

# Europass Curriculum Vitae

## Personal information

Surname / First name

Telephone

Personal Email

Nationality

Italian

## Work experience

Dates

Oct. 2020 - now

Occupation or position held

Postdoctoral researcher

Main activities and responsibilities

**Numerical simulations and analysis for the gravity experiment of the VERITAS mission:** by simulating the joint analysis of Doppler tracking data and tie points provided by the onboard synthetic aperture radar, we show that VERITAS would provide strong constraints on the interior structure of the planet. In particular we show that VERITAS would provide accuracies in the estimates of the tidal Love number  $k_2$  to  $3.9 \times 10^{-4}$ , its tidal phase lag to  $0.04^\circ$  and the moment of inertia factor to  $1.4 \times 10^{-3}$  (0.4% of the expected value). VERITAS has been definitely approved on June 2<sup>nd</sup>, 2021

Name and address of employer

Department of mechanical and aerospace engineering. University of

Dates

Oct. 2019 - Sept. 2020

Occupation or position held

Postdoctoral researcher

Main activities and responsibilities

**The radio science experiments MORE and 3GM onboard BepiColombo and JUICE missions: analysis by semianalytical models, numerical simulations and geomorphology of Mercury and Ganymede surfaces.** The semianalytical model for the covariance analysis of MORE (see below for details) has been improved in order to deal with several mission at the same time. Regarding 3GM experiment onboard JUICE, I quantified the gravity anomalies generated by different materials (clean or dirty ice) on the Ganymede's surface.

Name and address of employer

Department of mechanical and aerospace engineering. University of

Dates

Sept. 2018 - Oct. 2019

Occupation or position held

postdoctoral researcher

Main activities and responsibilities

**The radio science experiment MORE onboard BepiColombo: analysis by semi-analytical models and numerical simulations.** I investigated the potentialities to test the General Relativity theory of two interplanetary missions to Mercury (Bepi-Colombo and MESSENGER). The semianalytical model I developed for BepiColombo during my postdoc at Pisa (see below) has been optimized and other effects have been included (e.g. massive graviton). Again, uncertainties on ephemerides have been taken into account.

Name and address of employer

Department of mechanical and aerospace engineering. University of

Dates

Oct. 2016 - Sep. 2018

Occupation or position held

Postdoctoral researcher

Main activities and responsibilities	<b>Simulations of the geodesy measurements with the VERITAS mission to Venus.</b> We developed a method to estimate the crustal thickness of a planet and we applied it to Venus. The gravity field anomalies of the planet are assumed to be due to the combined effect of topography and relief on the crust-mantle interface. We calculated a map of the crustal thickness of Venus and compared our results with those predicted by previous work and with the global distribution of main geological features (e.g. rift zones, tesserae, coronae). Moreover, we developed an accurate error budget for the Doppler measurements to be used in simulations for the determination of the gravity field of Venus.
Name and address of employer	Department of mechanical and aerospace engineering. University of
Dates	Sept. 2015 - Aug. 2016
Occupation or position held	Postdoctoral researcher
Main activities and responsibilities	<b>Orbit determination for space probes in the Jupiter and Saturn systems by global updating of planetary ephemerides.</b> The work was focused on the ESA mission JUICE. We developed an hydrostatic model for the interior of Ganymede, satellite of Jupiter which is supposed to have a liquid ocean below the crust, and we performed simulations for the determination of the gravity field and the rotational state of the satellite.
Name and address of employer	Department of mechanical and aerospace engineering. University of
Dates	May 2013 - April 2015
Occupation or position held	Postdoctoral researcher
Main activities and responsibilities	<b>The radioscience experiments of BepiColombo and JUNO missions.</b> The Relativity experiment of BepiColombo will be a modern version of the traditional tests of General Relativity, based upon Mercury's perihelion advance and the relativistic light propagation near the Sun. We define the mathematical methods to be used to extract from the data of the BepiColombo mission the best constraints on the post-Newtonian parameters $\beta$ , $\gamma$ and the Nordtvedt parameter $\eta$ , but also the gravitational oblateness of the Sun $J_{2\odot}$ , the preferred frame parameters $\alpha_1$ , $\alpha_2$ and the rate of change in time ( $\zeta$ ) of the Sun's GM. We have performed a full cycle simulation of the BepiColombo radio science experiments, including this Relativity experiment, with the purpose of assessing in a realistic way the accuracy achievable on each parameter of interest. Moreover, I developed an analytical model to quantify the effects of the uncertainties on the gravitational parameters of planets and asteroids on the results of the Relativity experiment.
Name and address of employer	Department of mathematics. University of
Dates	Oct. 2011 - April 2013
Occupation or position held	Postdoctoral researcher
Main activities and responsibilities	<b>Geodesic motion with a double pendulum (PETER): Lagrangian model and disturbance estimation.</b> In preparation for the flight of LISA-Pathfinder, a torsion pendulum is a useful tool to understand and characterize all possible sources of spurious noise that can affect the free fall of a test mass in geodesic motion. PETER is a double torsion pendulum where force-free motion has to be achieved simultaneously in two different degrees of freedom. I developed, with a Lagrangian approach, a dynamical model that describes the most significative oscillations modes of PETER and its forced motion caused by magnetic damping, tilt noise, seismic disturbances, etc.
Name and address of employer	Department of physics
Dates	April - Sept. 2011
Occupation or position held	Postdoctoral researcher

Main activities and responsibilities	<p><b>Optimization of the LISA (Laser Interferometer Space Antenna) rendez-vous.</b> The purpose was to semi-analytically optimize the orbital parameters of the LISA constellation in order to minimize the perturbations coming from the Earth-LISA interaction. Including non-autonomous perturbations, an estimate of Doppler shift and breathing as a function of the trailing angle have been provided. Both LISA and NGO (New Gravitational wave Observatory) configurations have been analyzed.</p>
Name and address of employer	Department of physics. University of
Dates	March 2009 - March 2011
Occupation or position held	Postdoctoral researcher
Main activities and responsibilities	<p><b>Data analysis for LISA.</b> I developed a MATLAB code to calculate the force and torque on the test mass (LISA Pathfinder mission) as a function of the time, taking into account input voltages and a Poissonian model of charge accumulation.</p>
Name and address of employer	Department of physics. University of
Dates	Oct. 2008 - Feb. 2009
Occupation or position held	Postdoctoral researcher
Main activities and responsibilities	<p><b>Perturbations on the LISA orbits due to the Earth-Moon system.</b> We calculate analytically, with a perturbative approach, the effect of the Earth-Moon system on the free-fall motion of LISA test masses. We obtain that a few harmonics of the Earth-Moon gravitational potential can be detected in the Doppler data collected by the LISA space mission and we conclude that the Earth-Moon system gravitational near field could provide an additional crosscheck to the calibration of LISA.</p>
Name and address of employer	Department of physics. University of
Dates	Feb. - Sept. 2008
Occupation or position held	Fellow
Main activities and responsibilities	<p><b>Preservation of Lascaux cave.</b> Data from high precision thermometers, hygrometers and dew-point sensors placed into the Lascaux cave (France) have been analyzed in order to describe the stability of the microclimatic conditions of the Paleolithic paintings site.</p>
Name and address of employer	nstitute of Atmospheric Sciences and Climate (ISAC) of the Italian National Research Council (CNR)
<b>Education and training</b>	
Dates	March 2013
Title of qualification awarded	<b>MASTER:</b> "Space science and technology" (Scienza e tecnologia spaziale)
Principal subjects/Occupational skills covered	The Master provides a highly qualified preparation on the scientific issues of the space exploration. The master aim at the formation of a successful professional with a poly-hedric preparation on the many aspects and interaction between the research and the business worlds.
Name and type of organization providing education and training	Department of Mathematics. University of
Level in national or international classification	2nd level Master (Italian classification)
Dates	May 23, 2008
Title of qualification awarded	<b>Ph.D. in Astronomy.</b>

Principal subjects

My PhD thesis presents the analysis of a large sample of photometric data relative to the super metal-rich open clusters NGC6791 and NGC6253. The main goal of the surveys was the search for extrasolar planets using the transits method. I contributed to the extrasolar planet search by making numerical simulations in order to estimate the number of expected transiting planets. Moreover, I analyzed the entire sample of light curves in order to find variable stars. I discovered 260 new variable stars in the field of NGC6791 and 597 in the field of NGC6253. The classification of all variables is presented and discussed in this work.

Department of Astronomy, University of .

Name and type of organization providing education and training

Dates

July 22, 2004

Title of qualification awarded

**Master's degree in Astronomy.** Mark: 106/110

Principal subjects

Photometric data for 216 clusters were collected from the literature and 2782 blue stragglers stars (BSS) candidates were extracted from 76 of them. I found that the anticorrelation of BSS frequency vs. total magnitude identified in similar studies conducted on Galactic globular clusters extends to the open cluster regime: clusters with smaller total magnitude tend to have higher BSS frequencies. Moreover, a clear correlation between the BSS frequency and the age of the clusters was found. A simple model is developed here to try to explain this last and new result. The model allows us to ascertain the important effect played by mass loss in the evolution of open clusters.

Department of Astronomy, University of .

Name and type of organization providing education and training

Dates

July 1997

Title of qualification awarded

**High school graduation**

Name and type of organization providing education and training

Scientific High School

Mother tongue

**Italian**

Other language(s)

English, French

*Self-assessment  
European level<sup>(\*)</sup>*

**English**

**French**

Understanding		Speaking				Writing	
Listening		Reading		Spoken interaction		Spoken production	
C1	Proficient user	C2	Proficient user	C1	Proficient user	C1	Proficient user
B2	Independent user	C2	Proficient user	B2	Independent user	B2	Independent user

<sup>(\*)</sup> Common European Framework of Reference (CEF) level

Technical skills and competences

Lagrangian mechanics, celestial mechanics (perturbation theory, orbit determination). Data analysis: nonlinear least squares, signal extraction from time series data, frequency-domain analysis. Analysis of astronomical (photometric) data.

Computer skills and competences

Very good knowledge of computer programming languages Fortran 77/90 usage. Good knowledge of MATLAB usage. Excellent knowledge of *Mathematica* software usage.

Driving licence(s)

Category B. Motor vehicles.

**Teaching experiences**

Dates

Feb. 2010 - Jul. 2010

Position held

Graduate teaching assistant

Course

General Physics 1 at the Faculty of Engineering (Laurea Triennale Civile e Ambientale) of

Dates Oct. 2008 - Jan. 2009  
Position held Teaching fellow  
Course Calculus (Analisi Matematica 1) at the Faculty of Agriculture Sciences

Dates Mar. - Jun. 2007  
Position held Graduate teaching assistant  
Course: General Physics 1 at the Faculty of Agriculture Sciences

## Additional information

H-Index 13  
citations 501  
co-authors 218

### Meetings and conferences

**Second European Physical Society Conference on Gravitation: measuring gravity** - online conference. July 5-7, 2021. As author: *Testing General Relativity in the Solar System: present and future perspectives*

**Public conference. Department of Physics Univ. Tor Vergata** - Roma, Italy. June 4, 2020. As relator: *BepiColombo: science and technology for the exploration of Mercury*

**Online interview. TV3 Baiano** - Roma, Italy. May 11, 2020. As relator: *Bep-it! - Un team tutto italiano alla scoperta di Mercurio*

**Public conference. Associazione Tuscolana Astronomia** - Roma, Italy. March 31, 2020. As relator: *BepiColombo: alla scoperta di Mercurio*

**XVI Congresso Nazionale di Scienze Planetarie** - Padova, Italy, 3-7 Feb. 2020. As author of the talk: *Observability of Ganymede's gravity anomalies related to surface features by the 3GM experiment onboard ESA's JUICE mission.*

**Public conference. Gruppo Astronomico Tradatese** - Tradate (VA), Italy. May 20, 2019. As relator: *BepiColombo: alla scoperta degli ultimi misteri di Mercurio*

**XV Congresso Nazionale di Scienze Planetarie** - Firenze, Italy, 4-8 Feb. 2019. As author of the poster: *Investigation of superficial features of the Galilean moons by the 3GM experiment onboard ESA's JUICE mission.*

**5<sup>th</sup> IEEE International workshop on Metrology in Aerospace** - Roma, Italy. June 20-22, 2018. As relator (and author): *Covariance analysis applied to the MESSENGER and BepiColombo Relativity experiments.* Winner of the Best paper on Relativistic Metrology session award.

**Public conference. I cieli di Brera** - Milano, Italy. June 13, 2018. As relator: *Bepi-Colombo, scienza e tecnologia alla scoperta di Mercurio*

**2017 AGU Fall Meeting** - New Orleans, USA, 11-15 December 2017.  
As author of the poster: *An approach to the crustal thickness inversion problem.*

**PSG Cassini Meeting** - Pasadena, USA, 11-15 September 2017.

**BepiColombo 14th Science Working Team Meeting** - Tokyo, Japan, 7-10 November 2016. As relator (and author): *Discussion on the cruise tests of GR.*

**V Italian-Pakistani workshop on Relativistic Astrophysics** - Lecce, Italy, 22-23 July 2016. As relator (and author): *Space tests of the strong equivalence principle: BepiColombo Radioscience experiment and the Earth-Sun Lagrangian points opportunity.*

**XII Congresso Nazionale di Scienze Planetarie** - Bormio (SO) Italy, 2 - 6 February 2-6, 2015. As co-author: *The Radioscience Experiment with BepiColombo mission to Mercury.*

**Complex Planetary Systems - IAU Symposium** - University of Namur, Belgium. July 7-11, 2014. As relator (and author): *Testing the Strong Equivalence Principle with BepiColombo mission.*

**JUNO Science Team Meeting** - Boulder (CO), USA, 24-28 March 2014.

**CELMEC VI** - The Sixth International Meeting on Celestial Mechanics. San Martino al Cimino, Viterbo (Italy). September 1-7, 2013.

**First AstroNet-II Training School:** "Astrodynamics of natural and artificial satellites: from regular to chaotic motions". January, 14-17 2013, University of Roma "Tor Vergata".

**9<sup>th</sup> LISA Symposium.** May 21-25, 2012, BnF-Paris. As relator (and author): *Analytic model for the Rototranslational Torsion Pendulum* (Parallel session - Other experiments).

**38<sup>th</sup> COSPAR Scientific Assembly.** 18-25 July 2010, in Bremen, Germany. As author: *Data analysis for LISA and LISA-Pathfinder.* Symposium H, session 3, paper number H03-0021-10 (Oral). As co-author:

1. *Femto-Newton level testing of free-fall on-ground.* Symposium H, session 3, paper number H03-0012-10 (Oral)
2. *Testing of the LISA pathfinder GRS.* Symposium H, session 3, paper number H03-0010-10 (Oral)

**CELMEC V** - The Fifth International Meeting on Celestial Mechanics. San Martino al Cimino, Viterbo (Italy). September 6-12, 2009. As author: *Estimate of the gravitational effects of the Earth-Moon system on the breathing of the LISA constellation.*

**Scuola Nazionale di Astrofisica:** "Oggetti compatti e Pulsar - Scienza con ALMA". Cagliari, May 20-26, 2007.

**Scuola Nazionale di Astrofisica:** "Ammassi di galassie - Plasmii astrofisici". Trieste October 1-6, 2006.

**Summer School:** "Physics of the Interstellar Medium". International Max Planck Research School for Astronomy and Cosmic Physics at the University of Heidelberg. September 25-29, 2006

**Scuola Nazionale di Astrofisica:** "Dinamica delle galassie - Nuclei galattici attivi". Bertinoro (Italy). May 7-12, 2006

October 29<sup>th</sup>, 2021