# Marco Delbo *February 25, 1972*

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delbo@oca.eu • +33 6 8524 0371 • marcodelbo (*Skype*) • www.oca.eu/delbo
231 BD du Mont Boron • 06300 • Nice • France

## Scientific Interests

Origin and evolution of planetary systems. Study of the physical and dynamical properties of asteroids, comets and planets; observations, modelling, and laboratory experiments on meteorites and space material simulants. Asteroid collisional families. Formation of planets. Space missions: ESA's Gaia (with responsibility of asteroid spectroscopy), NASA's asteroid sample return OSIRIS-REx mission and JAXA's Hayabusa2 and MMX. Spectroscopic, thermal infrared, and inteferometric observations from the ground and from space. Mineralogy and spectroscopy in geophysics. Space mission data analysis and interpretation. Astronomical instrumentation. Telescopes and focal plane instruments. Open source scientific codes. High performance computing. Scientific databases and web tools for the Virtual Observatory.

## Education

Université de Nice Sophia, Observatoire de la Côte d'Azur — Nice, France
**Thèse d'Habilitation à Diriger des Recherches** — *2015*
Thesis title: Studies of the physical nature of asteroids: current trends and perspectives.
(committee. E. Lellouch, B. Marty, S. Raymond, O. Groussin, T. Guillot, P. Michel)

DLR (German Aerospace Center), Free University of Berlin — Berlin, Germany
**PhD degree in Planetary Science** — *2004*
Thesis title: The nature of Near Earth asteroids from the study of thermal infrared emission.
(supervisor A. W. Harris)

Physical, Natural and Mathematical Sciences, University of Genoa — Genoa, Italy
**Master Degree in Physics** — *1997*
Thesis title: Automatic guiding system for the astrometric telescope of the Observatory of Turin.
(supervisor M. Lattanzi)

## Skills

**Technical expertise:** Unix, Windows, Mac OS, C/C++, Python, Fortran, IDL, Assembly, Basic, Arduino.
**Languages:** Italian (*mother tongue*), English (*full professional proficiency*), French (*full professional proficiency*), German (*basic*), Spanish (*basic*), Greek (*very basic*).

## Current Position

Laboratoire Lagrange, CNRS, Observatoire de la Côte d'Azur — Nice, France
**CNRS Directeur de Recherche DR2 (section 17), i.e. Senior Research Scientist** — *Nov '18 – Now*
Permanent Position

## Previous Positions

Laboratoire Lagrange, CNRS, Observatoire de la Côte d'Azur — Nice, France
**CNRS CR1 (section 17), i.e. Research Scientist** — *Nov '12 – Oct '18*
Permanent Position

Laboratoire Cassiopee, CNRS, Observatoire de la Côte d'Azur — Nice, France
**CNRS CR2 (section 17), i.e. Research Scientist** — *Nov '08 – Nov '12*
Permanent Position

Laboratoire Cassiopée, Observatoire de la Côte d'Azur — Nice, France
**Poincare' Postdoctoral Fellowship** — *2008 & 2009*
Position left in 11/08 for the CNRS permanent position

Laboratoire Cassiopée, Observatoire de la Côte d'Azur — Nice, France
**ESA external postdoctoral fellowship** — *2006 & 2007*

INAF, Astronomical Observatory of Torino — Torino, Italy
**Research Engineer** — *2002 – 2008*
Permanent Position (2006 - 2008 detached at Observatoire de la Côte d'Azur)

Deutsches Zentrum fr Luft- und Raumfahrt, DLR — Berlin, Germany
**Ph.D. Student - 1/2 Position of Research Associate** — *2000 & 2001*

INAF, Astronomical Observatory of Torino — Torino, Italy
**Research Engineer and Data Analyst** — *1998 & 1999*

## Awards

Asteroid (16250) was named after **Delbo** by the International Astronomical Union (IAU).
ESA External Fellowship.
Poincaré post-doctoral Fellowship

## International and National Responsibilities

National Coordinator of the Minor Planet Physical Properties Catalogue (Virtual Observatory): 2014 – now
*mp3c.oca.eu* that was approved as national service for the centres of treatment, archiving, and diffusion of data "Services d'Observations SO5" in Dec-2015
Member of the direction board of the research alliance Center for Planetary Origin – C4PO 2016 – now
A training initiative at the doctoral and post-doctoral level from the IDEX – UCA JEDI
Referee for NASA's Research Opportunities in Space and Earth Sciences program. 2014
Referee for the ERC program of the European Union. 2019

**Telescope Time Allocation Committees:**

Member of the board of referees of the TNG and Large Binocular Telescope (LBT) 2018 – now
Member of the Scientific Council of the French Virtual Observatory. 2013 – 2014
Member of the science team of MATISSE, a second generation instrument for ESO VLTI 2012 – now
Member of the Observing Program Committee (OPC) of ESO. 2007 & 2010
Member of the time allocation committee for the Spitzer Space Telescope programs. 2006

**Space Missions:**

Co-I of the MacroOmega (IAS/CNES) near-infrared spectrometer for the sample return space mission Martian Moons Exploration (MMX) 2019 – now
Co-I of the Destiny+ (JAXA) mission to visit the near-Earth asteroid (3200) Phaethon sample return space mission Martian Moons Exploration (MMX) 2019 – now
Co-I of Thermal Infrared Imager (TIR, JAXA) on Hayabusa2 asteroid sample return space mission 2018 – now
Co-I of the OSIRIS-REx (NASA) sample return space mission. 2009 – now
Member of the DPAC Radiation Damage Task Force of ESA Gaia mission. 2008 – now
Responsible for ESA Gaia mission spectrophotometry of asteroids. 2007 – now
Member of the international consortium for the processing and analysis (DPAC) of Gaia data. 2006 – now
Member of the science team of the AIDA asteroid impact and deflection space mission. 2014 – 2017

**Referee for scientific journals and other publications:**

Nature Astronomy • Icarus • Science • Astronomy & Astrophysics • Advances in Space Research • Planetary and Space Science • Astronomical Journal • Astrophysical Journal • Monthly Notices of the Royal Astronomical Society • Journal of Geophysical Research • Space Science Reviews • Asteroids IV (the fourth-edition of the decadal book of asteroid studies).

**Reviewer of PhD Thesis:**

Diane Berard. LESIA Observatoire de Paris Meudon. 2017
*Study of the rings of Chariklo by stellar occultations*

**External Examiner of PhD Thesis:**

Jun Du. Peking University, China and Université Côte d'Azur, Nice, France. 2019
*Estimation of Lava Flow Thicknesses on the Moon and Mercury Based on Modeling the Topographic Degradation of Partially Buried Impact Craters.*
Alexander Garenne. Institute of Astrophysics and Planetology of Grenoble. 2014
*Hydration and Carbonation on asteroids and Mars.*
Anne-Sophie Maurin. Laboratoire d'Astrophysique de Bordeaux. 2012

*Characterisation of rocky exoplanets from their light-curve in the thermal infrared.*
Benoit Carry. University 7 of Paris. 2009
*Study of the physical properties of asteroids with high angular resolution imaging.*

## Funded grant proposals and other projects

**CNES** – Support to the science activity related to the MIRS instrument 2019 – now
Thermal Modeling for the selection of sampling site of JAXA's MMX mission
(**12k/year**) from the French Space Agency (CNES).

**CNES & Obs. C'ôte d'Azur** – PhD thesis 2021 – 2024
Scientific exploitation of Gaia asteroid spectra
(**107 kEu**) Co funding from CNES and Observatoire de la Côte d'Azur).l

**ANR ORIGINS** – Discovering the original planetesimals of our Solar System 2019 – 2023
Post doc (2 years) and PhD (3 years) funding
Four-year grant (**458k**) from the French National Research Agency (ANR)

**NASA** – Sample Return Mission OSIRS-REx). 2019 – 2020
Geological interpretation of OSIRIS-REx thermal infrared measurements. Post-doc funding for two years.
Grant of (**234k USD**) **NASA - OSIRIS-REx**

**IDEX Jedi** – Academies of Excellence of UCA. 2017
Uncovering the nature of celestial bodies with methods of material sciences. Advanced modelling of asteroid surfaces. Collaboration with CEMEF Mines-ParisTech
Grant of (**48 k**) from the IDEX of the Université Cote d'Azur

**EU Horizon 2020** – NEOShield-2: 2015 – 2018
Science and Technology for Near-Earth Object Impact Prevention
Grant of (**80 k**) as CoI

**PNP** – Primitive asteroids and asteroid families. 2015 – 2018
Identification of very old asteroid families ($>$ 2-3 Ga) and search for the asteroids composed by the most primitive material in the Solar System
Grant of (**4.5k,4.5k,7k,5k**) from the National Program of Planetology (PNP)

**ANR SHOCKS** – Shocks in the Solar System: The importance of thermal processes 2011 – 2015
and collisions for the formation of regolith on the surfaces of minor bodies and other small particles.
Four-year grant (**420k**) from the French National Research Agency (ANR)

**CNES** – Support to the science activity related to the OSIRIS-REx 2010 – 2015
Thermal Modeling and Study of the origin of the mission target asteroid
**15k/year**) from the French Space Agency (CNES). Coordinator P. Michel

**PNP** – Formation and evolution of regolith on asteroids by thermal cracking. 2011
An experimental approach.
Grant of (**5k**) from the National Program of Planetology (PNP)

**BQR** – Study of metamorphism of asteroids and meteorites by radiative overheating 2010
from close encounters with the Sun
Four contracts (**20k**) *Bonus Qualité Recherche* (BQR Géoazur, University of Nice and OCA).

**ESA contract** – Explore NEOs: Physical characterisation of 700 Earth-crossing asteroids 2010
using IR thermal observations from Spitzer.
Contract (**15k**) with the European Space Agency for extraction of asteroid sizes and albedos.

**Helmholtz-Gemeinschaft Deutscher Forschungszentren** 2008 – 2013
Planetary Evolution and Life.

**International Space Science Institute (ISSI) Bern** 2008
Light Scattering Phenomena in Small Body Surfaces.

**Competitive time at major observing facilities** 2000 – now
PI and Co-I of more than 68 observational programs
ESO VLT, VLTI, 3.6m, 2.2m; Keck; Spitzer; NASA–IRTF; TNG; Gemini.

## Organisation of Scientific Meetings and others activities (seminars)

SOC of the Section Small Bodies, Asteroids and Near Earth Asteroids, international European Planetary Science Congress (EPSC), Virtual 2021
Leader of the SOC of the Section Small Bodies, Asteroids and Near Earth Asteroids. International EuropeanPlanetary Science Congress (EPSC), Virtual 2020
SOC of the Section Small Bodies, Asteroids and Near Earth Asteroids, international European Planetary Science Congress and Division of Planetary Sciences of the American Astronomical Society (EPSC-DPS), Geneve 2019
$3^{st}$ International Conference on Thermal Models for Planetary Science (TherMoPS) 2019
Workshop on Minor Planet Databases – Nice, France. September 2017
Astrometry and Astrophysics in the Gaia Sky. International Astronomical Union Symposium April 2017
Nice, France.
International Workshop: Primitive material in the Solar System II: The outer Solar System perspective 2016
Villefranche sur Mer, France
$2^{nd}$ International Conference on Thermal Models for Planetary Science (TherMoPS), Tenerife 2015
Convener of the Section Small Bodies, international European Planetary Science Congress, Nantes 2015
International Workshop: Carbonaceous chondrites: their parent bodies and their link with primitive asteroids, Villefranche sur Mer, France 2014
Co-convener of the Section Small Bodies, Asteroids and Near Earth Asteroids, international European Planetary Science Congress and Division of Planetary Sciences of the American Astronomical Society (EPSC-DPS), Nantes 2011
Co-convener of the Section Small Bodies and Planetary Moons – Comets, Asteroids and TNOs, International European Planetary Science Congress (EPSC), Rome 2010
Scientific Seminars of OCA 2009 – 2012
$1^{st}$ International Conference on Thermal Models for Planetary Science (TherMoPS) 2008
Earth-Based Support to Gaia Solar System Science, Beaulieu 2008
Colloquium: Observations of minor bodies in the thermal infrared, Torino 2002

## Membership of Scientific Societies and Consortia

Member of the American Astronomical Society (AAS) and the Division of Planetary Sciences 2006 – now
Member of the International Astronomical Union – IAU 2004 – now

## Advisory and Direction of Research

**Post-doc**

*Chrysa Avdellidou* – (UCA-JEDI) Massive Asteroid Data Bases. 2018-2022
*Andrew Ryan* – (UCA-JEDI/NASA) Thermal modelling of asteroids. 2018-2021
*Josef Hanus* – (ANR/CNES) Thermal modelling of asteroids. 2013-2016
*Victor Ali-Lagoa* – (ANR/NEOSheild2) Thermal cracking of comets. 2014-2016
*Mathieu Niezgoda* – (ANR) Laboratory experiments of the thermal fracture of the meteorites. 2012-2013
*Naomi Murdoch* – (ANR) Analysis of the thermal fracture of meteorites. 2012
*Julie Gayon-Markt* – (CNES) Towards a new mineralogical map of the main asteroid belt. 2010-2012
*Michael Mueller* – (Poincaré) Determination of the size distribution of main belt (up to km-size) and Near Earth asteroids. 2009-2011

**PhD**

*Marjorie Galiner:* Supervisor – Thesis: Scientific exploitation of Gaia asteroid spectra. 2021-2024
*Saverio Cambioni:* Co-supervisor with University of Arizona, Tucson, USA) 2018-2020
Thesis: Constraining the thermal properties of planetary surfaces using machine learning.
*Diego Uribe:* Co-Supervision – Thesis: Modeling Fracture: From metallic alloys to comets. 2018-2021
*Bryce BolinL* Supervisor – Thesis: Identification of asteroid families older than 2 billions of years. 2014-2018
*Chrysa Avdellidou* (Co-supervisor with Kent, UK) – Thesis: Hypervelocity impacts in the Solar System: An experimental investigation on the fate of the impactor. 2014-2016
*Victor Ali-Lagoa* (Co-supervisor with IAC, Spain) – Thesis: Determination of the physical properties of asteroids from the WISE data in the thermal IR. 2009-2010
*Alexis Matter* (Co-supervisor at OCA) – Thesis: Determination of the physical properties of asteroids from interferometric observations in the thermal IR. 2009-2010

**Interships (*stage produced paper or technical note)**

*Salvatore Ferrone* – Efficiency characterisation of asteroid family detection methods 2021
*Robert Melikyan** – Long term dynamical evolution of asteroid families. 2021
*Andrew Marshall-Lee** – Study of asteroid collisional family halos. 2019-2020
*Edhah Munaibari** (Co-Tutor) – Real-time detection of impact flashes on the lunar surface. 2019-2020
*Saverio Cambioni** – Constraining the thermal properties of planetary surfaces using machine learning: 2018-2019
*Chrissy Comfort** – Thermal cracking of asteroid surfaces: preparation for OSIRS-REx. 2014
*Luca Lionni** – Thermophysical properties of near-Earth asteroid (341843) from WISE data. 2013
*Tristan Dequaire** – Test of the algorithm for the classification of asteroid spectra from Gaia. 2013
*Clara Maurel* – Study of the fracturing of meteorite. 2013
*Emilie Marchese** (Co-Tutor) – Software development: Shape model determination of asteroids, 2010
*Kelsey Hargrove* WISE Observations of Primitive Asteroid Families, 2009
*Mathieu Havel** (Co-Tutor) – Yarkovsky Effect on asteroids with Gaia: a feasibility study 2007
*Valeire Seymour* (Tutor of exchange student) – Asteroid Photometry 2001
*Martin Prescher* (Co-Tutor) – Physical properties of small bodies from IRAS data 2001

**Engineers**

*Nicolas Bruot:* New interface for the Minor Planet Physical Properties Catalogue 2020-2021
*Pierre Deram:* Asteroid spectroscopic tool. 2019
*Pascal Bottein:* A new data database for the Minor Planet Physical Properties Catalogue 2016-2017
*Jerome Gerakis:* Development of a database for the Minor Planet Physical Properties Catalogue 2012-2014

## Teaching Activities and Public Engagement

**Postgraduate Schools for Astrophysics**

Winter School for Astronomy – First solids and planetesimals: formation conditions and evolution — Les-Houches, France
**Constraints on initial size distribution of planetesimals** *2020*

International School for optical interferometry — Porquerolles, France
**Infrared interferometry of solar system minor bodies** *2010*

National School of Astronomy for the scientific administration — Porquerolles, France
**Astronomy in Dante's Divine Comedy.** *2009*

International School for Dynamics of Gravitational Systems: challenges and perspectives. — Aussois, France
**Yarkovsky and YORP effects : the link between the dynamics and the physical properties of small bodies** *2009*

International School of Space Chemistry, $6^{th}$ Course/Workshop — Erice-Sicily, Italy
**The Physical Properties of Potential Earth Impactors : Know your Enemy** *2001*

**University**

Cycle of Lectures and mastering for $1^{st}$ and $2^{nd}$ year of Master of astrophysics. — Nice, France
Université Côte d'Azur
**Physics of asteroids, Moon, and hypervelocity collisions** *2018-2020*

Cycle of Lectures, Centre de Recherches Pétrographiques et Géochimiques — Nancy, France
**Space missions to asteroids** *2014-2016*

Cycle of Lectures, Charles University — Prague, Czech Republic
**Asteroid physical properties** *2011*

Cycle of Lectures, University of Nice Sophia Antipolis — Nice, France
**Asteroid dynamic properties** *2010*

Teaching Assistant, University of Nice Sophia Antipolis — Nice, France
**Laboratory of experimental physics (Electromagnetism)** *2007*

**Schools**

Coordinator of teaching programs, University of Genova — Genova, Italy
**Laboratory of Astronomy – Science Exhibition 'Imparagiocando 3' (learn by playing)** *1996 – 1999*

**Laboratory of Astronomy – Astronomy for students and teachers (primary and high schools)** *1996 – 1999*

**Co-author of a didactic guide for teaching Astronomy in the primary and high schools.** *1996 – 1999*

Coordinator of teaching programs, University of California – Berkeley ,
**'How to teach Astronomy in the primary and the high schools' (with Prof. C. Sneider)** *1996*

## Visitor

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|---|---|
| Lunar and Planetary Laboratory, the University of Arizona, Tucson AZ, USA. | 2019 |
| The Discovery Channel Telescope (DCT) and Lowell Observatory, Flagstaff AZ, USA. | 2019 |
| Leiden Observatory, The Netherlands, Visiting Scientist. | 2017 |
| European Space Agency ESTEC, The Netherlands, Visiting Scientist. | 2016-2017 |
| University of Manoa, Hawaii, USA. Visiting Scientist. | 2012 & 2015 & 2017 |
| Infrared Telescope Facility (IRTF), Hawaii, USA. Visiting astronomer. | 2013,2017 |
| SouthWest Research Institute, Boulder (CO), USA. Visiting Scientist. | 2011 – 2013 |
| Astronomical Institute of the Charles University, Prague, CZ. Invited visiting Professor. | 2011 |
| European Southern Observatory, Garching, Allemagne | 2011 |
| Jet Propulsion Laboratory, Pasadena (CA), USA. Visiting Scientist. | 2010 |
| European Southern Observatory, Paranal. Visiting astronomer. | 2006 – 2010 |
| German Aerospace Center (Deutsches Zentrum fur Luft- und Raumfahrt - DLR), Berlin, Germany. | 2002 – 2004 |
| European Southern Observatory, La Silla. Visiting astronomer. | 2001 – 2004 |
| Institute for Radioastronomy, Bologna, Italy | 2001 |
| Keck Observatory, Waimea, Hawaii, USA. Visiting astronomer. | 2000 – 2002 |
| Institute of Astronomy, Hilo, Hawaii, USA. Visiting astronomer. | 2000 – 2001 |

## Major Collaborations

1. *K.T. Ramesh* and *J. Wilkinson*, Thermomechanical modeling and experiments of asteroids and meteorites thermal breakdown, Johns Hopkins University, Baltimore, US.
2. *K. Walsh* and *W. Bottke*, Origins of asteroids and asteroid families, Southwest Research Institute, Boulder, CO, US.
3. *M. C. Price* and *Ch.Avdellidou*, Survival of the impactor during hypervelocity collisions, Centre for Astrophysics and Planetary Science, University of Kent, Canterbury, UK.
4. *D. Hestroffer* and *W.Thuillot*, Asteroid physical properties, IMCCE and LESIA, Paris Observatory, France.
5. *J. Hanus, J.Durech*, Shape modelling of asteroids, Charles University of Prague, Czech Republic.
6. *A. Cellino*, Polarimetry and Spectroscopy of asteroids, INAF Torino Observatory, Italy.
7. *D. Lauretta*, Sample return mission OSIRIS-REx, University of Arizona, AZ, US.
8. *J. Emery* and *B.Rozitis*, Thermal modeling of asteroids, University of Northern Arizona and, US and Open University, UK.
9. *S. Fornasier, A. Barucci*, Spectroscopy of asteroids, Observatoire de Paris Meudon, France.

10. *D. Britt*, Asteroid material simulant, University of Central Florida, Orlando, Florida, US.
11. *T. Okada*, Asteroid thermal infrared imaging from space, JAXA, Tokyo, Japan.