

Emilio Bellini | Curriculum Vitæ

Center for Astrophysics and Cosmology, University of Nova Gorica

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Research Profile

Cosmologist working at the interface of **theoretical cosmology, large-scale structure and tests of gravity**, with a particular focus on modified gravity and dark energy. I developed the widely used **Bellini–Sawicki α -parametrization of Horndeski gravity** and I am the main developer of **hi_class**, a public Einstein–Boltzmann solver for non-standard gravity models. My research also covers **nonlinear structure formation, neutrino cosmology, gravitational waves and cosmological data analysis**, with an emphasis on connecting fundamental theory to cosmological observables. I have authored **40+ scientific publications**, with **5000+ citations** and an **h-index of 28**, and I am member of the **Euclid, LISA and Vera C. Rubin Observatory collaborations**. I am **Principal Investigator of the ESA PRODEX project HOPE** (2026–2028; €198,296), which develops precision one-loop galaxy-bispectrum modelling for Euclid DR2, and my research has also been supported by competitive European fellowships including **Marie Skłodowska–Curie SMASH and Fellini**. I have extensive **teaching and supervision experience across undergraduate, Master’s and PhD programmes**, including PhD-level courses in cosmology and dark energy at the University of Nova Gorica and SISSA, Master’s and undergraduate teaching at Oxford and Geneva, and the supervision and mentoring of graduate students and early-career researchers.

Academic Positions

Associate Professor <i>University of Nova Gorica</i>	Nova Gorica, Slovenia <i>Oct. 2026–present</i>
Marie Curie SMASH Fellow <i>University of Nova Gorica</i>	Nova Gorica, Slovenia <i>2024–Sept. 2026</i>
Marie Curie Fellini Fellow <i>Istituto Nazionale di Fisica Nucleare (INFN)</i>	Trieste, Italy <i>2022–2023</i>
Postdoctoral Researcher <i>Department of Physics, University of Genève</i>	Genève, Switzerland <i>2020–2021</i>
Beecroft Fellow <i>Department of Physics, BIPAC, University of Oxford</i> Supervisor: Prof. Pedro Gil Ferreira	Oxford, UK <i>2016–2020</i>
Postdoctoral Researcher <i>Institute of Cosmos Sciences, University of Barcelona</i> Supervisor: Prof. Licia Verde	Barcelona, Spain <i>2014–2016</i>
Visiting Postdoctoral Researcher <i>Institute for Theoretical Physics, University of Heidelberg</i>	Heidelberg, Germany <i>2013–2014</i>

Supervisor: Prof. Luca Amendola.

Position funded by the Fondazione Ing. Aldo Gini and Fondazione Angelo Della Riccia.

Research Funding and Fellowships

Awarded: SNSF–ARIS Weave grant – Relativistic simulations of screening mechanisms for modified gravity. Joint project with Martin Kunz; **Principal Investigator of the Slovenian node**, University of Nova Gorica. Planned start: **January 2027**.

2026–2028: ESA PRODEX – HOPE (Higher-Order Probes for Euclid: Precision higher-order galaxy-clustering modelling for Euclid DR2). **Principal Investigator and project coordinator**, University of Nova Gorica. Total award: **€198,296.12**. Project term: 1 October 2026–30 September 2028.

2024: Marie Curie SMASH Fellowship, University of Nova Gorica. €60k/year for subsistence and €10k/year for research.

2021: Marie Curie Fellini Fellowship, INFN Trieste. €45k/year for subsistence and €12k/year for research.

2017: Extraordinary Research Fellowship, Queen's College, University of Oxford. £3k/year for subsistence and £2k/year for research.

2016: Beecroft Fellowship, Department of Physics, University of Oxford. £35k/year.

2014: Fondazione Angelo Della Riccia Fellowship, Institute for Theoretical Physics, University of Heidelberg. €14k.

2013: Fondazione Ing. Aldo Gini Fellowship, Institute for Theoretical Physics, University of Heidelberg. €7k.

Academic Qualifications and Accreditations

2026: Habilitation as Associate Professor in Physics, University of Nova Gorica, Slovenia

Abilitazione Scientifica Nazionale, S.C. 02/C1 – Astronomy, Astrophysics, Physics of the Earth and Planets; Italian qualification for Associate Professor in Astrophysics, valid until 2034.

Abilitazione Scientifica Nazionale, S.C. 02/A2 – Theoretical Physics of Fundamental Interactions; Italian qualification for Associate Professor in Theoretical Physics, valid until 2030.

Professor Agregat accreditation, AQU Catalunya; accreditation for associate-professor-level appointments.

Professorat Lector accreditation, AQU Catalunya; accreditation for lecturer-level appointments.

Research Software and Computational Expertise

hi_class: Main developer. Public modification of CLASS for non-standard gravity scenarios, including Horndeski models.

Cosmology tools: Detailed knowledge of CLASS, MontePython, CosmoSIS, CCL and GetDist for theoretical predictions and cosmological inference.

Symbolic tools: Advanced user of Mathematica and xAct for symbolic and tensor calculations.

Programming: Experienced user of Python (NumPy, SciPy, Astropy, Matplotlib), C and C++.

Teaching and Supervision

Supervision and Mentoring.....

2015–present: Continuous mentoring activity involving more than six PhD students.

2017–2021: PhD co-supervision/mentoring: Dina Traykova, *Testing Gravitational Physics on Large and Small Scales*, University of Oxford.

2017: Master supervision/mentoring: Alessandro Casalino, *Cosmological perturbations in Horndeski gravity: a case study*, University of Oxford.

Teaching.....

2026: Co-lecturer, *Cosmology*, PhD course, University of Nova Gorica.

2025: Lecturer, *Dark Energy*, PhD course, SISSA.

2020–2021: Tutor, *Laboratoire IV Théorique*, Master's course, University of Genève.

2018–2020: Co-lecturer, *Cosmology*, Master's course, University of Oxford.

2017–2020: Tutor, *Cosmology*, Master's course, University of Oxford.

2017–2020: Tutor, *General Relativity and Cosmology*, Bachelor's course, Queen's College, Oxford.

2016: Instructor, *Manipulation of tensors with xAct*, University of Barcelona.

2023: Member of a PhD evaluation panel, University of Trieste.

Scientific Leadership and Service

Research Project Leadership.....

2026–2028: **Principal Investigator and project coordinator, ESA PRODEX HOPE**, University of Nova Gorica. Leadership and coordination of a five-work-package programme to implement, validate and optimise one-loop redshift-space galaxy-bispectrum modelling in CosmoSIS-gClust for Euclid DR2, including coordination with Euclid collaborators and the HPC partner Arctur.

Organization of Scientific Meetings.....

2026: Organizer, *2nd SMASHING Workshop*, University of Nova Gorica (70 participants).

2024: Organizer, *Testing Gravity with the Large-Scale Structure of the Universe*, focus week, Institute for Fundamental Physics of the Universe, Trieste (25 participants).

2023: Local Organizing Committee, *New Physics from Galaxy Clustering II*, IFPU, Trieste (50+ participants).

2019: Local Organizing Committee, Euclid Theory Working Group Meeting, University of Oxford (50+ participants).

2017: Organizer, *EFTCAMB/hi_ class meeting*, University of Oxford (20+ participants).

2016: Organizer / Local Organizing Committee for scientific meetings at the University of Barcelona, including *Meeting on Fundamental Cosmology* and *Manipulation of tensors with xAct*.

Institutional Responsibilities.....

2024–present: Organizer, SMASH seminars, University of Nova Gorica.

2017–2019: Organizer, Cosmology Seminars, University of Oxford.

2017–2021: Graduate Student Advisor, University of Oxford.

Peer Review.....
Journal referee for **Physical Review D**, **Journal of Cosmology and Astroparticle Physics**, **Journal of High Energy Physics**, **Physics of the Dark Universe**, **European Physical Journal C**, **General Relativity and Gravitation**, **Monthly Notices of the Royal Astronomical Society** and **Physical Review Letters**. Referee for **REPRISE**, the Italian Register of Scientific Experts.

Scientific Collaborations

2024–present: Member, Vera C. Rubin Observatory.
2019–present: Member, LISA Mission, Cosmology Working Group.
2016–present: Member, Euclid Consortium, Theory Working Group.

Selected Invited Talks and Seminars

Approximately 40 conference and seminar talks are listed in the extended CV; a selection of them includes:

2025: 14th Slovenian Physics Conference, Ljubljana – *When DESI meets Dark Energy.*
2025: Universum VI, Padova – *Detecting the mass of neutrinos with Large-Scale Structure data.*
2025: Trieste Observatory – *Detecting neutrino masses with Large-Scale Structure surveys.*
2024: CEICO, University of Prague – *Probing Gravity with Line Intensity Mapping.*
2024: University of Bologna – *Massive neutrinos modelling and testing in simulations.*
2023: University of Padova – *Probing Gravity with Line Intensity Mapping.*
2022: LAPTh, Annecy – *The h_i class way for testing gravity.*
2022: Workshop on Tensions in Cosmology, Corfu – *Towards consistent constraints on alternative theories of gravity.*
2021: Institute of Cosmology and Gravitation, Portsmouth – *Shear shear: weak lensing with one mode.*
2019: ICTP, Trieste – *Maximal freedom at minimum cost: on the future of general scalar-tensor theories in cosmology.*
2019: Lorentz Institute, Leiden – *Shear shear: weak lensing with one mode.*
2017: DARKMOD workshop, Paris – *Towards a unified description of theories with a single scalar degree of freedom.*

Education

Ph.D. in Physics <i>Department of Physics and Astronomy, University of Padova</i> Supervisors: Prof. Sabino Matarrese and Prof. Nicola Bartolo. Thesis: <i>On the growth of structures in Galileon cosmologies.</i>	Padova, Italy 2010–2013
Master's Degree in Physics – Theoretical and Computational Physics <i>Department of Physics, University of Trento</i> Supervisor: Prof. Sergio Zerbini.	Trento, Italy 2006–2009
Bachelor's Degree in Physics <i>Department of Physics, University of Trento</i>	Trento, Italy 2003–2006

Supervisor: Prof. Sergio Zerbini.

Outreach

2026: Seminar, Associazione Naturalisti Veronesi, Museo di Storia Naturale, Verona.

2024–2025: Speaker, Sauro Sapiens day, Scuola Primaria Sauro, Trieste.

2023: Interview, *Ad Astra* podcast, SISSA Medialab & Le Scienze.

2019: *Testing gravity at cosmological scales*, Queen's College Symposium, Oxford.

2013: *Introduction to Astrophysics*, Scuola Secondaria Cappelletti-Turco, Verona.

Languages

English: Proficient

Italian: Mother tongue

Spanish: Proficient

French: Basic

Selected Publications

2014: **E. Bellini and I. Sawicki**, *Maximal freedom at minimum cost: linear large-scale structure in general modifications of gravity*, JCAP 07 (2014) 050. Introduced the widely used α -parameter description of linear Horndeski cosmology.

2017: **M. Zumalacárregui, E. Bellini, I. Sawicki, J. Lesgourgues and P. G. Ferreira**, *hi_class: Horndeski in the Cosmic Linear Anisotropy Solving System*, JCAP 08 (2017) 019. Public Einstein–Boltzmann implementation of Horndeski gravity.

2017: **T. Baker, E. Bellini, P. G. Ferreira, M. Lagos, J. Noller and I. Sawicki**, *Strong constraints on cosmological gravity from GW170817 and GRB 170817A*, Phys. Rev. Lett. 119 (2017) 251301. A highly cited multimessenger constraint on scalar–tensor gravity.

2020: **E. Bellini, I. Sawicki and M. Zumalacárregui**, *hi_class: Background Evolution, Initial Conditions and Approximation Schemes*, JCAP 02 (2020) 008. Extended hi_class to covariant models, robust initial conditions and fast approximation schemes.

2025: **M. Berti, E. Bellini, C. Bonvin, M. Kunz, M. Viel and M. Zumalacárregui**, *Reconstructing the dark energy density in light of DESI BAO observations*, Phys. Rev. D 112 (2025) 023518. Model-independent reconstruction of dark-energy evolution using DESI-era data.

2026: **A. Nouri-Zonoz, F. Hassani, E. Bellini and M. Kunz**, *KGB-evolution: a relativistic N-body code for kinetic gravity braiding models*, JCAP 08 (2026) 011. Recent work extending relativistic structure-formation simulations to kinetic gravity braiding.