IREX Trottier Institute for Research on Exoplanets

Trottier Institute for Research on Exoplanets

ANNUAL REPORT 2023-2024

Université de Montréal · McGill · Université Bishop's University · Université Laval · espace pour la vie montréal

TABLE OF CONTENTS

About the Institute

Research Highlights

Team

Outreach and Education

Inreach

Appendices

Cover Image: Artistic representation of the exoplanet TRAPPIST-1 b (foreground) and its star, TRAPPIST-1, which is very active. Credit: B. Gougeon, UdeM.

ABOUT THE INSTITUTE

MISSION AND OBJECTIVES

Credit: A. Philibert, UdeM.

The **Trottier Institute for Research on Exoplanets** (IREx) was created to find new worlds beyond the Solar System and answer one of the biggest questions facing humanity: **Are we alone in the Universe?**

This question alone justifies investing billions of dollars in the robotic exploration of our Solar System and the construction of powerful astronomical observatories, both on the ground and in space.

Since the discovery of the first planet to orbit a Sun-like star in 1995, astronomers have confirmed the existence of **several thousand exoplanets**. Thousands of other candidates have also been identified, including rocky Earth-like planets and types of planet that defy our theories of planetary formation. A new generation of telescopes and instruments is now making it possible, for the first time, to probe the atmospheres of these extrasolar planets, and the progress forecast for the next few decades suggests that, on those that most closely resemble the Earth, we may soon be able to find **signatures of biological activity** (or biosignatures), such as specific ratios of oxygen, ozone, water vapour, methane or other molecules.

IREx brings together the best researchers and a team of dynamic, motivated students who are taking full advantage of the major observational projects underway or planned, and who are promoting this research through our sustained efforts in education and scientific communication, with the ultimate goal of finding **life elsewhere in our Universe**.

A WORD FROM OUR DIRECTORS

Credit:
A. Philibert, UdeM.

A Word from Our Director

The period covered by this annual report (September 2023 – August 2024) was an exceptional one for IREx. Thanks to the excellence of our researchers and the power of the James Webb Space Telescope, we reached significant milestones in the study of exoplanets and their host stars.

Our work on LHS 1140 b, a planet located in the habitable zone and significantly larger than Earth, revealed that a large portion of its mass is made up of water. It now stands out as one of the best exoplanet candidates for hosting liquid water on its surface. We also advanced the study of water-rich planets such as GJ 9827 d, and confirmed the crucial role of stellar activity in characterizing planetary atmospheres, as demonstrated by our results on TRAPPIST-1 b and HAT-P-18 b.

Here on Earth, the NIRPS instrument, installed in Chile, completed its first year of operations with outstanding performance, currently the best in the world for this type of spectrograph. We are also continuing the development of cutting-edge instruments, such as VROOMM at the Observatoire du Mont-Mégantic and ANDES for the upcoming 39-metre ELT, which will open new frontiers in exoplanet research.

Lastly, the April 8 solar eclipse was a major outreach highlight. IREx trained over 100 Ambassadors who shared their passion with thousands of people across Quebec.
I would like to warmly thank our exceptional team, whose talent, passion, excellence, and collective dedication have made IREx a world leader in exoplanet research.

René Doyon,
IREx Director

Credit:
J. Balthazard, Le Devoir.

A Word from Our Deputy Director

After years of preparation, often behind the scenes, on April 8, 2024 the members of IREx, the wider Montreal community and the whole of Quebec finally had a front row seat to the most beautiful cosmic spectacle you could hope to see: a total solar eclipse! Against all the odds, Quebec's clear skies provided an unobstructed view of this rare event, which I see as a reward for the hard work of our members.

Indeed, as well as enjoying this magical moment themselves, many IREx members acted as Ambassadors in their communities and beyond, helping to ensure that as many people as possible were able to observe the solar eclipse in a safe and enjoyable way. This desire to serve and engage the public is a common thread running through our Institute that I note with great pride. I am convinced that we will be able to draw on all these valuable experiences to develop even stronger community initiatives in the future.

Mirroring this long-term work for the eclipse, the patient and meticulous work of analysing the data from the James Webb telescope continues to bear fruit. Our researchers have revealed the secrets of the atmospheres of several exoplanets, including the famous worlds of the TRAPPIST-1 system and the potential water world LHS 1140 b, which has captured the world's attention. These discoveries take time and perseverance, but the end results are well worth the effort. The reward for these efforts is priceless, and it is our honour to have the chance to share them with you.

Nathalie Nguyen-Quoc Ouellette,
Deputy Director of IREx

YEAR IN REVIEW

In 2023–2024, members of IREx conducted several major studies that advanced our understanding of the **formation, evolution, and diversity of exoplanets, their host stars, and planetary systems as a whole**.

These worlds include the planet **TRAPPIST-1 b, which orbits the small, active star TRAPPIST-1**. The study of this planet, as well as others such as the **hot saturn HAT-P-18 b**, has contributed over the past few years to a growing awareness in the exoplanet research community: **understanding host stars is crucial to properly studying their planets**. IREx researchers also helped advance knowledge on a new type of planet that seems more and more likely to exist: **worlds composed of a significant fraction of water in various forms**. This may be the case for the **super-earth LHS 1140 b**, which could be covered in a thick layer of water or ice, and for **GJ 9827 d, a larger and hotter planet** that may be made up of a substantial amount of water vapour. Other worlds closely examined by IREx members include the **hot neptune LTT 9779 b**, the **hot saturn WASP-96 b**, as well as several other giant exoplanets and brown dwarfs.

IREx members contributed to **114 peer-reviewed scientific papers** this year, several of which quickly garnered strong interest from researchers across the global scientific community. At the ***Extreme Solar Systems V*** **conference** held in New Zealand in March 2024, **IREx's large delegation impressed attendees with the importance and variety of results presented**.

The James Webb Space Telescope (JWST) continues to reveal the mysteries of the Universe every day. During the telescope's second year of operation, from July 2023 to June 2024, IREx researchers led **observation programs totalling 102 hours**. The Canadian support team, composed of several IREx scientists, also continued its important work assisting astronomers across the country.

In 2023, the **NIRPS (Near-InfraRed Planet Searcher) instrument completed its first year of operations** at the La Silla Observatory in Chile. Initial analyses are promising, and confirm that this instrument is the most powerful in the world in the field of infrared spectroscopy. The ambitious target of 1 m/s precision in radial velocity measurements were achieved. The team is now working on **two new high-resolution spectrographs**: the optical instrument **VROOM**, developed for the 1.6-metre telescope at the Observatoire du Mont-Mégantic, and **ANDES**, a large near-infrared instrument designed for the 39-metre Extremely Large Telescope (ELT) in Europe.

IREx reached a new membership peak this year, with **91 members** at the height of the summer. This number includes **20 summer interns**, a record **40 graduate students**, and **20 postdoctoral researchers** and staff members.

1. The Perseus Cloud. Credit: ESA Webb, NASA & CSA, A. Scholz, K. Muzic, A. Langeveld, R. Jayawardhana.
2. A white dwarf with a debris disk. Credit: NOIRLab, NSF, AURA, J.
3. The career day, December 15. Credit: M-E. Naud.
4. An exoplanet. Credit: International Gemini Observatory, NOIRLab, NSF, AURA, J. da Silva, Spaceengine, M. Zamani.
5. A planet similar to Neptune. Credit: NASA.
6. Thomas Vandal at an AoT event. Credit: AoT-MTL.
7. Marie-Eve Naud. Credit: Savoir Média.

Thanks to **IREx's major outreach program**, its members reached tens of thousands of people in Quebec and all over the world through **92 presentations at primary and secondary schools, cegeps, and universities, 66 public talks, and 7 public events**, held both in person and virtually. In addition, the hundred Eclipse Ambassadors trained by the IREx team, mostly university students and staff who were not members of the Institute, also reached thousands more through their various initiatives surrounding the total solar eclipse on April 8.

IREx also had a **strong media presence** this year, particularly in connection with the solar eclipse. In total, **151 interviews were given: 21 on television, 58 on radio, and 72 in print and online media**: a record number for the Institute.

1. Eclipse Ambassadors. Credit: A. Philibert, UdeM.
2. René Doyon at 24 60. Credit: 24 60, Radio-Canada.
3. The Canada-France-Hawaï Telescope. Credit: Vadim Kurland (Flickr).

Trottier Institute for Research on Exoplanets

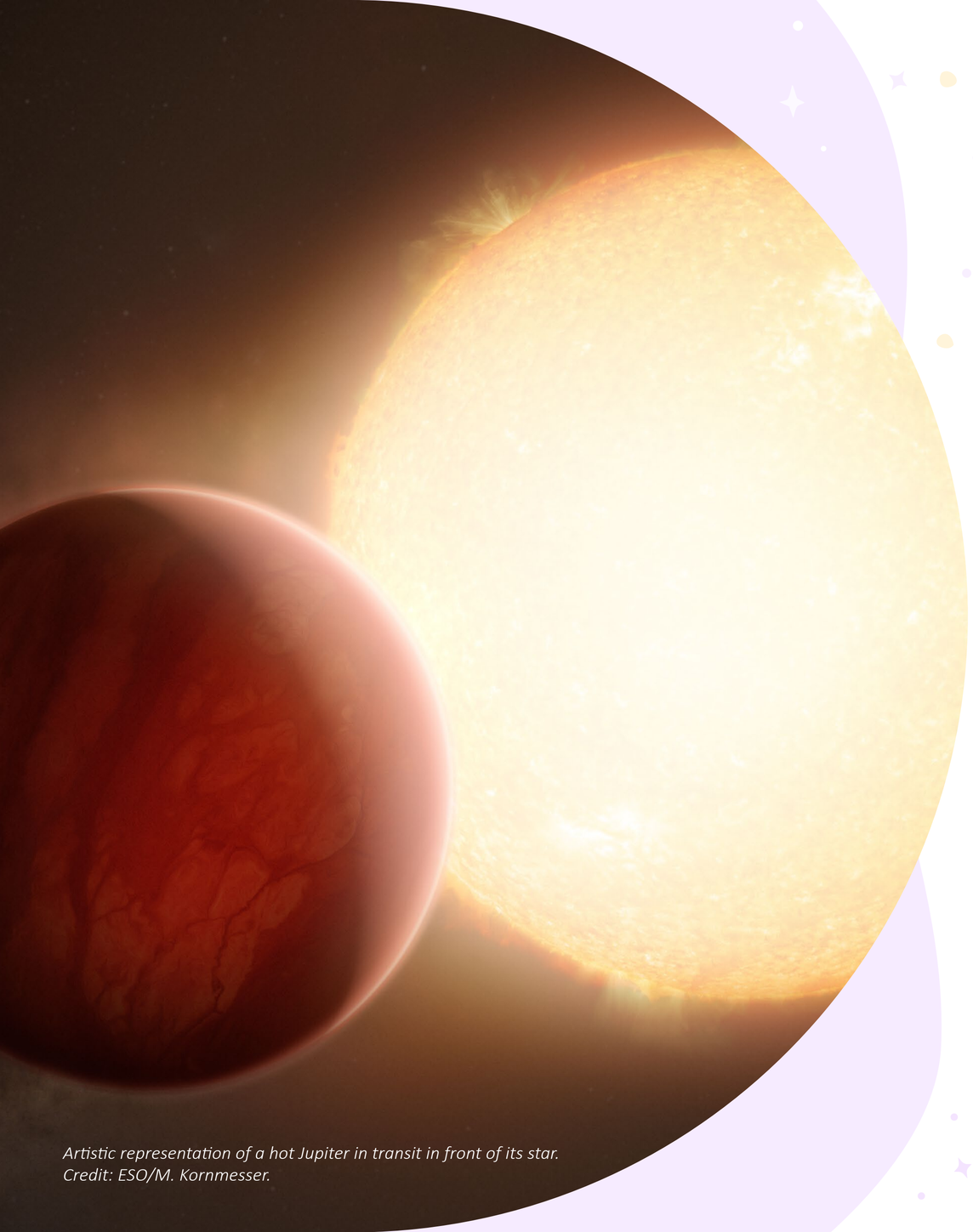
A NEW IREx LOGO (AND ACRONYM)!

At the end of the summer of 2024, IREx presented its new logo. The new logo, developed by the team at the Université de Montréal's Bureau des communications et des relations publiques (BCRP) in collaboration with the Institute's management, symbolises the IREx's mission: "To explore new worlds, in search of life", while harmonising with the logos of the other research centres and institutes based at the Université de Montréal.

David Tousignant, BCRP's graphic designer, explains that the main inspiration for the design came from IREx's quest to discover habitable exoplanets. The central blue circle represents both a habitable planet and a telescope lens, two elements central to the Institute's activities. The letters "IREx" are placed in the foreground, with the white contrasting with the blue. This visual combination is designed to evoke the image of a magnifying glass highlighting a discovery. The two small circles and the star in the background represent our vast Universe and its possibilities.

We have also decided to **change the Institute's acronym slightly**. So, rather than using "iREx", an original typography that was linked to the development of the first version of the logo, **we are now adopting "IREx"**, a more grammatically correct form that is consistent with the new visual identity.

With this new logo and acronym, IREx is asserting its visual identity while remaining true to its mission: to explore the vast diversity of worlds that make up exoplanets.



Artistic representation of a hot Jupiter in transit in front of its star.
Credit: ESO/M. Kornmesser.

SCIENTIFIC OVERVIEW

To carry out their mission, IREx researchers structure their research projects around three main areas: **observation, instrumentation and theory**.

Members of the Institute are exploring a wide variety of exoplanets: from **hot jupiters to oceanic worlds, sub-neptunes, lava planets and**, of course, **rocky planets with Earth-like characteristics!**

To detect and study these exoplanets, IREx researchers exploit a wide range of observational methods, both direct and indirect: **high-precision infrared velocimetry, transit and transit spectroscopy, direct high-contrast imaging, and light curve analysis.** In addition, several IREx members specialise in developing **theoretical models** to better understand this range of observations, as well as the f**ormation and evolution of planetary systems**. Today, it is also possible to say more about the **populations of exoplanets**, as well as the composition of the **interior, atmosphere and even climate** of some of them!

In addition to **exoplanets**, IREx researchers are interested in other celestial bodies: **stars of all sizes, brown dwarfs, white dwarfs, moons, comets and asteroids.**

Thanks to its collaboration with the **Laboratoire d'astrophysique expérimentale** (LAE) **at the Observatoire du Mont-Mégantic** (OMM), IREx has unique access to a **range of cutting-edge scientific instruments** dedicated to the observation of exoplanets. Flagship instrumentation projects include the **FGS/NIRISS** instrument, Canada's contribution to the James Webb Space Telescope, the **SPIRou** and **NIRPS** high-precision infrared spectrographs, installed in Hawaii and Chile respectively, the **GPI** imager on the Gemini-North telescope and the **PESTO** optical camera at the OMM. At the same time, our researchers are constantly developing and perfecting **advanced data analysis techniques**, propelling IREx to the pinnacle of exoplanet research.

ADMINISTRATIVE OVERVIEW

Organisational

Board of Directors

IREx is managed by the Board of Directors, which is made up of the **Dean of the Facutlé des arts et des sciences of the Université de Montréal** (UdeM), who chairs the Board, a **representative of the management of the UdeM Physics Department, the Director of the IREx, a professor who is a member of IREx**, a member of the Board of Governors, the Assistant Director of IREx and a representative of the Office of Development and Alumni Relations of the UdeM, a **professor who is a member of IREx, a member of the Board of Governors, the Assistant Director of IREx and a representative of the UdeM Development and Alumni Relations Office** as an observer. The functions of the Management Board include appointing the IREx Director, appointing members on the recommendation of the Scientific Advisory Board, approving the IREx scientific programme as defined by the Scientific Advisory Board, and approving financial reports and budget forecasts.

Members in 2023-2024 : Frédéric Bouchard (Chairman), Normand Mousseau, René Doyon, Patrick Dufour, Philippe Sureau, Nathalie Nguyen-Quoc Ouellette, Marie-Claude Giguère

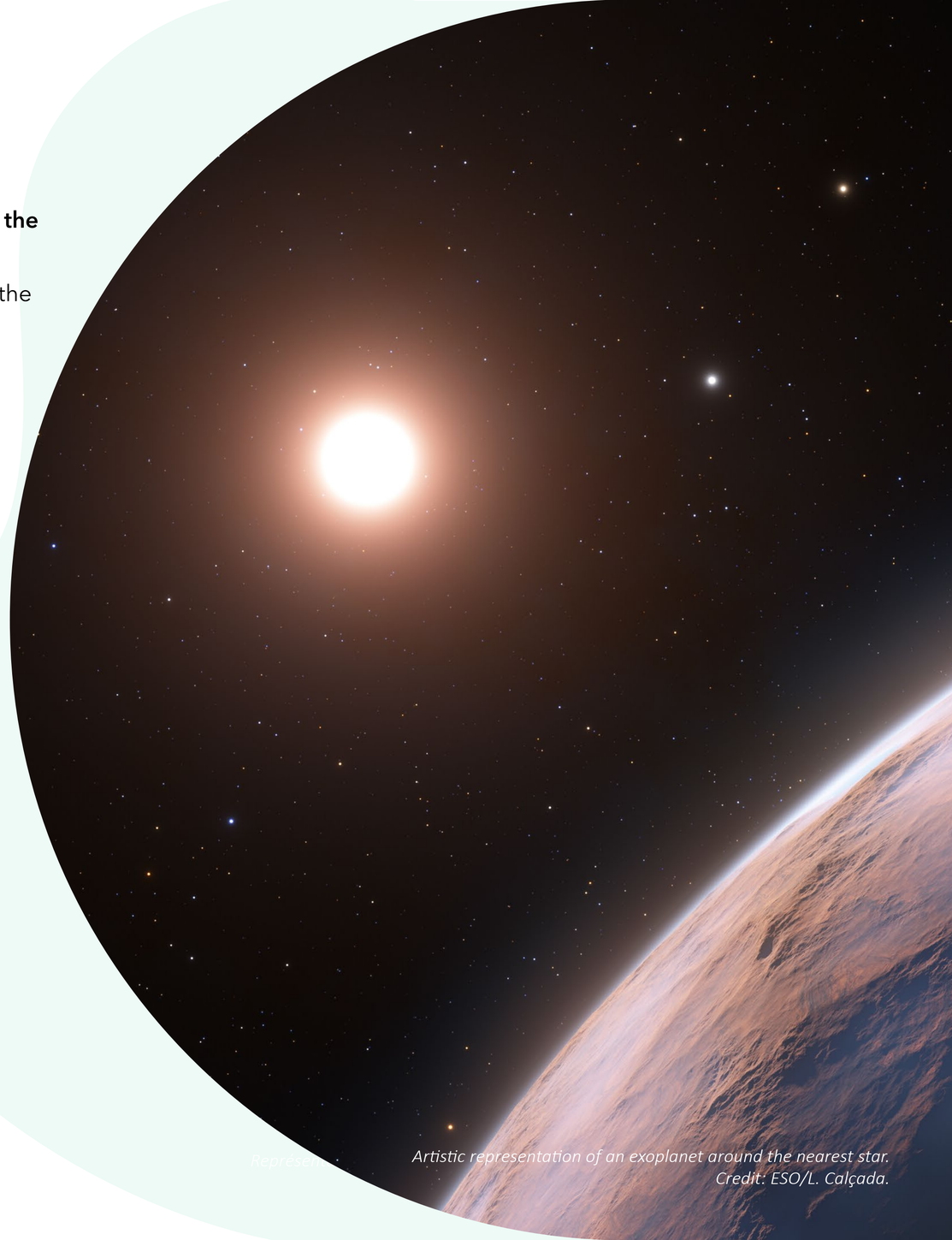
Scientific Committee

The Scientific Advisory Board advises the Director on the scientific development of IREx and defines its programme of activities. It is made up of the **IREx Director**, **the Vice-Dean - Research, Discovery and Creation of the UdeM Faculté des arts et des sciences, two IREx member professors, the IREx Deputy Director and a professor of astrophysics** from an institution other than UdeM.

Members in 2023-2024 : René Doyon, Éric Montpetit, Björn Benneke, David Lafrenière, Nathalie Nguyen-Quoc Ouellette, Nicolas Cowan

Board of Governors

IREx management is also advised by the Board of Governors on all matters concerning the smooth running of the Institute, its outreach and its funding. This committee is made up of **external representatives with an interest in the IREx's field of research and from a variety of backgrounds.**



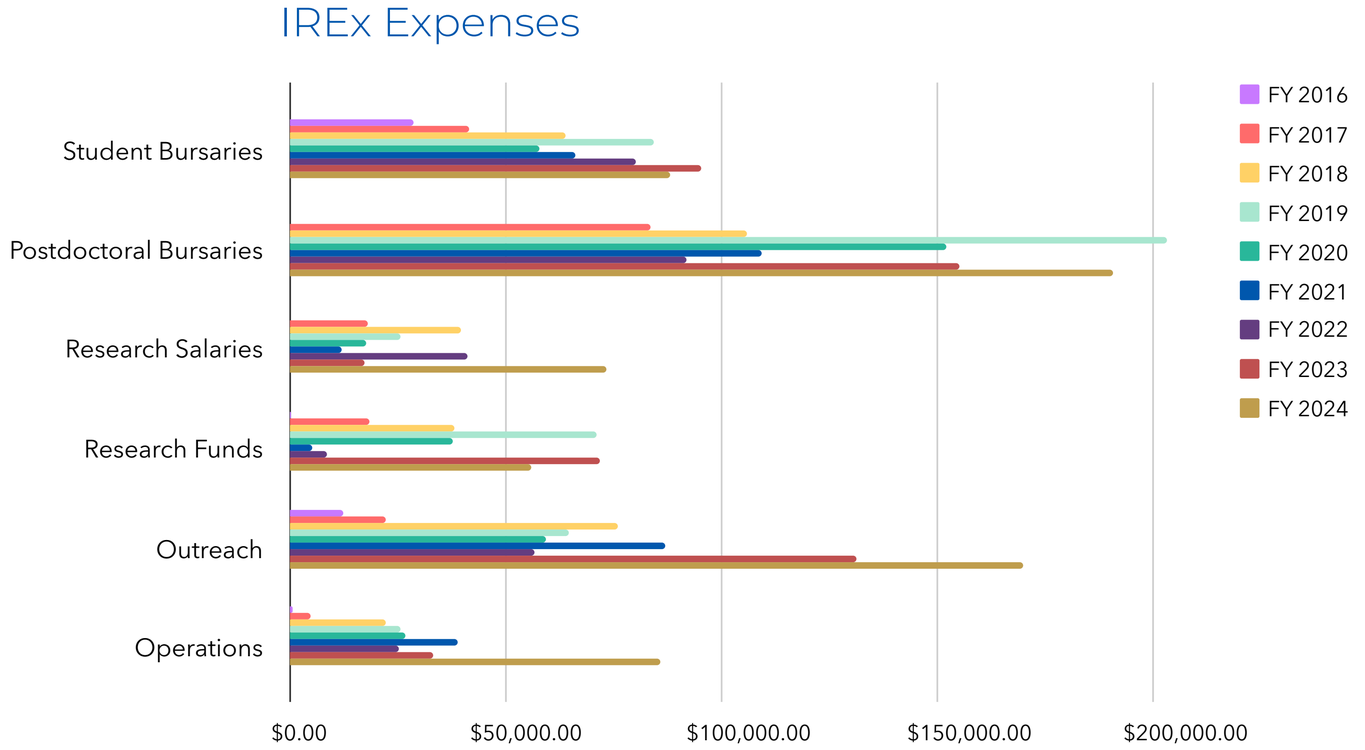
Artistic representation of an exoplanet around the nearest star. Credit: ESO/L. Calçada.

Finances

IREx's top priority remains excellence in **astrophysics research**. A significant portion of IREx's funding is also dedicated to **education and science outreach**, which is an essential pillar of the Institute's mission.

Student scholarships include bursaries for undergraduate summer interns as well as scholarships for graduate student-researchers. Several students also receive external scholarships from organizations such as NSERC, FRQNT, and their respective universities (see the Directory section in the Appendices for a full list of these awards). The **postdoctoral and research programs** cover salaries and research funding for all researchers holding a PhD. On average, these three components represent **61% of IREx's budget**.

A substantial portion of expenses related to the activities of IREx members is covered by government grants (NSERC, CFI, MEIE, FRQ, etc.). These grants, which complement IREx's philanthropic funding and are not included in the Institute's total operating budget, are used almost exclusively for research purposes. As a result, the **actual proportion of investment in research at IREx is significantly higher.**



The **outreach program** includes **all activities aimed at the general public and school-age audiences** (talks, public events, workshops, and web content production), all **communications made by the Institute**, and the **ambitious transferable skills training for our highly qualified personnel**. This part of the budget, **averaging 26%**, covers a portion of the salaries of the staff responsible for this program, as well as materials and supplies.

Finally, IREx's **administrative costs**, which include the purchase of equipment and software, photocopying and phone services, other administrative expenses, a portion of the Deputy Director's salary, and the salary of the administrative technician, account for only **13% of the budget**.

OUR DONORS

IREx could not exist without the precious contribution of its donors. Without their support and vision, it would be impossible to continue our research and educational work, which enables us to learn a little more about our Universe every day and to share these discoveries.

We would like to thank:

FONDATION FAMILIALE TROTTIER FAMILY FOUNDATION

Trottier Family Foundation

Philippe Sureau

Jean-François Bertrand

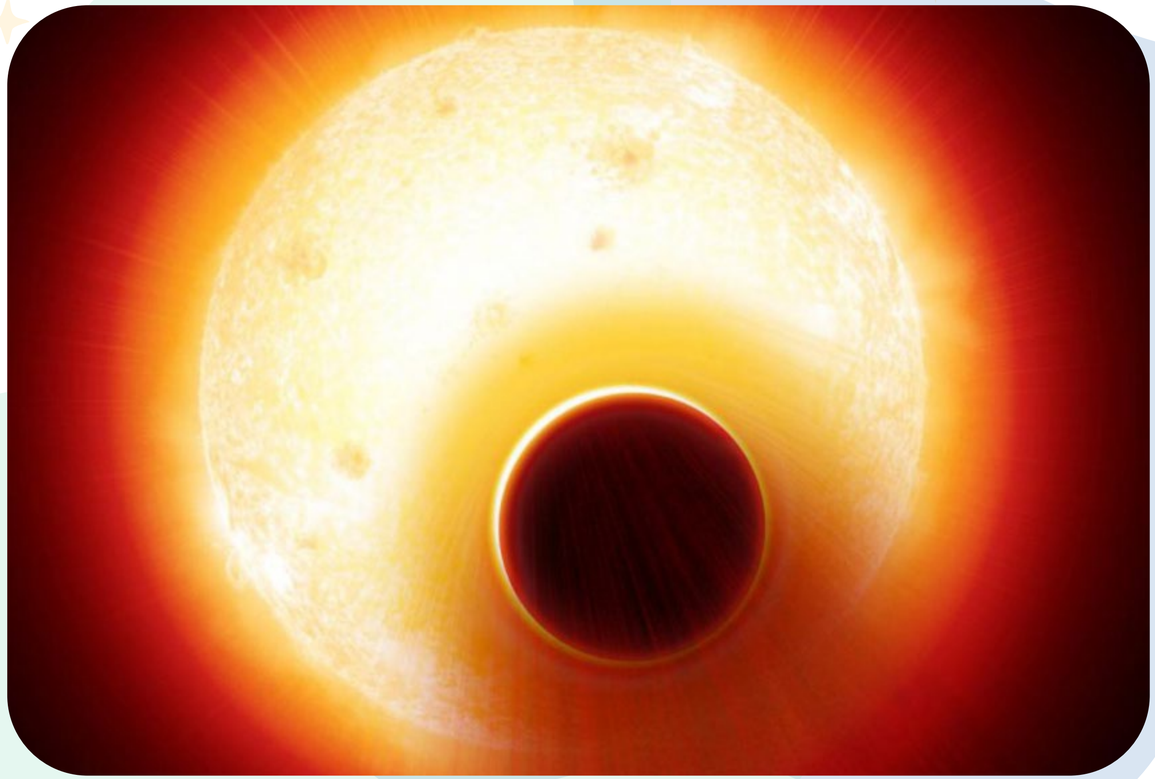
Stéphanie Robinson

Sylvain Lumbroso

Jean-Marc Lauzon

Credit: NASA, ESA, CSA, STScI, Kevin Luhman (PSU), Catarina Alves de Oliveira (ESA).

RESEARCH OVERVIEW



Artistic representation of the exoplanet HAT-P-11b passing in front of its star.
Credit: Denis Bajram.

ELEVEN GIANT EXOPLANETS STUDIED CLOSELY BY SPIROU

Romain Allart, a Trottier postdoctoral researcher at the Université de Montréal, has led a study of eleven gas giant exoplanets found very close to their star using the SPIRou spectrograph installed on the Canada-France-Hawaii Telescope. Published in June 2023, this study aimed to explain the "neptune desert", i.e. the fact that exoplanets similar in size to Neptune are rare very close to their star. One possible explanation is that intense stellar radiation could cause these planets to lose part of their atmosphere, making them smaller over time.

To measure the loss of gas, Allart and his colleagues observed the atmospheres of eleven exoplanets with masses varying between those of Neptune and Jupiter in order to detect the presence of helium. This gas, because of its lightness, makes it possible to measure the extent of the atmosphere and assess its escape. The team thus **confirmed the presence of helium on three of the exoplanets** studied, validating previous observations. For the others, the absence of detection has enabled an upper limit to be set for this quantity.

The team now plans to continue its research by using the NIRPS instrument to analyse the atmospheres of more than 75 other exoplanets, and thus continue to explore this hypothesis to explain the rarity of this type of planet.

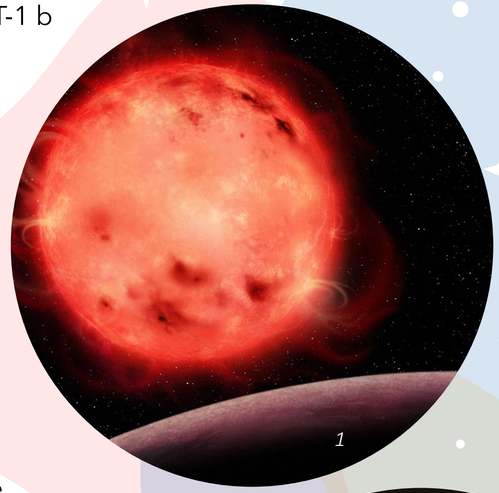
Homogeneous search for helium in the atmosphere of 11 gas giant exoplanets with SPIRou, **R. Allart, P.-B. Lemée-Joliecoeur**, A. Y. Jaziri, **D. Lafrenière, E. Artigau, N. Cook, A. Darveau-Bernier, L. Dang, C. Cadieux, A. Boucher**, V. Bourrier, E. K. Deibert, **S. Pelletier, M. Radica, B. Benneke**, A. Carmona, R. Cloutier, **N. B. Cowan**, X. Delfosse, J.-F. Donati, **R. Doyon** et al., A&A, 2023.

EXOPLANET TRAPPIST-1 b AND ITS STAR

A pioneering study **led by Université de Montréal doctoral student Olivia Lim** has significantly advanced our understanding of the exoplanet TRAPPIST-1 b and its star. Using the **NIRISS instrument on the James Webb Space Telescope** (JWST), the team observed two transits of TRAPPIST-1 b, the planet closest to its star, in order to analyse its possible atmosphere.

The results revealed that **contamination caused by the star's activity (such as stellar spots and flares) has a significant influence on measurements of the exoplanet's atmosphere**. In particular, this contamination generates "ghost signals", which can mislead researchers into believing that there are molecules in the exoplanet's atmosphere. Despite these pitfalls, the team was able to rule out the presence of a hydrogen-rich atmosphere around TRAPPIST-1 b, while leaving open the possibility of a more tenuous atmosphere.

These results, the **first obtained with JWST for the TRAPPIST-1 system, illustrate the power of the telescope, and underline the importance of accounting for stellar activity when studying exoplanets**.



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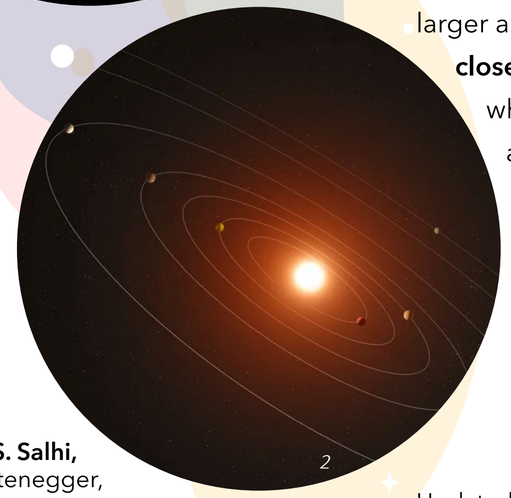

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Atmospheric Reconnaissance of TRAPPIST-1 b with JWST/NIRISS: Evidence for Strong Stellar Contamination in the Transmission Spectra, **O. Lim, B. Benneke, R. Doyon**, R. J. MacDonald, **C. Piaulet, É. Artigau, L.-P. Coulombe, M. Radica, A. L'Heureux, L. Albert**, B. V. Rackham, J. de Wit, **S. Salhi, P.-A. Roy**, L. Flagg, **M. Fournier-Tondreau, J. Taylor, N. J. Cook, D. Lafrenière, N. B. Cowan**, L. Kaltenegger, **J. F. Rowe**, N. Espinoza, **L. Dang, A. Darveau-Bernier**, ApJL, 2023.

THE NEW KEPLER CATALOGUE OF EXOPLANETS

A study co-directed by **Jason Rowe, professor at Bishop's University and member of IREx, has updated the catalogue of exoplanets discovered by NASA's Kepler mission**. This work, published in *The Planetary Science Journal*, provides a review of the properties of nearly 4,400 candidate planets and more than 700 multiplanetary systems.

While previous catalogues from the Kepler mission focused mainly on estimating the frequency of planets around other stars, this new edition focuses **on the precision of the data for each system**. This approach has brought to light some particularly fascinating systems, such as Kepler-385. Seven exoplanets, all larger than the Earth but smaller than Neptune, orbit this star, which is slightly larger and hotter than our Sun. The catalogue reveals that the **two planets closest to the star are probably rocky and could have a thin atmosphere**, while the other five, which are larger, appear to be enveloped in a thick atmosphere.

This new information will enable astronomers to better compare the planetary systems revealed by Kepler with our own Solar System, and to refine our understanding of exoplanets as worlds apart.

Updated Catalog of Kepler Planet Candidates: Focus on Accuracy and Orbital Periods, J. J. Lissauer, **J. F. Rowe**, D. Jontof-Hutter, D. C. Fabrycky, E. B. Ford, D. Ragozzine, J. H. Steffen, K. M. Nizam, PSJ, 5(6), 2024.

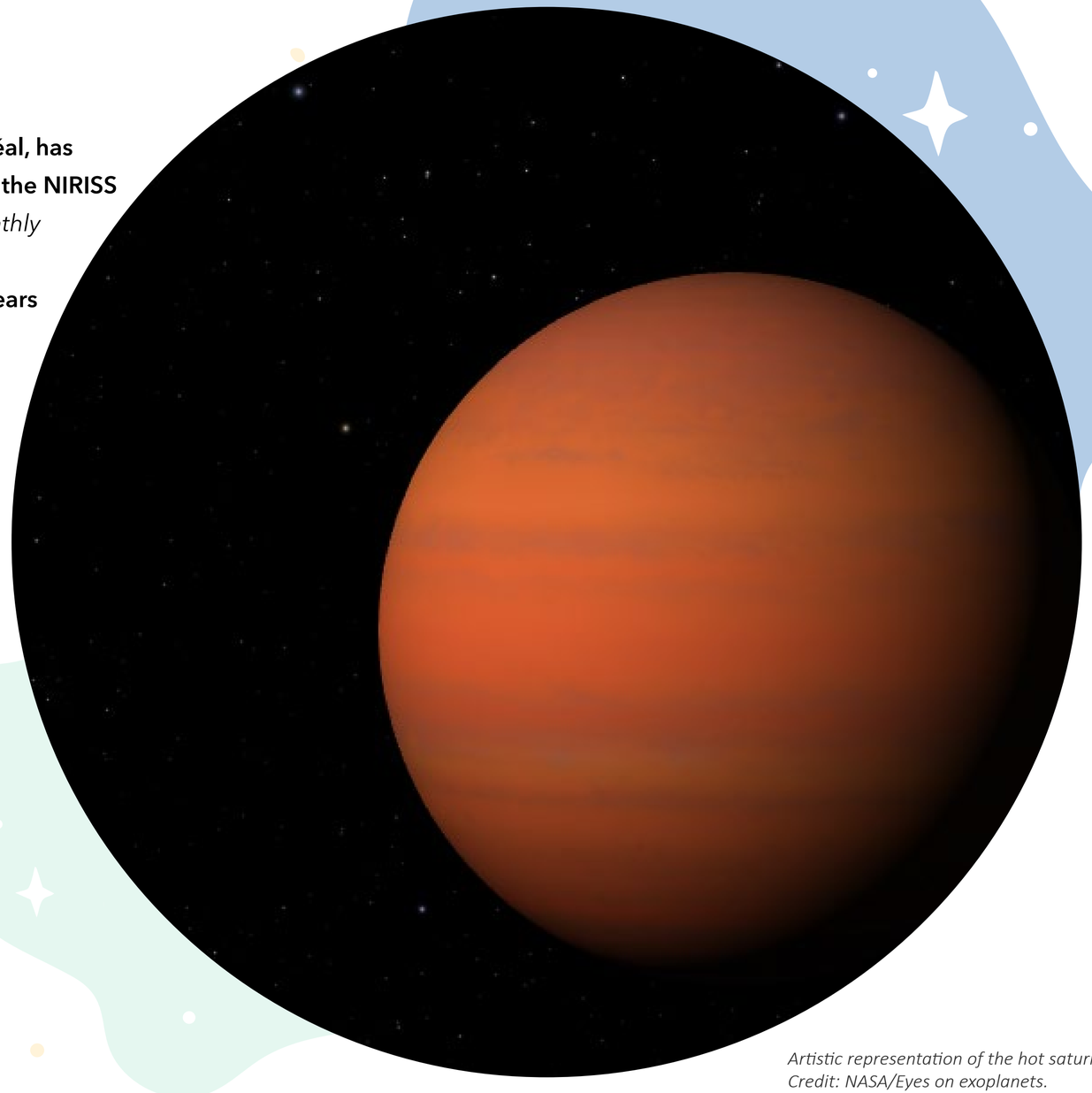
1. *Artistic representation of the exoplanet TRAPPIST-1 b (foreground) and its very active star, TRAPPIST-1. Credit: B. Gougeon, UdeM.*
2. *Artistic representation of the planetary system of the star Kepler-385. Credit: Bishop's/D. Rutter.*

THE SECRETS OF A HOT SATURN AND ITS MOTTLED STAR

A study led by **Marylou Fournier-Tondreau, a master's student at the Université de Montréal, has revealed the atmosphere of the giant exoplanet HAT-P-18 b, thanks to observations with the NIRISS instrument on the James Webb Space Telescope.** This pioneering work, published in *Monthly Notices of the Royal Astronomical Society*, revealed the **presence of water vapour, carbon dioxide and clouds in the atmosphere of this "hot saturn", located more than 500 light years away.**

The researchers used advanced modelling techniques to analyse the data obtained during the transit of the planet in front of its star, HAT-P-18. They paid particular attention to **the impact of stellar spots**. These stellar spots, located on the star, produce **certain signals that can be confused with characteristics of the atmosphere of a transiting exoplanet.** By taking this stellar contamination into account, the team adjusted its assessment of the composition of the atmosphere, revealing a **much lower abundance of water than that observed in previous studies.**

These results once again highlight the importance of considering the host star when analysing exoplanetary atmospheres.



Artistic representation of the hot saturn HAT-P-18 b. Credit: NASA/Eyes on exoplanets.

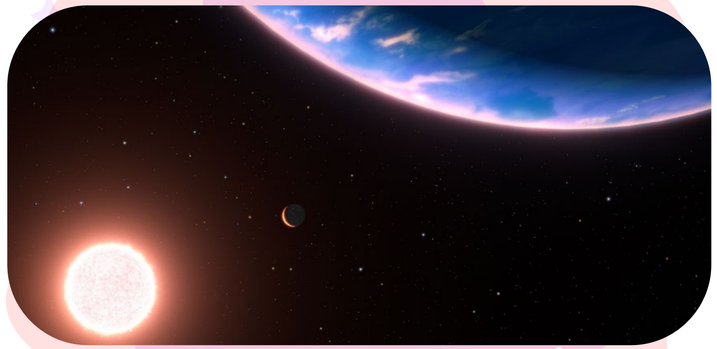
Near-Infrared Transmission Spectroscopy of HAT-P-18 b with NIRISS: Disentangling Planetary and Stellar Features in the Era of JWST, **M. Fournier-Tondreau**, R. J. MacDonald, **M. Radica, D. Lafrenière, C. Piaulet, L.-P. Coulombe, R. Allart, K. Morel, É. Artigau, L. Albert, O. Lim, R. Doyon, B. Benneke, J. F. Rowe, A. Darveau-Bernier, N. B. Cowan**, N. K. Lewis, **N. J. Cook, L. Flagg, F. Genest, S. Pelletier**, D. Johnstone, **L. Dang**, L. Kaltenegger, **J. Taylor**, J. D. Turner, MNRAS, 2023.

DISCOVERY OF WATER VAPOUR IN THE ATMOSPHERE OF A SMALL EXOPLANET

A team led by **Pierre-Alexis Roy, a PhD student at Université de Montréal, has detected water in the atmosphere of GJ 9827 d**, an exoplanet roughly twice the size of Earth, using **NASA's Hubble Space Telescope.**

In the study published in *The Astrophysical Journal Letters*, the team presents **two possible scenarios to explain the planet's size**. In the first, the planetary **atmosphere would be made primarily of water vapour**. That would make it a potential example of a new type of planet: a larger, hotter version of Europa, one of Jupiter's moons. In the second scenario, the **planet may have retained a hydrogen- and water-rich** envelope, making it a miniature version of Neptune.

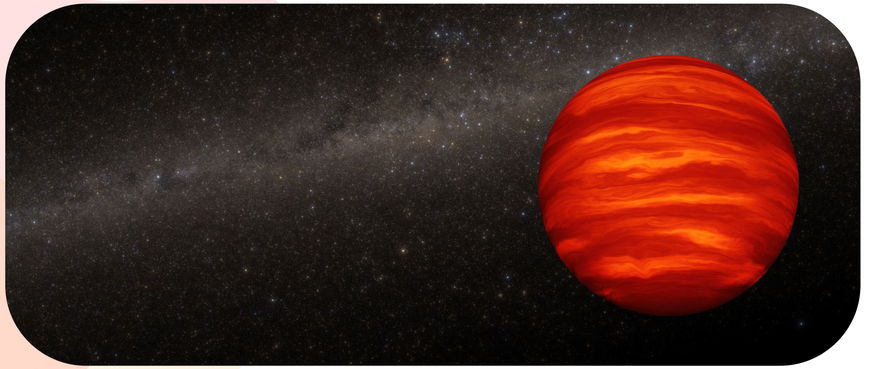
This discovery paves the way for more detailed studies, particularly with the James Webb Space Telescope. Although GJ 9827 d is undeniably a **hot and inhospitable world**, exhibiting temperatures around 430°C (similar to Venus), it holds great potential for expanding our understanding of the **diversity of atmospheres found on smaller exoplanets.**



Artist's impression of exoplanet GJ 9827 d.
Credit: NASA, ESA, Leah Hustak (STScI), Ralf Crawford (STScI).

Water Absorption in the Transmission Spectrum of the Water World Candidate GJ 9827 d, **Pierre-Alexis Roy, Björn Benneke, Caroline Piaulet**, Michael A. Gully-Santiago, Ian J. M. Crossfield, Caroline V. Morley, Laura Kreidberg, Thomas Mikal-Evans, Jonathan Brande, **Simon Delisle**, Thomas P. Greene, Kevin K. Hardegree-Ullman, Travis Barman, Jessie L. Christiansen, Diana Dragomir, Jonathan J. Fortney, Andrew W. Howard, Molly R. Kosiarek, and Joshua D. Lothringer, ApJL, 2023.

Artistic representation of an isolated brown dwarf.
Credit: NASA, ESA, Joseph Olmsted (STScI).



BROWN DWARFS AGE ALONE

A study led by **Clémence Fontanive, a postdoctoral researcher at Université de Montréal**, has revealed that **brown dwarfs, which are celestial objects more massive than planets but less massive than stars, often age alone.**

To reach this conclusion, the team **observed 33 cold brown dwarfs near the Sun using the Hubble Space Telescope**. These observations revealed **no companions around the objects**. Like stars, brown dwarfs can form in pairs and evolve within binary systems. However, the absence of such systems in the sample composed of low-mass and relatively old brown dwarfs suggests that **low-mass brown dwarf binaries tend to break apart over time**. This may occur, for example, due to the close passage of another star.

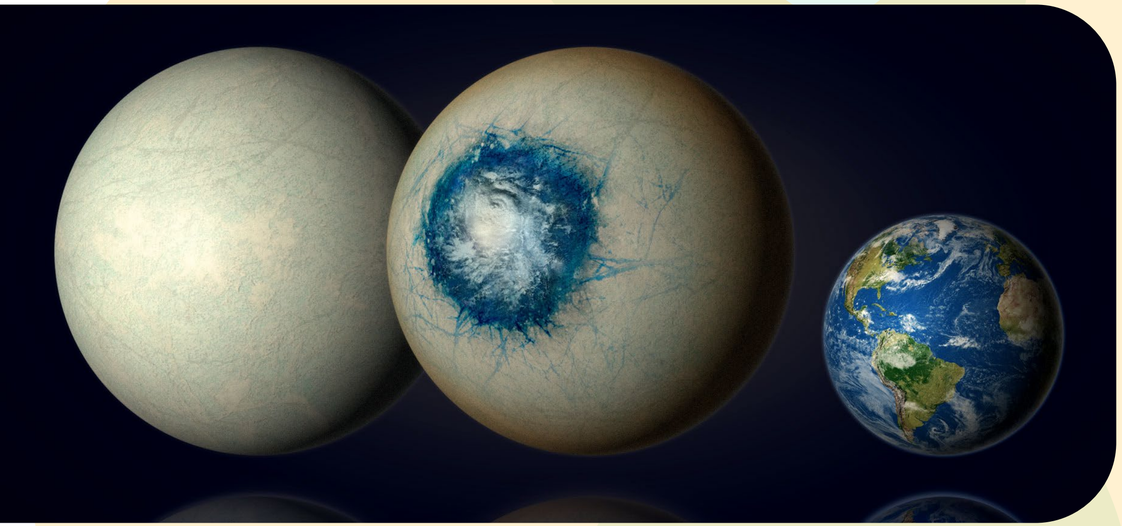
These exceptionally precise data offer a new window into understanding the dynamics of brown dwarfs.

An **HST survey of 33 T8 to Y1 brown dwarfs: NIR photometry and multiplicity of the coldest isolated objects, C. Fontanive**, L. R. Bedin, M. De Furio, B. Biller, J. Anderson, M. Bonavita, K. Allers, B. Pantoja, MNRAS, 2023.

LHS 1140 b: A SURPRISING ICY WORLD IN THE HABITABLE ZONE

A team of astronomers led by Université de Montréal **PhD student Charles Cadieux** has revealed that **exoplanet LHS 1140 b**, one of the few known exoplanets located in the habitable zone of a star in our solar neighbourhood, could potentially be a **super-earth covered in ice or water**.

Located about 48 light-years from Earth, this exoplanet was closely studied by the team using several **space telescopes: Spitzer, Hubble, the Transiting Exoplanet Survey Satellite (TESS), and even the James Webb Space Telescope (JWST),** thanks to exceptional observing time granted by the JWST's director. The team, who published their results in The *Astrophysical Journal Letters*, measured the planet's size and mass with unprecedented precision. Furthermore, JWST observations allowed them to **rule out the possibility that LHS 1140 b is an icy giant similar to a mini-neptune**. The most likely hypothesis now is that **LHS 1140 b is a super-earth** (a rocky planet larger than Earth) containing a **significant proportion of water, between 10 and 20% of its mass.**



Earth, shown on the right, is compared to two possible artistic representations of LHS 1140 b, an exoplanet that could either be entirely covered in ice (left) or have a small liquid ocean and a cloudy atmosphere (centre). Credit: B. Gougeon/UdeM.

Astronomers now hope to observe the planet with JWST as often as possible, to assess the presence of carbon dioxide in its atmosphere. This would provide crucial clues about the temperature and the potential for liquid water on this unique exoplanet.

New Mass and Radius Constraints on the LHS 1140 Planets: LHS 1140 b Is either a Temperate Mini-Neptune or a Water World, C. Cadieux, M. Plotnykov, **R. Doyon**, D. Valencia, **F. Jahandar, L. Dang**, M. Turbet, T. J. Fauchez, R. Cloutier, C. Cherubim, **É. Artigau, N. J. Cook**, B. Edwards, T. Hallatt, B. Charnay, F. Bouchy, **R. Allart**, L. Mignon, **F. Baron**, S. C. C. Barros, **B. Benneke**, B. L. Canto Martins, **N. B. Cowan**, J. R. De Medeiros, X. Delfosse, E. Delgado-Mena, X. Dumusque, D. Ehrenreich, Y. G. C. Frensch, J. I. González Hernández, N. C. Hara, **D. Lafrenière**, G. Lo Curto, **L. Malo**, C. Melo, D. Mounzer, V. M. Passeger, F. Pepe, A.-S. Poulin-Girard, N. C. Santos, D. Sosnowska, A. Suárez Mascareño, **S. Thibault**, V. Vaulato, G. A. Wade, F. Wildi, *MNRAS*, 2023.

LANDOLT SPACE MISSION: ARTIFICIAL STARS FOR PRECISE MEASUREMENT OF STAR LUMINOSITY

Jonathan Gagné, scientific advisor at the Planétarium de Montréal, is part of the scientific team for NASA's newly announced Landolt space mission. This unique mission, with a budget of $19.5 million, aims to **improve the precision of star brightness measurements.**

Through this mission, CubeSats equipped with calibrated lasers will be deployed 36,000 kilometers above Earth. These lasers will create **artificial stars**, visible to instruments and invisible to the naked eye, whose brightness will be known with high accuracy. These artificial stars will be used to **calibrate ground-based telescopes and improve brightness measurements for billions of stars** catalogued in major star surveys.

With more precise data, the mission promises tangible advancements across a wide range of astrophysics fields, from studying the expansion of the Universe to characterizing exoplanets.

Landolt space mission: more precise measurements of star brightness, UdeMNouvelles, 2024.

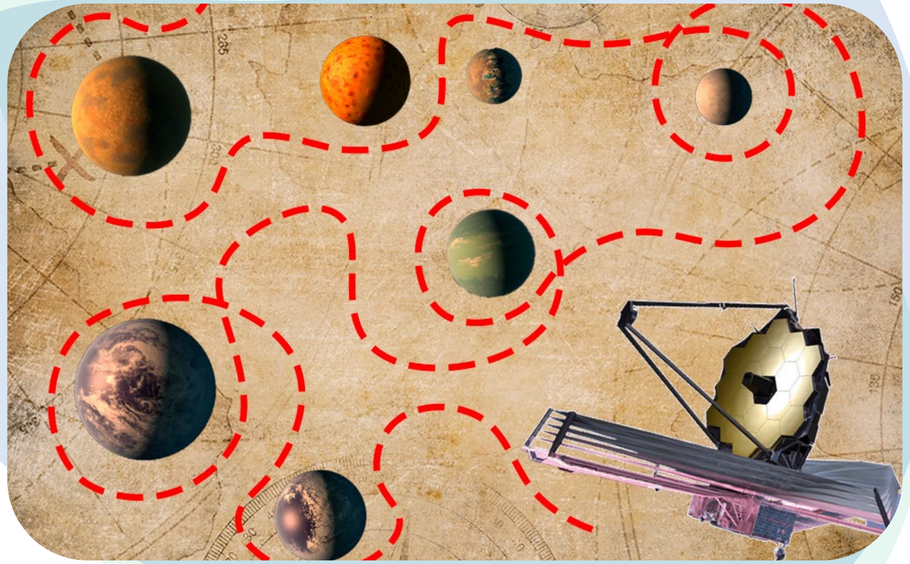
Deep field from the James Webb Space Telescope.
Credit: NASA, ESA, CSA, and STScI.

ROADMAP DETAILS HOW TO IMPROVE EXOPLANET STUDIES USING THE JWST

A team of scientists co-led by **René Doyon, Director of IREx and Professor at Université de Montréal**, has published a guide in *Nature Astronomy* to **optimize the use of the James Webb Space Telescope (JWST) in the search for habitable worlds**. This research relies heavily on transmission spectroscopy, a technique that details the planet's atmospheric composition by analysing the starlight filtered through a planet's atmosphere as the planet passes in front of its star.

In the coming years, a handful of potentially habitable temperate planets will be studied by JWST. Research on the planets of TRAPPIST-1, a small star with seven Earth-sized terrestrial planets, is groundbreaking in this regard. It has highlighted the **importance of properly characterizing the star to accurately interpret the properties of its planets**, as the numerous starspots and surface eruptions significantly affect observations.

The **concerted effort of the astronomical community to study the TRAPPIST-1 planets with JWST motivated the authors of the study to propose this guide**, aiming to standardise and optimise the work for all the worlds observable with JWST that may potentially support life.



Credit: Paige Colley/NASA/JPL-Caltech.

A roadmap for the atmospheric characterization of terrestrial exoplanets with JWST, J. de Wit, **R. Doyon**, B. V. Rackham, O. Lim, E. Ducrot, L. Kreidberg, **B. Benneke**, I. Ribas, D. Berardo, P. Niraula, A. Iyer, A. Shapiro, N. Kostogryz, V. Witzke, M. Gillon, E. Agol, V. Meadows, A. J. Burgasser, J. E. Owen, J. J. Fortney, F. Selsis, A. Bello-Arufe, Z. de Beurs, E. Bolmont, **N. Cowan**, C. Dong, J. J. Drake, L. Garcia, T. Greene, T. Haworth, R. Hu, S. R. Kane, P. Kervella, D. Koll, J. Krissansen-Totton, P.-O. Lagage, T. Lichtenberg, J. Lustig-Yaeger, M. Lingam, M. Turbet, S. Seager, K. Barkaoui, T. J. Bell, A. Burdanov, **C. Cadieux**, B. Charnay, R. Cloutier, **N. J. Cook**, A. C. M. Correia, **L. Dang**, T. Daylan, L. Delrez, B. Edwards, T. J. Fauchez, L. Flagg, F. Fraschetti, J. Haqq-Misra, Z. Huang, N. Iro, R. Jayawardhana, E. Jehin, M. Jin, E. Kite, D. Kitzmann, Q. Kral, **D. Lafrenière**, A.-S. Libert, B. Liu, S. Mohanty, B. M. Morris, C. A. Murray, **C. Piaulet**, F. J. Pozuelos, **M. Radica**, S. Ranjan, A. Rathcke, **v**, E. W. Schwieterman, J. D. Turner, A. Triaud, M. J. Way., Nature Astronomy, 2024.

For a complete list of publications, please refer to the appendix at the end of this report.

NEWS FROM THE JAMES WEBB SPACE TELESCOPE

The **second year of scientific operations (Cycle 2) for the James Webb Space Telescope (JWST)** has now ended. In its first year of operation, over 750 scientific papers were published, and this trend has only increased as more data has been collected and made available to the wider astronomical community.

At IREx, many fascinating exoplanets have been studied using JWST, in particular with the Canadian instrument NIRISS, including a **study of TRAPPIST-1 b led by Olivia Lim and a study of HAT-P-18 b led by Marylou Fournier-Tondreau.** These studies have highlighted one fact: it is **imperative to understand the nature of a host star in order to fully understand its exoplanet**. The challenge of stellar spots, ghost signals and stellar contamination will remain at the forefront of exoplanet science with JWST.

In September 2023, **many IREx members attended the *First Year of JWST Science Conference* at the Space Telescope Science Institute** in Baltimore, USA. They previewed many of their exciting results in presentations and posters, and networked with other astronomers working with JWST exoplanetary data.

Several Cycle 2 observing programmes led by IREx researchers were deployed in 2023-2024, totalling 102 hours. This included the largest Canadian Cycle 2 programme: a **large 82-hour programme led by IREx Professor Björn Benneke** entitled **"Exploring the existence and diversity of volatile-rich water worlds"**.

Our Institute was also r**epresented at a unique workshop organised by the Pontifical Academy of Sciences at the end of February 2024 in the Vatican, entitled "The James Webb Space Telescope: from first light to new worldviews"**. At this invitational event, approximately fifty astronomers from all over the world shared their ideas on the revolutionary impact of the JWST on different areas of science, as well as on society and humanity as a whole. **Our director, René Doyon, presented key results on exoplanets, and our deputy director and scientist in charge of JWST communications in Canada, Nathalie Nguyen-Quoc Ouellette, spoke about outreach and education efforts in Canada and abroad using JWST.**

In March 2023, **the selected time applications for JWST Cycle 3, which began in July 2023, were announced**. This year will be the most successful to date for Canada, with ten selected applications (263 observation hours) led by Canadian Principal Investigators and eight selected applications (121 observation hours) co-led by Canadian Co-Principal Investigators. **Five of these applications, totalling 125 observation hours - almost a third of Canadian time! - will be carried out by IREx researchers:** Loïc Albert, Björn Benneke, Michael Radica, Pierre-Alexis Roy and Joost Wardenier.

Photo of the Rho Ophiuchi star-forming region taken by JWST's NIRCam instrument. Credit: NASA/ESA/CSA/STScI/K. Pontoppidan/A. Pagan.

NEWS FROM THE OBSERVATOIRE DU MONT-MÉGANTIC

The **Observatoire du Mont-Mégantic (OMM) is a unique research facility** located in the Mont-Mégantic National Park, Québec. The observatory's **telescope is the largest on the East Coast of North America that is making significant contributions to scientific discoveries**. Additionally, the OMM allows **training for astronomers** and, in collaboration with the ASTROLab du Mont-Mégantic, **offers the public a unique showcase of astronomy research conducted in Québec and around the world.**

In 2023-2024, the OMM team continued to **update the design of the CPAPIR wide-field infrared camera**, the most used instrument at the telescope. This camera will soon be equipped with a **new infrared detector and a state-of-the-art cooling system**. These upgrades will be implemented in the spring of 2025, leading to the **launch of CPAPIR 2.0**. The small **visible camera PESTO** and the **spectro-imager SpIOMM** complete the array of instruments available to the community of astronomers using the telescope.

As in previous years, in 2023-2024, **several students and summer interns** from the Université de Montréal and Université Laval had the opportunity to visit the OMM for observation missions. They were guided by **support astronomer Sylvie F. Beaulieu and telescope operators Fidèle Robichaud and Ted Rudyk.**

On April 8, 2024, a few lucky individuals had the chance to **witness the total solar eclipse at the summit of Mont Mégantic**. Despite the snow still abundant at the summit at that time of year, a small team of OMM employees made their way there, including René Doyon, Director of IREx and OMM, as well as astronaut Steve MacLean and movie director Denis Villeneuve.

In the fall of 2023, the OMM team was also pleased to **unveil a new website**, which features updated content and pages highlighting the observatory itself, the team, the instruments, and a rich section of information for the general public. The site was designed by **Nathalie Nguyen-Quoc Ouellette, Assistant Director of IREx and OMM**, who worked with **Heidi White, science mediator at IREx and OMM**, and the agency Parkour3. The new website can be accessed at www.omm-astro.ca/en.

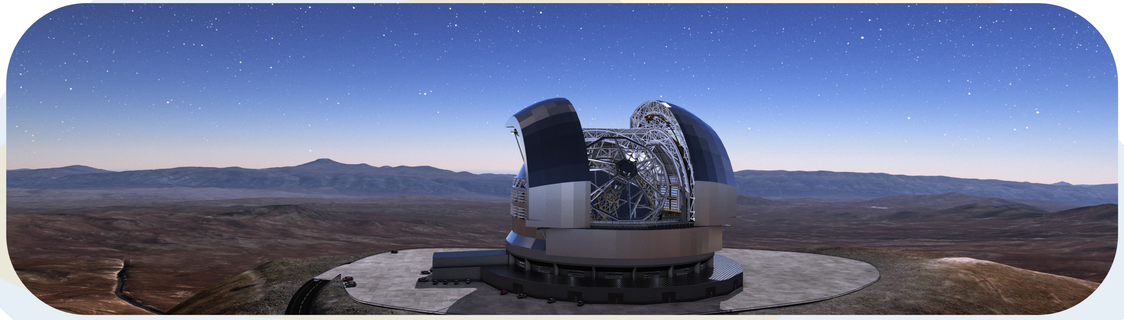
1. *Observatoire du Mont-Mégantic on the evening of April 8, 2024 Credit M-E Naud.*
2. *New website. Credit: Edit created with Canva.*
3. *Astronaut Steve MacLean and René Doyon, Director of IREx, at the summit of Mont Mégantic on April 8, 2024. Credit M-E Naud.*

NEWS FROM THE LABORATOIRE D'ASTROPHYSIQUE EXPÉRIMENTALE

The Laboratoire d'astrophysique expérimentale (LAE) is a branch of the Observatoire du Mont-Mégantic (OMM) dedicated to **designing astronomical instruments for the OMM telescope, other ground-based observatories around the world, and even for space telescopes**. Several IREx members are part of the LAE team.

This year, the team worked on the **design of ANDES**, a high-resolution spectrograph being developed for the Extremely Large Telescope (ELT), currently under construction in Chile by the European Southern Observatory (ESO). Once completed, the ELT will be the world's largest telescope, with a primary mirror measuring 39 metres in diameter. It is expected to begin operations in 2028.

The ANDES consortium includes 35 institutions across 13 countries, mostly in Europe: Italy, Brazil, Canada, Denmark, France, Germany, Poland, Portugal, Spain, Sweden, Switzerland, the United Kingdom, and the United States. The Canadian team, led by the LAE, is one of the main partners, playing a **leading role in the instrument's development and providing qualified scientific personnel**. In June 2024, the consortium and ESO officially confirmed that t**he instrument will be installed on the ELT by 2033**. The team also presented the optical and mechanical design of the ANDES infrared spectrograph cameras at the *SPIE Astronomical Telescopes + Instrumentation* conference, held in June 2024 in Japan.



Artistic rendering of the Extremely Large Telescope after construction is completed. Credit: ESO/L. Calçada.

Starry sky above the 3.6-metre telescope at La Silla Observatory, where the NIRPS instrument is studying exoplanets. The spectrum shown below is from Proxima Centauri, captured with NIRPS in June 2023. Credit: É. Artigau.

This year also marked the end of the **first year of operations for NIRPS** (Near-InfraRed Planet Searcher), in service at La Silla Observatory in Chile since April 2023. Data confirm that NIRPS is the **most precise infrared spectrograph currently in operation**, achieving the ambitious goal of 1 m/s in radial velocity measurements. These promising results were also presented at the SPIE conference in June 2024.

Finally, in 2023–2024, the team began designing **VROOMM** (Vitesses Radiales Observées à l'OMM), a **high-resolution optical spectrograph for the 1.6-metre telescope at the OMM**. This versatile instrument will support a wide range of scientific studies, from determining stellar properties and exploring the stellar populations of nearby galaxies, to confirming candidate exoplanets. The team also prepared a major grant proposal to support the instrument's development, which will be submitted to the John R. Evans Leaders Fund in fall 2024.

TEAM

The IREx team is made up of undergraduate and graduate students, postdoctoral and senior researchers, professors, and staff. Our members are located at the Université de Montréal, McGill University, Bishop's University, the Université Laval, and the Planétarium de Montréal.

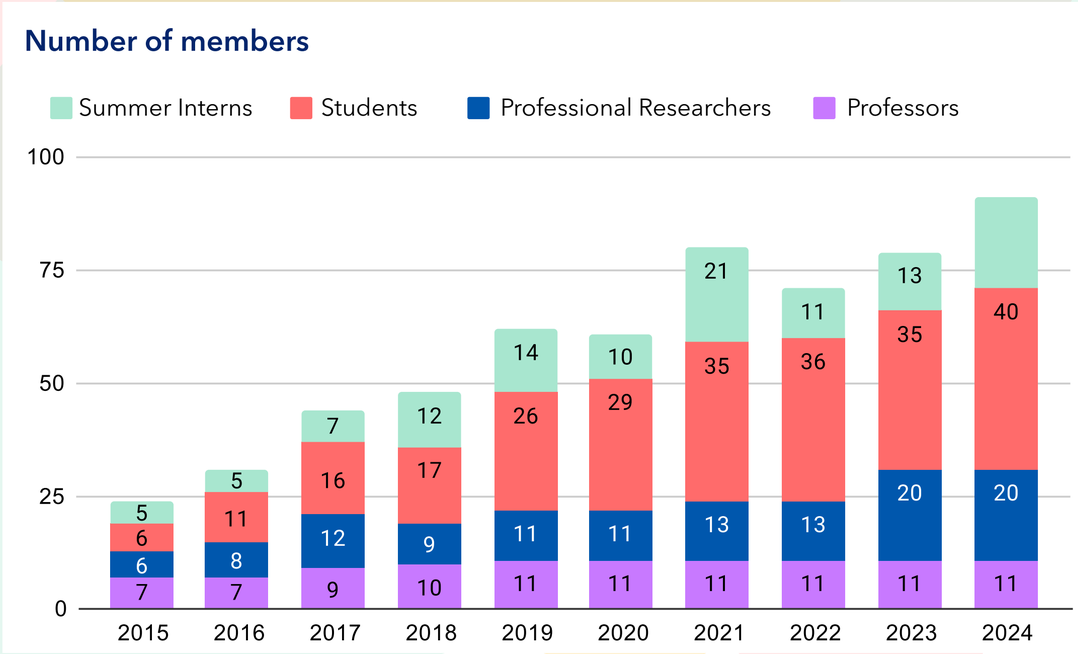
Together, we form the largest exoplanet research centre in Canada, and one of the most competitive in the world.

OUR TEAM'S GROWTH

Since its inception, IREx has grown remarkably, from a dozen members in 2014 to a much larger team today, fuelled by dynamic recruitment of new key personnel.

In 2023-2024, several new talents joined our team. At its peak in the summer of 2024, IREx had a record **91 members**. Among them, **20 students from across Canada and France interned with us**, a figure almost identical to our 2021 record (21 interns). This year we are also reaching a new high with **40 graduate students**. We also have **approximately twenty postdoctoral fellows and employees**, a high number that can be explained in part by researchers who extend their stay at our Institute thanks to external funding.

At the same time, our **network of former members, which now includes over a hundred people** who have worked with us as interns, students or researchers, continues to grow every year.



CHANGES TO THE TEAM

The IREx team brings together internationally renowned researchers who are leaders in exoplanet science and science communication. In 2023-2024, we welcomed a new renowned researcher, and unfortunately had to say goodbye to our administrative technician and three of our postdoctoral researchers.

Arrival of Joost Wardenier

Joost Wardernier joined IREx in **September 2023** as a **Trottier postdoctoral fellow at the Université de Montréa**l. He completed his PhD in atmospheric, oceanic and planetary physics at Oxford University. His research focuses on characterising the atmospheres of exoplanets. More specifically, he is interested in the three-dimensional structure of the atmospheres of ultra-hot jupiters. He uses a combination of computer models and telescope data to bridge the gap between theory and observation.

Departure of Antoine Darveau-Bernier

After completing his doctorate in January 2023, Antoine Darveau-Bernier took up a **postdoctoral research position at the Université de Montréal**. In this position, he was responsible for analysing data from the NIRISS instrument on the James Webb Space Telescope, and studying the atmospheres of hot jupiter-type exoplanets with the SPIRou instrument, located on the Canada-France-Hawaii Telescope. In **August 2024**, he left us to join the team of scientists at **Environment and Climate Change Canada**, where he works on various meteorological models produced by the federal agency.

Departure of Marie-Ève Lapierre

Marie-Ève Lapierre, whom we welcomed to the team in July 2023 as **an administrative technician**, left IREx at the end of her contract in the **summer of 2024**. With her organisational skills and thoroughness, she has had a very positive impact on our Institute. She will continue her career with the UdeM Alumni and Donor Network.

Departure of Roseane de Lima Gomes

Roseane de Lima Gomes, a postdoctoral fellow and scholarship holder from Brazil's National Council for Scientific and Technological Development (Conselho Nacional de Desenvolvimento Científico e Tecnológico), **completed her stay at the Université de Montréal in the summer of 2024**, and has now returned to Brazil. At IREx, Roseane worked on the variability of stars, in particular those around which candidate exoplanets identified by NASA's TESS space telescope orbit.

Departure of Yayaati Chachan

Yayaati Chachan, a postdoctoral researcher in the national programme of the Canadian Institute for Theoretical Astrophysics and McGill's Trottier Space Institute, completed his stay in Quebec in the summer of 2024, and began a **postdoctoral research** position **at UC Santa Cruz in the autumn of 2024**. He is continuing his research on the connections between planetary atmospheres, planet formation and protoplanetary disks.

Credit: NASA, ESA, CSA, STScI, Klaus Pontoppidan (NASA-JPL), Joel Green (STScI).

CONGRATULATIONS TO THE GRADUATES!

Congratulations to **Jared Splinter**, who started his PhD this year under the supervision of Nicolas Cowan at McGill. Congratulations also to **Érika Le Bourdais**, who completed her master's at Université de Montréal with Patrick Dufour and is now moving on to her doctorate with the same supervisor. Congratulations to **Kim More**l, who completed her master's degree with David Lafrenière at the Université de Montréal and is now continuing on to her doctorate in cosmology at McGill.

Congratulations also to **William Frost, Katherine Thibault, Amalia Karalis and Kevin Marimbu**, who completed their master's degrees under the supervision of René Doyon and Loïc Albert (UdeM) for the first, David Lafrenière (UdeM) for the second and Eve Lee (McGill) for the last two.

Finally, we congratulate six of our members who completed their PhDs in 2023-2024: **Christopther Mann** (supervised by David Lafrenière at UdeM), **Stefan Pelletier** (supervised by Björn Benneke at UdeM), **Farbod Jahandar** (supervised by René Doyon at UdeM), **Keavin Moore** (supervised by Nicolas Cowan at McGill), **Michael Radica** (supervised by David Lafrenière at UdeM) and **Timothy Hallatt** (supervised by Eve Lee at McGill).

WELCOME TO OUR NEW MEMBERS!

Welcome to our new Master's students: **Matthew Lightheart** (Jason Rowe, Bishop's), **Pierrot Lamontagne** (David Lafrenière, UdeM), **Jennifer Glover, Dhvani Doshi and Roman Akhmetshyn** (Nicolas Cowan, McGill), **Salma Salhi and Laurie Dauplaise** (René Doyon, UdeM), **Vincent Savignac** (Eve Lee, McGill), **Christopher Monaghan** (Björn Benneke, UdeM), as well as **Georgia Mraz**, who is starting her PhD with Nicolas Cowan at McGill.

AWARDS AND GRANTS

"Emerging Leader 2023" of the Women's Executive Network, Nathalie Nguyen-Quoc Ouellette

Nathalie Nguyen-Quoc Ouellette, Deputy Director of IREx, has been named one of the **"Emerging Leaders of 2023" by the *Women's Executive Network***. This prestigious award recognises her **outstanding contributions to astrophysics in Canada**, as well as her **inspirational leadership** in the fields of science, technology, engineering and mathematics. Dr. Ouellette stands out for her exemplary commitment to popularising science and for her achievements in management.

Hubert Reeves Fellowship, Pierrot Lamontagne

Pierrot Lamontagne, a master's student at the Université de Montréal, has been awarded the **Hubert Reeves Bursary for 2023**. This prize, which **highlights the exceptional motivation of a student in astrophysics**, was awarded to him because of his commitment and aptitude for research. After completing research placements at IREx on the simulator for the NIRISS instrument on the James Webb Space Telescope, he is now pursuing the study of exoplanets as part of his master's degree. Like Hubert Reeves, he is also very active in popularising science, having been a guide-animator at the Mont-Mégantic ASTROLab, and is enthusiastically involved in the Institute's activities.

Arthur B. McDonald Bursary, Nicolas Cowan

McGill University professor Nicolas Cowan has won the **Natural Sciences and Engineering Research Council (NSERC) Arthur B. McDonald Fellowship 2023**, worth $250,000 over two years. The fellowship rewards **early-career researchers in the natural sciences and engineering**. With his research group at McGill, he is conducting studies on various aspects of exoplanet science, including the mapping of exoplanet atmospheres, energy budgets and comparative exoplanetology. He is also involved in major instrumentation projects such as the James Webb Space Telescope and ESA's Ariel mission. This grant will enable him to intensify his scientific work and educational initiatives.

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1. Credit: Josh Fee Photography.
2. Credit: McGill.

1. *Credit: M. Campanozzi, La Presse.*
2. *Credit: Fantin Parreaux-Ey.*

First prize at the Impact Millénium Québecor Grand Final, Laurie Dauplaise and Caroline Piaulet-Ghorayeb

Laurie Dauplaise and Caroline Piaulet-Ghorayeb, graduate students at IREx, won fi**rst prize of $10,000 at the grand final of the L'Impact Millénium Québecor entrepreneurial competition**. Their **InitiaSciences project**, aimed at demystifying scientific research for secondary and cegep students, was praised by the panel of experts. This programme enables students to become actively involved in cutting-edge research projects, thanks to the personalised and sustained support of their graduate student mentors. This victory underlines the significant impact of InitiaSciences on science education in Quebec.

The Peak's "Emerging Leader 2024", Nathalie Nguyen-Quoc Ouellette

Nathalie Nguyen-Quoc Ouellette, Deputy Director of IREx, has been named one of Canada's **Emerging Leaders 2024 by *The Peak***, a newsletter for Canadian professionals. This honour recognises her **outstanding contributions to the advancement of space science and science communication in Canada**. In addition to her key position at IREx, she is the scientist in charge of communications for the Webb telescope at the Canadian Space Agency and deputy director of the Observatoire du Mont-Mégantic. In all these roles, she is committed to encouraging scientific curiosity, critical thinking and scientific culture in Canada.

Faculty of Arts and Science Engagement Scholarships, Érika Le Bourdais and Kim Morel

Érika Le Bourdais and Kim Morel, two IREx students, have received **commitment scholarships from the Université de Montréal's Faculté des arts et des sciences**. Érika Le Bourdais received the award in the Commitment to the University Student Community category, in recognition of her **many contributions that enrich the academic and community experience within our Institute, the Physics Department and the Faculty**. For her part, Kim Morel was nominated in the category of Commitment to an activity involving the media or the popularisation of science and research, in particular for her **essential role in the InitiaSciences organisation**. These awards underline the considerable impact of these two women on the university community and beyond.

Academic Medal of the Governor General of Canada, Marylou Fournier Tondreau

IREx graduate Marylou Fournier Tondreau has won the **Governor General of Canada's Academic Medal for academic excellence**. This distinction, the most prestigious for academic excellence in Canada, **recognises her outstanding academic achievements**, in particular her master's thesis on the impact of stellar spots in characterising the atmospheres of exoplanets with the James Webb telescope. Currently a doctoral student at Oxford University, Marylou epitomises scientific excellence, joining a prestigious line of recipients of this medal.

Rector's Prize, Collaboration category, Éclipse UdeM team

Université de Montréal's Éclipse team, co-directed by **Marie-Eve Naud, Nathalie Nguyen-Quoc Ouellette, Frédérique Baron and Heidi White**, and made up of staff from several parts of the university, won the **Rector's Prize** in the **Collaboration** category. The award **recognises the team's exceptional work in connection with the solar eclipse on April 8**, which involved distributing 70,000 pairs of protective glasses, organising large-scale events, producing informative content, training 120 student Ambassadors and making numerous media appearances. This award recognises the dedication and exceptional work of the entire team in promoting scientific culture and community involvement. It also highlights our members' exceptional ability to work collaboratively with a wide variety of entities

73rd Lindau Nobel Laureate Meeting, Lisa Dang

Lisa Dang, a Banting postdoctoral fellow at IREx, **took part in the 73rd Nobel Laureates Meeting** in Lindau, Germany. This prestigious event brought together 650 young scientists and 37 Nobel laureates in the summer of 2024. The meeting gave the young researcher a unique opportunity to present her research on exoplanets and their atmospheres, while exchanging ideas with passionate scientists from all over the world. This event highlights Lisa Dang's exceptional talent and her remarkable contributions to the field of astronomy.

1. Credit: A. Philibert, UdeM.
2. Credit: Courtesy of Lisa Dang.

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Chapeau les filles, Alexandra Rochon

Alexandra Rochon, a McGill student and summer intern at IREx in 2023 and 2024, has won the **Excelle Science prize in the Chapeau, les filles! competition**. The award **recognises women working in under-represented academic fields such as science and technology**. The young researcher, who has worked on modelling the ice caps of exoplanets and characterising hot Jupiters, is a role model for future generations of scientists. This distinction underlines her leadership role and her extraordinary commitment to the field of astrophysics.

Lumbroso Grant for Ambassador, Alexandrine L'Heureux

Alexandrine L'Heureux, a doctoral student at the Université de Montréal, has won the **Lumbroso Grant for IREx 2024 Ambassador.** The scholarship **recognises her leadership, community involvement and role in promoting scientific culture**. The scientist, who conducts research on small temperate planets, is also a key figure in IREx's outreach and education activities, having played a vital role in the events surrounding the **solar eclipse on 8 April**. She also mentored a team of cegep students as part of InitiaSciences in 2023-2024, and was an **instructor at the Pan-African School for Emerging Astronomers** in late summer 2024.

1. *Credit: Yan Turcotte.*
2. *Credit: M-Eve Naud.*

Artist's rendition, close-up of an exoplanet.
Credit: NASA, ESA, CSA, Ralf Crawford (STScI).

OUTREACH

IREx leads a dynamic outreach program, driven by a team of astrophysicists who specialise in science communication. They are committed to strengthening the relationship between the public and the scientific community by developing and contributing to numerous initiatives that allow all members to engage with a wide audience. These initiatives not only highlight the Institute's scientific accomplishments, but also foster teamwork and help researchers build strong communication skills.

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THE TOTAL SOLAR ECLIPSE OF APRIL 8, 2024

On April 8, 2024, a rare and spectacular astronomical event occurred across North America: a total solar eclipse. Throughout the year, IREx members **launched numerous initiatives and worked passionately to prepare for this unique event, ensuring that as many people as possible could experience it**.

- As part of Science Literacy Week in **September 2023**, astrophysicist **Marie-Eve Naud recorded the virtual workshop *E comme Éclipse* for classrooms and municipalities**. This workshop is available in short segments on IREx's YouTube channel. During Je lis la science Day, she also shared **reading suggestions related to eclipses and astronomy and compiled a list of relevant videos** on the eclipse theme.
- The ***2023 AstroMIL – Solar Wink event***, organized by IREx on **October 14, 2023**, at the **MIL campus of the Université de Montréal**, allowed nearly a thousand people to observe the partial solar eclipse that occurred that day and to learn more about astronomy through a variety of activities and booths for both young and old.
- The **Eclipse Ambassadors program**, launched in 2023 and led by **Marie-Eve Naud and Heidi White**, trained a third **cohort in February 2024**, bringing the total number of **university student ambassadors to 120**. Through numerous initiatives before and during the April 8 eclipse, these ambassadors raised awareness among thousands of people about the fascinating phenomenon of eclipses.
- **The Grande conférence de l'IREx, *Éclipses solaires : de Babylone à l'ère spatiale***, was presented on **March 27, 2024**, by Professor **Paul Charbonneau, a solar physics expert**. The 180 attendees also had the opportunity to learn more about the April 8 eclipse through information booths run by Eclipse Ambassadors

2

1. The eclipse of April 8, 2024. Credit: É. Artigau.
2. Tens of thousands of glasses were distributed free of charge to members of the Université de Montréal community and Montreal residents. Credit: A. Philibert/UdeM.

OUTREACH

- **The Grande conférence de l'IREx, *Éclipses solaires : de Babylone à l'ère spatiale***, was presented on **March 27, 2024**, **by Professor Paul Charbonneau**, a solar physics expert. The 180 attendees also had the opportunity to learn more about the April 8 eclipse through information booths run by Eclipse Ambassadors.
- In partnership with the Observatoire du Mont-Mégantic and the Université de Montréal, **IREx purchased and distributed over 70,000 eclipse glasses** free of charge to the university community and the general public in the weeks leading up to the eclipse. This was made possible through the efforts of Eclipse Ambassadors and partnerships with the Bibliothèques de Montréal, the Trottier Family Foundation, and Espace pour la vie.
- **Marie-Eve Naud, Nathalie Nguyen-Quoc Ouellette, Frédérique Baron, Heidi White, and Nicolas Cowan** were in high demand by the media as experts. Together, they gave **more than a hundred interviews on television, radio, print, and online platforms** in a crescendo that intensified in the weeks leading up to the eclipse.
- The IREx team also
  - jplayed a **leadership role within the *Regroupement Éclipse Québec***, a network of organizations involved in science communication that served as a reference for information about the eclipse in the province, notably through the website www.eclipsequebec.ca/en/.
  - led and participated in **various educational initiatives**, such as **attending conferences for primary, secondary, and college school staff** in 2023.
  - collaborated with Savoir.Media to produce a **series of ten videos that garnered over a million views on social media**.
  - made **significant contributions to all initiatives and events at the Université de Montréal**, including the website www.umontreal.ca/eclipse/en/solareclipse/, video capsules, and informative articles about the eclipse, as well as **organizing events at the MIL campus, the CEPSUM at the Université de Montréal, and several other locations**, which attracted thousands of people.

The MIL campus of the Université de Montréal, where most IREx members work, was directly in the path of totality, where the Moon completely covers the Sun for a brief moment. Credit: D-A Lizotte.

PUBLIC EVENTS

Public and School Talks

IREx members are always pleased to engage with diverse audiences about their research projects, exoplanets, and astronomy more broadly. They are frequently invited to give **talks at libraries, amateur astronomy clubs, science centres, bars, senior centres, and many other venues** across Canada and around the world. They also regularly **lead presentations, workshops, information booths, and a variety of activities in educational settings ranging from preschool to university.**

For a complete list of public talks and outreach activities in different settings, please refer to the appendix at the end of this report.

University Activities for Secondary School Students

Each year, IREx welcomes **secondary students to the Université de Montréal to learn about the typical career and day-to-day work life of an astrophysicist**. On D**ecember 15, 2023**, IREx hosted a **career day** where fourteen secondary school students had the opportunity to meet and speak with astronomers at various stages of their careers. The students also attended presentations, toured the campus and laboratories, and took part in interactive activities. Several members contributed to the event, which was organized by **Marie-Eve Naud: Laurie Dauplaise, Kim Morel, Nathalie Nguyen-Quoc Ouellette, Thomas Vandal, and Frédérique Baron**.

A shorter online activity took place on the evening of **April 18, 2024**. About twenty students in Secondary III, IV, and V attended the **webinar *Profession : Astrophysicienne***, also led by **Marie-Eve Naud**.

In June, IREx also **partnered with RevDec**, an organization that works to prevent school dropouts in Montreal. About fifteen **youth aged 12 to 16 first received a visit from Marie-Eve Naud and summer interns Thomas Lefèvre and Allison Moffat**, who introduced them to the basics of astronomy. The following week, the **group visited the MIL campus** to take part in an interactive activity about the Solar System, explore the campus, and observe the Sun through a telescope designed for that purpose. It was a rewarding experience for both the IREx team and these bright and curious students.

1. Credit: M.-E. Naud.
2. Observing the Sun during RevDec's visit to the MIL campus. Credit: M.-E. Naud.
3. Credit: L. Dang.

Astronomy on Tap

Each month at Siboire Saint-Laurent, a Montreal microbrewery, **a team of local astronomers hosts a fun and relaxed astronomy night**. These events, organized in collaboration with IREx, the Centre for Research in Astrophysics of Quebec, and the Trottier Space Institute, **feature two short talks by local astronomers along with games and prizes**. It's a fantastic opportunity for the general public to chat about space with passionate scientists!

The AoT-MTL team includes several IREx members, notably postdoctoral researchers **Clémence Fontanive, Yayaati Chachan, and Romain Allart,** who led the organization this year, along with **Lisa Danng, Vignesh Krishnamurthy, Neil Cook, Louis-Philippe Coulombe, Jared Splinter, Pierre-Alexis Roy, Joost Wardernier, Mahesh Herath, Thomas Vandal, Leslie Moranta, and Georgia Mraz**.

Seven events were held in 2023–2024: September 19, 2023 (bilingual, in French and English), with a **presentation by postdoctoral researcher Romain Allart**, October 17, 2023 (in English), November 14, 2023 (in French), with a **presentation by IREx Director René Doyon**, January 24, 2024 (in English), February 20, 2024 (in French), with **presentations by PhD student Thomas Vandal and Education and Public Outreach Coordinator Marie-Eve Naud**, April 23, 2024 (in English), with a **presentation by postdoctoral researcher Yayaati Chachan**, May 21, 2024 (in French), with a **presentation by PhD student Pierre-Alexis Roy**.

Science Literacy Week 2023

As part of **Science Literacy Week**, astrophysicist and science educator **Marie-Eve Naud demystified the phenomenon of solar eclipses in the virtual workshop *E comme Éclipse***. Presented in the form of sixteen short video segments totalling approximately one hour of content, the workshop has been available on the Institute's YouTube channel since **September 2023**.

The segments can be watched in any order, making this an ideal resource for **schools, municipalities, and libraries**. The videos help viewers of all ages better understand the trio of celestial bodies involved, the rarity of the event, the difference between partial and total eclipses, and how to observe this spectacular phenomenon safely.

1. *Credit: AoT-MT.*
2. *Credit: A. Philibert, UdeM.*

AstroMIL 2023

AstroMIL, a family-friendly astronomy celebration, was held this year during the **partial eclipse on Saturday, October 14, 2023**. This little celestial "wink" from the Sun gave organizers and volunteers the perfect opportunity to spark enthusiasm in almost **1,000 people gathered at the MIL campus**, while sharing information about the fascinating phenomenon of eclipses and astronomy more broadly.

At this event, IREx Science Mediator **Heidi White** collaborated with several students to create **a sensory astronomy booth, showcasing a variety of tools designed to help people experience the Universe using all their senses.** The booth was especially popular with children, who had the chance to explore 3D models of the Moon, listen to sonified astronomical images, and learn astronomical vocabulary in sign language.

1

Researchers' Night, Espace pour la vie

The 4th edition of Researchers' Night at Espace pour la vie took place on November 10, 2023, an event also held in other museums across Quebec and in 300 cities across Europe. This evening connects the public with people working at the heart of scientific research. During the event, astrophysicists **Alexandrine L'Heureux, Laurie Dauplaise, Kim Morel, Caroline Piaulet-Ghorayeb, and Frédérique Baron** presented a demonstration explaining one of the techniques used to study the atmospheres of exoplanets.s.

Séjour découverte en astrophysique 2024

This year, IREx partnered with the *Faculté des arts et des sciences* at the Université de Montréal to offer an in-person version of the popular event for cegep students, now known as the Séjour découverte en astrophysique. On **January 17, 2024, 75 students gathered at the MIL campus** to learn more about astrophysics research and other various duties of astronomers, helping them make informed decisions about their university studies. In addition to meeting several astrophysicists such as **Marie-Eve Naud, Heidi White, Frédérique Baron, Loïc Albert, and Nathalie Nguyen-Quoc Ouellette**, they had in-depth conversations with early-career researchers including **Thomas Vandal, Érika Le Bourdais, Déreck-Alexandre Lizotte, Alexandrine L'Heureux, and Pierrot Lamontagne.**

In the afternoon, the group toured the MIL campus and the Experimental Astrophysics Laboratory, and took part in the interactive activity *À la manière d'une astronome*, adapted from the *Des exoplanètes à l'école* educational kit.

2

1. *Credit: M. Gholamhosseini.*
2. *Credit: F. Baron.*

La Grande conférence de l'IREx 2024, Paul Charbonneau

On **March 27, 2024**, IREx hosted its Grande conférence, titled ***Les éclipses solaires : de Babylone à l'ère spatiale***, and given by Paul Charbonneau, professor in the Département de physique at the Université de Montréal, who explored the history and mechanics of eclipses. The in-person event, held at the MIL campus, drew a **record audience of 180 attendees**, who each received a free pair of certified eclipse glasses and had the opportunity to **meet with Eclipse Ambassadors** to learn more about the April 8, 2024, eclipse. The talk was also streamed live on Facebook and YouTube, where it garnered over **4,000 views**, thanks to a partnership with AstroPoly.

Each year, the Grandes conférences de l'IREx bring a **world-class scientist to Montreal to engage with IREx members and share their research and personal story with the public.** Past speakers have included **David Charbonneau** (Harvard), **Vicky Meadows** (University of Washington), **Clara Sousa-Silva** (Harvard/CfA), and **Thomas Fauchez** (NASA Goddard Space Flight Center).

24 Hours of Science 2024 - Discussion with UdeM astronomers, ep. 1: Romain, Charles & Marine

As part of the 24 Hours of Science, IREx, together with the Center for Research in Astrophysics of Quebec and the Faculté des arts et des sciences at the Université de Montréal, released a **filmed podcast on its YouTube channel in May 2024**. Designed for late secondary school and cegep students, the **45-minute discussion** has already been viewed by over 200 people. The conversation was **hosted by astrophysicist Frédérique Baron and featured three young astronomers, including Charles Cadieux and Romain Allart**. They discussed their experiences and career paths, key moments that shaped their journeys, and their hopes for the future.

AstroFest 2024

AstroFest was held on **June 15 and 16, 2024**, at the **Planétarium du Montréal at *Espace pour la vie***, with the theme "*Le Soleil dans tous ses éclats*." For the occasion, **Marie-Eve Naud, Heidi White, Nathalie Nguyen-Quoc Ouellette, Allison Moffat, Ben Coull-Neveu, Anthinéa Melot, and Sonya Liu, along with Julie Bolduc-Duval** (Director of À la découverte de l'univers, a partner program) and two Eclipse Ambassadors, invited attendees of all ages to write their own ***Message to an Extraterrestrial***, a fun way to spark curiosity and learn more about exoplanets and the search for life elsewhere in the universe. On Saturday evening, **Jonathan Gagné**, scientific advisor at the Planetarium, gave a talk about his research on young stars in the solar neighbourhood. It was a joyful celebration of science that gave thousands of people the chance to learn more about astronomy in a fun and inclusive atmosphere.

1. *Credit: NASA/Aubrey Gemignani.*
2. *Credit: Edit created in Canva.*
3. *Credit: M.-E. Naud.*

Eurêka! Festival 2024

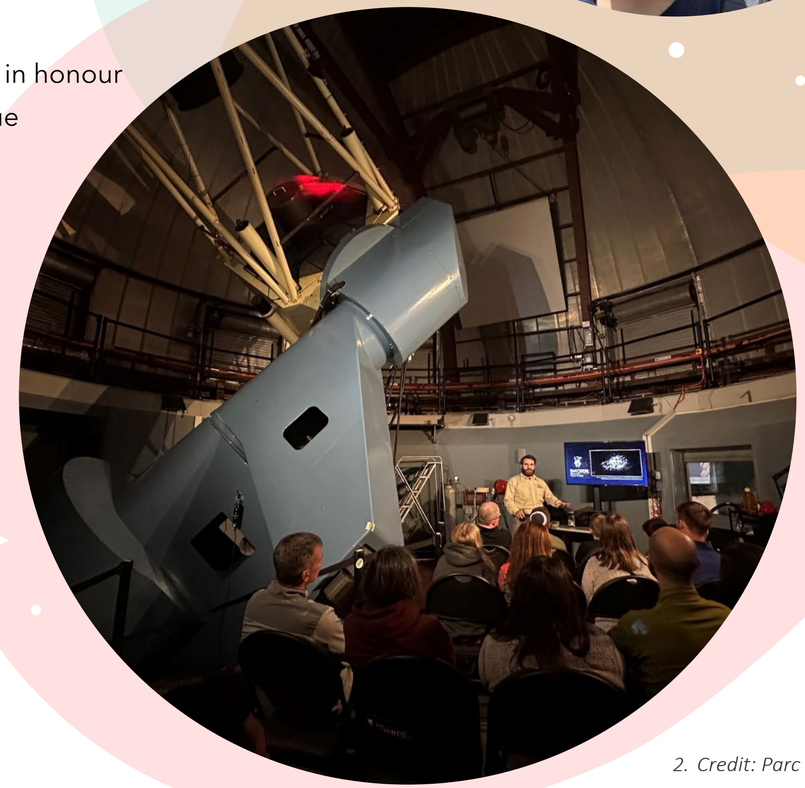
The Eurêka! Festival took place from **May 24 to 26, 2024**, at Parc Jean-Drapeau. During the event, IREx science communication interns **Allison Moffatt and Thomas Lefèvre, along with Frédérique Baron, Érika Le Bourdais, and Marie-Eve Naud**, hosted the booth for the Center for Research in Astrophysics of Quebec in the Zone de découverte.

This year's featured activity was titled ***La vie extraterrestre: fiction ou réalité?*** Visitors explored alien planetary systems, imagined their own extraterrestrials, and gained a better understanding of the vast distances separating Earth from other Solar System bodies and the nearest exoplanet through the **interactive LEGO activity *Quand est-ce qu'on arrive?*** As a bonus, they also had the chance to take a look through a **solar telescope** to see our star up close, especially exciting during this period of peak solar activity!

Mont-Mégantic Popular Astronomy Festival 2024

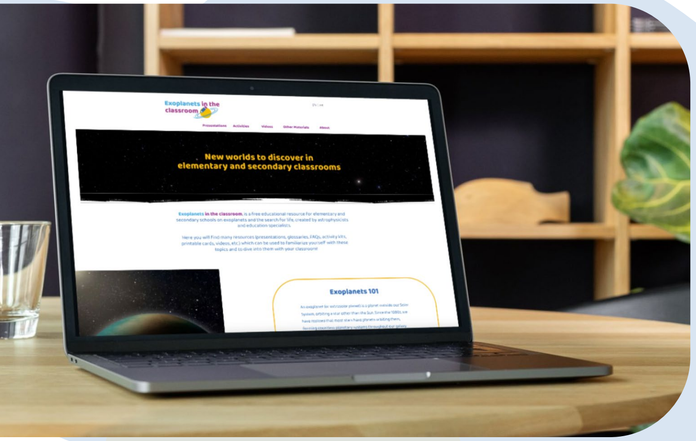
The Mont-Mégantic Popular Astronomy Festival, held on **July 4, 5, and 6, 2024**, was themed ***Poussières d'étoiles***, in honour of the beloved astrophysicist **Hubert Reeves**, who sadly passed away in 2023. This festival offers the public a unique opportunity to enjoy the stunning starry skies of Mont-Mégantic and to visit the ASTROLab du Mont-Mégantic, a museum institution dedicated to making astronomy accessible to all, notably through public talks.

Érika Le Bourdais, a master's student finishing her degree at IREx, gave a talk on her research titled ***Archéologie planétaire: reconstruire les systèmes planétaires une étoile à la fois***. During this unique event, the public can even access the dome of the Observatoire du Mont-Mégantic and look through the telescope's eyepiece.



1. Credit: C. Cruz-Vinaccia.
2. Credit: Parc national du Mont-Mégantic.

PROGRAMS AND CONTENT CREATION



Credit: Edit created with Canva.

Exoplanets in the Classroom

In **summer 2024**, the project Exoplanets in the Classroom, led by IREx in collaboration with Discover the Universe and other partners, reached an important milestone: the translation of its content into English. This wealth of **free educational resources** is now available at www.exoplanetesalecole.ca in French and www.exoplanetsintheclassroom.ca in English.

These resources were developed by a **team of education-focused IREx scientists** in collaboration with **hundreds of school staff from diverse backgrounds**. They are intended for educators in primary, secondary, and cegep settings, as well as astronomy enthusiasts across Canada and beyond. The materials: **presentations, activities, astronomer biographies, videos, virtual tool tutorials, encyclopedia, FAQs, posters**, and more, help users learn about **exoplanets, the search for life elsewhere in the Universe, and astronomy in general**.

These resources are now **widely used by IREx members and partners in a variety of settings**. For example, the activity *In an Astronomer's Shoes*, from the secondary school kit, is now featured in all outreach events that introduce participants to the astronomer's career. In addition, each year IREx partners with *Discover the Universe* to guide dozens of classrooms across Canada through the activity *Challenge - Explore the Sky... and Exoplanets!*, part of the primary-level kit, during the holiday season.

Meet the 2023 Interns – Video Series

In **September 2023**, IREx released a video series featuring the 2023 **interns**. The short videos, ranging from 2 to 7 minutes in length, were produced by **Rebecca Hamel**, a student at Saint Mary's University and the 2023 Sureau Science Communication Intern at IREx.

In this series, **Olivia Locke, Zoe Shu, Maddy Walkington, Maya Cadieux, Vincent Savignac, Élise Leclerc, Mathis Bouffard, Emilia Vlahos, Élyse D'Aoust, Rebecca Hamel, and Naman Jain** answer questions like "What do you enjoy most about research?", "What are your most memorable experiences?", and "If you could go anywhere in the Universe, where would you go?".

The series is available on the IREx YouTube channel and has gathered nearly 500 views to date. The videos are presented in both French and English, with subtitles available in both languages.

Rebecca Hamel, who led the design of the videos, is also interviewed in the series. Credit: Edit created with Canva.

IREx IN THE NEWS

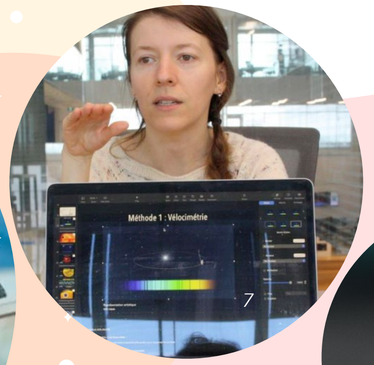
In 2023-2024, IREx researchers participated in **21 television interviews, 58 radio interviews, and 72 print and online interviews, for a total of 151 media appearances**.

This record number is partly explained by the particularly rich news cycle filled with significant astronomical events. The **eclipse on April 8, 2024**, naturally attracted considerable media attention, and our experts **Marie-Eve Naud, Nathalie Nguyen-Quoc Ouellette, Frédérique Baron, Heidi White, and Nicolas Cowan** were on all platforms to explain the phenomenon and help prepare the public. In May 2024, spectacular **northern lights** provided another opportunity to discuss astronomy on television, radio, and in newspapers.

As every year, numerous **discoveries made by members of the Institute** caught the attention of media outlets around the world. This includes the **significant study of TRAPPIST-1 led by PhD student Olivia Lim** and her team, and the **discovery of water vapour in the atmosphere of GJ 9827 d by PhD student Pierre-Alexis Roy** and his team. **Charles Cadieux**, also a PhD student, **made headlines again this year, this time for his study of LHS 1140 b, a potential water-covered super-earth**.

IREx members also contributed to numerous shows, documentaries, and feature stories, such as the TV program *Bulletin spatial*, which featured **Nathalie Nguyen-Quoc Ouellette, Loïc Albert, and Marie-Eve Naud**, or the feature *Trouvez l'exoplanète parfaite* in *Les Débrouillards*, with **Frédérique Baron, Olivia Lim, Leslie Moranta, Lisa Dang, Thomas Vandal, Étienne Artigau, and Marie-Eve Naud**. Deputy Director **Nathalie Nguyen-Quoc Ouellette** also continued her **regular segment on the radio show *Moteur de recherche***.

For a more complete list of IREx members' media appearances, please refer to the appendix of this report.



1. *Marie-Eve Naud. Credit: Salut Bonjour, TVA.*
2. *René Doyon. Credit: P. Sanfaçon, La Presse.*
3. *Lisa Dang at Les Lucioles Podcast. Credit: Espace pour la vie.*
4. *Nathalie Ouellette at RAD. Credit: RAD Radio-Canada.*
5. *Les Débrouillards. Trouvez l'exoplanète parfaite. Credit: Les Débrouillards (illustrations by Flaflam).*
6. *Marie-Eve Naud and Nathalie Ouellette. Credit: Martin Chamberland, La Presse.*
7. *Frédérique Baron. Credit: Raymond Fournier : Agence Science Presse.*
8. *Bulletin Spatial. Credit: TOU.TV, Radio-Canada.*

WEBSITE, NEWSLETTER AND SOCIAL MEDIA

IREx continues to stand out online by sharing rich, engaging content across a wide range of platforms, whether it's **introducing children and their families to the world of exoplanets, showcasing the team's scientific discoveries, or recruiting new members**.

IREx has a **dynamic website**, completely redesigned in 2022, which saw a **significant increase in traffic this year**, particularly due to initiatives related to the solar eclipse. The site now **totals nearly 600,000 visits**.

Our **bilingual newsletter**, created in **2014**, is published five times a year and has over **2,000 subscribers**.

The Institute also maintains a strong presence on several **social media platforms**. In **2024, IREx launched an Instagram account** to reach a younger audience, future IREx researchers among them.

As of **August 31, 2024**, IREx had:

Credit: NASA, ESA, CSA, STScI.

5805 subscribers	140 subscribers	593 048 visits	2488 subscribers	2552 subscribers	565 subscribers
@iREXoplanetes	@iexoplanets	www.exoplanets.ca	irex@astro.umontreal.ca	@exoplanetes	/exoplanetes

Inreach

CAFÉS IREx

Cafés IREx are weekly gatherings that take on various formats: **presentations, workshops, informal discussions, or Q&A sessions**. Typically bringing together around 40 participants, these meetings are always offered in a **hybrid format** so that members outside Montréal can join. They are held at the Université de Montréal and occasionally at McGill University.

The Cafés give IREx members a chance to **connect regularly, share scientific news, present research findings, and engage with guest researchers. Educational presentations on exoplanet science, research tools, and techniques** are also offered, particularly between May and August, during the summer internship period. These team meetings also cover topics related to **education, science communication, equity, diversity, inclusion, and career development.**

Credit: M-Eve Naud.

2024 Summer Interns. Credit: M-E Naud.

SUMMER INTERNSHIPS

The summer internship program has been at the heart of IREx's activities since the Institute was founded. Each year, the prestigious **Trottier Excellence Grants competition** attracts undergraduate students from across Canada who are drawn to IREx's cutting-edge research and the energy of its team.

In the **summer of 2024, 20 summer interns** joined the IREx team, including **seven Trottier fellows and one Sureau fellow** in science communication. Based across the MIL campus of the Université de Montréal, the Montréal Planetarium, McGill University, and Bishop's University, the interns had many opportunities to engage with IREx members throughout the summer. The interns were welcomed during the **Orientation Day on May 6**, then met weekly at the Cafés IREx, and also took part in various social and training activities throughout the season. They were **actively involved in public outreach** as well, hosting booths at both AstroFest and the Eurêka! Festival.

A new addition this year: most interns completed the ***Ambassadrices et Ambassadeurs du ciel d'été*** training, led by M.Sc. student **Pierrot Lamontagne**, summer intern **Jonathan Roussy, and Marie-Eve Naud**. Many also had the chance to conduct observing runs at the **Observatoire du Mont-Mégantic**, where they learned to operate the telescope and its instruments to collect astronomical data.

As is tradition, the internship program concluded with a **Final Presentations Day on August 15**, where each intern shared the work they had accomplished over the summer.

INITIASCIENCES PROGRAM

InitiaSciences is an innovative Quebec-based program launched by young researchers that offers **secondary school and cegep students from underrepresented groups in science their first research experience**. This program is made possible thanks to the dedication of a large volunteer team, led with great skill by **Caroline Piaulet-Ghorayeb and Laurie Dauplaise**, two graduate students at IREx.

Between **September 2023 and June 2024**, a second cohort of youth completed a research internship. Of the five mentors, two were young researchers from IREx. **Leslie Moranta** supervised Livia Poliquin (École secondaire Édouard-Montpetit), Himani Patel and Zahra Faikh (École secondaire Saint-Laurent), and Ilhem Lazizi (Collège Bois-de-Boulogne) in developing an artificial intelligence-based tool to better understand young stars. **Alexandrine L'Heureux** mentored Jacob Morneau, Zakaria Chakir, Simon Lafrance, and Xavier Vandelac from Collège Maisonneuve on a project to measure the mass of an exoplanet using data collected by the SPIRou instrument on the Canada-France-Hawaii Telescope.

In addition to the research component, InitiaSciences members also lead **popular workshops in secondary schools and cegeps** to introduce students to the scientific method, scientific articles, research tools, and science communication.

IREx is a proud partner of InitiaSciences, supporting the initiative financially and through various other contributions. The InitiaSciences team also includes several other young IREx researchers: **Kim Morel, Érika Le Bourdais, Thomas Vandal**, and IREx EPO coordinator **Marie-Eve Naud**, who acts as an advisor.

Credit: Carlos Riobo.

EDI COMMITTEE

The mission of the **IREx Equity, Diversity, and Inclusion (EDI) Committee** is to promote the integration of individuals from traditionally underrepresented groups in astrophysics within the Institute, thereby contributing to the scientific prosperity of an inclusive Institute proud of its diversity.

The committee's objectives are to:

- Increase **recruitment efforts of individuals from underrepresented groups** at all levels of study and employment,
- Foster the **integration and retention** of these individuals within IREx,
- **Promote diversity in science** through IREx, and
- Support the **professional development** of members so they can pursue the career of their choice.

In 2023–2024, the committee included graduate students **Érika Le Bourdais, Leslie Moranta, and Caroline Piaulet-Ghorayeb**, postdoctoral researchers **Romain Allart and Clémence Fontanive**, professor **Björn Benneke**, and research professionals **Frédérique Baron and Marie-Eve Naud**.

All IREx members continued their learning on EDI issues through **training sessions, presentations, and discussions**. This ongoing education has a significant impact on the Institute's recruitment, scientific, and outreach activities. As part of the Cafés IREx, members attended an **EDI training session by Dimitri Girier**, an inclusion specialist at the Université de Montréal, and a **presentation by IREx Outreach Officer Heidi White, who discussed her work with underrepresented communities** and shared ideas and strategies for fostering meaningful engagement with them.

Members also had access to several **career development activities**, including a training session on **effectively presenting research findings**. Finally, the EDI committee hosted a discussion on **articles about gender diversity in research environments**, sparking enriching exchanges on the current state and potential improvements.

A **self-identification form** was distributed to members for the third consecutive year to obtain a clearer picture of the Institute's demographics. This year, **only 38% of members completed it** (vs. 72% in 2022–2023), which affects the relevance of the conclusions. A discussion session with all members identified strategies to increase participation next year. However, the data collected shows that a **majority of members are not from underrepresented groups**, indicating the need to continue recruitment and retention efforts in this regard. On a positive note, t**he male-to-female ratio remained near parity**, with 41% of members identifying as cisgender women and 52% as cisgender men. A new question this year about the highest level of education attained by parents or grandparents revealed that **nearly 75% of members have at least one parent who attended university (bachelor's, master's, or doctorate)**. Presenting this result helped members understand the importance of family background and socioeconomic status as factors influencing access to research careers.

Finally, the committee continues its **collaborative work with other committees with similar missions**, including those from the Université de Montréal and McGill University's physics departments and the Centre for Research in Astrophysics of Quebec, to achieve broader-scale changes.

SOCIAL COMMITTEE

The IREx Social Committee is currently composed of **Romain Allart, Antoine Darveau-Bernier, Pierre-Alexis Roy, Thomas Vandal, and Joost Wardenier**. Its activities help reduce isolation among members, including those newly arrived in Montreal.

This year, the committee contributed to the creation of a **Welcome Day for new members, which was held for the first time on October 2, 2023**. This activity, organized in collaboration with the deputy director and outreach team, helps members strengthen connections and learn more about the many scientific, instrumentation, and outreach initiatives at the Institute.

The committee was also particularly active over the past year, organizing **lunch gatherings before Cafés IREx, a fall apple-picking outing, a bowling night to mark the end of the year, a snow day in winter 2024, the traditional summer picnic, numerous shared meals, and group viewings of films, comedy shows, and basketball, football, and hockey games.**

1. Credit: P. Vallée.
2. Credit: M-E Naud.

Appendices
PUBLIC EVENTS

School, Senior centers and Library Talks

1. *Une astronome à ta bibliothèque*, **Marie-Eve Naud**, Bibliothèque de Beaconsfield, 15 septembre 2023.
2. *Unveiling the Universe with the James Webb Space Telescope*, **Nathalie Ouellette**, Canadian Association of Science Centres CoP, 19 septembre 2023.
3. *Skype an Astronomer,* **Nathalie Ouellette**, Skype a Scientist, 22 septembre 2023.
4. *À la découverte de nouveaux mondes!*, **Frédérique Baron**, Cégep de Rimouski, 26 septembre 2023.
5. *Unveiling the Cosmos with the James Webb Space Telescope*, **Nathalie Ouellette**, Exploring by the Seat of your Pants (EN), 3 octobre 2023.
6. *Dévoiler le cosmos avec le telescope spatial James Webb*, **Nathalie Ouellette**, Exploring by the Seat of your Pants (FR), 4 octobre 2023.
7. *Fantastic Planets and Where to Find Them*, **Lisa Dang**, À la rencontre des femmes en STIM Collège Vanier, 6 octobre 2023.
8. *Discussion avec une astronome*, **Marie-Eve Naud**, Centre des aînés de St-Léonard, 6 octobre 2023.
9. *Teams Presentation and Q&A with Frederique Baron*, **Frédérique Baron**, École Kinscourt (UK), 10 octobre 2023.
10. I*ngrédient d'une Éclipse Solaire*, **Lisa Dang, Romain Allart**, École Primaire le Carignan, Montréal, 31 octobre 2023.
11. *Éclipse à Carignan*, **Romain Allart**, Ambassadeur éclipse à Montréal Nord, 30 octobre 2023.
12. *Skype an Astronomer*, **Nathalie Ouellette**, Skype a Scientist, 3 novembre 2023.
13. *Skype an Astronomer*, **Nathalie Ouellette**, Skype a Scientist, 14 novembre 2023.
14. *Une astronome dans ta classe*, **Marie-Eve Naud**, École primaire Notre-Dame-du-Rosaire, Val d'Or, 5 décembre 2023.
15. *Discussion avec une astrophysicienne*, **Marie-Eve Naud**, Bibliothèque Marie Uguay, 6 décembre 2023.
16. *Jamboree des étudiant.e.s aux cycles supérieurs (maitrise et doctorat) en astrophysique (x2); Les études en physique à l'Université de Montréal, la vie d'un.e astrophysicien.ne; Activité interactive À la manière d'un astronome, Les télescopes, au sol et dans l'espace, Visite des laboratoire, Rencontre avec des étudiants au baccalauréat*, **Kim Morel, Laurie Dauplaise, Marie-Eve Naud, Nathalie Ouellette, Thomas Vandal, Frédérique Baron, Élise Leclerc**, journée carrière en astrophysique, 15 décembre 2023. (x7)
17. *L'éclipse du 8 avril 2024 & Une astronome dans ta classe*, **Marie-Eve Naud**, École secondaire Mgr-Euclide-Théberge, Marieville, 19 décembre 2023.
18. *Les télescope modernes*, **Nathalie Ouellette**, Séjour découverte en astrophysique de l'UdeM, 17 janvier 2024.
19. *Jamboree des étudiant.e.s aux cycles supérieurs (maitrise et doctorat) en astrophysique, Les études en physique à l'Université de Montréal, la vie d'un.e astrophysicien.ne, activité interactive, Les télescopes, au sol et dans l'espace, Visite des laboratoire, Rencontre avec des étudiants au baccalauréat*, **Alexandrine L'Heureux, Pierrot Lamontagne, Dereck-Alexandre Lizotte, Marie-Eve Naud, Thomas Vandal, Érika Le Bourdais, Loïc Albert, Nathalie Ouellette, Frédérique Baron**, Séjour découverte en astrophysique 2024, Université de Montréal, 17 janvier 2024. (x9)
20. *A solar eclipse on April 8th, 2024 An event of a lifetime!*, **Marie-Eve Naud**, Art Gallery of Ontario Virtual School Program, 18 janvier 2024.
21. *L'éclipse solaire du 8 avril 2024*, **Marie-Eve Naud**, École primaire Notre-Dame-de-la-Sagesse, Sainte-Agathe-des-Monts, 26 janvier 2024.
22. *L'éclipse solaire du 8 avril 2024*, **Marie-Eve Naud**, École primaire Les Bocages, St-Augustin-de-Desmaures, 31 janvier 2024.
23. *A la Recherche des Mondes Extra-Solaires*, **Clémence Fontanive**, Présentation en ligne au Lycée Général et Technologique de Saint Joseph-La Salle, Toulouse, France, 8 février 2024.
24. *À la recherche de nouveaux mondes : l'étude des exoplanètes*, **Alexandrine L'Heureux**, École Jeanne-Mance, 19 février 2024.
25. *L'éclipse solaire du 8 avril 2024*, **Marie-Eve Naud**, École primaire Marguerite Bourgeoys, Québec, 21 février 2024.
26. *Une astronome dans ta classe*, **Marie-Eve Naud**, École primaire Alpha, Rosemère, 21 février 2024.

27. *L'éclipse solaire du 8 avril 2024*, **Marie-Eve Naud**, École secondaire Jacques-Rousseau, Longueuil, 26 février 2024.
28. *Une éclipse totale à Montréal*, **Mathis Bouffard**, Bibliothèque Sylvain-Garneau de Laval, 5 mars 2024.
29. *Une éclipse solaire totale le 8 avril 2024*, **Olivia Lim**, Résidence Rosemont Les Quartiers, 12 mars 2024.
30. *Les éclipses et le télescope spatial James Webb*, **Nathalie Ouellette**, Collège Trinité, 19 mars 2024.
31. *Présentation sur l'éclipse*, **Pierrot Lamontagne**, Pensionnat Notre-Dame-Des-Anges, 25 mars 2024.
32. *L'éclipse solaire du 8 avril 2024*, **Marie-Eve Naud**, École secondaire École secondaire Monseigneur-A.-M.-Parent, Longueuil, 26 mars 2024.
33. *Éclipse solaire totale - 8 avril 2024*, **Laurie Dauplaise**, École Laplume, Sorel-Tracy, 2 avril 2024.
34. *Ma vie de chercheur en astronomie*, **Thomas Vandal**, Cégep de la Gaspésie et des Îles, 3 avril 2024.
35. *Une éclipse solaire totale le 8 avril 2024*, **Charles Cadieux**, École secondaire Joseph-Charbonneau, 4 avril 2024.
36. *À la recherche de nouveaux mondes : l'étude des exoplanètes*, **Alexandrine L'Heureux**, École secondaire Monseigneur-Richard, 5 avril 2024.
37. *L'éclipse du siècle*, **Lisa Dang**, École Secondaire Joseph-François-Perrault, Montréal 5 avril 2024.
38. *Éclipse solaire totale - 8 avril 2024*, **Laurie Dauplaise**, CHSLD Angus, 6 avril 2024.
39. *Les études en physique à l'Université de Montréal, la vie d'un.e astrophysicien.ne*, **Marie-Eve Naud**, Webinaire - Profession: astrophysicienne, en ligne, 18 avril 2024.
40. *Président d'honneur et conférencier au Symposium des sciences du cégep de Shawinigan*, **Thomas Vandal**, 1er mai 2024
41. *Exciting Results from the James Webb Space Telescope*, **Nathalie Ouellette,** Exploring by the Seat of your Pants (EN), 28 mai 2024.
42. *Dévoiler le cosmos avec le télescope spatial James Webb*, **Nathalie Ouellette**, Camp de jour Folie Technique, 28 juin 2024.
43. *Les exoplanètes*, **Marie-Eve Naud**, Camp de jour Explorer l'univers, Montréal, 2 juillet 2024.
44. *Vingt mille lieues sur une exoplanète*, **Marie-Eve Naud**, Bibliothèque de Candiac (6-12 ans), Candiac, 3 juillet 2024.
45. *Les exoplanètes*, **Nathalie Ouellette**, Camp de jour Folie Technique, 4 juillet 2024.
46. *Jasette sur ma recherche*, **Sophie-Mu-Fei Gravel Depalle, Laurie Dauplaise**, Camp de jour Explorer l'univers, Montréal, 18 juillet 2024. (x2)
47. *À la découverte du ciel : Redécouvrir le ciel de jour et de nuit*, **Marie-Eve Naud**, Résidence ORA (personnes âgées), Montréal, 4 juillet 2024.
48. *Le télescope spatial James Webb*, **Nathalie Ouellette**, Camp de jour Explorer l'univers, Montréal, 11 juillet 2024.
49. *Le télescope spatial James Webb*, **Nathalie Ouellette**, Camp de jour Explorer l'univers, Montréal, 12 juillet 2024.
50. *Les exoplanètes*, **Marie-Eve Naud**, Camp de jour Explorer l'univers, Montréal, 16 juillet 2024.
51. *Jasette sur ma recherche*, **Thomas Vandal, Mathis Bouffard, Alexandra Rochon**, Camp de jour Explorer l'univers, Montréal, 18 juillet 2024. (x3)
52. *Les exoplanètes*, **Marie-Eve Naud**, École des langues de l'Université de Montréal, Montréal, 23 juillet 2024.
53. *La grande quête interstellaire : Comment on trouve des planètes autour d'étoiles lointaines*, **Alexandrine L'Heureux**, Immersion campus – Semaine Techno-Sciences, Montréal, 25 juillet 2024.
54. *Sprints de Science - Chasseurs d'exoplanètes: Débusquer la vie*, **Pierre-Alexis Roy**, 9 présentations au secondaire (en ligne), entre septembre 2023 à août 2024.(x 9)
55. *Sprints de Science - WR-124: Explosion Imminente*, **Pierre-Alexis Roy**, 2 présentations au secondaire (en ligne), entre septembre 2023 à août 2024.(x 2)
56. *Sprints de sciences WR-124: Explosition imminente? et Chasseurs d'exoplanètes*, **Thomas Vandal**, Coeur des sciences (UQAM), 9 présentations au secondaire (en ligne et en personne), à l'automne 2023 et l'hiver 2024. (x 9)
57. *Qu'est-ce qu'un article scientifique? - Ateliers d'initiation à la recherche d'InitiaSciences*, **Laurie Dauplaise**, Collège Mont-Royal et École St-Georges de Montréal, à l'automne 2023 et l'hiver 2024.(x2)

Public Talks

1. *Les premiers résultats du télescope spatial James Webb*, **René Doyon**, Génial - Le congrès 2024, 17 septembre 2023.
2. *Houston on a un problème*, **Romain Allart**, Astronomie en Fût Montréal, Le Siboire, 19 Septembre 2023.
3. *Les Naines Brunes : Chaînon Manquant de l'Astronomie*, **Clémence Fontanive**, Conférence Publique au Club d'Astronomie Bois de Belle-Rivière-Mirabel, 26 septembre 2023.
4. *À la découverte de nouveaux mondes!*, **Frédérique Baron**, Club d'astronomie de Rimouski, 26 septembre 2023.
5. *Alien Eclipses and the Search for Distant Worlds*, **Heidi White**, Trottier Space Institute at McGill University, 5 octobre 2023.
6. *How is the Webb Telescope Changing our Understanding of Exoplanets?*, **Loïc Albert**, Royal Astronomical Society of Calgary, 19 Octobre 2023.
7. *An Update on Beyond the Stars*, **Heidi White**, Las Cumbres Observatory Global Sky Partners Forum, 19 octobre 2023.
8. *Hellish Worlds: The Science of Lava Planets*, **Lisa Dang**, Hal-Con Sci-Fi Fantasy Convention, Halifax, 27 Octobre 2023.
9. *Far Far Away & In Our Backyard*, **Lisa Dang**, Hal-Con Sci-Fi Fantasy Convention, Halifax, 28 Octobre 2023.
10. *Les Naines Brunes : Chaînon Manquant de l'Astronomie*, **Clémence Fontanive**, Conférence Publique au Club d'Astronomie Cassiopée de Québec, 30 Octobre 2023.
11. *Effective and meaningful engagement of underserved and disproportionately impacted communities in STEM learning*, **Heidi White**, Center for Astrophysics | Harvard & Smithsonian, 30 octobre 2023.
12. *Les premiers résultats du télescope spatial James Webb*, **René Doyon**, Congrès annuel de la Fédération des astronomes amateurs du Québec, octobre 2023.
13. *Effective and meaningful engagement of underserved and disproportionately impacted communities in STEM learning,* **Heidi White**, Boston University, 1 novembre 2023.
14. *Unveiling the Universe with the James Webb Space Telescope*, **Nathalie Ouellette**, RASC Ottawa, 3 novembre 2023.
15. *Effective and meaningful engagement of underserved and disproportionately impacted communities in STEM learning*, **Heidi White**, Massachusetts Institute of Technology, 6 novembre 2023.
16. *Préparez-vous pour l'éclipse solaire totale d'avril 2024!*, **Marie-Eve Naud et Julie Bolduc-Duval**, Midi-Express de l'Association des communicateurs scientifiques du Québec, 7 novembre 2023.
17. *Voir au-delà du visible avec le télescope spatial James Webb*, **Nathalie Ouellette**, UQAC et le Club d'astronomie Sirius (Saguenay), 10 novembre 2023.
18. *Discussion avec une astronome - Épisode 1 : À la découverte de l'astronomie : le métier d'astronome, l'astronomie au Québec, visite guidée de l'Univers*, **Marie-Eve Naud**, Les Belles Heures de l'Université de Montréal, en ligne, 14 novembre 2023.
19. *Pourquoi les extraterrestres sont-ils si silencieux?*, **René Doyon**, Astronomie en Fût Montréal, Le Siboire, 14 novembre 2023.
20. *Exploring the Diversity of Highly Irradiated Exoplanets by Revealing their Multidimensional Nature*, **Lisa Dang**, UMaryland Centre for Theory and Computation Seminar, 15 novembre 2023.
21. *Exploring the Diversity of Distant Worlds: Characterizing Exoplanets and their Atmospheres*, **Lisa Dang**, NASA Goddard Exoplanet Seminar, 16 novembre 2023.
22. *Exploring the Diversity of Highly Irradiated Exoplanets by Revealing their Multidimensional Nature*, **Lisa Dang**, Carnegie Earth and Planetary Laboratory Seminar, 17 novembre 2023.
23. *Discussion avec une astronome - Épisode 2 : À la découverte des nouveaux mondes : les exoplanètes et la recherche de vie dans l'Univers*, **Marie-Eve Naud**, Les Belles Heures de l'Université de Montréal, en ligne, 21 novembre 2023.
24. *Exploring the Diversity of Distant Worlds: Characterizing Exoplanets and their Atmospheres*, **Lisa Dang**, York University Physics Colloquium, 21 novembre 2023.
25. *Les amas stellaires*, **Leslie Moranta**, Société d'astronomie du Planétarium de Montréal, 24 Novembre 2023.
26. *À la découverte des nouveaux mondes*, **Marie-Eve Naud**, Festival d'astronomie de Marrakech édition 2023, 27 novembre 2023.
27. *Discussion avec une astronome - Épisode 3 : À la découverte du ciel : redécouvrir le ciel de jour et de nuit, guide pratique*, **Marie-Eve Naud**, Les Belles Heures de l'Université de Montréal, en ligne, 28 novembre 2023.
28. *Aliens Worlds through the Eyes of the James Webb Space Telescope*, **Nathalie Ouellette**, TELUS Spark After Dark 2023 Best Of, 15 décembre 2023.

29. *Atmospheric Characterization of Temperate Rocky Exoplanets – A JWST and ELT Perspective,* **René Doyon**, ELT Science in light of JWST Conference (UCLA), décembre 2023.
30. *The Exciting First Year of Atmospheric Characterization of Exoplanets with JWST*, **René Doyon**, Laurence Livermore National Laboratory, décembre 2023.
31. *Astronomy News of 2023*, **Nathalie Ouellette**, Astronomy on Tap NOLA, 9 janvier 2024.
32. *Panel Women in Science*, **Frédérique Baron**, CCUWiP, 20 janvier 2024.
33. *Women in Space Science Panel*, **Nathalie Ouellette**, Women in Science and Engineering Conference, 20 janvier 2024.
34. *Unveiling the Universe with the James Webb Space Telescope*, **Nathalie Ouellette**, Third Age Learning York, 22 janvier 2024.
35. *Seeing Beyond the Visible with the James Webb Space Telescope*, **Nathalie Ouellette**, Math4America, 25 janvier 2024.
36. *Unveiling the Cosmos with the James Webb Space Telescope*, **Nathalie Ouellette**, Queen's Space Conference, 3 février 2024.
37. *Investigation Exoplanets from Ground & Space*, **Lisa Dang**, Queen's Space Conference, 4 février 2024.
38. *NIRPS, Le nouveau chercheur de planètes*, **Frédérique Baron**, AstroPoly, 8 février 2024,
39. *NIRPS, Le nouveau chercheur de planètes*, **Frédérique Baron**, Mensa Québec, 13 février 2024.
40. *L'éclipse du 8 avril : l'événement d'une vie!*, **Marie-Eve Naud**, Astronomie en Fût Montréal, Le Siboire, 20 février 2024.
41. *Observations d'exoplanètes au fil du temps*, **Thomas Vandal**, Astronomie en Fût Montréal, Le Siboire, 20 février 2024.
42. *À la découverte des mondes aquatiques!*, **Charles Cadieux**, Club d'astronomie de Sherbrooke, 23 février 2024.
43. *Exploring the Diversity of Distant Worlds: Characterizing Exoplanets and their Atmospheres,* **Lisa Dang**, University of Waterloo Physics and Astronomy Colloquium, 27 février 2024.
44. *Do Temperate Rocky Planets Around M Dwarfs Have an Atmosphere?*, **René Doyon**, The Pontifical Academy of Sciences Workshop on: The James Webb Space Telescope: From First Light to New World Views, février 2024.
45. *La recherche en astrophysique*, **Alexandrine L'Heureux**, Symposium Annuel de Physique en Recherche et en Industrie (SAPHARI) , 4 mars 2024.
46. *Voir au-delà du visible avec le télescope spatial James Webb*, **Nathalie Ouellette**, Université du Troisième Âge de l'Université de Sherbrooke, 11 mars 2024.
47. *Les éclipses et le télescope spatial James Webb*, **Nathalie Ouellette**, Ordre des ingénieurs du Québec, 13 mars 2024.
48. *Eclipse, what are they and what are they good for?*, **Nicolas Cowan**, TSI Public Talk 14 mars 2024
49. *L'éclipse solaire totale*, **Nathalie Ouellette**, Lavery Lawyer Law Firm, 15 mars 2024.
50. *Voir au-delà du visible avec le télescope spatial James Webb*, **Nathalie Ouellette**, Club d'astronomie de Boucherville, 20 mars 2024.
51. *Seeing Beyond the Visible with the James Webb Space Telescope*, **Nathalie Ouellette**, University of Calgary EarthX Speaker Series, 21 mars 2024.
52. *L'éclipse du siècle*, **Lisa Dang**, Maison d'Haïti, Montréal, 5 avril 2024.
53. *L'éclipse du siècle*, **Lisa Dang**, Ville Lac Brome, 6 avril 2024.
54. *L'éclipse du siècle*, **Lisa Dang**, Lundi Inspiration de L'Oréal Canada, Montréal, 8 avril 2024.
55. *NIRPS, Le nouveau chercheur de planètes*, **Frédérique Baron**, Société d'astronomie de Montréal, 16 avril 2024.
56. *A Cosmic Journey with Dust*, **Yayaati Chachan**, Astronomie en Fût Montréal, Le Siboire, 23 avril 2024.
57. *The Road Map to First Alien Contact: Astrobiology Panel*, **René Doyon et Nathalie Ouellette**, Trottier Space Institute Public Event, 1 mai 2024.
58. *Contributions et résultats canadiens du télescope spatial James Webb*, **Nathalie Ouellette**, Congrès de l'Acfas, 13 mai 2024.
59. *Midi-Discussion | Payé pour scruter le ciel: parcours d'un astronome professionnel*, **Nicolas Cowan**, Bibliothèque de l'ETS, 15 mai 2024.
60. *Comment devenir plus vieux que son jumeau?*, **Pierre-Alexis Roy**, Astronomie en Fût Montréal, Le Siboire, 21 mai 2024.
61. *Exoplanets in the Classroom*, **Heidi White**, Canadian Astronomical Society Annual General Meeting (CASCATO 2024), 4 juin 2024.
62. *Seeing Beyond the Visible with the James Webb Space Telescope*, **Nathalie Ouellette**, Microscopy Society of Canada Banquet Keynote, 6 juin 2024.
63. *Astronomy x Tech*, **Nathalie Ouellette**, GirlCon, 20 juin 2024.
64. *Archéologie planétaire : reconstruire les systèmes planétaires une étoile naine blanche à la fois,*

Érika Le Bourdais, Festival d'astronomie populaire du Mont-Mégantic, 4 juillet 2024.

65. *Exploring Nearby Habitable Worlds with The James Webb Space Telescope*, Doha (Qatar), **René Doyon**, 20 et 21 août 2024.
66. *James Webb Space Telescope – Canadian Virtual Town Hall*, **Heidi White, René Doyon, Loïc Albert**, 29 août 2024.

Public Events

1. *Kiosque sur l'éclipse du 8 avril à la Fête des récoltes*, **Caroline Piaulet-G**., campus MIL de l'Université de Montréal, 23 septembre 2023.
2. *Kiosque astrophysique à La nuit des chercheuses et des chercheurs,* **Frédérique Baron, Lisa Dang, Laurie Dauplaise, Leslie Moranta, Caroline Piaulet-G.**, Espace pour la Vie, 10 novembre 2023.
3. *Les éclipses solaires : de Babylone à l'ère spatiale*, **Paul Charbonneau (NASA) et l'équipe de l'IREx**, La grande conférence de l'IREx (Université de Montréal), 27 mars 2024.
4. *Kiosque du CRAQ (La vie extraterrestre, fiction ou réalité?) au Festival Eurêka –* , **Frédérique Baron, Érika Le Bourdais, Allison Moffat, Thomas Lefèvre, Marie-Eve Naud, Heidi White**, Montréal, 24-26 mai 2024.
5. *Kiosque IREx*, **Frédéric Genest, Marie-Eve Naud, Maria Bayder**, Symposium InitiaSciences, 9 juin 2024
6. *Kiosque IREx/CRAQ à l'AstroFest 2024*, **Marie-Eve Naud, Nathalie Ouellette, Allison Moffat, Thomas Lefèvre, Ben Coull-Neveu, Sonya Liu et Heidi White**, Planétarium de Montréal, 15 et 16 juin 2024.
7. *Astronomie en fût / Astronomy on Tap MTL* (7 éditions), Astronomes de Montréal incluant des **membres de l'IREx**,19 septembre 2023, 17 octobre 2023, 14 novembre 2023, 24 janvier 2024, 20 février 2024, 23 avril 2024, 21 mai 2024.

MEDIA INTERVIEWS

Television Interviews and Online Videos

1. *Épisode 3 : Civilisations extraterrestres*, **Marie-Eve Naud & Loïc Albert**, Bulletin Spatial saison 2 (Radio-Canada), tournage 29 novembre 2023.
2. *Y a-t-il de la vie ailleurs?*, **René Doyon et Nathalie Ouellette**, Curium (Radio-Canada), 20 janvier 2024.
3. *Pour tout savoir sur l'éclipse solaire totale du 8 avril 2024* (série de 10 capsules vidéo), **Marie-Eve Naud**, Savoir.media, tournage 30 janvier 2024.
4. *Comment regarder l'éclipse solaire totale 2024*, **Nathalie Ouellette**, Rad (Radio-Canada), 27 mars 2024.
5. *L'éclipse solaire du 8 avril 2024*, **Marie-Eve Naud**, L'info maintenant (RDI), 1er avril 2024.
6. *Pour tout savoir sur l'éclipse solaire du 8 avril*, **Nathalie Ouellette**, Le Devoir (Série Entrevue), 4 avril 2024.
7. *The magic of a solar eclipse*, **Nicolas Cowan**, McGill News Webcast, 4 avril 2024.
8. *Buzz Éclipse solaire le Québec en préparation*, **Marie-Eve Naud**, Salut Bonjour (TVA), 5 avril 2024.
9. **Éclipse totale: Qui peut retirer ses lunettes spéciales, et quand?**, **Marie-Eve Naud**, Le Bilan avec Emmanuelle Latraverse (LCN), 5 avril 2024.
10. *150 000 paires de lunettes à distribuer*, **Nathalie Ouellette**, TVA Nouvelles, 7 avril 2024.
11. *Épisode du 8 avril 2024* (Première heure), **Marie-Eve Naud, Mario Dumont** (LCN), 8 avril 2024.
12. *Éclipse: des scientifiques qui retombent en enfance*, **Marie-Eve Naud**, Novoo, 8 avril 2024.
13. *Un grand spectacle céleste avec Pierre Chastenay, Marie-Ève Naud, Robert Lamontagne, Olivier Hernandez et Charles Tisseyre*, **Marie-Eve Naud**, 24-60 (Radio-Canada), 8 avril 2024.
14. *Éclipse solaire totale*, **Nathalie Ouellette**, TVA Nouvelles, 8 avril 2024.
15. *Les femmes de l'espace*, **Nathalie Ouellette**, Bulletin spatial (ICI Explora), 8 avril 2024.
16. *Mission du Europa Clipper*, **Nathalie Ouellette**, TVA Nouvelles, 12 avril 2024.
17. *ASTRONOMIE | LES AURORES BORÉALES Grâce à une tempête géomagnétique*, **Marie-Eve Naud**, Salut Bonjour (TVA), 13 mai 2024.
18. *D'autres aurores boréales bientôt?*, **Nathalie Ouellette**, Radio-Canada Info, 29 mai 2024.
19. *Galaxie la plus distante observée par le télescope Webb*, **Nathalie Ouellette**, QUB TV, 31 mai 2024.
20. *Détection potentielle d'une atmosphère sur LHS 1140 b*, **Charles Cadieux**, CTV News Montreal, 12 juillet 2024.
21. *NASA releases new 'Penguin and Egg' image from James Webb Space Telescope*, **Olivia Lim**, CBC News, 12 juillet 2024.

Radio Interviews and Podcasts

1. *Astronomie en Fût,* **Lisa Dang** & Clémence Fontanive, Balado Voyage dans l'Espace, 6 septembre 2023.
2. *Quelle est la plus grosse et la plus petite taille qu'une planète peut avoir?*, **Nathalie Ouellette**, Moteur de recherche (Radio-Canada ICI Première), 26 septembre 2023.
3. *Débusqueuse de Naines Brunes*, **Clémence Fontanive**, Balado Voyage Dans l'Espace, 8 octobre 2023.
4. *Serait-il possible d'assister à un alignement des 8 planètes du système solaire?,* **Nathalie Ouellette**, Moteur de recherche (Radio-Canada ICI Première), 24 octobre 2023.
5. *Nathalie Ouellette, astrophysicienne influente*, **Nathalie Ouellette**, Pénélope (Radio-Canada ICI Première), 6 novembre 2023.
6. À la découverte du télescope James Webb, **Nathalie Ouellette**, C'est jamais pareil (Radio-Canada Saguenay), 9 novembre 2023.
7. *Comment la planète Terre absorbe-t-elle les rayons X émis par le soleil?*, **Nathalie Ouellette**, Moteur de recherche (Radio-Canada ICI Première), 21 novembre 2023.
8. *Comment se préparer à notre imminente rencontre avec les extraterrestres?*, **Nathalie Ouellette**, Les idées folles (Radio-Canada ICI Première), 23 novembre 2023.
9. *Romain Allart et le surprenant monde des exoplanètes*, **Romain Allart**, Balado Voyage dans l'espace, 10 Décembre 2023.
10. *Sujets Chauds en Recherche: la Nuit des Chercheuses*, **Lisa Dang**, Balado Les Lucioles,19 décembre 2023.
11. *Quel est le cycle de vie des étoiles?*, **Nathalie Ouellette**, Moteur de recherche (Radio-Canada ICI Première), 23 janvier 2024.
12. *Qu'arrivera-t-il lorsque toutes les étoiles s'éteindront?*, **Nathalie Ouellette**, Moteur de recherche (Radio-Canada ICI Première), 20 février 2024.
13. *La mission lunaire Odyssey*, **Nathalie Ouellette**, Radio-Canada Québec, 23 février 2024.
14. *Bien se préparer pour voir l'éclipse solaire le 8 avril prochain*, **Marie-Eve Naud**, Les matins d'ici (Radio-Canada Gatineau), 7 mars 2024.
15. *Voices from Women in Aerospace*, **Nathalie Ouellette**, The Sound of Space Podcast, 17 mars 2024.
16. *Où trouver des lunettes pour regarder l'éclipse solaire du 8 avril?*, **Marie-Eve Naud**, le Québec maintenant (98,5), 20 mars 2024.
17. *April 8th, 2024 Solar Eclipse*, **Heidi White**, CBC News Radio's Here and Now (99,1), 20 mars 2024.
18. *Les enjeux de l'éclipse solaire*, **Marie-Eve Naud**, Le Show du Matin (95,7 KYK, Cogéco Media Saguenay Lac-StJean), 22 mars 2024.
19. *Une partie du jugement a sacré le camp concernant l'éclipse totale*, **Marie-Eve Naud**, le Québec maintenant (98,5), 25 mars 2024
20. *The do's and don'ts of viewing the eclipse*, **Nicolas Cowan**, Andrew Carter Morning Show (CJAD 800), March 25, 2024.
21. *Éclipse*, **Frédérique Baron**, Balado Maison de la Famille LeMoyne, 26 mars 2024.
22. *8 avril prochain quelle sera la météo*, **Marie-Eve Naud**, Puisqu'il faut se lever (98,5), 2 avril 2024.
23. *L'éclipse : Un événement spécial qu'il ne faut pas manquer!*, **Marie-Eve Naud**, Debout les comiques (96,9 CKOI), 3 avril 2024.
24. *Observer l'éclipse solaire en toute sécurité*, **Marie-Eve Naud**, Le 6 à 9 avec Patricia Bitumassions Tshikudi (Radio-Canada), 4 avril 2024.
25. *Émission spéciale sur l'éclipse solaire*, **Nathalie Ouellette**, Moteur de recherche (Radio-Canada ICI Première), 5 avril 2024.
26. *Interview with Nicolas Cowan*, **Nicolas Cowan**, Montreal Now (CJAD 800), 5 avril 2024.
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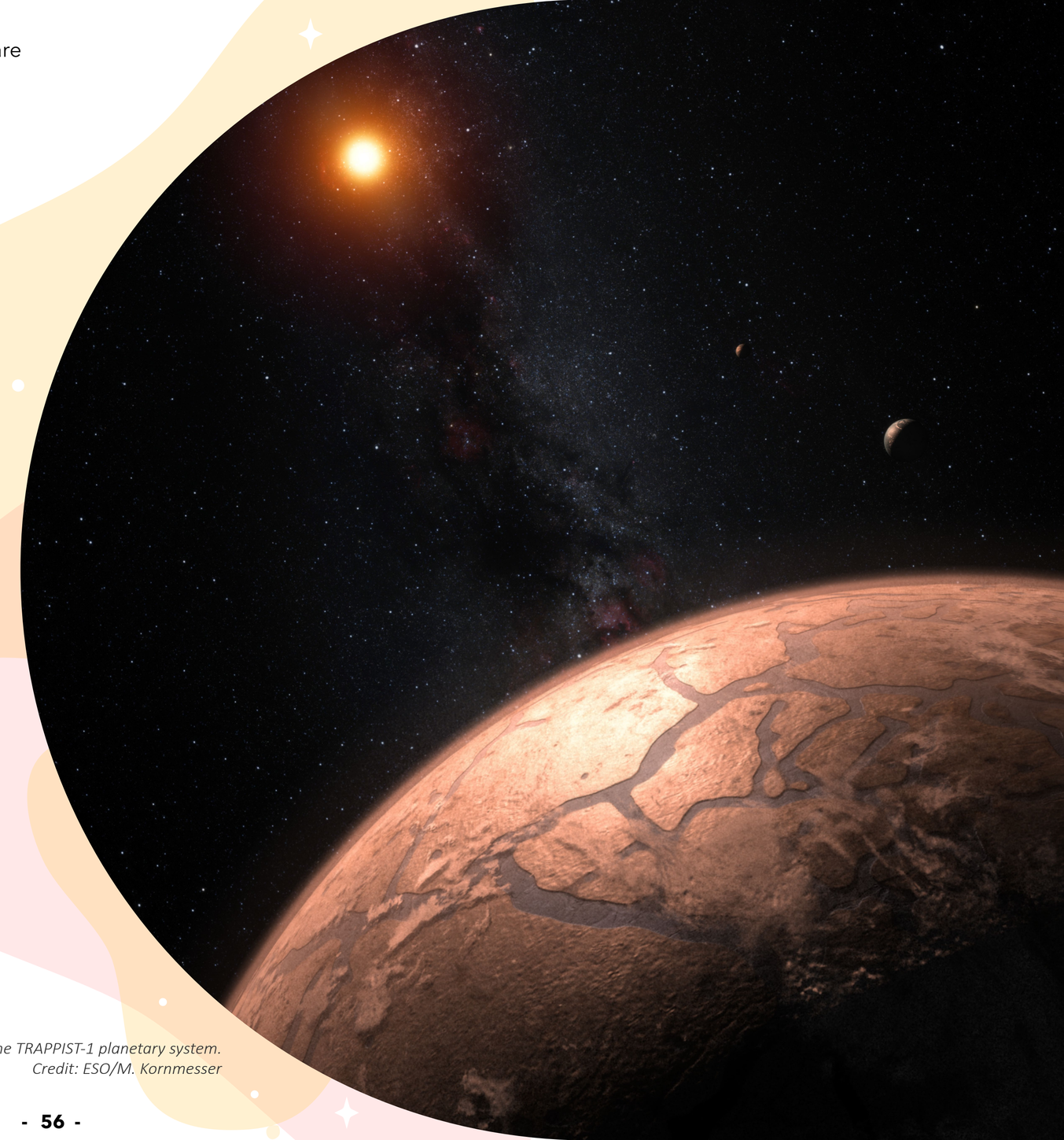

Artistic representation of the TRAPPIST-1 planetary system.
Credit: ESO/M. Kornmesser

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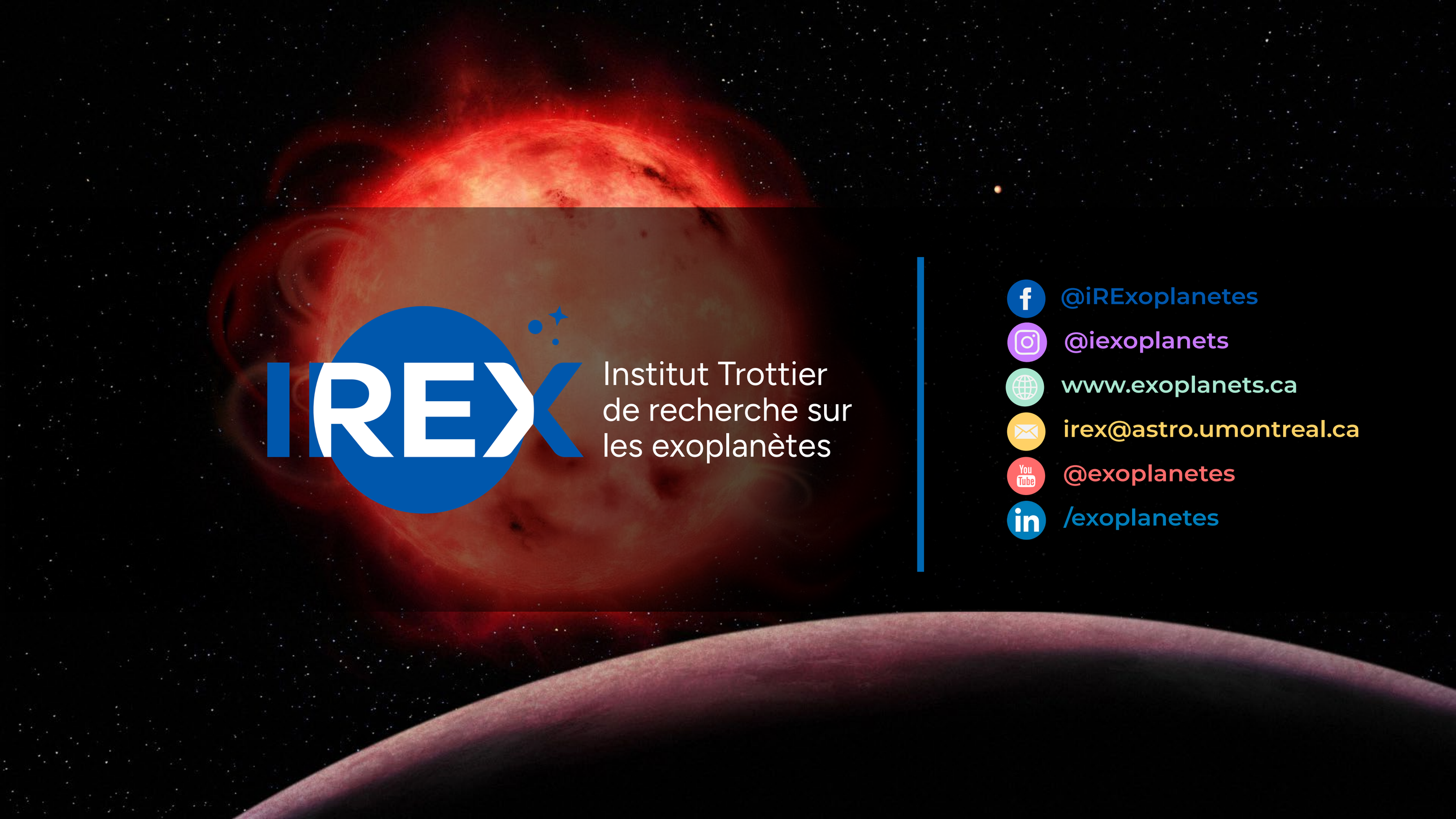
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