

# SONIA FORNASIER: CURRICULUM VITAE

**Name** : Sonia      **Surname** : Fornasier

- Assistant professor at **Paris University**, researcher at the Laboratoire d'études spatiales et instrumentation en astrophysique (**LESIA**)
- **senior member of the Institut Universitaire de France**

## ACADEMIC RECORD

-Habilitation à diriger des recherches (**HDR**), Paris Diderot University, obtained on 25 May 2012 on Physico-chemical characterization of minor bodies of the Solar System

-PhD in Space Science and Technology, CISAS-University of Padova, and PhD in Astrophysics, University of Paris Diderot (PhD in co-tutoring Italy-France), obtained on 18 December 2002. PhD Thesis on "Rosetta mission: scientific characterization of the Wide Angle Camera of the OSIRIS instrument and physical studies of minor bodies of the Solar System".

-Degree in Astronomy, Padova University, Italy, period of studies from 1991 to 1997. Final examination of 25 October 1997, thesis on "Aqueous alteration on primitive asteroids" (note 107/110)

## EMPLOYMENT

- Since Sept. 2006 : Assistant professor at the Paris-Diderot University/Paris University and LESIA/Observatoire de Paris
- Jan. 2006-August 2006: Research contract at CISAS (Center of Studies and Activities for Space "G. Colombo"), Padova University, on the *In flight photometric calibrations of the OSIRIS instrument onboard the Rosetta mission*
- January-February 2006: invited scientist at ESO, Santiago, Chile
- July-October 2005: research contract with the Padova University to work on the baffling system for straylight suppression for the ESO-QUANTEYE instrument.
- Dec. 2002-June.2005: Post-Doc fellow at Padova University to work on Investigation of the physical properties of Solar System minor bodies
- Gini foundation fellow (9 months) to finance my studies in France during the PhD
- 1998-1999: contract at the CISAS-Padova University as technician with research task on Calibration of the Wide Angle Camera for the Rosetta mission
- July 1998-December 1998: research contract with CISAS-Padova University, on Study of reflectance properties of Sun illuminated surfaces in the space environment

## SCIENTIFIC RESEARCH

I am expert on spectroscopy, photometry and polarimetry of minor bodies of the Solar System (NEA, main belt asteroids, Jupiter Trojans, Centaurs, TNOs and comets). My work is based on multi-wavelength observational campaigns from groundbased and space telescopes, on the modelling of the bodies' physico-chemical surface composition and of their thermal properties, and on statistical analysis. I am involved in several space missions devoted to the asteroids, comets, planets and their satellites investigation (Rosetta, Herschel, Spitzer, OSIRIS-REX, MMX, JUICE , BepiColombo). I am an expert of small bodies surface composition which gives important constrains on the primordial composition of the early solar system. Among the main research results, the extensive study of the aqueous alteration process on primitive asteroids, process of high exo-biological importance because produced by the interaction of liquid water with the minerals; the spectral characterisation of several Jupiter Trojans members of dynamical families, with the discovery of an atypical carbonaceous rich family named Eurybates; the most extensive study of the thermal properties of TNOs (from Herschel observations), which permit to derive the size and albedo for 140 bodies and their thermal properties, including the first submm studies of their emissivity; the discovery of exposed volatiles, morphological changes, and surface variation of the 67P nucleus with time/heliocentric distances due the seasonal and diurnal cycle of water.

I have published more than 250 articles in peer review journals, including 25 articles for the prestigious reviews Science, Nature, Nature Astronomy.

The complete list of my publications is available at: <https://sites.lesia.obspm.fr/sonia-fornasier/publication-list/>

## SCIENTIFIC RESPONSABILITIES

- **Leader of the Planetology team** (about 45 people) of the **LESIA** laboratory since 2016
- **Scientific and technical responsible at LESIA** laboratory of the French **ANR project ORIGINS** "Discovering the original planetesimals of our Solar System", financed in 2018 for 5 years with a total budget of 456706 euro between Lagrange and LESIA laboratories
- **Scientific and technical responsible at LESIA** laboratory of the French **ANR project CLASSY** "Composition of Low Albedo Surfaces of the Solar System", financed in 2017 for 5 years with a total budget of 620000 euro between IPAG, LESIA, IAS, UMET and MNHN laboratories
- **Instrument Scientist** and Co-Investigator (Co-I) of the imaging spectrometer **MIRS for the JAXA mission Martian Moons Exploration (MMX)**; member of the international working groups of the MMX mission : "Origin of Phobos and Deimos", "Surface Science and Geology", "Landing Site Selection", "Mission Operations"
- **(Co-I)** of the imaging system **OSIRIS** for the **Rosetta** mission (ESA) which includes 2 cameras (WAC and NAC), and it is realized by a consortium of 9 institutes from 6 different countries (about 65 people between co-investigators and associated scientists), and associated scientist of the VIRTIS spectro-imager onboard Rosetta
- Responsible of the inflight radiometric calibrations for both cameras, WAC and NAC of OSIRIS : definition and computation of the absolute photometric calibration factors for all the cameras filters (level 2 images of OSIRIS pipeline) and production of the radiance

factors (level 3 pipeline); active participation to the OSIRIS observing sequences definition and implementation during all the scientific and calibration goals

- **Scientific coordinator**, since 2012, of the **working group** on "**Composition and physical properties of the 67P/CG comet nucleus**" in the **OSIRIS team**. This working group has been involved in planning and preparing observations for the study of the composition and photometric properties of the 67P nucleus surface, as well as the analysis and interpretation of the data. I organized and participated at 2-3 teleconferences per week during 2014-2016 as coordinator and member of the OSIRIS working groups (composition, morphology, activity, dust).
- Collaborator of the NASA –Rosetta Data Analysis Program proposal “Comet 67P Nucleus-Coma Interactions with Rosetta Observations and Models”.
- **Co-I of the SIMBIO-SYS** instrument for the **BEPI COLOMBO** (ESA) mission
- **Associated scientist of the OSIRIS-REX (NASA)** mission, involved in the spectral analysis and photometry working groups
- **Associated scientist of the JANUS** instrument of the **JUICE (ESA)** mission
- Co-I of the MarcoPolo, MarcoPolo–R and MarcoPolo-M5 missions selected by ESA for assessment studies for the ESA Cosmic Vision-M2, M3, and M5 program
- **Chair of the working group** : *Remote sensing payload* for the asteroid sample return mission **Marco Polo-R**
- **Science lead for the LESIA laboratory of the MARIS instrument**, and Co-I of 4 instruments (MARIS-spectrograph, Vespa- multi sensor package, MaNAC-camera, et CUC-close up camera) of the **MarcoPolo-R mission**
- Co-I of the CASTAWAY mission selected by ESA for assessment study for the ESA Cosmic Vision-M5 program
- Co-I of the CHIMERA mission for assessment study for the NASA Discovery Programme (2019)
- 2009-2010: Co-I of the Binary Asteroid in situ Explorer (BASiX) mission proposed to NASA for the Discovery 2010 program
- 2001-2007: Co-I of the Asteroid missions MASTER and ISHTAR selected by ESA for a phase A study
- **Co-I of a key program** devoted to the study of TNOs and Centaurs with the space telescope **Herschel** (372 hours awarded); **responsible of the reduction and interpretation of the submm data** obtained with the **SPIRE instrument** within this program.
- Co-I of the projects Quantum Optics for Astronomy (PI Barbieri, Padova University, 2007-2009), and Quantum properties of light and astronomy ( project of scientific excellence financed by the Cariparo foundation with 290000 Euro)
- Member of the European FP7 COST - MP1104 program "Polarization as a tool to study the Solar System and beyond" (2011-2015)
- Member of the European FP7 program NEOSHIELD (2011-2014) “A Global Approach to Near-Earth Object (NEO) Impact Threat Mitigation Planning the deflection of hazardous Near Earth Objects and expanding our knowledge of the science behind them” (funding of 1.4 million of Euro); I was also responsible for gender related issues within this program
- Member of the European Horizon2020 program NEOSHIELD2 (2015-2018) « Science and Technology for Near-Earth Object Impact Prevention »(funding of 4.2 million of Euro). Our Team at LESIA was responsible of the compositional characterization of small NEO. In this framework we got a large program of observations at ESO-NTT telescope, and we

observed about 170 NEO of size smaller than 300 m over 30 nights. This is the first extensive survey on spectroscopy of small NEO

- Member of the European Horizon2020 program NEOROCKS NEO Rapid Observations, Characterisation and Key Simulation (2020-2022) devoted to the characterization of the physical properties of Near-Earth Objects.
- Member of the working group “Closing the gap between ground based and in-situ observations of cometary dust activity : Investigating comet 67P to gain a deeper understanding of other comets et The Life Cycle of Comets” , International Team (2020-2022), International Space Science Institute (ISSI)
- Member of the working group “The Life Cycle of comets”, International Team (2021-2023), International Space Science Institute (ISSI)

## SERVICES TO THE COMMUNITY

-since 2021: **member of the European Space Science Committee (ESSC)** and member of the Solar System and Exploration Panel of ESSC

- **Leader and coordinator of the LESIA Planetology team** (*including 26 permanents+ 20 PhD-postdoc –contractual people*) since 2016

- Member of the administrative council of the Université de Paris since 2019

- Member of the administrative council of the Paris Observatory since 2019

- Member of the LESIA enlarged direction board

- Member of the European Space Agency Planetary Science Archive User Group (PSA-UG) since 2016, and referent and contact point for issues/questions related to the small bodies of the Solar System

- 2011-2019 : member of the 34 section (Astronomy & Astrophysics) of the French Universities National council (CNU)

- 2012-2015: member of the scientific council of the Paris Diderot University’s Physic Department

- 2012-2015 : member of the panel of experts for Physics and Astronomy for the Physic Department of the Paris Diderot University

- 2013-2016: scientific coordinator of the Paris Observatory on “Spatial activity competences”

- 2010 and 2020: member of the Staff Appointing Panel for the University Paris Diderot

- 2010-2011: member of 11 PhD thesis Jury, 8 of which as international expert at the Padova University (CISAS and Astronomy department) and one as reviewer at Liege University.

## Awards and Achievements

- Senior member of the prestigious Institut Universitaire de France (2019-2024)

- ESA Achievement Awards for outstanding contribution to the ROSETTA Mission

- Since 2013: holder of the prime for the Scientific Excellence (PES and PEDR since 2017)

- Main belt asteroid 13248 named “Fornasier” in my honor by the Asteroids Meteors and Comets (ACM) commission (2002)

- Member of the IAU commissions F2 Exoplanets and the Solar system, F3 Astrobiology, and F4 Asteroids, comets and Transneptunians; member of divisions F Planetary Systems and Astrobiology, and B Facilities, Technologies and Data Science

- Member of the Division of Planetary Science (DPS)- American Astronomical Society, of the l'European Geosciences Union (EGU), and of the French Society of Astronomy Specialists (SF2A)
- Several invited talks on the Solar System minor bodies physical properties and on the Rosetta mission results ( Max Planck Institut MPS, Germany; Monte Porzio Observatory, Rome, Italy, Bologna University , Italy; CISAS and Astronomy Department of Padova University, Italy; Univ. Pontificia Catolica, Chile ; INAF-Firenze Observatory, Italy ; European Southern Observatory, Santiago, Chile; Galileo Galilei foundation, INAF-TNG, La Palma, Spain; IMCCE-Paris Observatory; INAF-Catane observatory, Ecole Nationale Supérieure, Paris, France, INAF-Rome Monte Porzio Catone, Italy)
- On 2000-2001: young researcher award of the Padova University for the project: Study of the diffuse and reflectance properties of materials for space applications
- On 2001: Holder of the foundation A. Gini fellow to finance studies in a foreign country during the PhD
- Reviewer and member of the NASA scientific experts panel for the Space Mission Selection Committee for the 2014 DISCOVERY Program.
- Reviewer for national and international scientific projects submitted of the ANR (France National Research Agency), ANEP (National Evaluation and Foresight Agency, Spain), NCN-Preludium (National Science Center, Poland), GRIS (Czech Republic), PRIN-MIUR (Italian university research ministry)
- Reviewer for Consolidated Grant Projects, Science and Technology Facilities Council, UK
- Reviewer for the scientific journals: Nature Astronomy, Icarus, Astronomy and Astrophysics, Planetary and Space Science, New Astronomy, Journal of Quantitative Spectroscopy and Radiative Transfer, Moon Earth and Planets;
- reviewer for 3 books proposals for Elsevier publisher, and of two chapters in books devoted to Asteroids and Transneptunians
- Successful application for a post-doc fellow funding (2018) of the DIM-ACAV-Ile de France region program

### **International collaborations and invitations to foreign universities**

- Invited scientist at the Max Planck institute for the study of Solar System (MPS): 3 months in 2001- calibration campaign of the ROSETTA/OSIRIS imaging system; 2 weeks in Sept. 2008- analysis of the 2867 Steins OSIRIS data; 2 weeks in July 2010: analysis and interpretation of the OSIRIS data of 21 Lutetia, 1 month in August 2014, 8 weeks in 2015-2016 for the science planning and data analysis and interpretation of comet 67P/CG
- Invited visiting scientist at the Center for Space Studies CISAS of the Univ. of Padua, 1 month in April 2011 and 1 month in April 2014
- Invited visiting scientist at the Astronomy departments, Padova University, 5 weeks during 2006-2009 in the framework of the EUROPLANET program of personnel exchange (2004-2009).
- Invited visiting Scientist at ESO (European Southern Observatory), Santiago, Chile in January-February 2006
- Collaborations with several colleagues from various institutes in Europe, USA, Brazil in the framework of the Rosetta, Bepi-Colombo, OSIRIS-REX space missions or large observational projects (Key-program TNOs are Cool with HERSCHEL, characterization of the Transneptunians, Trojans, and Near-Earth Asteroids physical properties with NTT-VLT telescopes). Close collaborations with the colleagues of Max Planck MPS, Germany, Univ.

of Bern, of the Institute of Astrophysics of Granada, Univ. of Padua / CISAS, INAF-Observatory of Florence, INAF-Observatory of Monte Porzio, IAPS-Rome, Florida, Univ., Cornell University, MIT-USA, Karkiv Univ.

### **Conference board**

- Organizer of the first Asteroid Day in Paris, Paris Diderot University, 30 June 2017
- Member of the board and speaker for the Asteroid Day conference event, Paris 30 June 2018
- Co-organizer of the Multi scale Planetary Science Workshop, Paris Observatory, 21-22 June 2017
- Organizer of the colloquium "Calibration tools for imaging systems" conference, Meudon, May 2014
- Co-organizer of the "Day on spatial skills at Paris observatory", Meudon, 10 April 2015
- Organizer of the colloquium "Rosetta fly-by of 21 Lutetia: results from the OSIRIS instrument", Paris (1-2 march 2011)
- Member of the local committee of "International Symposium Marco Polo and other Small Body Sample Return Missions", Paris Diderot University, Paris, May 2009
- Member of the local committee for the "Regolith in the Solar System" conference, Meudon, Dec. 2010
- Organizer of the workshop "Osiris calibrations (mission Rosetta)", Meudon (10 January 2008)
- Organizer of the colloquium 'Rosetta Earth, Mars and asteroids fly-bys', Paris (11-12 January 2008)

### **Doctoral and post-doctoral advisor**

- Oct. 2019-2022: Jules Bourdelle de Micas, PhD on "Characterizing the primordial asteroids and remnants of planetesimals". Thesis financed by the ANR-project ORIGIN
- Oct. 2018-2021: Van Hoang Hong, PhD on "Spectro-photometric characterization of the primitive surfaces of comet 67P/CG and the TNO 2014 MU69: analysis of data from the Rosetta and New Horizons space missions based on laboratory experiments." Co-supervisor at 50% with E. Quirico, Grenoble. Thesis financed by the ANR-project CLASSY
- Oct 2018-2020: supervisor of the post-doc Pedro Hasselmann on "OSIRIS-REX mission: new insights on the Solar System primitive matter. Fellow financed by the DIM-ACAV project, Ile de France region, France
- 2015-2018: Jasinghege Don Prasanna Deshapryia, PhD on « Spectrophotometric properties of the nucleus of the comet 67P/Churyumov-Gerasimenko observed by the Rosetta spacecraft », co-supervisor at 25%, with M.A. Barucci. Current position: post-doc (ATER) at LESIA-Paris observatory.
- 2016-2018: supervisor at 40% of the post-doc Pedro Hasselmann on "Temporal evolution of the surface of the 67P/CG comet, Rosetta mission", Fellow financed by the DIM-ACAV project, Ile de France region, France
- 2014- 2017: PhD supervisor of Clement Feller, thesis title « Physical properties of the 67P/Churyumov-Gerasimenko comet from the OSIRIS imaging system data of the Rosetta mission. Current position: post-doc at LESIA

- 2012-2015 : Cateline Lanz, PhD on "Study of the aqueous alteration process and of space weathering processes on primitives asteroids: support to the future space mission with sample returns OSIRIS-Rex (NASA), Hayabusa 2 (JAXA) and MarcoPolo-R (ESA)". PhD co-supervisor at 50% with M.A. Barucci. Cateline thesis got mentions at the 2015 Daniel Guinier thesis prize of the French Society of Physics. Current position: permanent position (CNAP) at IAS-France
- 2013-2017 : Davide Perna, LESIA post-doctorate, supervision at 30% shared with M.A. Barucci "Physical properties of small Near Earth Objects in the Framework of the NEOSHIELD and NEOSHIELD2 European Projects" Current position: Marie Curie fellow at INAF-Rome
- 2009-2011: Cédric Leyrat, LESIA post-doctorate, supervision at 60% shared with M. Fulchignoni. "Photometric models of asteroids 2867 Steins and 21 Lutetia flew-by by the Rosetta mission". Current position: permanent researcher at LESIA
- 2007-2009: Davide Perna, PhD thesis. "Physical properties of the asteroids target of the Rosetta mission and of minor bodies of the outer Solar System", co-supervisor at 33% with E. Dotto and M.A Barucci.
- 2007-2010: Francesca Demeo, PhD thesis on «Compositional variation of the minor bodies throughout the Solar System»,co-supervisor at 25% with R.P. Binzel and M.A. Barucci. Current position : post-doctorate fellow at MIT-USA
- 2004-2007: Alessandra Migliorini, PhD on « Physical studies of minor bodies of the Solar System . Co-supervisor at 35% with C. Barbieri and M.A Barucci. Current position: permanent position at INAF/IFSI (Rome)

I also supervised 6 Master-2 internship stages (A. Greganin, R. Soave, C. Feller, P. Deshapryia, V. Hoang, J. Bourdelle de Micas), of 4 Master-1 stages (A. Gicquel, J. Claudel et R. Colomba)

### **Scientific dissemination**

- Several Interviews for France 3 television, Radio France and on the Rosetta mission results, on Near Earth Asteroids and OSIRIS-Rex mission.
- Several press release at the European Space Agency, Paris Observatory, CNRS, Paris Diderot University, MPS institute on Transneptunians bodies, Near Earth Asteroids and results from the Rosetta mission on Steins and Lutetia Fly-bys and the comet 67P/CG.
- co-author of the MarcoPolo-R cartoon, the adventure of MarcoPolo-R robot. MarcoPolo-R is a Near-Earth Asteroid sample return mission under study at the European space Agency (see [https://www-n.oca.eu/MarcoPolo-R//Cartoon/MarcoPolo-R\\_Cartoon.html](https://www-n.oca.eu/MarcoPolo-R//Cartoon/MarcoPolo-R_Cartoon.html))
- Several participations to public events and invited conferences on different Solar System bodies organized by French Science Academy, Science festivals, Science and Industry City (La Villette –Paris), Astronomical societies of Bourgogne, Dijon, Nancy, VEGA-Plaisir, Vicenza