouded in darkness, causing large temperature differences. A likely habitable strip would be right along the edge between the light and dark sides of the planet, where the temperature could be comfortable for Earth-like life, just in an eternal state of twilight. This is assuming the planet has retained its atmosphere.

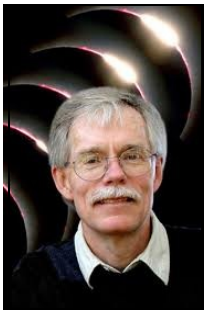
What are the habitable aspects hardest to find in space?

It depends on what you consider a requirement for habitability. If surface temperature is the ultimate decider, then we already have quite a few planets that spend at least a fraction of their orbits in a habitable zone and potentially many more bodies, either planets or moons that could support the right temperature conditions under layers of ice like Europa.

If liquid water is the deciding factor, then we might have to look harder. Although water appears to be very common in the universe, not all of it will be in the right conditions.

Other factors include a suitable atmosphere. Or more controver-

Cont. "TRAPPIST-1" page 3



Fred Espenak is known as "Mr. Eclipse" because of his 45 years of researching eclipses.

KSU public lecture geared towards total eclipse / astrophotography

MANHATTAN—Interest in the August 2017 total eclipse of the Sun is all one needs to enjoy KSU's upcoming Neff Public Lecture in Physics.

Retired NASA astrophysicist Fred Espenak will deliver "The Great American Total Eclipse of 2017" on Tuesday, April 11, at 4:30 p.m. in Room 101 of Cardwell Hall at Kansas State University.

The lecture will be at a non-technical level and all are invited to attend. Those unable to attend will find a livestream of the program as well as an archived version at www.phys.ksu.edu/alumni/neff/2017

Espenak will also host an astrophotography workshop in Cardwell 101 at 3 p.m. prior to the lecture.

Astrobiology research at Goddard Space Flight Center engages WSU physics major

Sure—the possibility of finding extraterrestrial life is intriguing—but that was not what drew Mark Sutton to astrobiology.

It was the multidisciplinary aspect of that field.

Though he started in biochemistry at Newman University, Wichita, his first course in physics piqued his interest in more than just one discipline. "I wanted to know how the world works, from the atom to the organism. Astrobiology requires a working knowledge of biology, chemistry, physics, geology, astronomy and beyond," says Sutton.

Now a physics major at Wichita State University, this past summer he served as a research associate in astrobiology at Goddard Space Flight Center (GSFC).

His task was evaluating a new kind of instrument in astrobiology for spaceflight: a DNA "nanopore" sequencer called the "MinION". About twice the size of a flash drive it can be plugged in to a laptop. One went up recently to the ISS and passed its proof-of-concept in zero gravity test.

In its sequencing process, single biological molecules (such as a DNA strand) flow through a hollow protein nanopore embedded in the MinION. As the ionic solution flows through the nanopore, changes in the current (denoting variations in the molecules) are measured. As data streams continuously, real-time analysis can be performed. One application could be to assess crew's health.

Research in the field is still young, but one major hurdle is already clear. "It's hard to get the DNA into the purified form needed to prepare a sample for analysis in the sequencer," says the Oxford, Kansas, native.

"What makes this technology particularly interesting is that, at least in principle, it could also be adapted to detect/sequence not only DNA, but other polymers of similar structure that might have been adopted by a second genesis of life. These similar, yet distinct, polymers are collectively referred to as XNA," says Sutton.

He is back at GSFC now until August as a full-time contractor, after which he will return to WSU. His research from last summer continues with added responsibilities in the mass spectrometry field, one of GSFC's specialties. Mass spectrometry instruments are used to determine the chemical composition of a sample and have been used to analyze the atmospheres and surfaces of other planets and moons in our solar system. Sutton will be working on a secondary project using these techniques to investigate origins of life on earth and study the chemistry of the early earth. "Astrobiology is the study of life in the universe, including that which lives right here on Earth. Understanding how life works on Earth is paramount in the search beyond," says Sutton.

Sutton is also minoring in biology, chemistry and math, which brings him back to the reason he got into astrobiology in the first place.

"I get the most pleasure out of seeing two or more different subjects come together to solve a problem that I wouldn't have been able to solve if I only had knowledge in one field," he says.

WSU physics senior Mark Sutton is on his second stint at GSFC doing astrobiology research.

"TRAPPIST-1" from page 2

sially, is a large moon a requirement? Without our moon Earth's climate would be much more wide, as we wouldn't have a nice stable tilt at 23.5 degrees. So our tilt would change more and we would have many more bizarre climactic periods in Earth's history.

Yet another unknown factor is whether a planet like Jupiter in an orbit similar to Jupiter's is a requirement for life to develop. On Earth Jupiter has sort of played a role as a guardian of Earth. It sweeps up a lot of comets coming in from the outer reaches of the solar system, potentially saving Earth from many more mass extinctions.

What are the next steps in the exploration of these planets?

We already have mass and radius measurements for the planets, so the most likely next step would be trying to get some measurements of their atmospheres. If we can determine there is water vapor or oxygen in any of their atmospheres, we can start considering them highly likely to be habitable. This goes especially true for oxygen, as we don't currently know of any natural phenomenon that produces large amounts of oxygen gas besides biologic processes.

Cont. "Science" from page 1

event will be matched.

Also, we are looking for individuals, groups or organizations willing to share their enthusiasm for their STEM fields with festival-goers with displays, demos, interactive or other creative activities.

Anyone interested in sponsorship of or participation in this exciting event in any way please contact jeanettesteinert@att.net

AD ASTRA KANSAS SPACE CELEBRATION

INTERSTELLAR R & D

Ad Astra Kansas News

Published through the
Ad Astra Initiative of
Space Age Publishing Company
230 California Avenue #108
Palo Alto, CA 94306

Editor/Publisher: Steve Durst
news@spaceagepub.com
Managing Ed: Jeanette Steinert
jeanettesteinert@att.net
Webmaster: Ken Moum

We're on the web! and facebook

This "Interstellar R&D" thirty-first feature in the Ad Astra Kansas News these past 16 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—Steve Durst

Observation

Seven Worlds of Trappist-1 and Starlife Possibilities

Trappist-1 is an ultra-cool dwarf star, about as large as Jupiter and some 10% the size of our Sun, located 39.5 light-years away in the direction of the Aquarius constellation.

Trappist-1 (T-1) is orbited, and transited, by at least 7 Earth-size planets, all with rocky composition, possibly hosting liquid water on their surface, with at least 3 in the 'Goldilocks' or 'habitable' zone.

Three planets of the T-1 system were first discovered in 2015 by astronomers led by Michael Gillon at the University of Liege in Belgium using the Transiting Planets and Planetesimals Small Telescope (TRAPPIST) at the La Silla Observatory in Chile. Additional planets were then identified using TRAPPIST and the Spitzer Space Telescope, the Very Large Telescope, UKIRT, the Liverpool Telescope and the William Herschel Telescope.

"This is the first time so many planets of this kind are found around the same star", confirmed Gillon, providing humanity the most promising opportunity to discover evidence of life beyond the Solar System.

Ultra-cool stars are the most frequent kind of star in our Galaxy. Choosing to study common stars, the TRAPPIST team discovery of T-1 Earth-like planets may enable understanding of the frequency that biology has emerged in the Cosmos. Ultra-cool stars are small. Their small size results in transit signals produced by Earth-sized planets that are 80x more pronounced compared to similar planets transiting a Sun-like star. The transit signals allow calculation of the orbital periods, sizes, masses, densities, climates and atmospheres of the terrestrial-like planets beyond the Solar System, which were found to be comparable to Earth and Venus in size, mass, and light received. The 4th, 5th and 6th T-1 planets lay in the habitable zone, where oceans could be supported.

Study of the T-1 system is just beginning, and is being enhanced with the repurposed Kepler K2 satellite observatory and additional Spitzer observations, which may detect more T-1 planets. Soon the Hubble Telescope will make first attempts to detect the atmospheres of the T-1 planets, followed by James Webb Space Telescope and EELT deeper investigations and spectroscopic analysis of the atmospheres' chemical composition. They may also be able to assess greenhouse gas content and biosignatures like ozone and methane and confirm if life may be present.

Communication

Icarus Interstellar Communications Design

Icarus Interstellar is an international project aiming to design humankind's first interstellar communications mission as a global effort.

Project Icarus was initiated by the British Interplanetary Society (BIS) and the Tau Zero Foundation (TZF) and is currently being managed by Icarus Interstellar Inc., a nonprofit foundation. During a recent Icarus meeting to study interstellar communications, scientists included Robert Freeland, Nathan Morrison, Lukas Schrenk, Bruno Doussau, Matt Johnson and Larry Papincak. The group initially considered using lasers to communicate between Earth and Alpha Centauri. However they concluded that using radio frequency seems likely to be the only viable approach because using lasers would be very difficult due to the very accurate pointing precision needed for laser communications.

This meeting's proposed interstellar communications design was by Peter Milne (and provided by Robert Freeland) and required a one kilometer diameter antenna at the Alpha Centauri end and a 40 kilometer diameter antenna on Earth. They debated whether both antennas could be in mesh form, or solid form, and whether the remote antennas would be built in space, or constructed from materials extracted and refined in space. The idea of using an array of smaller antennas was also considered. No conclusions were reached, but more discussions of interstellar communications will continue at Icarus Interstellar. To find out about future interstellar communication discussions at Icarus, please visit http://icarusinterstellar.org/

Transportation

Icarus Project Tin Tin and Icarus Project Forward

Two Icarus Interstellar transportation studies include Project Tin Tin and Project Forward. Project Tin Tin aims to launch the first interstellar spacecraft to Alpha Centauri by the end of this decade.

In the 2012 paper "Interstellar Nanosat Mission to Alpha Centauri" presented at the 63rd International Astronautical Federation, Dr. Andreas Tziolas and other Icarus Interstellar scientists discussed their theories and prototypes for an interstellar precursor mission using a 10 kg Cubesat. Their paper included a discussion of the cost-effective technologies and innovative design of Cubesat missions to accomplish this. Dr. Tziolas described the concepts for design and launch of a set of nanosat-sized spacecraft, or "Tins" and how they will be used on a flight to Alpha Centauri.

Icarus Interstellar Project Forward to be continued in future issue.