

HAVE STARSHIP, WILL TRAVEL

The Newsletter of the Tennessee Valley Interstellar Workshop



Step by Step: Building a Ladder to the Stars
Celebrating the 2017 TVIW Symposium



Have Starship, Will Travel

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Issue 13
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Welcome back!

We are about a month out from TVIW 2017, and we hope that all those that were able to join us in Huntsville for the symposium have fully recovered. For those of you that were not able to join us this year, we sure hope you are able to attend our next symposium scheduled for spring of 2019.

Issue 13 of Have Starship, Will Travel will be dedicated to TVIW 2017. For us all to relive the fun we had, and to share that with those that could not join us this year.

NEWSLETTER CONTENTS

TVIW 2017 Wrap-Up	2
Closing Remarks from TVIW 2017 by Paul Gilster	4
TVIW 2017 Stories: From Finland to Huntsville in a Tweet	6
TVIW 2016 Proceedings.....	6
Pushing the Interstellar Agenda: Buy an e-car, mine an asteroid.6	
Use AmazonSmile to Benefit TVIW	8

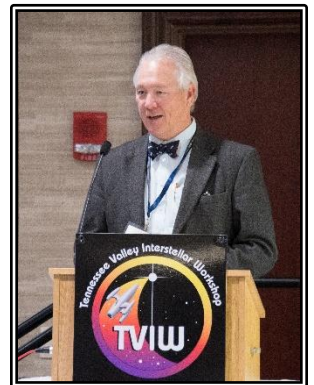
TVIW 2017 WRAP-UP

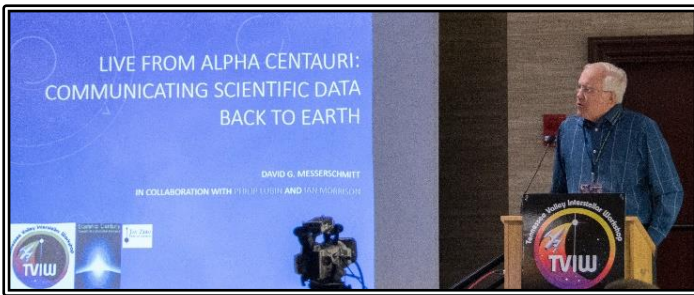
TVIW 2017 has come and gone, but what a great symposium it was. The seminars on Tuesday were very popular, with people showing up at the door to attend. After a slight hiccup, the tour to the United Launch Alliance rocket plant was enjoyed by all.



Tuesday night's opening reception was once again sponsored by Baen Books and hosted by Toni Weisskopf. With an over-the-top buffet, it started the symposium out with a bang. The collage below captures just some of the fun.

Wednesday followed the theme of Breakthrough Star Shot with presenters sponsored by Starship Century. Starting the day was Pete Klupar speaking on 'Are We Alone?' [shown in the image at right]. Several other speakers from Breakthrough Star Shot included: the Breakthrough Star Shot System Model and Trade Studies by Kevin Parkin; the Star Shot Laser Driver by Robert Fugate; Our First Starships: Sails & Payloads for Star Shot by Jim Benford; and Data Return from Star Shot Probes: Live from Alpha Centauri by David Messerschmitt [shown on the following page].





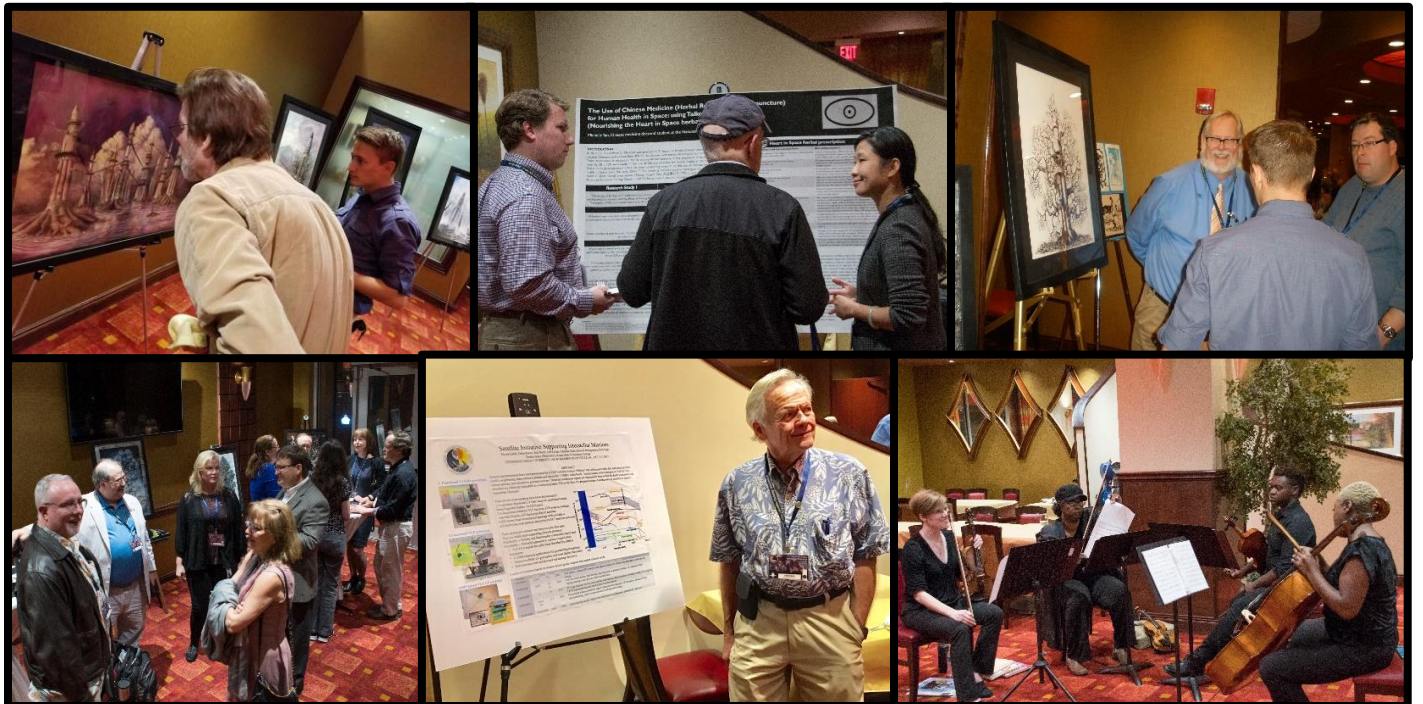
After lunch, the attendees split into smaller groups. Many went to the three working tracks: Planning for First Contact/SETI (led by Scott Guerin and Ken Wisian); The Evolving Role of Security & Intel in Space (led by Robert Hampson); and Step by Step to the Stars (led by Doug Loss). Others went to the first installment of the Sagan Meetings: Likelihood of Biosignature Detection in the Spectra of Exoplanets. The remainder attended the free-form Discussion Groups covering a variety of topics. The image on the left illustrates the participants of a working track diligently solving an interstellar challenge and the image on the right illustrates a discussion group vigorously debating a precursor to interstellar spaceflight.



Wednesday evening, we had a reception for our Artist Guest of Honor, Chris Wade. Chris began his current series about three years ago after a series of recurring dreams of finding abandoned rockets and realizing the profound symbolism in these dreams as related to his own life. In the hotel's atrium and restaurant, the symposium participants gathered to enjoy the art and learn from a

stimulating poster session. The Valley Conservatory provided the lovely background music of a string quartet.

Thursday highlighted speakers brought in by Tau Zero Foundation following the theme of Pioneering Interstellar Flight. Two of these speakers were Marc Millis, discussing Tau Zero's intriguing NASA grant, and Jeff Greason, discussing magnetic solar sails, featured in the below images, respectfully. Thursday evening brought everyone to the US Space and Rocket Center for German food under the Saturn V. Andrew Siemion spoke on 'The Search for Ourselves Among the Stars', as part of the Pass the Torch lecture series. It proved to be a wonderful talk in an energizing atmosphere.

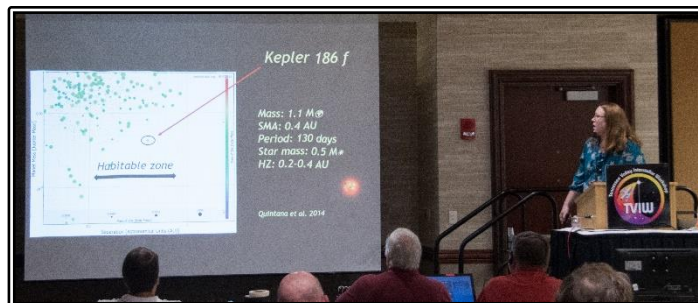


The final day's featured presentations followed the theme of First Step on the Journey, sponsored by TVIW. A Leadership Panel started the day vigorously. Moderated by Pete Kluper of Starship Century, shown at the far left of the first image below, the panel featured Dr. Paul McConnaughey (Associate Director, NASA MSFC), Rep. John Culberson (R-TX), Rep. Mo Brooks (R-AL), and Gen. Steven Kwast (Air University, MAFB), in order from left to right. The panel covered the present views from Washington and NASA as well as Gen. Kwast advocating for more involvement by America in space endeavors.



Following the panel, Friday's speakers covered a variety of topics from exoplanets to solar sails. The working tracks and Sagan meeting met for a last time, and the tracks provided concluding reports on their efforts. Paul Gilster gave an amazing sum up of the symposium. An excerpt of that is provided below as well as a link to access the full work. After dinner, the participants as well as members of the general public returned for the SciFi Writers Panel. This event was well attended and many books were shared afterwards in the autograph session.

The video archive containing the 2017 presentations can be found at tviw.us/2017-presentation-video-archive/.



CLOSING REMARKS FROM TVIW 2017 BY PAUL GILSTER

*We are delighted with the opportunity to share some excerpts from the closing discussion given by **Paul Gilster**, Tau Zero Social Media Director and writer/editor of Centauri Dreams. His full dedication is at <https://tviw.us/2017-symposium-summary/>.*

Somewhere around the 6th Century BCE, a man named Lao Tzu, an almost legendary philosopher and writer, purportedly produced the book known as the Tao Te Ching, a fundamental text of Taoism and Chinese Buddhism. This year's Tennessee Valley Interstellar Workshop arrived made to order for Taoist thought, with its theme "Step by Step: Building a Ladder to the Stars." Because for years I've used as the line on my digital signature the Tao Te Ching's aphorism: "You accomplish the great task by a series of small acts." Confucius, who may have known Lao Tzu, would echo the same philosophy.

As anyone paying attention to this year's sessions learned at the beginning, many of the acts we are trying to accomplish are anything but small. A 100 GW laser array is not small either in concept or in physical dimension. A sail five meters to the side is small by many earlier standards, but what we discuss doing with it, a mission to the nearest star, is not small, nor is the exploration of the outer Solar System — with precursors fueled by fusion or driven by plasma sail — a small accomplishment. But conceptualizing each of these things, one at a time, that is a series of small steps, and we need many such steps.

The emergence of Breakthrough Star Shot clearly changes the game for everyone in the interstellar community. We have a congressional subcommittee report that 'encourages NASA to study the feasibility and develop propulsion concepts that could enable an interstellar scientific probe with the capability of achieving a cruise velocity of 10 percent of the speed of light.' I doubt seriously that that phrasing would have emerged without the powerful incentive of the funding provided by Breakthrough, nor would the Tau Zero Foundation's recent grant.

We're on new terrain that is a long way from where we once were, in the days when there were few interstellar meetings as such and most discussions among those of an interstellar bent happened at occasional get-togethers in meetings on largely different subjects. Today we have a community and, if it is one with a pointing problem in terms of how often it meets and how well it stays focused, it is at least one with high energy levels and a steep drive to succeed.

TVIW 2017 gave us a range of focused sessions which I have chosen to group, trying to avoid being too arbitrary, into loose themes. Pete Kluper gave us the Breakthrough overview, which includes the welcome and related work of both Breakthrough Watch and Listen, a reminder that we must gain more information about the target of our mission, and indeed decide whether there may not be an even more attractive target near Centauri A or B. The welcome news that the RFP process has begun with work on

the project's laser array shows us a community with an actual interstellar project seriously defining the parameters of a mission.

Here we are in the larger realm of vision, as Andrew Siemion reminds us when he tells us that we search for ourselves as we venture to the stars. We also, whether or not we send Star Shot sails on their journeys in 40 or 50 years, define the limits of our present technology and infuse the entire enterprise with an unprecedented prospect of well-funded trade studies. The interstellar enterprise advances whether or not Star Shot's sails launch to Centauri, and who can say what spinoffs we won't gain from the effort in the interplanetary arena with its tools.

On the matter of overview, let me mention Marc Millis' discussion of the Tau Zero grant from NASA, which as I mentioned derived from the impetus of the Star Shot initiative. Comparing propulsion approaches to take us through what Millis calls the era of precursors, the era of infrastructure and the non-extrapolatable future helps us identify the critical issues that need study, just as Star Shot itself helps us locate, one by one, the major problems we need to solve for a specific mission concept. What we do need to be wary of is premature lock-in when competing methods for doing interstellar missions remain very much on the table.

Meanwhile, the inputs from the broader community continue. Al Jackson showed us an analysis of trajectories for a Star Shot probe, and we're reminded by Benjamin Diedrich, who has been working with the NEA Scout mission, that we can learn much from a mission with a much different objective, and one with the ability to apply guidance and control forces that our Centauri-bound sail will be unable to muster. Congratulations to Diedrich and particularly Les Johnson for the recent successful deployment tests of the NEA Scout sail.

Let me also mention the Sagan session on detecting life through biosignatures in planetary atmospheres in which I spoke along with Greg Benford and Angelle Tanner. This is by way of looking at what we can learn about nearby stars, the fact being that nearby red dwarfs are going to be under intense scrutiny by the James Webb Space Telescope, and we have the possibility of detecting gases like oxygen and methane which, if found together, offer us a strong indicator of some kind of metabolism. Tanner's analysis of planet finding techniques in a later session took us through the range of methods available, ranging from radial velocity to direct imaging and transits, particularly in terms of distinguishing stellar noise from terrestrial mass planets.

TVIW 2017 was marked by its focus on sail technologies, due to all the factors I've already mentioned, but of course we have other options to consider. Jason Cassibry talked about the problems of solid state nozzles when dealing with pulsed fusion and fission/fusion hybrids for rapid precursor missions, the primary issues being erosion and wall heating. He showed us a 3D plasma simulation of a pulsed magnetic nozzle crafted for z-pinch propulsion.

Antimatter appeared in two sessions this year, with Gerald Jackson describing crowdfunded ongoing experimentation into antimatter production. Jackson would like to see antimatter emerge at a rate of at least 1 gram per year, a startling figure given that I can remember when NASA gave a figure of \$62.5 trillion per gram of antihydrogen. Measure this against a Fermilab production rate of 2 nanograms per year. If we can do this in a way that is economically feasible, we have the option of missions like the antimatter sail that Jackson and Steve Howe, also at Hbar, have developed through NIAC work. Jackson also examined antimatter storage possibilities through diamagnetic levitation.

Talking about interstellar mission concepts reminds me inescapably of a loss we suffered this year in science fiction writer Jerry Pournelle. Familiar, I think, to most of us here, Jerry explored numerous interstellar schemes including beamed sails (early on), and in *Footfall* used Orion technology to save the species.

Because Larry Niven wrote *Footfall* with Pournelle, I want to mention how pleased I was to be able to shake his hand at long last. Larry brought a whole new dimension to my science fiction reading back in the early 1970s with short stories and the novel *Ringworld*. What a compliment to TVIW to have Larry along with writers Geoff Landis, James Cambias, Greg Benford and Alan Steele here for tonight's writers' panel, not to mention our host Les Johnson himself. About Steele, I want to say that I've read *Arkwright* twice, and if you don't know the novel, you need to acquire a copy immediately, as it addresses the issues a small community of devoted advocates face when trying to do something as outlandish as build vehicles that can move between stars.

The infrastructure theme emerged several times at this year's sessions, with Tracie Prater looking at NASA's In-Space Manufacturing Project, under the theme Make It, Don't Take it. And it only makes sense as we contemplate long-term manned missions that we look at manufacturing and recycling parts on demand, using the ISS while we can, before its 2024 deorbit, as a testbed. We learned about NASA's plans for a multi-process fabrication laboratory called FabLab, with current experiments on the ISS pointing to a robust future for assembly of materials in space with 3-D printing technology.

Our leadership panel included Rep. John Culberson, whose language we've already discussed regarding a NASA inquiry into interstellar prospects to coincide with the anniversary of the Moon landing in 2069. Also Congressman Mo Brooks of Alabama, Lt. General Steven Kwast and Dr. Paul McConaughy, who directs Marshall Space Flight Center. It was rousing to hear the energy in Rep. Culberson's voice as he described missions like Europa Clipper and the possibilities of the Space Launch System. A takeaway was his belief that the discovery of life, either in our system at Europa or Enceladus, or in biosignatures in an exoplanet atmosphere, will be a civilization-changing discovery that ignites public support for future exploration.

And there we are, TVIW 2017. Thank you all for the opportunity to listen to and learn from your deliberations. If there is one thing that the interstellar community has taught me, it is that scientists working at the top of their form are willing to listen to questions and explain their work to writers like me, and to put breathtaking concepts out to a receptive and growing audience like those who gathered here. This is a mission that all of you make possible, and while it may seem less dazzling than a Star Shot, it is vital in making our interstellar effort a planet-wide affair.

I close by returning to Lao Tzu: "To avoid disappointment," says the Tao Te Ching, "know what is sufficient. To avoid trouble, know when to stop."

I want to thank Les Johnson and the conference organizers at TVIW, Tau Zero and Starship Century for the opportunity to make this presentation, and for the huge outlay in time and energy they devoted to the event. That includes our workshop leaders and participants who carried the original workshop notion forward.

TVIW 2017 STORIES: FROM FINLAND TO HUNTSVILLE IN A TWEET

Pauli E. Laine, *Participant in TVIW 2017*



I have always been interested in space exploration and interstellar flight.

After all, what could be more challenging and yet important task for humanity, than reaching the stars? I was fascinated by the British Interplanetary Society's (BIS) Project Daedalus project, and became member of BIS in the 1990's.

My "career" in interstellar travel began with the NASA & DARPA 100 Year Starship call in 2011. Although, my presentation was not selected in to this event, I participated in Mae Jemison's 100 YSS symposiums in 2013 and 2014. By then, I was networked with many interstellar advocates, and mainly followed their Twitter feeds. I think it was Tau Zero's tweet that included link to a blog about the TVIW 2014 workshop that caught my attention. I was interested, since I knew Les Johnson from 100 YSS symposium (I even bought Les' and Jack McDevitt's *Going Interstellar* book there).

It was also Twitter where I noticed upcoming 2017 workshop, and I decided to submit an abstract on a further developed fission fragment rocket (I talked about FFR first in 100 YSS symposium in 2013).

I really enjoyed this year's workshop. I met many interesting people, saw interesting presentations, and twice visited the US Rocket and Space Center. Especially, it was nice to talk with Les Johnson, Douglas Loss, Kelly Smith, Scott Guerin, and Stacy Weinstein-Wiess.

Pauli Laine is a senior specialist in FDF C5 Agency, a freelance astrobiologist, and a PhD candidate in Jyväskylä, Finland. He received BSc degree in software engineering from the Kymenlaakso University of Applied Sciences in 1997, MSc degrees in information technology from the Tampere University of Technology and in cognitive science from the University of Jyväskylä, in 2010 and 2014, respectively.

In 1997 he joined the Novo Group plc as a system specialist, working with many customer projects. In 2005 he joined FDF C5 Agency. His current duties include development of system management systems. After establishing solid career in the ICT, he started creating careers in cognitive science and astrobiology. He started PhD studies in cognitive science after accomplishing MSc degree in it, in 2014. In 2013 he accomplished additional astrobiology studies in the University of Turku. Short after this, he was invited to create new NASA astrobiology roadmap, which was then released in 2015. He is currently Member of ORIGINS (Origins and evolution of life on Earth and in the Universe) EU COST Action working group. His current research interests in astrobiology include early life, habitability, detection methods of biosignatures, and multidisciplinary SETI research.

TVIW 2016 PROCEEDINGS

We are excited to announce that our Proceedings from the 2016 TVIW Symposium are now available online at:

tviw.us/wp-content/uploads/2017/11/Proceedings-TVIW-2016.pdf

TVIW 2016 was held in Chattanooga, TN in February of 2016 with the theme From Iron Horse to Worldship: Becoming an Interstellar Civilization.

We hope to release the 2017 Proceedings for sale in early 2018.

PUSHING THE INTERSTELLAR AGENDA: BUY AN E-CAR AND MINE AN ASTEROID

David Fields, *TVIW Director at Large*

With the successful completion of our 2017 TVIW Symposium, we might ask how we afford the investment to go Interstellar.

The new electric and hybrid car market is booming. Tesla makes the nice ones, but they are pricey. Then there's Chevrolet with the Bolt and Volt (half the price and with similar features as the Tesla models) and the lightweights (the Volkswagen e-car may be a bargain in the used models). The Smart Car and Leaf are attractive, although it appears that Leaf hasn't yet mastered battery cooling.

The Interstellar connection: These electric vehicles are heavy users of Ni, Co, and rare earths, and Earth's resources are of limited quantity and quality. Over half of Ni reserves are poor quality for advanced batteries, for example, and Ni is the key 'common' element that may first show shortages [1]. The Co markets are in transition, and this is a direct result of market pressure from the electric motor industry, especially the vehicle sector [2, 3].

These elements are available on asteroids in large quantities, although it is likely that initial efforts will focus on rarer materials, such as Au, Ag, Pa, Li, and the rare earths. And water, of course. This wealth might be removed from an asteroid without payment to anyone (current international law prohibits asteroid ownership), but transportation cost will initially be high. How much wealth? A graphical estimate is shown on the next page titled "There's Big Money to be Made in Asteroid Mining" [4].

So now we may develop space resources, and our new tools will stimulate Interstellar exploration. Perhaps we should all buy electric cars. And prepare for an asteroid mining boom.

References:

- [1] Desjardins, J., *Visual Capitalist*, "Nickel: The Secret Driver of the Battery Revolution" <http://www.visualcapitalist.com/nickel-secret-driver-battery-revolution/>, Nov. 1, 2017.
- [2] Bochove, D., "The Canadian Ghost Town that Tesla is Bringing Back to Life", *Bloomberg*, <http://www.bloomberg.com>, Nov. 1, 2017.
- [3] Shilling E., "We May Not Have Enough Minerals to Even Meet the Electric Car Demands", <http://www.jalopnik.com>, Nov. 1, 2017.
- [4] Infographc: "There's Big Money to be Made in Asteroid Mining", <http://www.visualcapitalist.com>, Nov. 1, 2017.

UPCOMING INTERSTELLAR OR SPACE EVENTS



2017

JAN	FEB	MAR	APR
S M T W T F S	S M T W T F S	S M T W T F S	S M T W T F S
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SEP	OCT	NOV	DEC
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22 23 24 25 26 27 28	22 23 24 25 26 27 28	19 20 21 22 23 24 25	20 21 22 23 24 25 26
29 30	29 30 31	26 27 28 29 30	27 28 29 30 31

November (Moon). China to launch robotic mission to return samples from the lunar surface.

November 10-11 (Austin, TX). New Worlds 2017 Symposium. Website: newworlds2017.com

November 13 (Earth). Venus joins Jupiter

December (Earth). Launch of NASA's TESS (Transiting Exoplanet Survey Satellite) space telescope.

December (Earth). Launch of ESA's CHEOPS (CHAracterizing ExOPlanet Satellite).

December 4 (Cape Canaveral, FL). SpaceX Launch Falcon 9, CRS 13.

December 5-7 (Houston, TX). SpaceCom. Space Commerce Conference and Exposition. Website: spacecomexpo.com

December 13 (Earth). Geminid Meteor Shower

December 21 (Earth). Northern hemisphere winter solstice. Southern hemisphere summer solstice. Ursid meteor shower

February 1, 2018 (Kennedy Space Center, FL). SpaceX Launch Falcon / Dragon V2 (Crew Dragon) Demo 1.

April 16-19, 2018 (Colorado Springs, CO). Space Symposium. Website: spacesymposium.org

2018 (LEO). Bigelow Aerospace LLC, Launch Alpha Station to orbit.

COVERAGE OF TVIW IN THE MEDIA

[TVIW Taking the Long View to the Stars](#) - Bart Leahy

[My Week at "Band Camp": Beyond Rocket Science](#) - Ask Dr. Ben

[Why We Must Go To The Stars](#) – Sarah Hoyt

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<https://smile.amazon.com/ch/46-4572727>

FEEDBACK

What would you like to hear about in the next newsletter? Suggestions? Comments? Do you have a technical note or an article that you would like to share with the TVIW community? Or comments on an article in the TVIW newsletter or other publications? Just drop us an email at info@tviw.us, connect us via social media or by regular mail at:

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Thank you to everyone that contributed to this newsletter and to all those that helped make the 2017 TVIW Symposium a smashing success.

*Until Next Time...
Look Up at the Stars and Dare to Dream Big.
Something Really Big!*

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