

IRG23 - the first two days

Michel Lamontagne

Michel is a long standing contributor to interstellar studies and to the work of i4is. Here he recounts his impressions of the first two days of IRG's 8th Interstellar Symposium 2023, the biggest event of the year in interstellar studies. This is the first time this IRG (formerly TVIW) event has taken place outside the USA,

We will have a detailed summary of each presentation in our next issue, P43 in November 2023. .

1 Introduction

After the opening ceremony, the presentations started with one of the patrons of the event, the Canadian Space Agency. John E Moores presented some of the projects the CSA are working on, that might eventually have some Interstellar applications. In particular Canadarm 3, Starchip, the Infrared Imager of the James Webb Space Telescope (JWST) and Canada's participation in the Osiris Rex Asteroid sample return mission.

The following presentation was from another patron, the International Academy of Astronautics, IAA. The IAA president described the IAA membership and structure: Basic Sciences, Engineering Sciences, Life Sciences and Social Sciences. He then gave the podium to a star speaker, the astronaut (and former Governor General of Canada) Julie Payette.



The inspirational Julie Payette
(this image 2017 at Rideau Hall).
Credit: Wikipedia

◀ Julie Payette got her bachelor's in electrical engineering from McGill, and was happy to return to her Alma Mater for the event. She showed a genuine interest in the Interstellar question, and was seen listening attentively for a number of later talks. In particular, many students went up to meet her in the breaks between the talks, and she shared career advice with them, and how passion tended to pay off with results, sometimes in the most unexpected ways. In particular, how choral singing was instrumental in her astronaut career!

Julie Payette's talk was quite inspirational, in particular about the importance of human presence in space. After her talk, Julie Payette was presented an achievement award by the IAA, previously given to John Glenn and Valentina Tereshkova, so she is in prestigious company!

Les Johnson, one of the pillars of the IRG organization, was awarded an Honorary IAA membership for his exemplary involvement in research and science outreach.

A short break was followed by a keynote speech from Frank Tipler, American mathematical physicist and cosmologist “The Ultimate Rocket and the Ultimate Energy Source, and Their Use in the Ultimate Future”. Tipler presented the results of an experiment purporting to show proof for some of the cosmological equations of his Omega point theory [1]. The theory points to the use of vacuum energy as a propulsion mode and energy source, and although quite abstract, the presentation was certainly entertaining. I missed the following presentation, Joseph Gottlieb “Should we colonize (interstellar) space?”, having been called away on mundane matters from my day job. I did get to hear most of Claudio Maccone's presentation of some of his work on gravitational lensing: “Human Interstellar Expansion driven by Gravitational Lensing”. In particular, how gravitational lensing could be used as an amplifier for SETI communications. Maccone proposed that the gravitational focus might be explored for signs of Interstellar communications, as the lens allows for communications at much reduced power levels.



Claudio Maccone delivers his talk on Gravitational Lensing
Credit: Dr René Heller

[1] See en.wikipedia.org/wiki/Omega_Point - see also the *Hart-Tipler argument against the existence of extraterrestrial intelligence* (en.wikipedia.org/wiki/Hart%E2%80%93Tipler_conjecture) and *Self-replicating probes and SETI*, in *Principium* 38, August 2022, page 13 (i4is.org/principium-38/). Dr Tipler's most famous work is the book *The Anthropic Cosmological Principle*. Oxford University Press (1986), Frank J Tipler and John D Barrow.. ▶



Alan Stern, Stephane Linter and Setthivoine You - Helicity team reporting their work in development of a fusion drive
Credit: Michel Lamontagne

The author also presented his ideas on using lenses as bilateral communication systems, and how these could exist already between a multitude of stars, but be unseen by us until we ourselves reached the gravitational lens focal point.

Lunch was followed by a one hour panel, that was more fundamentally a presentation, by Alan Stern, Stephane Linter and Setthivoine You of the current status of the work at Helicity, a company dedicated to the development of a fusion drive in the near future. Alan Stern, building on his long experience as a NASA project leader (notably New Horizons) presented what new missions might be achievable with a fusion drive. Stephane Linter presented the business plan for the company, and how they might achieve a progressive roadmap towards fusion, in particular an interesting 'augmented ion drive' mode, based on Solar Electric Propulsion (SEP)

and some fusion gain. The roadmap aims for a test prototype in space by 2032. Setthivoine You presented some of the hardware built at this time, and the simulations done for the fusion reactions. The fusion mechanism, pulsed magneto inertial fusion, a form of magnetized target fusion, is an interesting intermediate between ICF and tokamak type magnetic fusion that lends itself to a rapid development path where injectors could be combined into larger and larger engines, eventually reaching high thrusts and significant neutron and Bremsstrahlung absorption in a simple package. The focus of the company is now on preparing a first prototype, that they hope will validate the mathematical modelling. They are also targeting Deuterium-deuterium fusion at first, as that fusion fuel is much more accessible than others.

After the afternoon coffee break, Alex Gmerek

presented an "Astrobiology payload for Interstellar missions". Although clearly developed for exploration of the Solar system the instrument suite presented by Gmerek provide an interesting number of functions in tiny packages, suitable for cubesat missions, or very low mass Interstellar explorers.

This presentation was followed by Victor Toth's "Look before you leap: Using the solar gravitational lens to explore exoplanets". The extreme difficulties of actually implementing gravitational lensing, the technical problems involved in reaching the focal line, navigating to the correct position and extracting the information from the annular image that the gravitational lense creates were all covered in detail. The precision needs to be very high, in the order of hundreds of meters, and Toth presented some ideas on how to achieve that precision.

The evening outreach event "Interstellar Travel: Are We Ready?" was held before a large audience at the McGill Leacock building. Les Johnson, AJ Link, Alan Stern, Philip Lubin, Erika Nesvold, Trevor Kijorlien. Trevor asked this panel a number of open questions, with particular emphasis on how Interstellar travel might be achievable in the future, and why thinking about it today could bring immediate benefits. AJ Link was particularly interesting as he challenged the audience on the accessibility of space to disabled people, and the need to outreach towards all the communities that might usually be omitted from space research.



The Outreach event. Trevor Kijorlien at the podium Les Johnson, Alan Stern, AJ Link, Erika Nesvold, Philip Lubin . Credit: Michel Lamontagne

About the Author

Michel Lamontagne, Ingenieur senior principal chez CIMA+, is a bit of a "Renaissance Man" - visionary, artist and practical engineer. He holds first and masters degrees from Université du Québec à Chicoutimi and has been a mechanical engineer in many aspects of building systems for 25 years.

Michel was the co-leader, with Robert Freeland III, of the Icarus Firefly design study for an interstellar probe propelled by Z-pinch fusion, see *To the Stars in a Century: Z-Pinch fusion & Firefly Icarus* by Patrick Mahon in Principium 22, August 2028 (i4is.org/principium-22/).

He is a renowned imaginer of spacecraft and space technology, including Firefly on the cover of Principium 22, a worldship fleet on the cover of Principium 30, a worldship interior on the cover of Principium 31 and an image of Firefly close to Jupiter on the back cover of Principium 41, the issue distributed at IRG23, which he reports here.

In Principium 32 February 2021 (i4is.org/principium-32/), *Worldship and self replicating systems*, Michel considers the requirements for worldships and a worldship-building society and concludes that worldships can be a relatively early part of a society beginning to occupy the solar system with little impact on its economies or ecosystems (i4is.org/wp-content/uploads/2021/06/Worldship-and-self-replicating-systems-Principium32-print-2102221659-opt.pdf).

On Lasers and Lagrange Points – 8th Interstellar Symposium

Colin Warn

Colin Warn is a Music Producer, Coder and Rocket Propulsion Engineering Student. Having been recommended by Professor Andrew Higgins, the IRG23 host at McGill University, we asked him to report on the Symposium. Unfortunately transport problems meant he only joined on the second full day of the symposium but Michel Lamontagne (see previous report) is a Montreal local.

This report adapted from medium.com/@DJVeaux. All images are credited to Colin.



Introduction

A few weeks ago I had the honor and privilege to attend and present at the 8th Annual Interstellar Symposium: This year held at the incredibly beautiful campus of McGill University, based in Montreal, Canada. This was my second time attending this conference, the first time being in Tuscon, Arizona. As it was when I last attended, this conference gathered a group of academics, artists, and engineers to answer the great existential question: How (and should) humanity travel to the stars?

To capture the discussions for future me and others to reminisce on, much like my writeup at the last conference [1]. This conference report will be written from the perspective that I feel the most natural writing in: My own. In the two years since my first Interstellar Symposium, I've had the fortune to take a job at Maxar as a propulsion engineer, working primarily on plasma thrusters for NASA's Lunar Gateway as well as a mix of other government defense programs. This job has been an incredibly invaluable experience, as it not only has helped me fill in the gaps of much of my self-taught propulsion knowledge, but also has really crystalized what knowledge isn't taught in textbooks that is crucial to making theoretical advanced propulsion systems a practical reality. This knowledge, acquired in the last couple of years, helped me be "less impressed, more involved" at this conference. I'm forever thankful to the Maxar propulsion team I work with for giving, and continuing to nurture, that skillset.

[1] medium.com/@DJVeaux/warp-drives-and-wormholes-the-2021-interstellar-research-group-symposium-865071f5abf4.

Day 1 – Monday

My conference started off a bit rocky: My flight from New York was delayed one day, so I ended up not flying in until Monday night. While disappointed that I missed most of the first day's worth of talks, was great to talk to some of the presenters from the day in the late afternoon happy hour.

I particularly enjoyed my conversation with Setthivoine You of Helicity Space. Discussing the technical development roadmap and promise of his magnetic-reconnection fusion drive (arc.aiaa.org/doi/10.2514/6.2020-3835) was incredibly insightful and taught me a lot: Everything from the thermal problems they're experiencing, to the lifetime problems due to channel erosion are all very analogous to problems we see on the plasma thrusters at Maxar. Also thankful for him in reminding me of one of the big benefits of a fusion drive: That once fusion ignition is achieved, there is a net positive energy gain from the actual fusion reaction. This means that their thruster wouldn't require an external power source to continue the reaction, unlike current electric propulsion which requires separate power sources such as solar arrays/nuclear fission plants.



I was also excited to make it into Montreal in time for the major public talk of the symposium: “Interstellar Travel: Are We Ready?” It ended up being a great discussion between the principal investigator of the mission that went to explore Pluto (Alan Stern), an incredibly knowledgeable space lawyer AJ Link, amongst the cast of other very knowledgeable panelists from NASA and the University of Santa Barbara who we'll revisit later. Trevor Kjørlién, the moderator, was an absolute natural and did an incredible job fielding a list of interesting questions on topics ranging from space accessibility to the practical limitations of interstellar travel (an analogy from Trevor: If the distance from Earth to Alpha Centauri was a football field, our furthest spacecraft has travelled the distance of one index card).

Day 2 – Tuesday

The following day began my first full day at the conference. And as was the case at the last conference, the entire day was filled with some very smart people talking about some very cool ideas on well-crafted PowerPoint decks. Richard Norte, an incredibly energetic and engaging presenter, blew our minds with a counter-intuitive idea on making a solar sail reflective: Place a bunch of tiny holes roughly smaller than the wavelengths of light being reflected in the sail! Poking your own holes is definitely one way to get around the micrometeoroid problem in space.



His PhD-candidate student working with him on the technology, Lucas Norder, also quickly became a great post-conference friend to tour Montreal with as we found out he and myself were sharing the same hostel. Kid knows a lot about machine learning optimization, also has that great Dutch perspective on life. Very charismatic and hilarious, can't wait to hang out with him again. post-conference.



A crippled Lucas Norder, being carried to safety by a touring American on our journey around Montreal

The indelible Phil Lubin, very much the mastermind of the beamed energy technology upon which much of the conference was built on, then gave a great update on the status of the first beamed energy module prototypes his lab has been working on. Though I keep in touch with him via yearly phone-calls/road-trips down Highway One to Santa Barbara, it was great to interact with him at the conference with a ton of other like minds. The Technology Readiness Level of his beamed energy system, the path forward to development, and its adaptation to industry for spacecraft mission-enabling profiles continue to be talking points that I revisit with him every year (and upon which I based my talk at this conference).

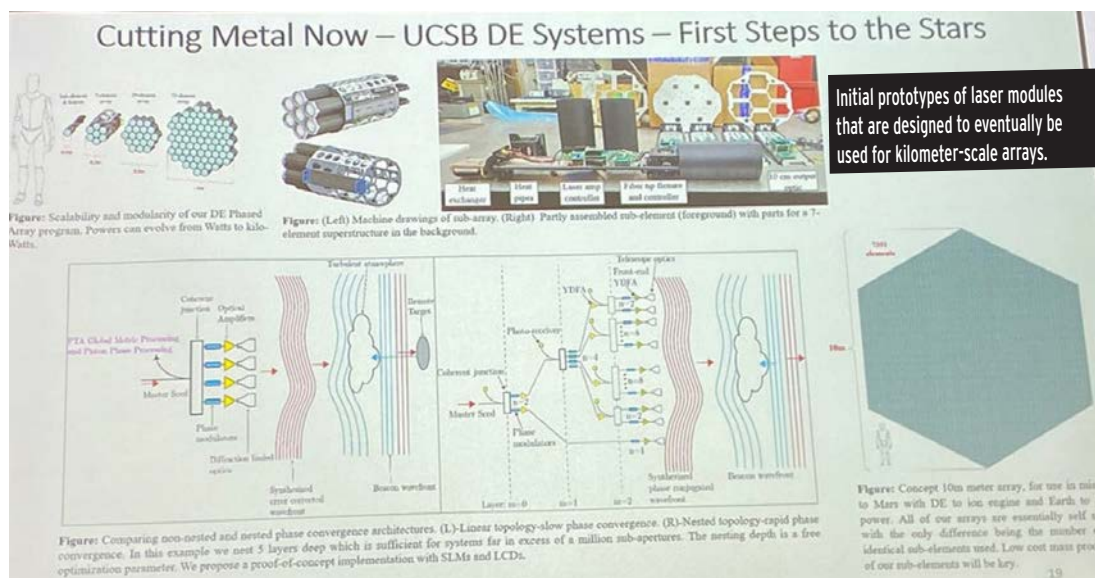


Phil Lubin et al at the public seminar: Interstellar Travel, Are We Ready?

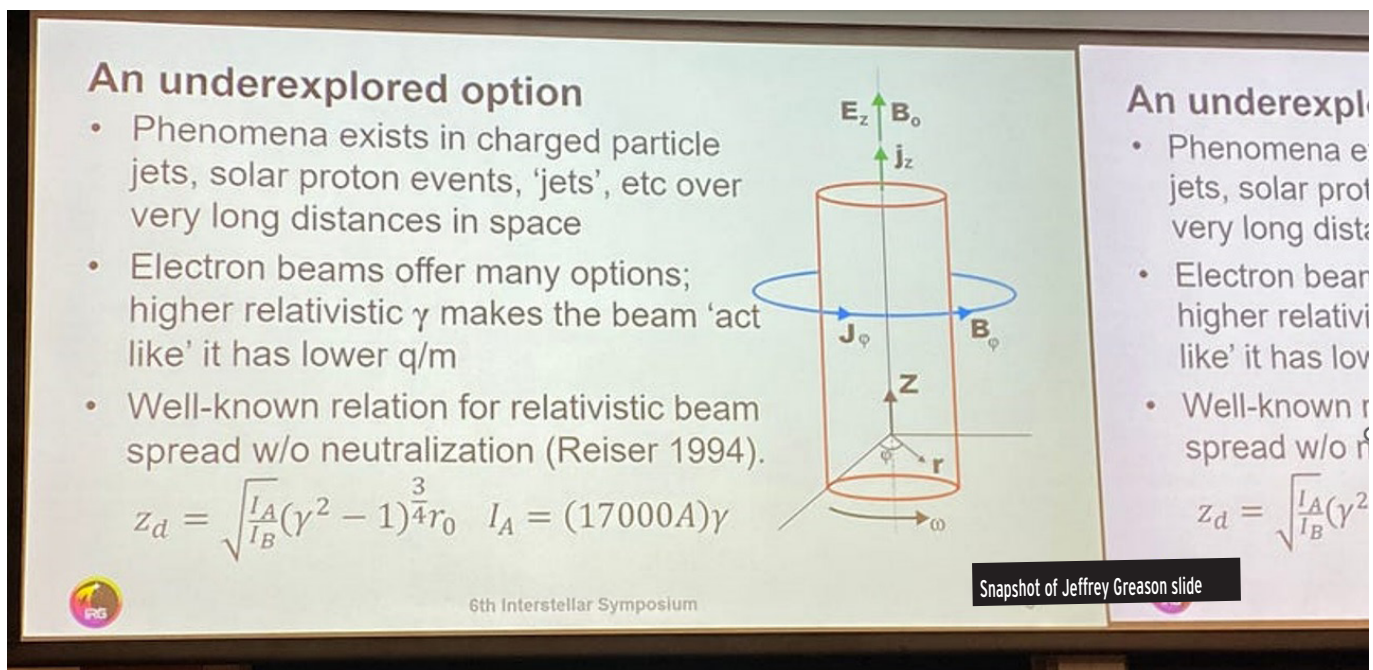
Day 3 – Wednesday

Sonny White, formerly of NASA's EagleWorks and now Director, Advanced Research & Development at Limitless Space Institute, moderating the morning series of lectures on Wednesday

More than halfway through the symposium, the talks continued to be as strong as the previous days. Dr Rene Heller of the Max Planck Institute for Solar System Research, University of Göttingen, presented some interesting analysis on an interstellar sail mission profile that could explore all three stars of the Alpha Centauri system. Was interesting learning in his analysis that a sphere/hemisphere may be an ideal shape for such a sail such that any incident photon flux is uniformly distributed. It sounded like, talking with him afterwards, his group needed more work to determine the effects of such a sail interacting with the local magnetic fields in their mission profile (ie Eddy Current-induced forces on the spacecraft). On the same day, Gerrit Bruhaug's presentation on interstellar communication via X-ray and Gamma-rays proved to be one that stimulated a lot of conversation and references in future talks. Could it be that other galactic systems are using these communication technologies, and we just don't have the equipment set up to listen to them? He also had a great poster on using electrostatic fields to solve the fissioning plasma core containment problem in nuclear gas core rockets that I want to shout out here as well. Also had a ton of great questions for the presenters throughout the entire conference, by far one of the more impressive attendees to engage with.

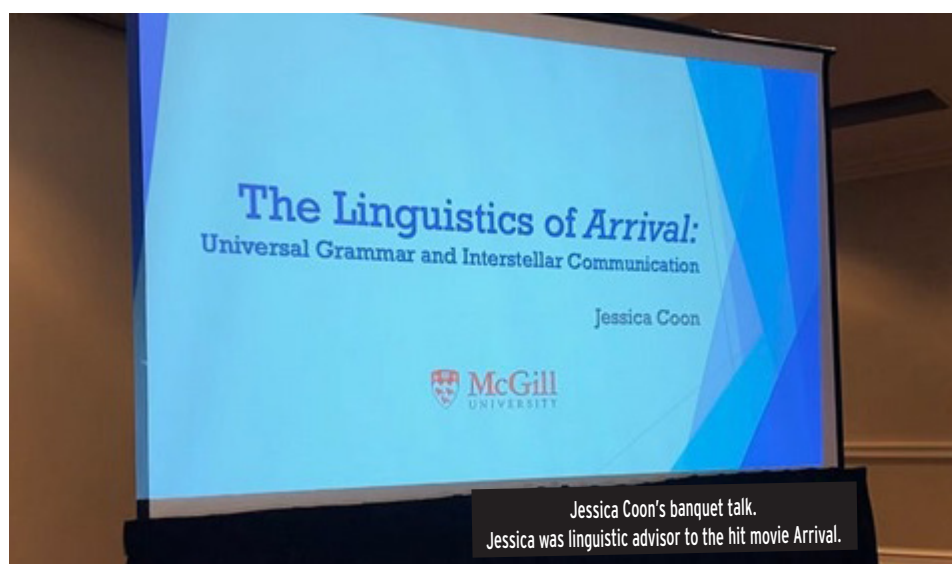


Tom Bone presented an interesting talk on using thermionic emission to harness the power of Bremsstrahlung-generated radiation (his first presentation as a master's student!). Additionally, Jeffrey Greason presented an interesting talk on revisiting the concept of using electron beams for beamed energy applications. Jeff per usual was as interesting of a speaker off the stage as he was on it.



Towards the end of the day it was exciting hearing about a mission concept Joseph Cassady and his team at Aerojet Rocketdyne put together to travel to interstellar objects using technologies readily available today. I'll be honest in that as I write this, I'm completely forgetting all the details of his talk, but it was great to see commercial industry proposing ideas at the conference. The forthcoming whitepaper from them is one to read when it comes out.

However, the highlight of the entire day was the banquet talk given by Jessica Coon, linguistic advisor for the hit box-office movie *Arrival*. In one hour, she gave a great high-level overview on everything linguistics: How all languages share a "Universal Grammar," that language's effect on thought is at best extremely subtle, and most importantly dispelling the myth that being a linguist is synonymous with being a polyglot. Topping that off with formally meeting NASA's Dr Les Johnson in person at dinner, through his wife as everyone does, Wednesday proved to be as eventful as the previous day.



Day 4 – Thursday

The final day of talks, and the day in which I gave my own! The morning kicked off with a great overview from the Breakthrough Initiatives on the current state of work that's been dedicated to the widely acclaimed Breakthrough Starshot project. Was great to see the current state of sail stability analysis, laser array engineering schematics, and future work to continue to develop the technology that is currently humanity's best engineering solution to the problem that is interstellar travel. After Breakthrough, I presented my talk on the coupling of beamed energy to potential future commercial interests: More specifically the coupling of beamed energy to electric propulsion, with its ability to scale better than other nuclear/solar power sources for certain mission profiles. Subjectively I think the first half of my talk ended up being less-polished than I would've liked as I worked through the verbal tics born from cumulative nights of drinking and sub-optimal sleep to enable the engaging late discussions with fellow attendees at the top of the hotel. That said, from the conversations and comments at the end of the conference I think the talk went fine: My impression was that the key points were communicated to those who took an interest, and sedative to those who needed to catch up on sleep.

Rounded out the day with a great talk from Stephen Fleming on the promise of quantum computing-enabled optics to circumvent the Rayleigh limit: Potentially enabling up to a couple of orders of magnitude increase in imaging resolution.

A quick visit to the Canadian Space Agency and a Montreal-sponsored "water tornado" on our bus ride back rounded out the conference. To tie up the final loose ends that I missed from the Monday portion of the conference, I ended up talking to Emmanuel Duplay about his initial prototype for a laser-thermal propulsion system. Incredibly interesting to learn how he and his team are using lasers to ignite and sustain a plasma that heats the propellant gas (something that hasn't been explored for rocket propulsion in decades). They had problems igniting plasma with a spark plug, so they ended up transitioning to a tungsten rod to get a more consistent/efficient ignition. Excited to see the forthcoming whitepaper from him towards the end of the year formally presenting what we informally discussed.



View of downtown Montreal from the top of the conference hotel.

PLENARY LECTURE
The Promise of Beamed Energy for Spacecraft Propulsion and Power






Colin Warn
Associate Propulsion Component Engineer
Research interests in advanced propulsion and machine learning

8TH INTERSTELLAR SYMPOSIUM

JULY 10-13 2023
McGill University
Montreal, Canada

Presentation from yours truly.



Canada Arm: Much bigger in person than on TV.

Conclusion

Re-reading my writeup of the 2021 Interstellar Symposium, I find it surreal that many of the novel conversations I found unreal back then are now just a part of my daily life. During my day job I'm discussing the thruster-life implications of a plasma thruster whose confining magnetic field isn't optimized for its propellant, the next week I'm discussing with one of the top researchers of the Max Planck Institute whether the effects of stellar magnetic fields compromise his as-presented interstellar mission profile. To think these sorts of conversations are habitual for me now is a bit surreal: Especially given I didn't know basic trigonometry six years ago when I decided to make the transition from music production to rocket science.

A huge thank you to all the fellow attendees, but most importantly Andrew Higgins and his army of McGill volunteers who flawlessly organized and executed a conference to remember. Going to be hard for Texas to top this when the 9th Interstellar Symposium comes to town in 2025, will be exciting to revisit and do this all again in two years.



Texas A&M University, College Station, Texas. Venue of the 9th Interstellar Symposium in 2025