Flavio Petricca

NASA Jet Propulsion Laboratory
Planetary Interiors and Geophysics Group
4800 Oak Grove Drive, Pasadena, CA, USA
flavio.petricca@jpl.nasa.gov

Short Bio

I am an early-career (PhD in Space Engineering in 2023) planetary scientist specializing in geophysics and interior modeling of planets and moons. My research combines spacecraft data analysis with advanced multi-physical modeling to investigate planetary interiors and their habitability potential using complementary measurements from gravity, radio science, magnetometry, altimetry, and imaging. Currently a postdoctoral researcher at NASA's Jet Propulsion Laboratory, I have been involved in NASA's Europa Clipper mission as affiliate of the Gravity / Radio science team, to which I contributed new generation models of Europa's interior that combine observations from multiple instruments to improve the science return from the mission. I was also involved in the early science requirements definition of JPL for the Uranus Orbiter and Probe, NASA's priority for future planetary exploration, particularly in defining an observational strategy for detecting oceans in Uranus' moons from a suite of multiple instruments. I am also interested in science planning, deep space operations and navigation.

Professional Experience

2024 – **Postdoctoral Researcher**
NASA Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA - USA
Research projects (Advisor: Dr. Julie Castillo-Rogez, Dr. Steven D. Vance):
- Development of interior models for the interpretation of future data from Europa Clipper, combining measurements of gravity and magnetic fields, altimetry, rotational state and compositional data to improve knowledge of Europa's interior and habitability potential.
- Reanalysis of Cassini data that improved Titan's gravity field measurements and demonstrated that Titan does not harbor a subsurface ocean, questioning an interpretation that lasted for two decades and reconciling for the first time all the available geophysical data at Titan.
- Assessment of the best observational strategy for detecting oceans in Uranus' moons from a suite of multiple instruments (gravity, magnetometry, altimetry, imaging) as part of the early formulation of the Uranus Orbiter and Probe mission, NASA's top priority for future exploration.

2023 – 2024 **Postdoctoral Researcher**
Sapienza Università di Roma, Rome - Italy
Research projects (Advisor: Prof. Antonio Genova):
- Modeling of Enceladus' interior structure and numerical simulations of gravity investigations in support of a mission proposal to NASA's New Frontiers exploration program.
- Analysis of the gravity field of Mars' polar caps to determine their structure and composition.
- Development of a least-squares filter for orbit determination and deep-space navigation in support of the analysis of BepiColombo radio science data.
- Numerical simulations in support of the development of an inter-satellite navigation system based on the fusion of multiple datasets.

2022 **JPL Visiting Researcher (JVSRP)**
NASA Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA - USA
Research projects (Advisor: Dr. Julie Castillo-Rogez):
- Determination of Europa's interior by combining gravity, magnetic and compositional data.

Education

2020 – 2023 **Ph.D.**, *Space Engineering*
Sapienza Università di Roma, Rome - Italy, Final Mark: **with honors**
Thesis: "Characterization of Planetary Atmospheres and Interiors with Radio Science Data"
Research projects (Advisor: Prof. Antonio Genova):
- Analysis of the Mars Reconnaissance Orbiter radio occultation data to determine profiles of Mars atmospheric density, pressure and temperature.
- Numerical simulations of the effects of Venus' atmosphere on the gravity investigation of NASA's VERITAS mission. Modeling of Venus' interior in support of the mission.
- Numerical simulations of the Europa Clipper's gravity and radio science investigation to finalize the trajectory design of the spacecraft. Simulations and analyses of the perturbative effects of the Io Plasma Torus on the investigation.
- Development of Europa's interior models to interpret gravity and magnetic field measurements acquired by NASA's Galileo mission.
- Preliminary design and requirements definition for an inter-satellite radio tracking system and numerical simulations to evaluate its performances for deep space navigation.

2017 – 2019 **Master's Degree**, *Space and Astronautical Engineering*
Sapienza Università di Roma, Rome - Italy, Final Mark: **110/110 with honors**
- Thesis: "Preliminary Design of an Inter-Satellite Radio Tracking System"
- Advisor: Prof. Antonio Genova, Co-Advisor: Prof. Luciano Iess

2014 – 2017 **Bachelor's Degree**, *Aerospace Engineering*
Sapienza Università di Roma, Rome - Italy, Final Mark: **110/110 with honors**
- Thesis: "Preliminary Design of an orbiter-to-probe link for a mission to Venus"
- Advisor: Prof. Luciano Iess

Awards & Affiliations

2025 JPL Award for "Delivering a Refined Science Traceability Matrix for a Uranus Orbiter and Probe Mission"

2021 Outstanding Sapienza University of Rome Graduate Student

2021 – American Geophysical Union Member

2020 – Affiliate of the Europa Clipper Science Team, Gravity / Radio Science Investigation

Peer Review Activities

Journals
- Journal of Geophysical Research: Planets
- Icarus
- Planetary and Space Science
- The Planetary Science Journal
- Astronomy and Astrophysics
- Radio Science
- Aerospace
- Remote Sensing
- IEEE Communications Letters
- RAS Techniques and Instruments

Software and IT Skills

- Programming Languages: Python, MATLAB, C, Fortran
- Software: MONTE Navigation Toolkit (NASA-JPL), NAIF SPICE (NASA-JPL)

Publications

2025 **Petricca, F.**, Vance, S. D., Parisi, M., Buccino, D., Cascioli, G., Castillo-Rogez, J. C., Downey, B. G., Nimmo, F., Tobie, G., Journaux, B., Magnanini, A., Jones, U., Panning, M., Bagheri, A., Genova, A., Lunine, J. I., Titan's Strong Tidal Dissipation Precludes a Subsurface Ocean, *Nature, in press.*

2025 **Petricca, F.**, Castillo-Rogez, J. C., Genova, A., Melwani Daswani, M., Cochrane, C., Vance, S. D., Partial Differentiation of Europa and Implications for the Origin of Materials in the Jupiter System, *Nature Astronomy.*

2025 **Petricca, F.**, Corey, C. J., Cascioli, G., Mazarico, E., Chang, S., Vance, S. D., Nimmo, F., Castillo-Rogez, J. C., Characterization of Europa's Interior through Synthesis of Europa Clipper's Data, *The Planetary Science Journal, under review.*

2025 **Petricca, F.**, Landau, D., Melwani Daswani, M., Castillo-Rogez, J. C., Gravity and Radio Science Investigation at the Moons of Uranus to Reveal Subsurface Oceans and Characterize Interior Structures, *Journal of Geophysical Research: Planets.*

2024 **Petricca, F.**, Tharimena, S., Melini, D., Spada, G., Bagheri, A., Vance, S. D., Exploring the tidal responses of ocean worlds with PyALMA3, *Icarus.*

2023 **Petricca, F.**, Genova, A., Castillo-Rogez, J. C., Styczinski, M. J., Corey, C. J., Vance, S. D., Characterization of Icy Moon Hydrospheres Through Joint Inversion of Gravity and Magnetic Field Measurements, *Geophysical Research Letters.*

2022 **Petricca, F.**, Genova, A., Sequential Processing of Inter-Satellite Doppler Tracking for a Dual-Spacecraft Configuration, *Remote Sensing.*

2022 **Petricca, F.**, Genova, A., Goossens, S., Iess, L., Spada, G., Constraining the Internal Structures of Venus and Mars from the Gravity Response to Atmospheric Loading, *The Planetary Science Journal.*

2021 **Petricca, F.**, Cascioli, G., Genova, A., A Technique for the Analysis of Radio Occultation Data to Retrieve Atmospheric Properties, *Radio Science.*

2025 Cascioli, G., Mazarico, E., **Petricca, F.** et al., The Effect of the Io Plasma Torus on Precise Orbit Determination and Gravity Recovery: Application to Europa Clipper, *The Planetary Science Journal.*

2024 Genova, A., **Petricca, F.**, et al., Water Ice Concentration and Distribution in Martian Polar Deposits Constrained by Lateral Variations of Bulk Density, *Icarus.*

2024 Del Vecchio, E., Gargiulo, A. M., **Petricca, F.**, et al., First Analysis of BepiColombo Radio Science and Accelerometer Data Acquired During Venus and Mercury Flybys, *IEEE Transactions on Aerospace and Electronic Systems.*

2024 Genova, A., Parisi, M., Gargiulo, A. M., **Petricca, F.**, et al, Gravity Investigation to Characterize Enceladus's Ocean and Interior, *The Planetary Science Journal.*

2024 Gargiulo, A. M., Genova, A., **Petricca, F.**, et al., Determination of Venus Gravity and Atmospheric Density Through EnVision Radio Science, *Acta Astronautica.*

2023 Sulcanese, D., Mitri, G., Genova, A., **Petricca F.**, et al., Topographical analysis of a candidate subglacial water region in Ultimi Scopuli, Mars, *Icarus.*

2023 Genova, A., Goossens, S., Del Vecchio, E., **Petricca F.**, et al., Regional variations of Mercury's crustal density and porosity from MESSENGER gravity data, *Icarus.*

2023 Andolfo, S., **Petricca, F.**, Genova, A., Precise Pose Estimation of the NASA Mars 2020 Perseverance Rover Through Stereo-vision, *Journal of Field Robotics.*

2021 Genova, A., **Petricca F.**, Deep-Space Navigation with Inter-Satellite Radio Tracking, *Journal of Guidance, Control, and Dynamics.*

2020 Cascioli, G., **Petricca F.**, Genova, A., Mars' atmospheric calibration of radio tracking data for precise orbit determination, *Acta Astronautica.*