

Europass Curriculum Vitae



Personal information

Name / Surname

Professional Email

Home page

Nationality

Matteo Teodori

matteo.teodori@inaf.it

matteo.teodori@unicampania.it

<https://matteoteodori.github.io/>

Italian

Research Interests

I am mainly interested in analytical and numerical models to study the structural, spatial, kinematic and thermal characteristics of physical systems, in particular, Lagrangian models for multi-components simulations.

Among them, we have the emission of volatiles from the surface and subsurface of planetary science targets through the Smoothed Particle Hydrodynamics approach.

Similarly, the evolution of Globular Clusters and their Multiple Populations, focusing on energy equipartition, mass segregation and evaporation through dynamical models and N-body simulations.

I am generally curious about fundamental physics and astrophysics, planetary sciences, stellar formation and evolution, dark matter, cosmology, and data analysis techniques.

Research experiences

1st Dec. 2022 - Now

PhD student in Mathematics, Physics and application for Engineering at University of Campania Luigi Vanvitelli in collaboration with **INAF - Osservatorio Astronomico d'Abruzzo** studying the dynamical evolution of Globular Clusters and their Multiple Populations through dynamical models and N-body simulations. Supervisors: Prof. Oscar Straniero and Prof. Lucio Gialanella.

1st June 2022 - 30th Nov. 2022

Studentship at INAF - IAPS entitled "Activity of study and formation of planetary structures, through modeling and/or remote sensing and/or laboratory data" concerning the projects "ExoMars", "Dawn" and "TRIS". Study of the Smoothed Particle Hydrodynamics numerical method for the simulation of volatiles emission from planetary surfaces of interest for the mentioned projects.

1st Feb. 2022 - 31th May 2022

Internship at INAF - Astronomical Observatory of Rome, finalized at learning the mathematical techniques of the "Information Field Theory" and their application to astronomical data, with reference to the high-contrast images produced within the SHARK-VIS project, an instrument intended for the LBT telescope for deep detection of exoplanets through direct images.

1st Dec. 2021 - 30th Nov. 2022

Research collaborator at the Physics Department - University of Rome "La Sapienza", concerning the study of multi-mass dynamical models for Globular Clusters.

Education

16th Nov. 2021

Master degree in Astronomy & Astrophysics, University of Rome "La Sapienza", cum laude. Thesis title: Gravothermal catastrophe in models of Globular Clusters with a mass distribution. Supervisor: Prof. Marco Merafina.

Collaborations

Active

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Collaboration with INAF-IAPS on the study of volatiles emission from planetary surfaces and fractures using a Smoothed Particle Hydrodynamics (SPH) approach. Member of the International Space Science Institute (ISSI) group led by Dr. Michelangelo Formisano, for the project (526) "*Thermophysical characterization of ice-rich areas on the surface of specific planetary bodies: conditions for the formation of a transient exosphere*", active in the development of SPH codes able to collaborate with Eulerian codes.

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Development of multi-mass dynamical models for Globular Clusters within the research group lead by Prof. Marco Merafina, concerning a research project entitled "*Stellar evolution and dynamical evolution in Globular Clusters: theoretic development and N-body simulations*".

Past

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Collaboration with INAF-OAR concerning the development of codes for High Contrast Imaging in the SHARK-VIS project, finalized at the direct detection of extra-solar planets.

Publications

2025

M. Teodori, L. Maggioni, G. Magni, M. Formisano, M. C. De Sanctis, F. Altieri, "Plumes emission from a fracture on a planetary surface using Smoothed Particle Hydrodynamics: the case of Enceladus", *Icarus*, under review.

2024

M. Teodori, O. Straniero, M. Merafina "[Energy equipartition in Globular Clusters through the eyes of dynamical models](#)", *Astronomy & Astrophysics*, 691, A202, DOI: 10.1051/0004-6361/202450783, [supplementary material](#).

2022

M. Merafina and **M. Teodori**, "[Generalization of the Fokker-Planck equation for stellar orbit diffusion in multi-mass star systems](#)", *arXiv*: 2205.10209, DOI: 10.48550/ARXIV.2205.10209.

As a co-author

2024

M. Formisano, M. C. De Sanctis, S. Boazman, A. Frigeri, D. Heather, G. Magni, **M. Teodori**, S. De Angelis, M. Ferrari, "[Thermal modelling of the lunar South Pole: Application to the PROSPECT landing site](#)", *Planetary and Space Science*, 251, 105969, DOI: 10.1016/j.pss.2024.105969.

Abstract as first author

Talks

3-7 Feb. 2025

M. Teodori, L. Maggioni, G. Magni, M. Formisano, M. C. De Sanctis, F. Altieri, E. D'Aversa, "*Modeling volatiles emission through Smoothed Particle Hydrodynamics: Enceladus' plumes*", XX Congresso Nazionale di Scienze Planetarie 2025 (CNSP2025), Pescara, Italy.

8-13 Sept. 2024

M. Teodori, L. Maggioni, G. Magni, M. Formisano, M. C. De Sanctis, F. Altieri, E. D'Aversa, "*Volatiles emissions from surface fractures: Enceladus' plumes through Smoothed Particle Hydrodynamics simulations*", *Europlanet Science Congress 2024*, Berlin, Germany, [EPSC2024-55](#), DOI: 10.5194/epsc2024-55.

19-21 Mar. 2024

M. Teodori, G. Magni, M. Formisano and L. Maggioni, "*Advancements in SPH modeling for volatiles emission*", ISSI International Team Meeting, Bern, Switzerland.

16-20 Oct. 2023

M. Teodori, O. Straniero, M. Merafina and L. Gialanella, "[Dynamical evolution of Multiple Populations in Globular Clusters](#)", STARS Across the Universe, INAF - Osservatorio Astronomico di Capodimonte, Napoli, Italy, DOI: 10.5281/ZENODO.10105297.

6-10 Feb. 2023

M. Teodori, G. Magni, M. Formisano, M. C. De Sanctis and F. Altieri, "[Volatiles emission from a fracture on a planetary surface: a Smoothed-Particle-Hydrodynamics approach](#)", XVIII Congresso Nazionale di Scienze Planetarie, Perugia, Italy.

14th Nov. 2022

M. Teodori, "Multi-mass collisional stellar systems models for Globular Clusters", G11 Workshop, Physics Department, University of Rome "La Sapienza".

Posters

19-23 Aug. 2024

M. Teodori, O. Straniero and M. Merafina, "[Measuring energy equipartition in Globular Clusters with dynamical models](#)", MODEST-24: Exploring Dense Stellar Systems Across Cosmic Time, Nicolaus Copernicus Astronomical Center, Warsaw, Poland.

16-21 June 2024

M. Teodori, G. Magni, M. Formisano, L. Maggioni, M. C. De Sanctis, F. Altieri, "*Volatiles emission from the Moon's surface: a Smoothed Particle Hydrodynamics approach*", European Lunar Symposium 2024, Dumfries and Galloway, Scotland, United Kingdom. Awarded of a Travel Grant.

8-12 May 2023

M. Teodori, G. Magni, M. Formisano, M. C. De Sanctis, F. Altieri, "*Volatiles emission from a cavity on a planetary surface using smoothed particle hydrodynamics*", Biennial European Astrobiology Conference BEACON 2023, La Palma & Teneguia Princess Hotel on Fuencaliente, La Palma Island, Canary Islands, Spain. Awarded of a financial support for accommodation.

Abstract as co-author

Posters

2024

L. Maggioni, **M. Teodori**, G. Magni, M. Formisano, M. C. De Sanctis, F. Altieri, "*Volatiles emission from planetary fractures through a Smoothed-Particle-Hydrodynamics approach: the case of Mars*", Europlanet Science Congress 2024, Berlin, Germany, 8–13 Sep 2024, [EPSC2024-312](#), DOI: 10.5194/epsc2024-312.

2024

M. Formisano, M. C. De Sanctis, A. Frigeri, S. Boazman, D. Heater, S. De Angelis, M. Ferrari, G. Magni, **M. Teodori**, F. Altieri, "*Numerical analysis of a south pole lunar region through a 3-D FEM model: the case of the PROSPECT landing site*", European Lunar Symposium 2024, Dumfries and Galloway, Scotland, United Kingdom.

2023

M. Formisano, G. Magni, **M. Teodori**, M. C. De Sanctis, A. Raponi, M. Ciarniello, G. Filacchione, O. Aharonson, S. Bertoli, J. Castillo-Rogez, N. Davari, A. Deutsch, C. Federico, A. Frigeri, D. Hurley, "*Thermophysical characterization of ice-rich lunar polar regions*", European Lunar Symposium 2023, Padova, Italy.

Participation to workshops

Nov. 2024

MAJIS Science Team Meeting #9, ASI, Rome, Italy.

March 2024

International Team Meeting at International Space Science Institute (ISSI), Bern, Switzerland.

Nov. 2022

G11 Workshop, Physics Department, University of Rome "La Sapienza".

Funded projects

2024

Participation as **Co-I** in the INAF MiniGrant for the project *PLUMES: Planetary fractures Lagrangian simUlations for Multi-component EmissionS*, PI: Dr. Emiliano D'Aversa. Funding Institute: **INAF**. Role: development and refinement of the SPH model.

2024

Participation in the **INAF Theory Grant** for the project *Thermophysical modeling of Permanently Shadowed Regions (PSRs) on Moon and Mercury*, PI: Dr. Michelangelo Formisano (IAPS). Funding Institute: **INAF**. Role: refinement of the SPH code and its application.

2023-2024

Participation in the project "*Thermophysical characterization of ice-rich areas on the surface of specific planetary bodies: conditions for the formation of a transient exosphere*". PI: Dr. Michelangelo Formisano. Funding Institute: **International Space Science Institute (ISSI)**. Role: development of SPH codes for volatiles emission from planetary surfaces and subsurfaces.

2022	Participation in the project " <i>Stellar evolution and dynamical evolution in Globular Clusters: theoretic development and N-body simulations</i> ". PI: Prof. Marco Merafina, Funding Institute: University of Rome La Sapienza . Role: development of multi-mass dynamical models.
Organization of workshops	
2025 (incoming)	Organization of a workshop to gather Italian expertise on the study of volatiles emission from planetary surfaces, to be addressed with numerical models. The workshop promotes the mobility of young researchers and PhD students and is funded by SISP-AC (Società Italiana di Scienze Planetarie - Angioletta Coradini).
Code/software development	
<i>Language</i>	<i>Description</i>
C, Cython, Python	Smoothed Particle Hydrodynamics (SPH) code for simulating volatiles emission from planetary surfaces, tracing their dynamical and thermal evolution.
Fortran	Development of a code for obtaining equilibrium solution of a multi-mass King-like dynamical model, to describe Globular Clusters 3D and 2D observables (structural, spatial, kinematic and thermodynamic properties).
C	Development of a customized version of MCLUSTER code, to set up N-body initial conditions for Multiple Population, in the case of single and multi-mass dynamical models.
Python	Codes for analyzing and fitting globular clusters observational data concerning kinematical properties related to energy equipartition as well as surface brightness profiles.
Python	Codes for analyzing results from N-body simulations.
Python	Codes for visualization and analysis of SPH simulations results.
Fortran	Code for solving equilibrium configuration of a single-mass King-model, produce results concerning structural properties, spatial distribution, internal kinematics and thermodynamic stability (Master Thesis).
C	Code for carbon ignition curve and their analysis (Bachelor Thesis).
Coding/software experience	
Programming languages	C intermediate level (5 yrs, Bachelor's degree thesis and courses, PhD project), Fortran intermediate level (3 yrs, Master thesis, PhD project), MATLAB (for programming) basic level (PhD course) and Python intermediate level (3 yrs, INAF experiences and PhD project).
Professional skills	Basic experience (2 yrs) with parallel codes and simulations: PySPH for hydrodynamical SPH simulations, MCLUSTER and NBODY6++ respectively for setting initial conditions and run N-body simulations of Globular Clusters and their Multiple Populations.
Data analysis and visualization	Experience with MATLAB (6 yrs) and Python (3 yrs) acquired during university courses, thesis work, INAF experiences and PhD project.
Document drafting	Experience of 8 yrs with L^AT_EX , in particular for scientific reports, thesis, abstracts, papers and proposal drafting.
Remote control	Basic knowledge (2 yrs) of remote connection to servers for running numerical simulation using SSH and SFTP protocol or by using a remote desktop software (AnyDesk, Splashtop and TeamViewer).
Website	Basic knowledge of HTML (website customization).
Others	Intermediate experience in Office automation packages, in particular with software for presentation, document elaboration and spreadsheets, refined from Italian secondary school to today (around 12 yrs experience). Basic ability in managing videoconferencing.

PhD schools

24 June - 5 July 2024

INAF - [Course in Computing and High Performance Computing in Astronomy & Astrophysics](#), Bologna, Italy.

2-6 Oct. 2023

INAF - [Scientific Communication in Astronomy School](#), Bertinoro, Italy.

Seminars

12th June 2024

IAPS Seminar, "[Smoothed Particle Hydrodynamics: simulation of volatiles emission from planetary surfaces](#)".

16th Feb. 2023

INAF-OAAb colloquia, "[The interconnection between multi-mass dynamical models and multiple populations in Globular Clusters](#)".

Teaching experiences

Tutoring

Occasional and sometimes regular tutoring of high school students in Math and Physics.

Others

Helping out with master degree thesis work of Prof. Merafina students.

Personal skills

Mother tongue

Other languages

*Self-assessment
European level**

Italian

English

Understanding		Speaking		Writing
Listening	Reading	Spoken interaction	Spoken production	
B1 Independent user	B1 Independent user	B1 Independent user	B1 Independent user	B1 Independent user

* Common European Framework of Reference (CEF) level