

FRANCESCO AMADORI - CV

Born: 26th November 1997
Birthplace: Borgosesia (VC)
Driving L: B
Status: PhD student in Physics, Astrophysicist and Software Analyst
Languages: Italian: Native, English: C1, Spanish: B1
Fields: Exoplanets, Coding, Astrophysics, Observations
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GITHUB: <https://github.com/francescoa97outlook>
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I am an astrophysicist and software developer focusing on the characterization of exoplanet atmospheres: measuring what they are made of by combining ground-based high-resolution and space-based low-resolution spectroscopy, and inferring their properties with Bayesian retrievals. I am also interested in what that chemistry reveals about how planets form and evolve, and ultimately about their potential habitability.

Research & PhD Topics

My research goal is to measure what exoplanet atmospheres are made of, and to connect that composition to how planets form and evolve. I combine ground-based **high-resolution** spectroscopy (which resolves individual molecular and atomic lines) with space-based **low-resolution** spectrophotometry (sensitive to the broad shape of the spectrum), analysing them jointly through **Bayesian retrievals**. My current focus is on Neptune- to Saturn-sized planets, with a growing interest in sub-Neptunes and, in the future, rocky worlds.

GUIBRUSHR® (Graphic User Interface for Bayesian Retrieval Using Spectroscopy at High Resolution) is the pipeline I lead and use to carry out this analysis. It unifies, in a single tool, steps that are usually scattered across separate codes:

- **Data Reduction:** calibrates and wavelength-aligns raw high-resolution spectra (also released as a [standalone tool](#) for GIANO-B, HARPS-N, CRIRES+ and ESPRESSO).
- **Telluric Removal:** strips the Earth's atmospheric and stellar lines (via PCA) that would otherwise bury the far weaker planetary signal.
- **Cross-Correlation:** co-adds thousands of faint molecular lines into a single, significant detection from the planet's orbital motion.
- **Forward Model and Bayesian Retrieval:** builds transmission and emission spectra (petitRADTRANS, Pyrat-Bay) and infers molecular abundances, temperature structure, clouds and velocities with a differential-evolution MCMC, on high-resolution, low-resolution, or both jointly.

It supports high-resolution spectrographs such as GIANO-B at the TNG, HARPS-N, ESPRESSO, IGRINS and the future ANDES at the ELT, and low-resolution data from JWST, HST and, in the future, Ariel. A paper presenting GUIBRUSHR is in preparation.

Science targets. *WASP-107b* (warm super-Neptune): the subject of my master's thesis, characterised through a joint high- and low-resolution retrieval with GUIBRUSHR; paper in preparation. *WASP-77Ab* (benchmark hot Jupiter): used to validate GUIBRUSHR on combined high- and low-resolution data; paper in preparation.

Education

[11/2025 present]	PhD in Physics <i>University of Turin - UNITO</i> Doctoral research on exoplanet atmospheric characterization, combining high- and low-resolution spectroscopy within the GUIBRUSHR pipeline (see Research & PhD Topics above). Elected PhD student representative for the first year of the programme. Website: https://www.phdphysics.unito.it/do/home.pl	📍 Turin
[10/2023 09/2025]	Master's Degree <i>University of Padua - UNIPD</i> Master program in Astrophysics and Cosmology Thesis: Multi-instrument atmospheric characterization of the warm super-Neptune WASP-107b using GUIBRUSHR® Final grade: 110/110, <u>ON TIME</u> Website: https://astrophysics-and-cosmology.dfa.unipd.it/	📍 Padova
[08/2020 07/2023]	Bachelor's Degree <i>ALMA MATER STUDIORUM - UNIBO</i> Bachelor program in Astronomy Thesis: Pipeline for characterization of exoplanetary atmospheres with high-resolution spectroscopy: from spectra acquisition to retrieval of atmospheric parameters (translated title, the original one is in Italian) Final grade: Graduated with 97/110 <u>ON TIME</u> Website: https://corsi.unibo.it/laurea/Astronomia	📍 Bologna
[08/2016 10/2019]	Bachelor's Degree <i>ALMA MATER STUDIORUM - UNIBO</i> Bachelor program in Computer Science and Engineering Thesis: Analysis, design and development of PLC software for industrial automation (translated title, the original one is in Italian) Final grade: Graduated with 94/110 <u>ON TIME</u> Website: https://corsi.unibo.it/laurea/IngegneriaScienzeInformatiche	📍 Bologna

Work experience

[10/2021 06/2025]	Software and Scientific Analyst in the Exoplanets Atmosphere Characterization field <i>INAF (National Institute of Astrophysics)</i> - 10/2021 – 04/2024: close collaboration with the Exoplanet group at INAF-OATo. - 05/2024 – 06/2025: research fellowship on the graphical interface and the optimization of a reduction-and-analysis pipeline for high-resolution spectra, under the ESPLORA project (Exoplanet Spectroscopy at high resolution to Probe their Lost Origins by Revealing their Atmospheric compositions; PRIN 2022). • Lead developer of GUIBRUSHR®: rewrote the original IDL codebase in Python, added CPU and GPU parallelization of the radiative-transfer step, and built differential-evolution MCMC retrievals on petitRADTRANS and PyratBay, with a PostgreSQL-to-SQLite3 database backend (detailed in Research & PhD Topics). • Developed pyExoRaMa, a Python tool for the radius–mass diagram of exoplanets.	📍 Turin (TO), Italy
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[01/05/2020
31/01/2024]

Software and Scientific Analyst in the Solar Physics field

📍 Turin (TO), Italy

INAF (National Institute of Astrophysics)

A sequence of INAF fellowships and collaborations spanning solar-coronagraph instrumentation and space-weather forecasting:

- **PROBA-3 / ASPIICS**: end-to-end MATLAB simulator for the Shadow Position Sensor (SPS) and the OPSE occulter sensors; later managed the in-flight SPS software.
- **Metis / Solar Orbiter**: Python GUI converting PDOR/IOB command sequences into TCL files for ground testing.
- **CorMag / HEMERA**: pointing, thermal and communication software for the stratospheric-balloon coronagraph.
- **Space weather (SWESNET)**: automatic detection of coronal mass ejections from SOHO, STEREO and Solar Orbiter imagery, with drag-based prediction of their arrival time at Earth.

[23/06/2019
12/03/2020]

Analyst and developer of industrial machines (PLC)

📍 Mercato Saraceno (FC), Italy

Denken Italia

Tasks:

- draw UML schemes that describe the machine station life cycle and develop relative code;
- identify and apply software design methodologies for managing the software development process;
- identifies the re-usability, reliability, interoperability, and maintainability requirements to guarantee the quality of the software product.

This experience helped me to improve my teamwork attitude, to get a more efficient organization of my task-oriented work time, to extend my knowledge in the field of automation. Main improvements in software development competencies:

- PLC programming using the AWL;
- C# and SQL for data analysis.

[31/01/2019
08/06/2019]

Software Developer

📍 Bologna (BO), Italy

CTM: Club Tecnica e Motori

Trainee using LabView to realize control strategies for Formula SAE vehicle. University internship (150 hours):

- formula SAE CPU optimization;
- study MATLAB algorithms and partial conversion in VI LabView;
- creation of bin-CSV file converter using LabView, adapted to the complete machine management cluster;
- logger modifications for data storage and saving.

Involvement in a team for the implementation and analysis of strategies aimed at reducing CPU consumption due to sensors and their data processing.

Talks & Conferences

[05–10/07/2026]

HoRS3S, Granada (Spain)

Talk Poster

Talk on the joint high- and low-resolution analysis of WASP-107b's atmosphere; poster on GUIBRUSHR.

[29/06–
03/07/2026]

Exoplanets 6, Porto (Portugal)

Talk Poster

Talk: "Joint High- and Low-Resolution Analysis of WASP-107b's Atmosphere"; poster on GUIBRUSHR.

[12–15/05/2026]

Italian ELT Instrumentation Meeting (MORFEO & ANDES), Naples

Talk

Talk on WASP-107b and its implications for ANDES at the ELT.

[04–08/05/2026]

LXVII Congresso SAI, L'Aquila

Talk Poster

Talk on the multi-instrument characterization of WASP-107b; poster on GUIBRUSHR.

[27/04/2026]	GAPS Collaboration Meeting (online) Talk presenting GUIBRUSHR to the GAPS collaboration.	Talk
[25–27/03/2026]	On the Shoulders of Giants, Turin Attendee (cold Jupiters and the formation of inner low-mass planets).	Attendee
[09–13/02/2026]	Exoplanets with the ELT (ExoELT2026), Sexten Talk: “From Neptunes to Earths: implications from the multi-resolution characterization of WASP-107b”. I also led the hands-on session on how to use GUIBRUSHR.	Talk Hands-on
[15–19/12/2025]	Hi-Res in the Desert, Tempe (Arizona, USA) Two posters: one on GUIBRUSHR and one on the WASP-107b analysis.	2 Posters
[14/05/2025]	GAPS Meeting, Palermo Talk on the multi-instrument atmospheric characterization of WASP-107b with GUIBRUSHR.	Talk
[13/02/2025]	Seminar at Fundacion Galileo Galilei, La Palma “Exoplanet Atmospheric Characterization Using GUIBRUSHR: a graphical user interface for Bayesian retrieval with high-resolution spectroscopy”.	Seminar
[08–10/11/2023]	GAPS Meeting, Turin (co-speaker) Brief presentation on the development and goals of GUIBRUSHR.	Co-speaker
[31/03/2021]	International Conference on Space Optics (ICSO 2020) Poster: “Formation Flying performances simulator for the Shadow Position Sensors of the ESA/PROBA-3 mission”.	Poster

Observing Runs & Missions

[2024 – present]	Primary Observer, GAPS programme (TNG, La Palma) HARPS-N and GIANO-B runs: 12–15 Aug 2024; 13–19 Mar 2025; 4–11 Mar 2026; 28–30 Sep 2026. Secondary observer 17–26 Dec 2022.
[2024 – present]	Observations at the Asiago Astrophysical Observatory (UNIPD) Optical observations with Prof. Stefano Cirri (University of Padua) and colleagues from my master’s degree.
[06/2024]	Collaboration with Patricio Cubillos (IWF, Graz, Austria) Integrated the PyratBay radiative-transfer software into GUIBRUSHR.
[2020 – present]	Meetings between ESA and INAF Participation in ESA, CSL and INAF meetings for the PROBA-3 and Solar Orbiter missions, preparing discussion material and presentations.
[2022 & 2023]	CorMag pointing & tracking software manager (Timmins, Canada) On site for the HEMERA stratospheric-balloon launches carrying the coronagraph.
[09/2021]	ASPIICS calibration campaign (OPSys / ALTEC, Turin) Radiometric and stability calibration and validation of the SPS algorithms (PROBA-3).

Publications

Astronomy & Astrophysics [2026]	The GAPS Programme at TNG. LXXII. TOI-5734 b: a hot sub-Neptune orbiting a relatively young K dwarf with an Earth-like density <i>S. Filomeno, T. Trifonov, M. Damasso, F. Amadori, A. Sozzetti et al.</i> Astronomy & Astrophysics, 708, A90 https://doi.org/10.1051/0004-6361/202555931
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Astronomy & Astrophysics [2025]	The GAPS Programme at TNG. LXIX. The dayside of WASP-76b revealed by GIANO-B, HARPS-N and ESPRESSO: evidence for three-dimensional atmospheric effects <i>G. Guilluy, P. Giacobbe, M. Brogi, F. Borsa, J. P. Wardenier, F. Amadori, P. E. Cubillos, M. Basilicata, A. S. Bonomo, A. Sozzetti et al.</i> Astronomy & Astrophysics, 701, A261 https://doi.org/10.1051/0004-6361/202555702
Astronomy & Astrophysics [2025]	The GAPS Programme at TNG. LXVII. Detection of water and preliminary characterisation of the atmospheres of the two hot Jupiters KELT-8 b and KELT-23 Ab <i>M. Basilicata, P. Giacobbe, M. Brogi, F. Amadori, E. Pacetti, M. Baratella, A. S. Bonomo, K. Biazzo, D. Turrini, L. Mancini, A. Sozzetti, G. Andreuzzi, W. Boschin, L. Cabona, S. Colombo, M. C. D'Arpa, G. Guilluy, A. F. Lanza, L. Malavolta, F. Manni, L. Naponiello, M. Pinamonti, L. Pino, D. Sicilia, and T. Zingales</i> Astronomy & Astrophysics, 695, A107 https://doi.org/10.1051/0004-6361/202452733
Astronomy & Astrophysics [2024]	The GAPS Programme at TNG. LXIII. Photo-evaporating puzzle: exploring the enigmatic nature of TOI-5398 b atmospheric signal <i>M.C. D'Arpa, G. Guilluy, G. Mantovan, F. Biassoni, R. Spinelli, D. Sicilia, D. Locci, A. Maggio, A.F. Lanza, A. Petralia, C. Di Maio, S. Benatti, A.S. Bonomo, F. Borsa, L. Cabona, S. Desidera, L. Fossati, G. Micela, L. Malavolta, L. Mancini, G. Scandariato, A. Sozzetti, M. Stangret, L. Affer, F. Amadori, M. Basilicata, A. Bignamini, W. Boschin, A. Ghedina</i> Astronomy & Astrophysics, 692, A77 https://doi.org/10.1051/0004-6361/202451237
The Astrophysical Journal [2023]	Prediction Capability of Geomagnetic Events from Solar Wind Data using Neural Networks <i>Daniele Telloni; Maurizio Lo Schiavo; Enrico Magli; Silvano Fineschi; Sabrina Guastavino; Gianalfredo Nicolini; Roberto Susino; Silvio Giordano; Francesco Amadori; Valentina Candiani; Anna Maria Massone; Michele Piana</i> The Astrophysical Journal, Volume 952, Number 2 https://doi.org/10.3847/1538-4357/acdeea
Astronomy & Astrophysics [2022]	The GAPS Programme at TNG. XXXIII. HARPS-N detects multiple atomic species in emission from the dayside of KELT-20b <i>F. Borsa, P. Giacobbe, A. S. Bonomo, M. Brogi, L. Pino, L. Fossati, A. F. Lanza, V. Nascimbeni, A. Sozzetti, F. Amadori, S. Benatti, K. Biazzo, A. Bignamini, W. Boschin, R. Claudi, R. Cosentino, E. Covino, S. Desidera, A. F. M. Fiorenzano, G. Guilluy, A. Harutyunyan, A. Maggio, J. Maldonado, L. Mancini, G. Micela, E. Molinari, M. Molinaro, I. Pagano, M. Pedani, G. Piotto, E. Poretti, M. Rainer, G. Scandariato, H. Stoev</i> Astronomy & Astrophysics, 2022 https://doi.org/10.1051/0004-6361/202142768
Research Notes of the AAS [2022]	PyExoRaMa: An Interactive Tool in Python to Investigate the Radius-Mass Diagram for Exoplanets <i>Francesco Amadori, Mario Damasso, Li Zeng, Alessandro Sozzetti</i> Research Notes of the AAS, Volume 6, Number 2 https://doi.org/10.3847/2515-5172/ac52f2
SPIE Digital Library [2022]	CorMag – coronal magnetograph for the stratospheric Hemera mission <i>Silvano Fineschi, Gerardo Capobianco, Luca Zangrilli, Donata Bonino, Federico Landini, Davide Loreggia, Maurizio Pancrazzi, Roberto Susino, Alessandro Bemporad, Valeria Caracci, Francesco Amadori, Salvatore Caschera</i> Proc. SPIE 12184, 2022 https://doi.org/10.1117/12.2630866
International Conference on Space Optics [2021]	Formation Flying performances simulator for the Shadow Position Sensors of the ESA/PROBA-3 mission <i>CAPOBIANCO Gerardo, AMADORI Francesco, FINESCHI Silvano, BEMPORAD Alessandro, CASTI Marta, LOREGGIA Davide, NOCE Vladimiro, PANCRAZZI Maurizio, LANDINI Federico, THIZY Cedric, ROUGEOT Raphael, GALANO Damien, VERSLUYS Jorg</i> Proceedings of the International Conference on Space Optics (ICSO 2020) https://doi.org/10.1117/12.2600310

International Conference on Space Optics [2021]	Laboratory testbed for the calibration and the validation of the Shadow Position Sensor subsystem of the PROBA3 ESA mission <i>Davide LOREGGIA, Luca ZANGRILLI, Gerardo CAPOBIANCO, Giuseppe MASSONE, Massimiliano BELLUSO, Silvano FINESCHI, Francesco AMADORI, Vladimiro NOCE, Alessandro BEMPORAD, Marta CASTI, Gianalfredo NICOLINI, Federico LANDINI, Marco ROMOLI, Maurizio PANCRAZZI</i> Proceedings of the International Conference on Space Optics (ICSO 2020) https://doi.org/10.1117/12.2600312
International Conference on Space Optics [2021]	The Coronal Magnetograph CorMag Mission for the Stratospheric Hemera Mission <i>Silvano FINESCHI, Luca ZANGRILLI, Gerardo CAPOBIANCO, Federico LANDINI, Alessandro LIBERATORE, Giuseppe MASSONE, Maurizio PANCRAZZI, Roberto SUSINO, Francesco AMADORI, Marco ROMOLI,</i> Proceedings of the International Conference on Space Optics (ICSO 2020) https://doi.org/10.1117/12.2599647
INAF Technical report [2020]	End-to-end numerical simulator of the Shadow Position Sensor (SPS) metrology subsystem of the PROBA-3 ESA mission First author <i>F. Amadori, G. Capobianco, D. Loreggia, M. Casti, A. Bemporad, S. Fineschi, V. Noce, L. Zangrilli, M. Belluso, M. Pancrazzi</i> INAF, 2020, pp.1-184 https://openaccess.inaf.it/handle/20.500.12386/28811

Software Publications

Zenodo [2022]	pyExoRaMa: an interactive tool to investigate the radius-mass diagram for exoplanets Developers: Francesco Amadori Co-Authors: Mario Damasso, Li Zeng, Sozzetti Alessandro Zenodo, January 25, 2022 10.5281/zenodo.5899601 Other links: GitHub - ASCL - EMAC-NASA
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IT Skills

Python (9.5/10)	My most adopted IT language. I first used to create a converter from PDOR and IOR files (used for sending commands to the METIS coronagraph) to TCL files (used to test the commands in the ground instrumentation). I also used it to create the pyExoRaMA tools and GUIBRUSHR®. During the development of the latter, I learned how to properly use many libraries like astropy, petitRADTRANS, PyratBay, matplotlib, numpy, scipy, sklearn (for scientific purposes), multiprocessing, pyopencl, pycuda (for the CPU and GPU parallelization) and tkinter (for the graphics implementation). I try to continue to keep updated with the new technologies related to this language.
Matlab/Octave (7/10)	Used to develop an end-to-end simulator for the Formation Flying (FF) algorithm of the PROBA-3 mission. I am also using Matlab to improve the FF algorithm.
C++ (6/10)	I used the C++ language in my University Collaboration for the CBL and MOKA libraries.
C (7.5/10)	I used the C language for the CORMAG mission. I used it a lot in my University courses and I want to continue to use it as a bridge language for GPU parallelization in Python.
Linux (8/10)	I learned how to use Linux in my University courses. I am still using it as the main operating system.
Web Development (6/10)	I learned how to develop websites in my University courses. I created my website (https://www.francescoamadoriastronomy.com/) and I used it in some projects.
LabView (7/10)	I used it in my University Internship, in particular for the Engine Management for the formula SAE machine, and also for the background application for communication of CORMAG.

SQL (8/10)	I used it a lot in my past experiences with Denken Italia, to manage the product information and production of the various automated prototypes. I still use to store the information of the retrievals for GUIBRUSHR®
Java (7/10)	I created a 2-D game at the University in Java. It was a group project where we developed a portable application.
Git (8/10)	I have used it since my first year at the Computer Science University and I still use it as the main method to manage projects.
Office (6.5/10)	I have used Office applications (Word, PowerPoint, Excel, etc) in all my work experiences.
C# (6/10)	I used it during my past experiences with Denken Italia.
PLC/AWL (6.5/10)	I used it a lot in my past experiences with Denken Italia.
Assembly (5/10)	I used it during my past experiences with Denken Italia and at the University.
IDL (4.5/10)	I learned some basic commands of IDL during my experience at INAF.
GPU parallelization (6/10)	I started to parallelize Python code over GPU by using OpenCV and PyCuda libraries that run C kernels to get faster execution of loops that bottleneck the code.
LaTeX (8/10)	I have been using LaTeX since my first publications and official documents produced for INAF and the University, especially Overleaf for shared projects.

Language Skills

Italian	<i>LISTENING</i> Native, <i>READING</i> Native, <i>WRITING</i> Native, <i>SPOKEN PRODUCTION</i> Native, <i>SPOKEN INTERACTION</i> Native,
English	<i>LISTENING</i> B2, <i>READING</i> B2, <i>WRITING</i> B2, <i>SPOKEN PRODUCTION</i> B2, <i>SPOKEN INTERACTION</i> B2, <i>Duolingo English Test Certification</i> - C1 - Score 130/160
Spanish	<i>LISTENING</i> B1, <i>READING</i> B1, <i>WRITING</i> A2, <i>SPOKEN PRODUCTION</i> A1, <i>SPOKEN INTERACTION</i> A1,

Affiliations and Collaborations

2016-present	Unibo - Alma Mater Studiorum
2020-present	INAF-OATo - National Institute of Astrophysics -Astrophysical Observatory of Turin
2022-present	GAPS - Global Architecture of Planetary Systems
2023-present	UNIPD - University of Padua
2025-present	UNITO - University of Turin