

ELEONORA ALEI

Contact Information

Address ETH Zurich - Institute for Particle Physics and Astrophysics (IPA).
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Nationality Italian

Known Languages Italian (Native), English (Level C1), French (Level B1), German (Level B1).

Research Interests

exoplanets (terrestrial), exoplanet atmospheres, Bayesian retrievals, radiative transfer codes, astrobiology, habitability, transmission and emission spectroscopy, exoplanets detection, observation and theory, Virtual Observatory.

Research Experience

Jan 2020 – present **Post Doctoral Fellow**, *ETH*, Zürich, Switzerland, Topic: "Exoplanet characterization with future instruments".

Education

Oct 2016 – Dec 2019 **Ph.D. Course in Astronomy**, *University of Padua – INAF Astronomical Observatory of Padua*, Padua (Italy), Supervisor: Dr. Riccardo Claudi.
Topic: "Habitability Studies of Super Earths Atmospheres"
Description: Development of: software that handles exoplanet catalog data; radiative-convective transfer model; ozone photochemistry model. Synthetic atmospheres produced by the various models were then recreated in the laboratory, to study the behaviour of photosynthetic bacteria under exotic conditions.

Dec 2014 – Sep 2016 **Master's Degree in Astronomy and Astrophysics**, "*La Sapienza*" *University of Rome*, Rome (Italy), Supervisors: Dr. Riccardo Claudi, Prof. Corinne Rossi.
Topic: "Stability Studies of Super Earths Atmospheres"
Description: Development of radiative transfer model and validation grid of models.

Oct 2011 – Dec 2014 **Bachelor's Degree in Physics and Astrophysics**, "*La Sapienza*" *University of Rome*, Rome (Italy), Supervisors: Dr. Riccardo Claudi, Prof. Corinne Rossi.
Topic: "Chemical and dynamical processes in Hot Jupiters atmospheres"
Description: Review of the state of the art concerning Hot Jupiters.

Grants

Mar 2021 **European Space Agency (ESA) Open Space Innovation Platform (OSIP)**, *Role: Co-PI*.
Amount: EUR 90k

Developer Experience

Jan 2020 - present **LIFE Atmospheric Retrieval Framework - Developer**.
I am developing the Bayesian retrieval framework to be used to perform atmospheric retrievals of *LIFE* observations.

Jan 2020 - present **petitRADTRANS - co-Developer**.
petitRADTRANS is a Python package for calculating transmission and emission spectra of exoplanets, at low and high resolution, for clear and cloudy atmospheres. I implemented the surface scattering feature and enhanced the Collision-Induced Absorption treatment.

- Jan 2019 - present **Exo-MerCat - Developer.**
Exo-MerCat is a VO-aware Python code that collects and selects the most precise measurement for all planetary and orbital parameters contained in the main exoplanet archives, accounting for the presence of multiple aliases for the same target.
- Jan 2016 - Sep 2019 **Radiative-Convective transfer code for terrestrial atmospheres - Developer.**
I was one of the main developers of a 1-D radiative transfer structural model with convective adjustment, written in FORTRAN with an MPI parallelization. The model is able to calculate a self-consistent atmospheric profile at thermal equilibrium given an initial atmospheric composition.

Student Projects Supervision

Ph.D. Projects

4-year projects.

- Dec 2020 - present **Machine learning-driven design requirements for future ESA exo-life finder observatories**, *Björn Konrad*, ETH, Zürich, Switzerland. Role: Co-Supervisor.

Master's Projects

6-month full-time projects.

- Oct 2022 - Feb 2023 **The potential of LIFE in characterizing the Earth in time around K stars**, *Xiaoyu Sun*, ETH, Zürich, Switzerland. Role: Co-Supervisor.
- Feb 2021 - Aug 2021 **A method to retrieve the interior composition of bare rocky planets from their emission and reflectance spectra**, *Fabian Seidler*, ETH, Zürich, Switzerland. Role: Co-Supervisor.
- Apr 2020 - Oct 2020 **Atmospheric retrieval sensitivity analysis for Earth-Twin exoplanets: estimating the minimum sensitivity requirements for the characterization of the atmospheric composition & structure of Earth-Twin exoplanets**, *Björn Konrad*, ETH, Zürich, Switzerland. Role: Co-Supervisor.
- Feb 2020 - Aug 2020 **The production of ozone layer and its fate in habitable planets orbiting M stars**, *Massimiliano Monetti*, Università degli Studi Roma Tre, Rome, Italy. Role: Co-Supervisor.

Semester Projects

160-hour projects.

- Oct 2022 - Feb 2023 **Atmospheric retrievals of Earth-like planets at varying O₃ abundances**, *Jingyu Wang*, ETH, Zürich, Switzerland. Role: Co-Supervisor.
- Sep 2020 - Feb 2021 **Tidal Locking of terrestrial Exoplanets**, *Caroline Hasler*, ETH, Zürich, Switzerland. Role: Co-Supervisor.

Teaching Experience

- Sep 2022 - May 2023 **Teaching Assistant Coordinator - Physics I & II Class**, *ETH*, Zürich, Switzerland.
- Mar 2022 - May 2022 **Teaching Assistant - "Exoplanets" Class**, *ETH*, Zürich, Switzerland.
- Sep 2021 - Jan 2022 **Teaching Assistant - "Earth - A Unique (?) Habitable Planet" Class**, *ETH*, Zürich, Switzerland.
- Mar 2021 - May 2021 **Teaching Assistant - Physics II Exercise Class**, *ETH*, Zürich, Switzerland.
- Sep 2020 - Jan 2021 **Teaching Assistant - Astronomy Class**, *ETH*, Zürich, Switzerland.
- Mar 2020 - May 2020 **Teaching Assistant - Physics II Exercise Class**, *ETH*, Zürich, Switzerland.
- Mar 20, 2018 **Python Lecture at Py@stroPD**, *Astronomical Observatory of Padua*, Padua, Italy.
Topic: "Plotting With Pandas"
- Nov 6, 2018 **Masters Class Lecture**, *Università degli studi Roma Tre*, Rome, Italy.
Topic: "Exoplanet Atmospheres"
- Mar 20, 2018 **Python Lecture at Py@stroPD**, *Astronomical Observatory of Padua*, Padua, Italy.
Topic: "Plotting With Pandas"

Mar 13, 2018 **Python Lecture at Py@stroPD**, *Astronomical Observatory of Padua*, Padua, Italy.
Topic: "Pandas: Python Data Analysis Library"

Conferences, Workshops and Contributions

Invited Talks

- Sep 19 – 23, 2022 **Europlanet Science Congress 2022**, *Granada, Spain*, Topic: "Atmospheric retrievals of terrestrial planets with future space missions".
- Sep 15, 2022 **PlanetS WP 1 "Spectroscopic biosignatures in planetary atmospheres" Kick-off meeting**, *Bern, Switzerland*, Topic: "Review of biosignatures".
- May 11, 2022 **Exoplanets Seminar at STScI (Space Telescope Science Institute)**, *Baltimore, Maryland, USA*, Topic: "Atmospheric Retrievals as a Tool to Define the Requirements of the LIFE Space Mission".
- May 10, 2022 **Exoplanets Seminar at NASA Space Flight Center**, *Greenbelt, Maryland, USA*, Topic: "Atmospheric Retrievals as a Tool to Define the Requirements of the LIFE Space Mission".
- May 9, 2022 **Exoplanets Seminar at University of Maryland**, *College Park, Maryland, USA*, Topic: "Atmospheric Retrievals as a Tool to Define the Requirements of the LIFE Space Mission".
- Mar 10, 2022 **Laura Bassi Series**, *Virtual seminar*, Talk: "Life in the universe, and everything".
- Aug 23 – 28, 2021 **ESO Atmo 2021 Workshop**, *Virtual meeting*, Role: member of the SOC; Lecture Topic: "petitRADTRANS, Low and high resolution, forward and retrieval models".
- Jun 3, 2021 **NCCR Site Visit**, *Virtual meeting*, Role: WP 4.2 spokesperson. Topic: "P4.2: Observational Signatures of Habitability".
- Apr 30, 2021 **Exoplanets Seminar at Ohio State University**, *Virtual meeting*, Talk: "Atmospheric Retrieval with the LIFE Space Mission".
- Apr 27, 2021 **IPA colloquium**, *Virtual meeting*, Topic: "Atmospheric retrieval of terrestrial exoplanets".
- Oct 6 – 10, 2019 **Annual Conference on Astronomical Data Analysis and Software Systems**, *Groningen, The Netherlands*, Topic: "Exo-MerCat: merged exoplanet Catalog with VO connection".
- Mar 5 – 9, 2018 **Planetology Congress**, *Bormio, Italy*, Topic: "Stability Studies of Super Earths Atmospheres".
- Nov 30, 2016 **Astro-pizza Day**, *Padua, Italy*, Topic: "Stability Studies of Super Earths Atmospheres".

Selected Contributed Talks

- Sep 19 – 23, 2022 **Europlanet Science Congress 2022**, *Granada, Spain*, "Status and progress of the Large Interferometer For Exoplanets (LIFE) mission".
- Aug 30 – Sep 2, 2022 **Latsis Symposium "The Origin and Prevalence of Life"**, *Zürich, Switzerland*, Topic: "Could the mid-infrared space interferometer LIFE find biosignatures in the spectrum of the Earth in time?".
- Jul 4 – 8, 2022 **Rocky Worlds 2**, *Oxford, UK*, Topic: "Diagnostic potential of the mid-infrared space interferometer LIFE for studying Earth analogs".
- May 15 – 20, 2022 **AbSciCon 2022**, *Atlanta, Georgia, USA*, Topic: "Atmospheric Retrievals as a Tool to Define the Requirements of the LIFE Space Mission".
- Apr 25 – 28, 2022 **NCCR PlanetS General Assembly**, *Grindelwald, Switzerland*, Topic: "Diagnostic potential of a mid-infrared space interferometer for studying Earth analogues".
- Sep 13 – 24, 2021 **Europlanet Science Congress 2021**, *Virtual meeting*, Topic: "Diagnostic potential of a mid-infrared space interferometer for studying Earth analogues".
- Feb 11, 2021 **PlanetS workshop on "exoplanet atmosphere-interior interactions"**, *Virtual meeting*, Topic: "Bayesian retrieval for terrestrial atmospheres and interiors".

- Jan 18, 2021 **NCCR PlanetS Bonus Project Workshop**, *Virtual meeting*, Topic: "WP 4.2.2: Observational signatures of habitability: The information content of terrestrial planet spectra".
- Sep 23 – Oct 9, 2020 **Europlanet Science Congress 2020**, *Virtual meeting*, Topic: "Assessing the habitability of observed Super Earths".
- May 25, 2020 **NCCR PlanetS Bonus Domain Workshop**, *Virtual meeting*, Topic: "Atmospheric retrieval of terrestrial exoplanets".
- Jun 17 – 19, 2019 **INAF Science Archives & the Big Data Challenge**, *Rome, Italy*, Topic: "Exo-MerCat: merged exoplanet Catalog with VO connection".
- May 12 – 17, 2019 **IVOA Interoperability Meeting**, *Paris, France*, Topic: "Exo-MerCat: merged exoplanet Catalog with VO connection".
- May 8 – 10, 2019 **14th GAPS Progress Meeting**, *Trieste, Italy*, Topic: "MAGRATHEA: state of the art and new updates".
- Mar 18 – 20, 2019 **ARIEL Consortium Meeting**, *Palermo, Italy*, Topic: "The Exoplanet Ozone Model: studying ozone on planets orbiting M stars".
- Feb 4 – 8, 2019 **XV Congresso Nazionale di Scienze Planetarie**, *Florence, Italy*.
Topic: "Joint Exoplanet Catalog with VO connection"
- Nov 28 – 30, 2018 **13th GAPS Progress Meeting**, *Naples, Italy*, Topic: "MAGRATHEA: state of the art and new updates".
- May 14 – 16, 2018 **12th GAPS Progress Meeting**, *Cagliari, Italy*, Topic: "Stability Studies of Super Earths Atmospheres".

Public Outreach and Scientific Dissemination

I regularly participate in public outreach events, including: Nacht der Physik (ETH, Zürich, Switzerland June 17, 2022), PlanetS @ Fantasy Basel (Basel, Switzerland, May 26, 2022 & Oct 9–10, 2021), Scientifica – Zürich Science Days (ETH, Zürich, Switzerland, Sep 4 – 5, 2021), European Night of Researchers 2017 & 2018 (Padua, Italy). I have spoken at virtual seminars for middle school and college students at Waggoner Road Middle School in Columbus (Ohio, USA) and Wheeling University (West Virginia, USA). I developed the "Exoplanet Treasure Hunt" in 2017, a laboratory game for 4/13-year-old kids. The game was a successful entertainment during outreach events in Padua, Italy. I am involved in the management of the science dissemination Facebook/Instagram Page "La Scienza Coatta" (≈130K followers). We explain complex science topics and highlight relevant present and past scientists (including women and LGBTQIA+ members) using an Italian dialect to make it accessible to everyone regardless of their socioeconomic status.

Affiliations and Memberships



Hard skills

Programming Languages: FORTRAN (Advanced), Python (Advanced), C/C++ (Basic), SQL (Basic), Java (Basic).

Web Languages: HTML (Advanced), CSS (Advanced).

Industry Software Skills: MS Office suite (Advanced); Photoshop CS6 (Medium); LaTeX (Medium); IDL (Basic).

Analytical Skills: Research, Data presentation, Database management, Data and metrics interpreting, Reporting, Diagnostics.

Additional Information

Hobbies Singing, Acting, Swimming, Playing volleyball.