

MARINE PRUNIER

PhD in Astrophysics

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[Github](#)

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I am a doctoral student at the University of Montreal, my research focuses on the feedback of active galactic nuclei (AGN) on galaxy clusters. I am conducting a comprehensive comparative analysis of the observational signature of AGN feedback on galaxy clusters with the TNG-Cluster cosmological simulation (Illustris TNG). I work under the supervision of Prof. Hlavacek-Larrondo, a specialist in AGN feedback in galaxy clusters, and Dr. Annalisa Pillepich at the Max Planck Institute in Heidelberg, Co-PI of TNG-Cluster. My academic journey has taken me to several European universities in Switzerland, Belgium, France and now Canada. My skills encompass a variety of fields, including astrophysics, fundamental physics, and machine learning, and this diversity greatly enriches my research. Throughout my academic path, I have always been committed to popularizing science for the general public and promoting women in science.

EDUCATION

PhD in Physics

University of Montreal - Max Planck Institute for Astronomy

2023-now

Montreal, Canada - Heidelberg, Germany

Title: Supermassive Black Hole Feedback in Galaxy Clusters: A Synergy between Cosmological Simulations and Observations.

M.Sc. in Astrophysics (GRADE:14.4/20)

Observatoire de Paris

2022-2023

Paris, France

Field: *Dynamics of gravitational systems* oriented in Galaxy and Large-Scale structures.

Relevant Courses: Gravitation, Galaxy, Cosmology, Astrophysical fluid dynamics.

M.Sc. in Space Instrumentation (CGPA: 3.8/4)

ISAE-Supaero

2020-2022

Toulouse, France

Field: Master of Science in Aerospace Engineering, specialization in Space Instrumentation.

Thesis Title: Spacecraft-plasma interactions study applied to the Comet Interceptor mission (ESA).

Supervisor: Pierre Henri, Centre National Recherche Scientifique (CNRS) Orleans.

Relevant Courses: Machine Learning, Signal Processing and Estimation, Microwave and Antennas, Image Processing and Data Analysis, Global Navigation Satellite System.

3rd year exchange B.Sc in Physics (GRADE: 16.0/20) 🏆 High distinction

Université Libre de Bruxelles

2019-2020

Bruxelles, Belgium

Relevant courses: Quantum mechanics, Introduction to Quantum Field Theory, Statistical Physics, Group Theory, Spectrophysics and Astrophysics.

B.Sc in Physics (GRADE: 4.6/6)

Ecole Polytechnique Fédérale de Lausanne (EPFL)

2016-2020

Lausanne, Switzerland

Relevant courses: Numerical Modelling in Physics, Advanced Algebra and Group Theory, Analytical mechanics, Object Oriented programming.

Scientific Baccalaureat (GRADE: 19.2/20) 🏆 Highest distinction

Lycée Notre-Dame de Bourg-la-Reine

2016

France

PUBLICATIONS

- 2024 **X-ray cavities in TNG-Cluster: AGN phenomena in the full cosmological context.** Marine Prunier, Julie Hlavacek-Larrondo, Annalisa Pillepich, Katrin Lehle, Dylan Nelson. [MNRAS](#)
- 2024 **HST Observations within the Sphere of Influence of the Powerful Supermassive Black Hole in PKS 0745-191.** J. Hlavacek-Larrondo , H. Choi , M. Guo, A. Richard-Laferrriere, C. Rhea, M. Prunier, H. Russell, A. Fabian, J. L. Walsh, MJ. Gingras, B. McNamara, S. Allen, AN. Chen, A. Edge, ML. Gendron-Marsolais, M. McDonald, P. Natarajan, J. Sanders, J. F. Steiner, B. Vigneron, and A. von der Linden. [AAS](#)
- 2024 **Analysis of a subsolar-mass black hole candidate from the second part of the third observing run of Advanced LIGO.** Marine Prunier, S.Clesse, J.Nuno, G.Morras, J.Garcia-Bellido. [PDU](#)
- 2024 **Deconvolving X-ray Galaxy Cluster Spectra Using a Recurrent Inference Machine.** Carter Rhea, Hlavacek-Larrondo, Akos Bogdan, Ralph Kraft, Laurence Perreault-Levasseur, Farbod Jahandar and Marine Prunier. [AJ](#)

Other Publications


- 2022 Experiment collaboration program during a Martian analog mission to introduce young students to human space exploration. E. Contreras, M.Prunier and L.Rouverand, for the 4th Symposium on Space Educational Activities [link](#).
- 2021 Testing of an augmented reality tool for geological fieldwork during two analog missions. Prof. F. Aditya, E.Contreras, O.Veronica, M.Prunier, L. Rouverand,V.Bourgeois, M. Fouchet, N.Watelle, A.Monoyer and M.Beller. Conference paper for the 73th International Astronautical Congress 2022 Paris, IAF Spaceflight Symposium.
- 2021 ESA DFP-Consortium Technical Note, CNRS Orleans. Technical Note on the results obtained during my master's thesis for the ESA DFP-consortium in charge of Comet Interceptor scientific payload.

AWARDS


 Grant  Prize

 2024 Grant J. Armand Bombardier (10.000 CAD)

 2023 Excellence ESP Grant from the Physics Department of UdeM (FESP) (30.000 CAD)


 2023 Diversity Grant from the Centre for Research in Astrophysics of Quebec (CRAQ) for doctoral students from groups traditionally underrepresented in astrophysics research (15.000 CAD)


 2023 SMARTS-UP scholarship for a 4 months research internship (3.000 EUR)

 2022 E. Contreras, M.Prunier and L.Rouverand, abstract selected to be presented at the 4th Symposium on Space Educational Activities: "Experiment collaboration program during a Martian analog mission to introduce young students to human space exploration." .

 2022 Initi'active Grant for the educational project "Mission to Mars" (4.000 EUR). Dedicated to youth-led projects, the grant provides financial assistance for projects that have a social purpose.

 2022 Fondation ISAE-Supaero Grant for the Mars analog mission project (2.000 EUR).

 2021 E. Contreras, M.Prunier and L.Rouverand, winners of the 2021 IAC-Space Generation Advisory Council SMLS abstract competition with "Ultrasound medical surveillance during a 3-week isolation mission at the Mars Desert Research Station".

 2019 Scholarship from EPFL for a 3rd year of a bachelor exchange program in the physics department of the Université Libre de Bruxelles (Belgium) (2.000 CHF).

CONTRIBUTED TALKS & POSTERS

- Dec 2024 25 Years of Science with Chandra. Boston, MA
- Sept 2024 Galaxy Clusters & Radio Relics II. CfA, Cambridge MA
- Jun 2024 7th ICM Theory & Computation Workshop. University of Michigan in Ann Arbor
- May 2024 Center for Astrophysics of Quebec (CRAQ) annual meeting. Quebec
- March 2024 MPIA Galaxy Coffee. Max Planck Institute for Astronomy, Germany
- Poster - Jun 2022 *Geological field study in Martian life simulation conditions* [Journée LIBS France](#).
- Poster - Jan 2022 *Visiting a Dynamically New Comets: the Comet Interceptor mission*, ISAE-Supaero, France.
- June 2019 Measurement of the Angular Distribution of Cosmic Muons, Inter-university Institute for High Energies, Belgium.

RESEARCH EXPERIENCE

Galaxy Clusters Active Galactic Nuclei SMBH Feedback X-ray astronomy
Cosmological simulations Machine Learning

High Energy and Extragalactic Astrophysics with Machine learning.

Université de Montréal

📅 April 2022- Sept 2022

📍 Montréal, Canada

Master's final internship supervised by Prof. Julie Hlavacek-Larrondo (Research Chair in Observational Astrophysics of Black Holes), at the X-TRA group for extragalactic and high-energy astrophysics.

Role: Develop machine learning routines on X-ray data emitted by galaxy clusters. Characterize the calibration of CHANDRA using machine learning.

Study the filamentary nebulae of NGC 5813 (active galactic nuclei galaxy) using SITELE (Canada France Hawaii Telescope) and CHANDRA observations.

Results: Write a paper as first author.

Spacecraft-plasma interactions study applied to Comet Interceptor mission (ESA)

Université de Montréal

📅 March 2021- March 2022

📍 Toulouse, France

Master thesis supervised by Pierre Henri, researcher in Space Plasma/Plasma Physics at the Laboratoire de Physique et de Chimie de l'Environnement et de l'Espace (LPC2E, CNRS), taking place in the scope of the Comet Interceptor spacecraft mission (European Space Agency).

Role: Set-up simulation of the spacecraft charging and plasma interaction during the comet's flyby in order to quantify how it affects the performances of one of the instruments using the Spacecraft Plasma Interaction Software.

Results: Publication of a Technical Note on the results obtained for the ESA DFP-consortium in charge of Comet Interceptor scientific payload.

ASTRONOMER EXPERIENCE

Radioastronomy week school at the Nançay Observatory

📅 March 2023

📍 Nançay, France

Experience: Programming observations on the NenuFAR large low-frequency radio telescope. Post-processing -calibration, imaging- of NenuFAR and MeerKAT (South African Radio Astronomy Observatory) observations of radio galaxies and clusters.

Astronomer at the Observatoire du Mont-Mégantic (OMM)

Université de Montréal

📅 June 2022

📍 Mont-Mégantic, Canada

Role: Support astronomer at the observatory for eight nights, assist in the collection of observational data using the 1.6m telescope situated in the Canadian nature-preserved Mont Mégantic.

Results: Familiarisation with the astronomical methods and with the use of PESTO (exoplanet search) and CPAPIR (infrared observations) under the supervision of the night technician and astronomer.

Astronomer for the 2022 Isae-Supaero Crew's Martian Mission Simulation at the Mars Desert Research Station [Website link](#)

📅 March 2022

📍 Utah, United States

Organizer and participant of a 3-week Martian mission simulation at the Mars Desert Research Station.

- **Mission preparation** (1 year): Experiments with french research laboratories (CNRS, CNES), companies and startups specialized in different scientific fields applied to space (telecommunications, astronomy, medicine, human factors). Fundraising for the funding of the mission (18,000 dollars) through sponsorship, grants and partnership.
- **Status in the crew:** crew Astronomer -operation of the station's telescopes for sun observation and astronomy research (exoplanet detection using transit method) during the mission.

Results: Several publications, and mission results were sent to the research lab in partnership with the mission.

Variable star light curve observation

La coupole astronomique de l'ULB, Université de Bruxelles

📅 March 2020- June 2020

📍 Bruxelles, Belgium

Bachelor's final internship in "La coupole astronomique de l'ULB".

Role: Monitor a variable star using remotely a telescope in New Mexico and analysis of the star's light curve.

SCIENTIFIC COMMUNICATION AND TUTORING

👤 Astronomy on Tap Montreal [Website link](#)

📅 2023-2024

📍 Canada

Organizer of several events in Montreal consisting of short talks on astrophysics for all audiences, in collaboration with several institutes (CRAQ, iREx and the Trottier Space Institute).

👤 ESERO Belgium - Space in class

📅 2023

📍 Belgium

Member of ESERO (The European Space Education Resource Office) project in Belgium. I performed outreach in several schools of Brussels on the topic of space, the solar system, and the planet Mars. The goal is to raise the interest of pupils in space/astrophysics and make them feel more comfortable and familiar with sciences in general.

👤 Club M.A.R.S. President

📅 2020-2022

📍 ISAE-Supaero, France

President of an ISAE-Supaero association of scientific outreach centered around the planet Mars and missions dedicated to the exploration and study of the Red Planet (~ 100 members).

Role:

- Organize weekly conferences on human space exploration and planetary astrophysics.
- Management of scientific communication activities in Toulouse high schools.
- Mentoring scientific projects led by the Club M.A.R.S .

Martian Analog Mission [Website link](#)

📅 Janv 2021-April 2022

📍 Mars Desert Research Station, Utah, United States

1 year Management and crew member of a 3-week Martian simulation mission (analog mission) at the Mars Desert Research Station in Utah with 6 other students: fundraising (18.000 \$), organization of scientific experiments with several space research laboratories. Member of the mission as the crew Astronomer.

👤 Space@YourService Founding Member [Website link](#)

📅 2017-2019

📍 EPFL, Lausanne, Switzerland

Founding member and vice president of an association promoting scientific communication about space and astronomy.

Role: Organisation of several events in Lausanne consisting in short talks on space sciences for all audiences:

- *Space Oddity*. **Invited speaker:** Manu Stalport, Aurelien Verdier and Emilie Hertig.
- *The Eagle has landed, 50 years of Man on the Moon*. **Invited speaker:** Swiss astronaut Claude Nicollier and Dr. Apurva Oza.
- *From Earth to Outer Space*. **Invited speaker:** Astronaut Claude Nicollier, Dr. Camille Pirat, Dr. Florian Gallien and Dr. Daniel Angerhausen.
- *Aiming for the Moon*. **Invited speaker:** Martine Harmel, George Meylan and Dr. Daniel Angerhausen.

Mission analysis leader on IGLUNA CoRoDro project

📅 Oct 2021-August 2022

📍 Toulouse, France

Engineering project for the **IGLUNA 2021 Field Campaign**, a mission launched by EPFL's Swiss Space Center to develop innovative technologies for the future of space exploration.

Role: Management of the mission analysis team. Design of an autonomous navigation and operations software for a space robotic systems consisting in a drone and a rover collaborating together to map and explore a field.

TUTORING & MENTORING

✍ High school tutoring with OSE

📅 2020-2022

📍 ISAE-Supaero, France

Organizing tutoring sessions to share work methods and scientific knowledge with high school students from 10th-12th grades (5 class \approx 150 high-school students \approx 40 hours).

Workshops and scientific activities on topics related to astronomy, space and environmental issues.

✍ Tutoring-Mentoring

📅 2017-2018

📍 EPFL, Lausanne, Switzerland

Provide help in the integration of new students on campus by offering tutoring services. Mentoring of 10 students for one year.

LANGUAGE PROGRAMMING

Python (Advanced)

C/C++ (Advanced)

Fortran (Advanced)

Machine Learning (TensorFlow)

JavaScript

Bash

Matlab

Git-Github

LANGUAGE

• French: Mother-tongue

English: TOEIC C1

Spanish: Intermediate

ADDITIONAL TRAININGS AND SUMMER SCHOOLS

Centre for Research in Astrophysics of Quebec (CRAQ) Summer School on Cosmology

📅 June 2022

📍 Mc Gill, Montreal

Canadian Astronomical Society (CASCA) Summer School

📅 June 2022

📍 Montréal, Canada

TimeWorld Artificial Intelligence Congress

📅 May 2022

📍 Université de Montréal, Canada

Computer Vision class -Stanford University School of Engineering

📅 Feb-March 2022

ANF LIBS Formation - From laboratories to the surface of Mars

📅 Nov 2021

📍 CNRS Orleans, France

ANF LIBS is a formation of the cold plasmas network of the CNRS and the LIBS France network on the method of spectroscopy of optical plasma emission created by laser (LIBS: laser-induced breakdown spectroscopy)

OTHER ACTIVITIES

Organizer of several workshops on film photography and astrophotography.

Organizer of the Festival Inédit de l'Université Libre de Bruxelles (short films competition).

Diving certification (supervised diving PE-20).