Enrico Garaldi

Curriculum Vitae

Personal information

Date of birth	25 October 1990
Citizenship	Italian
Email	egaraldi@ipmu.jp
ORCID identifier	0000-0002-6021-7020
Personal website	https://egaraldi.github.io
Languages	Italian (native), English (fluent), Spanish (fluent), German (intermediate), Japanese (beginner)
Mail address	5-1-5 Kashiwanoha, Kashiwa, Chiba, 277-8583, Japan

Scientific interests

Structure formation, first galaxies, cosmic reionization, IGM properties, numerical simulations and methods, radiation transport

Short professional bio

I am a **numerical astrophysicist with 10 years of active research experience** in 6 institutions across 3 continents. I am currently a Project Assistant Professor at the Kavli Institute for the Physics and Mathematics of the Universe (Tokyo, Japan). I have **expertise in various fields connected to galaxy formation and cosmology**, including the properties of galaxies in the first billion years of cosmic history, cosmic reionization, magnetogenesis, galaxy formation, beyond-ΛCDM cosmologies and numerical methods. My achievements have been **recognized by the three summa cum laude (BSc., MSc. and PhD), prestigious fellowships, awards, computational and observational time in world-leading facilities**. I regularly **supervise** and co-supervise students, **teach** in Bachelor-, Master- and PhD-level courses, present my work in international conferences and colloquia as **invited and review speaker**, **contribute to scientific outreach**, and to the academic life.

Research experience and education

2025 – **Project Assistant Professor**,
Kavli Institute for the Physics and Mathematics of the Universe, *Tokyo, Japan*

2024 – 2025 **Post-doctoral Research Fellow in Astrophysics**,
Institute for Fundamental Physics of the Universe, *Trieste, Italy*, *Independent position*

2022 – 2024 **Canon Fellow (visiting scientist)**,
University of Osaka, *Japan*,
Host: Prof. Ken Nagamine

2018 – 2024 **Post-doctoral Research Fellow in Astrophysics**,
Max-Planck-Institut für Astrophysik, *Garching bei München, Germany*, *Independent position*, advisor: Prof. Volker Springel

2018
2018

Visiting scientist,
University of California Santa Cruz, *U.S.A.*,
Host: Prof. Piero Madau

2015
2019

PhD in Astrophysics,
Argelander Institut für Astronomie, *Bonn, Germany*,
Supervisor: Prof. Cristiano Porciani

Thesis title: From galaxies to the cosmic web and back: the interplay of different scales in galaxy formation and cosmic web
Date of defense: 11 October 2019
Evaluation: Summa cum laude

2012
2014

Master's degree in Physics,
University of Bologna, *Italy*,
Supervisors: Prof. Lauro Moscardini and Dr. Marco Baldi

Thesis title: Numerical simulations of halo segregations in cosmological models with multiple species of interacting dark matter
Date of defense: 24 October 2014
Evaluation: Summa cum laude

2009
2012

Bachelor degree in Physics,
University of Modena and Reggio Emilia, *Italy*,
Supervisors: Prof. Anna Franchini and Prof. Giorgio Santoro

Thesis title: The role of long-ranged dispersive interactions in the structure of dimers and solids. A comparison between different functionals that include the van der Waals interactions
Date of defense: 26 October 2012
Evaluation: Summa cum laude

Awards, Grants and Fellowships

2021–2025	78 million CPU-hours on the SuperMUC-NG machine (LRZ, Germany), as co-I
2024	Research Fellowship at the Institute for Fundamental Physics of the Universe
2023	147 hours of observing time on MUSE (Large program), as co-I
2021	Canon Fellowship ($\sim$ 8500 EUR, delayed to 2022 because of restrictions due to COVID-19)
2021	Kavli Institute for Astronomy and Astrophysics Fellowship in Beijing (declined)
2021	Research Fellowship at the Max-Planck-Institute für Astrophysik
2019–2021	51 million CPU-hours on the SuperMUC-NG machine (LRZ, Germany), as PI
2019	Summa cum Laude (Ph.D.), University of Bonn
2018	Research Fellowship at the Max-Planck-Institute für Astrophysik
2018, 2019	'Arte o Scienza?' (Art or Science?) exhibition (selected for public display)
2018	John Hunter Excellence in Plotting Contest 2018 (2nd place)
2017	Research exchange grant (5000 EUR) for selected PhD students
2015–2018	International Max Planck Research School (IMPRS) of Bonn and Cologne membership
2014	Summa cum Laude (Master's degree), University of Bologna
2012	Summa cum Laude (Bachelor's degree), University of Modena and Reggio Emilia
2010–2012	Top-5% student ($\sim$2100 EUR, obtained every year), at the University of Modena

Supervision

Supervisor or co-supervisor
Supervisee: Riccardo Zangarelli (PhD, Bologna University, 2025 –)
Chi Zhang (PhD, Purple Mountain Observatory, 2024–2025)
Alejandro Silva (Intern, YachayTech University, 2025)
Takafumi Hashimoto (MSc. student, University of Tokyo, 2025 –)
Jaime Raynaud Sanchez (MSc. student, KTH Royal Institute of Technology, 2025)
Riccardo Zangarelli (MSc. student, Bologna University, 2022 – 2023)
Marie Boussard (Intern, Max Planck Institute for Astrophysics, 2023)
Verena Bellscheidt (Intern, Max Planck Institute for Astrophysics, 2022)
Anshuman Acharya (PhD, Max Planck Institute for Astrophysics, 2022 – 2024)
Arghyadeep Basu (PhD, Max Planck Institute for Astrophysics, 2021 – 2024)
Benedetta Spina (PhD, University of Bonn, 2021 – 2023)
Aniket Bhagwat (PhD, Max Planck Institute for Astrophysics, 2021 – 20244)
Silvia Fiaschi (PhD, Max Planck Institute for Astrophysics, 2019 – 2021)
Akshit Katiyar (Intern, Max Planck Institute for Astrophysics, 2019)

Teaching

2025 **Lecturer (course)**
University of Tokyo, Japan
Course: Introduction to advanced topics in Astrophysics ('Rironensyu')

2025 **Lecturer**
EPIC V Programming School, Ecuador
Title lecture 1: Methods for numerically solving differential equations
Title lecture 2: Analysis of cosmological simulations

2024 **Lecturer (individual lecture)**
Osaka University, Japan
Title: AREPO tutorial

2022, 2023 **Lecturer (course)**
North-West University, South Africa (virtual)
Course: Computational Astrophysics

2018 **Lecturer (individual lecture)**
University of Bonn, Germany
Title: Cosmic Reionization – observations and theory

2015–2018 **Teaching assistant**
University of Bonn, Germany
Courses: Astrophysics of galaxies (1 semester)
Theoretical Astrophysics (2 semesters)
Observational Cosmology (2 semesters)

2010–2014 **Private instructor** for high-school students
Modena, Italy
Subjects: mathematics, physics
Weekly individual lectures for a total of approximately 30 students.

Service

2023–present **Referee for funding bodies and computing centers**:
CINECA (computing time allocation)
Swiss National Science Foundation
UK Research and Innovation (Rutherford Fellowship, Large Award)
DiRAC Resource Allocation Committee
Leibniz supercomputing center (Medium project)

2019–present **Referee for peer-reviewed academics journals**:
Open Journal of Astrophysics (since 2025)
Physical Review Letters (since 2025)
The Astrophysical Journal (since 2019)
Monthly Notices of the Royal Astronomical Society (since 2020)
Journal of Open Source Software (since 2023)
Science (since 2024)

2022–present **Organizer** of international conferences
May 2025 *The galaxy-IGM connection during the first billion years* Institute for Fundamenta Physics of the Universe (Trieste, Italy).
May 2022 *Dust and metals during cosmic reionization*, part of the SAZERAC-SIP series, online.
May 2023 *Visualizing simulations of turbulence and beyond*, Garching bei München, Germany.

2025– **Member** of the IPMU HPC committee

2025– **Organizer** of the weekly IPMU Numerics Meeting

2024–2025 **Organizer** of the weekly IFPU Colloquium

2021–2023 **Founder** of a task force to attract master's students at the Max-Planck-Institut für Astrophysik

2021 **Member** of a committee evaluating the effectiveness of the bias-reduction and inclusiveness training performed

2019–2021 **Organizer and chair** of a weekly Galaxy Journal Club

2015–2017 **Student representative** for SFB956 (deputy)

2015–2018 **Member** of the Argelander-Institut für Astronomie Social Committee

Publications

Summary I have **published 45 academic papers**, including **12 as first author** and one as shared corresponding author, 5 proceedings and 1 book chapter. In total, I have published papers with **44 different co-authors in 5 different sub-fields** (cosmic reionization, galaxy formation, magnetogenesis, alternative gravity theories, numerical methods). My papers have been **cited 1505 times** (as of Oct 17th 2025 according to the ADS database)**, resulting in an h-index of 23.**

Academic papers

(1) A. Basu, B. Ciardi, J. S. Bolton, M. Viel, and **E. Garaldi**
Influence of the Spectral Energy Distribution of Reionization-Era Sources on the Lyman-α Forest
arXiv e-prints arXiv:2509.15179 (2025)
DOI: 10.48550/arXiv.2509.15179

(2) **E. Garaldi**, V. Bellscheidt, A. Smith, and R. Kannan
The galaxy-IGM connection in THESAN: the physics connecting the IGM Lyman-α opacity and galaxy density in the reionization epoch
The Open Journal of Astrophysics 8, 116 (2025)
DOI: 10.33232/001c.143245

(3) N. Jamieson, A. Smith, M. Neyer, R. Kannan, **E. Garaldi**, M. Vogelsberger, L. Hernquist, O. Zier, X. Shen, and K. Kakiichi
The THESAN project: tracking the expansion and merger histories of ionized bubbles during the Epoch of Reionization
Monthly Notices of the Royal Astronomical Society 541, 1088 (2025)
DOI: 10.1093/mnras/staf996

(4) P. Ralegankar, **E. Garaldi**, and M. Viel
Matter power spectrum induced by primordial magnetic fields: from the linear to the non-linear regime
Journal of Cosmology and Astroparticle Physics 2025, 011 (2025)
DOI: 10.1088/1475-7516/2025/08/011

(5) Y. Zhao, A. Smith, R. Kannan, **E. Garaldi**, H. Li, M. Vogelsberger, A. Benson, and L. Hernquist
The THESAN project: environmental drivers of Local Group reionization
arXiv e-prints arXiv:2507.16245 (2025)
DOI: 10.48550/arXiv.2507.16245

(6) T.-E. Bulichi, O. Zier, A. Smith, M. Vogelsberger, A.-C. Eilers, R. Kannan, X. Shen, E. Puchwein, **E. Garaldi**, and J. Borrow
High-redshift AGN population in radiation-hydrodynamics simulations
arXiv e-prints arXiv:2507.11605 (2025)
DOI: 10.48550/arXiv.2507.11605

(7) W. McClymont, S. Tacchella, A. Smith, R. Kannan, **E. Garaldi**, E. Puchwein, Y. Isobe, X. Ji, X. Shen, Z. Wang, V. Belokurov, J. Borrow, F. D'Eugenio, L. Keating, R. Maiolino, S. Monty, M. Vogelsberger, and O. Zier
The THESAN-ZOOM project: Mystery N/O more – uncovering the origin of peculiar chemical abundances and a not-so-fundamental metallicity relation at 3¡z¡12
arXiv e-prints arXiv:2507.08787 (2025)
DOI: 10.48550/arXiv.2507.08787

(8) W. McClymont, S. Tacchella, X. Ji, R. Kannan, R. Maiolino, C. Simmonds, A. Smith, E. Puchwein, **E. Garaldi**, M. Vogelsberger, F. D'Eugenio, L. Keating, X. Shen, B. Trefoloni, and O. Zier
Overmassive black holes in the early Universe can be explained by gas-rich, dark matter-dominated galaxies
arXiv e-prints arXiv:2506.13852 (2025)
DOI: 10.48550/arXiv.2506.13852

(9) Z. Wang, X. Shen, M. Vogelsberger, H. Li, R. Kannan, E. Puchwein, A. Smith, J. Borrow, **E. Garaldi**, L. Keating, O. Zier, W. McClymont, S. Tacchella, Y. Ni, and L. Hernquist
The THESAN-ZOOM project: Star formation efficiency from giant molecular clouds to galactic scale in high-redshift starbursts
arXiv e-prints arXiv:2505.05554 (2025)
DOI: 10.48550/arXiv.2505.05554

(10) K. Kakiichi, X. Jin, F. Wang, R. A. Meyer, **E. Garaldi**, S. E. I. Bosman, F. B. Davies, X. Fan, M. Trebitsch, J. Yang, E. Bañados, J. B. Champagne, A.-C. Eilers, J. F. Hennawi, F. Sun, Y. Wu, S. Zou, R. Kannan, A. Smith, G. D. Becker, V. D'Odorico, T. Connor, W. Liu, K. Protušová, F. Walter, and H. Zhang
JWST ASPIRE: How Did Galaxies Complete Reionization? Evidence for Excess IGM Transmission around [O III] Emitters during Reionization
arXiv e-prints arXiv:2503.07074 (2025)
DOI: 10.48550/arXiv.2503.07074

(11) W. McClymont, S. Tacchella, A. Smith, R. Kannan, E. Puchwein, J. Borrow, **E. Garaldi**, L. Keating, M. Vogelsberger, O. Zier, X. Shen, and F. Popovic
The THESAN-ZOOM project: central starbursts and inside-out quenching govern galaxy sizes in the early Universe
arXiv e-prints arXiv:2503.04894 (2025)
DOI: 10.48550/arXiv.2503.04894

(12) O. Zier, R. Kannan, A. Smith, E. Puchwein, M. Vogelsberger, J. Borrow, **E. Garaldi**, L. Keating, W. McClymont, X. Shen, and L. Hernquist
The THESAN-ZOOM project: Population III star formation continues until the end of reionization
arXiv e-prints
arXiv:2503.03806 (2025)
DOI: 10.48550/arXiv.2503.03806

(13) O. Zier, R. Kannan, A. Smith, E. Puchwein, M. Vogelsberger, J. Borrow, **E. Garaldi**, L. Keating, W. McClymont, X. Shen, and L. Hernquist
The THESAN-ZOOM project: Long-term imprints of external reionization on galaxy evolution
arXiv e-prints arXiv:2503.02927 (2025)
DOI: 10.48550/arXiv.2503.02927

(14) X. Shen, R. Kannan, E. Puchwein, A. Smith, M. Vogelsberger, J. Borrow, **E. Garaldi**, L. Keating, O. Zier, W. McClymont, S. Tacchella, Z. Wang, and L. Hernquist
The THESAN-ZOOM project: Star-formation efficiencies in high-redshift galaxies
arXiv e-prints
arXiv:2503.01949 (2025)
DOI: 10.48550/arXiv.2503.01949

(15) W. McClymont, S. Tacchella, A. Smith, R. Kannan, E. Puchwein, J. Borrow, **E. Garaldi**, L. Keating, M. Vogelsberger, O. Zier, X. Shen, F. Popovic, and C. Simmonds
The THESAN-ZOOM project: Burst, quench, repeat – unveiling the evolution of high-redshift galaxies along the star-forming main sequence
arXiv e-prints arXiv:2503.00106 (2025)
DOI: 10.48550/arXiv.2503.00106

(16) R. Kannan, E. Puchwein, A. Smith, J. Borrow, **E. Garaldi**, L. Keating, M. Vogelsberger, O. Zier, W. McClymont, X. Shen, F. Popovic, S. Tacchella, L. Hernquist, and V. Springel
Introducing the THESAN-ZOOM project: radiation-hydrodynamic simulations of high-redshift galaxies with a multi-phase interstellar medium
arXiv e-prints arXiv:2502.20437 (2025)
DOI: 10.48550/arXiv.2502.20437

(17) **E. Garaldi** and V. Bellscheidt
The galaxy-IGM connection in THESAN: observability and information content of the galaxy-Lyman-α cross-correlation at $z \geq 6$
arXiv e-prints arXiv:2410.02850 (2024)
DOI: 10.48550/arXiv.2410.02850

(18) X. Shen, M. Vogelsberger, J. Borrow, Y. Hu, E. Erickson, R. Kannan, A. Smith, **E. Garaldi**, L. Hernquist, T. Morishita, S. Tacchella, O. Zier, G. Sun, A.-C. Eilers, and H. Wang
The THESAN project: galaxy sizes during the epoch of reionization
Monthly Notices of the Royal Astronomical Society 534, 1433 (2024)
DOI: 10.1093/mnras/stae2156

(19) A. Basu, **E. Garaldi**, and B. Ciardi
Helium reionization from empirical quasar luminosity functions before and after JWST
Monthly Notices of the Royal Astronomical Society 532, 841 (2024)
DOI: 10.1093/mnras/stae1488

(20) A. Bhagwat, T. Costa, B. Ciardi, R. Pakmor, and **E. Garaldi**
SPICE: the connection between cosmic reionization and stellar feedback in the first galaxies
Monthly Notices of the Royal Astronomical Society 531, 3406 (2024)
DOI: 10.1093/mnras/stae1125

(21) M. Neyer, A. Smith, R. Kannan, M. Vogelsberger, **E. Garaldi**, D. Galárraga-Espinosa, J. Borrow, L. Hernquist, R. Pakmor, and V. Springel
The THESAN project: connecting ionized bubble sizes to their local environments during the Epoch of Reionization
Monthly Notices of the Royal Astronomical Society 531, 2943 (2024)
DOI: 10.1093/mnras/stae1325

(22) **E. Garaldi**, R. Kannan, A. Smith, J. Borrow, M. Vogelsberger, R. Pakmor, V. Springel, L. Hernquist, D. Galárraga-Espinosa, J. Y.-C. Yeh, X. Shen, C. Xu, M. Neyer, B. Spina, M. Almualla, and Y. Zhao
The THESAN project: public data release of radiation-hydrodynamic simulations matching reionization-era JWST observations
Monthly Notices of the Royal Astronomical Society 530, 3765 (2024)
DOI: 10.1093/mnras/stae839

(23) A. Acharya, **E. Garaldi**, B. Ciardi, and Q.-. bo . Ma
Cosmic variance suppression in radiation-hydrodynamic modelling of the reionization-era 21-cm signal
Monthly Notices of the Royal Astronomical Society 529, 3793 (2024)
DOI: 10.1093/mnras/stae782

(24) X. Shen, J. Borrow, M. Vogelsberger, **E. Garaldi**, A. Smith, R. Kannan, S. Tacchella, J. Zavala, L. Hernquist, J. Y.-C. Yeh, and C. Zheng
THESAN-HR: galaxies in the Epoch of Reionization in warm dark matter, fuzzy dark matter, and interacting dark matter
Monthly Notices of the Royal Astronomical Society 527, 2835 (2024)
DOI: 10.1093/mnras/stad3397

(25) A. Bera, S. Hassan, A. Smith, R. Cen, **E. Garaldi**, R. Kannan, and M. Vogelsberger
Bridging the Gap between Cosmic Dawn and Reionization Favors Models Dominated by Faint Galaxies
The Astrophysical Journal 959, 2 (2023)
DOI: 10.3847/1538-4357/ad05c0

(26) J. Borrow, R. Kannan, **E. Garaldi**, A. Smith, M. Vogelsberger, R. Pakmor, V. Springel, and L. Hernquist
THESAN-HR: how does reionization impact early galaxy evolution?
Monthly Notices of the Royal Astronomical Society 525, 5932 (2023)
DOI: 10.1093/mnras/stad2523

(27) R. Kannan, V. Springel, L. Hernquist, R. Pakmor, A. M. Delgado, B. Hadzhiyska, C. Hernández-Aguayo, M. Barrera, F. Ferlito, S. Bose, S. D. M. White, C. Frenk, A. Smith, and **E. Garaldi**
The MillenniumTNG project: the galaxy population at z 8
Monthly Notices of the Royal Astronomical Society 524, 2594 (2023)
DOI: 10.1093/mnras/stac3743

(28) **E. Garaldi**
CoReCon: an open, community-powered collection of Reionization constraints
The Journal of Open Source Software 8, 5407 (2023)
DOI: 10.21105/joss.05407

(29) C. Xu, A. Smith, J. Borrow, **E. Garaldi**, R. Kannan, M. Vogelsberger, R. Pakmor, V. Springel, and L. Hernquist
The THESAN project: Lyman- emitter luminosity function calibration
Monthly Notices of the Royal Astronomical Society 521, 4356 (2023)
DOI: 10.1093/mnras/stad789

(30) J. Y.-C. Yeh, A. Smith, R. Kannan, **E. Garaldi**, M. Vogelsberger, J. Borrow, R. Pakmor, V. Springel, and L. Hernquist
The THESAN project: ionizing escape fractions of reionization-era galaxies
Monthly Notices of the Royal Astronomical Society 520, 2757 (2023)
DOI: 10.1093/mnras/stad210

(31) D. Galárraga-Espinosa, **E. Garaldi**, and G. Kauffmann
Flows around galaxies. I. The dependence of galaxy connectivity on cosmic environments and effects on the star formation rate
Astronomy and Astrophysics 671, A160 (2023)
DOI: 10.1051/0004-6361/202244935

(32) W. Qin, K. Schutz, A. Smith, **E. Garaldi**, R. Kannan, T. R. Slatyer, and M. Vogelsberger
Effective bias expansion for 21-cm cosmology in redshift space
Physical Review D 106, 123506 (2022)
DOI: 10.1103/PhysRevD.106.123506

(33) R. Kannan, A. Smith, **E. Garaldi**, X. Shen, M. Vogelsberger, R. Pakmor, V. Springel, and L. Hernquist
The THESAN project: predictions for multitracer line intensity mapping in the epoch of reionization
Monthly Notices of the Royal Astronomical Society 514, 3857 (2022)
DOI: 10.1093/mnras/stac1557

(34) **E. Garaldi**, R. Kannan, A. Smith, V. Springel, R. Pakmor, M. Vogelsberger, and L. Hernquist
The THESAN project: properties of the intergalactic medium and its connection to reionization-era galaxies
Monthly Notices of the Royal Astronomical Society 512, 4909 (2022)
DOI: 10.1093/mnras/stac257

(35) A. Smith, R. Kannan, **E. Garaldi**, M. Vogelsberger, R. Pakmor, V. Springel, and L. Hernquist
The THESAN project: Lyman- emission and transmission during the Epoch of Reionization
Monthly Notices of the Royal Astronomical Society 512, 3243 (2022)
DOI: 10.1093/mnras/stac713

(36) R. Kannan (co-first author), **E. Garaldi** (co-first author), A. Smith (co-first author), R. Pakmor, V. Springel, M. Vogelsberger, and L. Hernquist
Introducing the THESAN project: radiation-magnetohydrodynamic simulations of the epoch of reionization
Monthly Notices of the Royal Astronomical Society 511, 4005 (2022)
DOI: 10.1093/mnras/stab3710

(37) **E. Garaldi**, R. Pakmor, and V. Springel
Magnetogenesis around the first galaxies: the impact of different field seeding processes on galaxy formation
Monthly Notices of the Royal Astronomical Society 502, 5726 (2021)
DOI: 10.1093/mnras/stab086

(38) **E. Garaldi**, M. Nori, and M. Baldi
Dynamic zoom simulations: A fast, adaptive algorithm for simulating light-cones
Monthly Notices of the Royal Astronomical Society 499, 2685 (2020)
DOI: 10.1093/mnras/staa2064

(39) **E. Garaldi**, N. Y. Gnedin, and P. Madau
Constraining the Tail End of Reionization Using Ly Transmission Spikes
The Astrophysical Journal 876, 31 (2019)
DOI: 10.3847/1538-4357/ab12dc

(40) **E. Garaldi**, M. Compostella, and C. Porciani
The Goldilocks problem of the quasar contribution to reionization
Monthly Notices of the Royal Astronomical Society 483, 5301 (2019)
DOI: 10.1093/mnras/sty3414

(41) **E. Garaldi**, E. Romano-Díaz, C. Porciani, and M. S. Pawlowski
Radial Acceleration Relation of CDM Satellite Galaxies
Physical Review Letters 120, 261301 (2018)
DOI: 10.1103/PhysRevLett.120.261301

(42) **E. Garaldi**, E. Romano-Díaz, M. Borzyszkowski, and C. Porciani
ZOMG - III. The effect of halo assembly on the satellite population
Monthly Notices of the Royal Astronomical Society 473, 2234 (2018)
DOI: 10.1093/mnras/stx2489

(43) E. Romano-Díaz, **E. Garaldi**, M. Borzyszkowski, and C. Porciani
ZOMG - II. Does the halo assembly history influence central galaxies and gas accretion?
Monthly Notices of the Royal Astronomical Society 469, 1809 (2017)
DOI: 10.1093/mnras/stx878

(44) M. Borzyszkowski, C. Porciani, E. Romano-Díaz, and **E. Garaldi**
ZOMG - I. How the cosmic web inhibits halo growth and generates assembly bias
Monthly Notices of the Royal Astronomical Society 469, 594 (2017)
DOI: 10.1093/mnras/stx873

(45) **E. Garaldi**, M. Baldi, and L. Moscardini
Zoomed high-resolution simulations of Multi-coupled Dark Energy: cored galaxy density profiles at high redshift
Journal of Cosmology and Astroparticle Physics 2016, 050 (2016)
DOI: 10.1088/1475-7516/2016/01/050

Proceedings

(46) **E. Garaldi**, R. Kannan, A. Smith, V. Springel, R. Pakmor, M. Vogelsberger, and L. Hernquist
Early structure formation in the THESAN radiation-magneto-hydrodynamics simulations
The Predictive Power of Computational Astrophysics as a Discover Tool
362, 1 (2023)
DOI: 10.1017/S1743921322001636

(47) A. Smith, R. Kannan, **E. Garaldi**
First results from the THESAN radiation-hydrodynamic simulations of the Epoch of Reionization
Bulletin of the American Astronomical Society, Vol. 54, No. 6
hyperlink: https://baas.aas.org/pub/2022n6i414p06/release/1

(48) Y.-C. Yeh, A. Smith, **E. Garaldi**, R. Kannan, M. Vogelsberger, R. Pakmor, V. Springel, L. Hernquist
The escape of ionizing photons in the THESAN simulations
Bulletin of the American Astronomical Society, Vol. 54, No. 6
hyperlink: https://baas.aas.org/pub/2022n6i126p04/release/1

(49) **E. Garaldi**, R. Kannan, A. Smith, V. Springel, R. Pakmor, M. Vogelsberger, L. Hernquist
Early structure formation in the THESAN radiation-magneto-hydrodynamics simulations
IAU Symposium 362
DOI: 10.1017/S1743921322001636

(50) **E. Garaldi**, M. Compostella, C. Porciani
Quasars at the Cosmic Dawn
IAU Symposium 333, 56–59 (2018)
DOI: 10.1017/S1743921317011310

Book chapters

(51) **E. Garaldi**
The THESAN *project: radiation magneto-hydrodynamic simulations of the epoch of reionization*
in 'High Performance Computing in science and engineering – Garching/Munich 2020' (2021)
editors: P. Bastian, D. Kranzlmüller, H. Brüchle, M. Brehm, and G. Mathias
ISBN: 978-3-9816675-4-7

Selected talks and seminars

Summary I am **regularly an invited speaker** in international conferences and research institutes. I list below a selection of the most relevant talks I have given in the last years.

Invited Colloquia

(1) *First galaxies, cosmic reionization and their interplay – successes and challenges of numerical models*
NAOJ Science Colloquium, Mitaka, Jun. 2025

(2) *Towards a comprehensive understanding of the first billion years of the Universe*
Bologna joint astronomy colloquium, Italy, Sept. 2024

(3) *A fierce new challenge: simultaneously understanding first galaxy formation, reionization and their connection*
Center for Astrophysics, Harvard, U.S.A, Sep. 2022

(4) *A fierce new challenge: simultaneously understanding first galaxy formation, reionization and their connection*
Royal Observatory Edinburgh, UK (virtual), Dec. 2021

(5) *Magnetogenesis around the first galaxies: the impact of different field seeding processes on galaxy formation*
University of Bologna, Italy (virtual), Oct. 2020

Invited reviews

(6) *Radiation-hydrodynamical simulations in the reionization epoch*,
Building galaxies from scratch, Vienna, Austria, Feb. 2024

(7) *Simulating Reionization and first galaxies: recent advancements and the road ahead*,
Reionization in the summer, Heidelberg, Germany, Jun. 2023

Invited talks

(8) *Towards a comprehensive understanding of the first billion years of the Universe*,
GECKO Seminar series, online, June 2025

(9) *Galaxy-IGM connection in RHD simulations*,
Workshop 'The galaxy-IGM connection in the first billion years', Trieste (Italy), May 2025

(10) *Radiation-hydrodynamical modeling of the galaxy-IGM interplay during cosmic reionization*,
Cosmic Dawn at High Latitudes, Stockholm, Sweden, June 2024

(11) *Radiation-hydrodynamical modeling of the galaxy-IGM interplay during cosmic reionization*,

Tokyo University, Japan, May 2024

(12) *Radiation-hydrodynamical modeling of the galaxy-IGM interplay during cosmic reionization*,
Osaka University, Japan, May 2024

(13) *A fierce new challenge: simultaneously understanding first galaxy formation, reionization and their connection*,
Kapteyn Astrophysics Institute, Groningen, The Netherlands, Nov. 2023

(14) *A fierce new challenge: simultaneously understanding first galaxy formation, reionization and their connection*,
CEA Astrophysics group, Paris, France, Apr. 2023

(15) *Unveiling the connection between galaxies and reionization*,
Understanding the Epoch of Reionization, Sexten, Italy, Mar. 2023

(16) *Magnetic fields creation in reionization fronts*
Cosmic magnetism in voids and filaments, Bologna, Italy, Jan. 2023

(17) *A fierce new challenge: simultaneously understanding first galaxy formation, reionization and their connection*,
Donostia International Physics Center, San Sebastian, Spain, Oct. 2022

(18) *Magnetic fields creation in reionization fronts*
Cosmic magnetism in voids and filaments, Bologna, Italy, Jan. 2023

(19) *Magnetogenesis at cosmic dawn*
Center for Astrophysics, Harvard, U.S.A, Sep. 2022

(20) *The Thesan simulations of cosmic reionization*
Tsukuba University, Japan, Jul. 2022

(21) *The Thesan simulations of cosmic reionization*
ICRR, Tokyo, Japan, Jul. 2022

(22) *The Thesan simulations of cosmic reionization*
Tokyo University, Japan, Jul. 2022

(23) *The Thesan simulations of cosmic reionization*
Waseda University, Japan, Jul. 2022

(24) *The Thesan simulations of cosmic reionization*
Tsukuba University, Japan, Jul. 2022

(25) *The Thesan simulations of cosmic reionization*
Nagoya University, Japan, Jul. 2022

(26) *The Thesan simulations of cosmic reionization*
Osaka University, Japan, May 2022

(27) *A fierce new challenge: simultaneously understanding first galaxy formation, reionization and their connection*
IAS, Paris, France (virtual), Feb. 2022

(28) *A fierce new challenge: simultaneously understanding first galaxy formation, reionization and their connection*
DAWN Center, Copenhagen, Denmark (virtual), Jan. 2022

(29) *The Thesan simulation suite*
MPIA, Heidelberg, Germany, Oct. 2021

(30) *Investigating the connection between the first galaxies and their environment*
NYU, Abu Dhabi (virtual), Apr. 2021

(31) *Unveiling the connection between galaxies and IGM at high-z*
University of Heidelberg, Germany (virtual), Nov. 2020

(32) *Exploring the link between galaxies and IGM at high-z*
CfA, Harvard, USA (virtual), May 2020

(33) *The unforeseen IGM*
University of California, Santa Barbara, USA, Mar. 2018

(34) *A brief overview of the ZOMG project*
University of California, Santa Cruz, USA, Feb. 2018

(35) *Numerical structure formation from reionization to the local Universe*
Max-Planck Institute für Astrophysik, Garching, Germany, Jan. 2018

(36) *Quasar-only reionization: a numerical perspective*
Rome Observatory, Italy, Nov. 2017

(37) *The ZOMG project*
University of Bologna, Italy, Oct. 2017

(38) *Numerical investigations at high and low redshift*
Scuola Normale Superiore di Pisa, Italy, Oct. 2017

(39) *Understanding assembly bias*
SFB956 annual retreat, Schleiden, Germany, May 2017

Selected schools and workshops

Hard skills

Aug 2023 Machine Learning in Astrophysics
Heidelberg, Germany

May 2021 C++ intermediate programming
Julich Supercomputing center, Germany

Nov. 2018 Data, lights, camera, action! Scientific visualization done beautifully
SURFsara, Amsterdam, The Netherlands

Jun. 2018 4th School on Scientific Data Analytics and Deep Learning
CINECA, Bologna, Italy

Feb. 2017 Machine Learning: the elegant way to extract information from data
IMPRS Blackboard Lectures, Bonn, Germany

Oct. 2016 HPC methods for Computational Fluid Dynamics and Astrophysics
CINECA, Bologna, Italy

Sep. 2016 Parallel programming workshop
HLRS, Stuttgart, Germany

Soft-skills

2025 – 2026 Future Faculties Development Program (teaching theory and techniques)
Tokyo, Japan

Nov. 2021 Science communication and media training
Max Planck Society Training Center

Oct. 2021 Effective proposal writing
Max Planck Society Training Center

Sep. 2021 Write like a thought leader
Max Planck Society Training Center

May 2021 Implicit Bias training
Max Planck Society Training Center

Apr. 2021 Unconscious Bias in Academia
Max Planck Society Training Center

Oct. 2016 Teaching techniques
Bonn, Germany

Sep. 2016 Science integrity
Köln, Germany

Outreach Talks

(1) *JWST: A new eye on the Universe*
Modena, Italy, Dec. 2021

(2) *Fundamental physics explained with pasta and baseball*
Pint of Science 2021, online, May. 2021

(3) *Codes & Qubit*
Modena, Italy, Apr. 2021

(4) *Black Hole Santa*
Modena, Italy, Dec. 2020

(5) *Cosmology and exoplanets*
Modena, Italy, Dec. 2019

(6) *Gravitational waves*
Modena, Italy, Dec. 2017

(7) *Symmetries in physics*
Popular scientific talk, Planetarium and high schools, Modena, Italy, Feb.–Jun. 2013

Other outreach activities

(8) Collaboration with company VIS for research-based virtual reality outreach materials
Italy, ongoing

(9) Science consultant for National Geographic
U.S.A., 2023

(10) Part of the MPA team for 'Girls' day',
Munich, Germany, 2019, 2023

(11) Written and filmed two videos for science@home,
Munich, Germany, 2020 – 2021

(12) Scientist for SkypeAScientist,
Munich, Germany, Jan. 2019 – present

(13) Organizer of Pint of Science Munich,
Munich, Germany, Oct. 2018 – present

(14) Organizer of Astronomy on Tap Bonn,
Bonn, Germany, Jun.–Oct. 2018

(15) Scientific guide for *Higgs show*,
Modena, Italy, Sep. 2012

Memberships

2025–present Prime Focus Spectrograph
2025–present Wide-field Spectrographic Telescope
2022–present Euclid Consortium
2022–present International Astronomical Union junior member
2017–present European Astronomical Society
2015–2018 International Max Planck Research School (IMPRS) of Bonn and Cologne
2015–present SFB956 consortium, sub-project C4
2012–present Inco.Scienza Incontriamo la scienza (Italian outreach organization, based in Modena)

Academic references

The following three people have agreed to provide reference letters in support of my application.

Prof. Naoki Yoshida
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Prof. Volker Springel
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Prof. Marco Baldi
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Supervision feedback

I consider crucial to ask for feedback from the students I supervise, in order to constantly improve my skills. I have asked the ones that I have supervised for the longest time to provide a write-up of their experience with me. Their names are:

- Benedetta Spina. Currently a postdoctoral researcher at Heidelberg University. I co-supervised her with Prof. Cristiano Porciani during her PhD;
- Chi Zhang. Currently finishing his PhD at the Purple Mountain Observatory, Nanjing, China. I co-supervised him together with Dr. Matteo Viel during his PhD;
- Aniket Bhagwat. Currently a postdoctoral researcher at the Max-Planck-Institut für Astropysik in Munich. I co-supervised him together with Dr. Benedetta Ciardi and Dr. Tiago Costa during his PhD;
- Anshuman Acharya. Currently a postdoctoral fellow at UC Berkeley. I co-supervised him together with Dr. Benedetta Ciardi during his PhD;
- Silvia Fiaschi. She completed part of her PhD at the Max-Planck-Institut für Astropysik. I co-supervised her with Dr. Benedetta Ciardi;
- Riccardo Zangarelli. He completed a MSc. at Bologna University, under the supervision of myself, Prof. Marco Baldi and Prof. Federico Marinacci. He is currently a PhD student at Bologna University.
- Verena Bellscheidt. She completed an internship at the Max-Planck-Institut für Astropysik, with me as sole supervisor. She is currently an undergraduate student at the Massachusetts Institute of Technology.
- Marie Boussard. She completed an internship at the Max-Planck-Institut für Astropysik, with me as sole supervisor. She is currently finishing her MSc.

I attach their evaluations below (highlights mine).

February 25, 2022

To whom it may concern,

it is my great pleasure to write this statement regarding my collaboration with Dr. Enrico Garaldi.

I started working with Enrico in May 2021, during my second year of PhD, on a project about forecasts for SKA-1 MID detection of helium reionization. We then continued collaborating on a second project concerning the role of the environment in the star-formation-rate of dwarf galaxies during reionization. In both cases, by means of hydrodynamical simulations Enrico largely contributed to develop.

Enrico knowledge on these topics helped me pursuing my research goals and boosted my motivation into a deeper understanding of the physical processes involved. Most importantly, I feel affected by his curiosity towards our universe in such a way I desire both to answer the problems we are aware of and to find even more of them to be answered.

Not only Enrico showed a vast preparation on these regards, but he has always been very clear when explaining it: I can not count the number of times I needed help or clarification with both his simulations and the models we considered and he was able to solve my doubts in the most simple way possible. Enrico has never diminished my ideas and my questions, on the contrary he always make me feel my work considered and appreciated.

Our meetings are very productive and I have never encountered problems into arranging them. Moreover, he is easily reachable and he always replies within a few hours at maximum.

I feel drowned by Enrico's motivation and I greatly appreciate his expertise and understanding of many astrophysical problems. I am grateful I had the amazing opportunity to work with Enrico and I truly hope our collaboration will be even closer in the future.

Sincerely,

Benedetta Spina

To whom it may concern,

It is my pleasure to write this letter to express my sincere appreciation for the supervision and guidance of Dr. Enrico Garaldi during my Ph.D. research. Over the past year (from September 2024 to September 2025), I have been a visiting Ph.D. student at SISSA in Trieste, and we have worked closely together on the AIDA–TNG project, focusing on the analysis of gas properties in alternative dark matter models and, in particular, the study of galaxy–IGM correlations.

Enrico has been an exceptional mentor in both scientific and personal aspects. His deep understanding of cosmological simulations and his clear, logical way of thinking always help me connect technical results to their underlying physics. Since this was my first time working with truly state-of-the-art cosmological simulations, Enrico guided me patiently through many essential steps—from understanding the data structure to developing analysis codes. His advice at these early stages was invaluable and gave me the confidence to move forward. Whenever I encounter difficulties in data analysis or interpretation, he provides insightful suggestions that not only solve the problem at hand but also help me develop a broader perspective on the science behind it. He is patient in discussions and consistently dedicates time to reviewing my drafts, figures, and code, which I deeply appreciate.

Beyond his scientific expertise, Enrico is kind, approachable, and always supportive. His enthusiasm for research and his genuine care for students create an inspiring, collaborative atmosphere that makes working with him a pleasure.

I feel deeply grateful to have Enrico as my supervisor. His guidance has not only shaped my research but also taught me to think with clarity and patience. Working with him on the AIDA–TNG and galaxy–IGM correlation studies has been truly inspiring. I will always remember his calm encouragement and thoughtful advice, which have guided me through many challenges and made this journey both meaningful and fulfilling.

Sincerely,

Chi Zhang
Purple Mountain Observatory, CAS
University of Science and Technology of China

To whom it may concern,

I'm honoured to be writing an evaluation of co-supervision for Dr. Enrico Garaldi. I have had the pleasure of being a colleague of and interacting with Enrico since 2018. The time period since covers my growth as an inexperienced young researcher, Enrico has been a very important part of this growth.

Between 2018-2019 I was at the Max Planck Institute for Astrophysics as an internship student. During this time, I did not work directly in collaboration with Enrico but he encouraged active discussions via paper discussion sessions or even over a cup of coffee. As a young inexperienced student, these discussions were invaluable as I could tap into Enrico's insights and experience working on the high redshift universe and learn from it.

I joined the Max Planck Institute for Astrophysics as a PhD student in 2020, since joining, I have been closely collaborating with Enrico on two very different projects. The diverse nature of Enrico's scientific interests and his experience with running large scale numerical simulation projects have enabled me to quite confidently take on with both numerical and theory oriented projects knowing there is someone in-house who has the expertise to help and guide me through these projects. Enrico's motto for his supervision is "my office doors are always open", as a young researcher this is very comforting and I take full advantage of this. Enrico is always happy to have long extended discussions, answer my questions and share resources.

Despite being his student, Enrico always treats me as an equal colleague to him. One key aspect that is very motivating is that Enrico is very open and responsive to ideas that I bring up while being a healthy level of truthful of how feasible certain ideas are in terms of execution, I personally feel this is invaluable. Enrico has indeed played a key role in my growth and development as a young researcher. Away from the scientific point of view, every young researcher has roadblocks when they feel stuck, demotivated and affected by imposter syndrome. I have had moments like these along the way and Enrico has helped me overcome these by discussing the problems, reassuring me and finding ways to fix the issues. Instilling positivity and enthusiasm is a key skill Enrico has which has helped me through my PhD outside of the scientific side of things.

In summary, I am grateful that I have Dr. Enrico Garaldi as a guide and a co-supervisor through the course of my PhD. He not only manages to share his knowledge and insights with me to carry on my own research, he has also helped my overall growth. His zest and enthusiasm towards learning the high redshift universe motivate me and make me a better student.

Sincerely,

Aniket Bhagwat
2nd Year PhD Student
Max Planck Institute for Astrophysics

October 2, 2023

To Whom it May Concern:

It is a great pleasure to enthusiastically support my collaborator and mentor Dr. Enrico Garaldi by writing this letter.

I have interacted with Enrico since the beginning of my PhD in September 2021 and began working with him directly on a project in October 2022. In this project, we used the radiative-hydrodynamical simulations `THESAN` (Enrico being a co-PI of the `THESAN` project) setup to explore the suppression of cosmic variance on using the Fixed and Paired approach put forward by Pontzen et al. (2016) in modelling the reionization-era 21-cm signal.

Having previously only worked with simulation data but not having run simulations myself, this was a project where I heavily relied on the guidance and mentoring of Enrico. We started right from the basics of the `AREPO`-based framework and how the different components worked, up to the point of understanding the capabilities as well as the limitations of the `THESAN` simulations. Enrico also ensured that I developed a keen understanding of the physical implications of the simulations, and the results we obtained. Further, we carefully analysed the Fixed and Paired approach to understand its assumptions and read through papers that used the technique for other applications. The clarity and patience with which Enrico addressed my queries and doubts was exceptional. In the project, there were times when things did not work, but Enrico's enthusiasm ensured that I continued to be motivated. Suffice it to say, this has led to the project leading to fascinating results, as well as adding significantly to my knowledge and experience. Working with Enrico encouraged me to delve deeper into developing and running cosmological simulations for Reionization-era studies, and I have begun working on my own simulation setup based on the things I have learned from him.

One of the key aspects that I liked about Enrico's method of supervision was his two-pronged approach. That is, he focused on the following:

1. **Scaling by my background knowledge:** A key thing he does is to check how much I know about a specific topic so that he can adapt his explanation to best fit my needs. This is incredibly important and shows his clarity of concepts and teaching skills.
2. **Providing constructive criticism:** While pointing out flaws and issues is fairly trivial, it requires a significant amount of effort to suggest methods on how to improve on them. As a PhD student, I found this immensely helpful, especially when it came to writing the paper on the results of our project.

At no point of the project did I feel lost during the project, as Enrico was always approachable, through in-person meetings or emails/messaging. Thus, I believe my PhD experience was enriched by my opportunity to work with Enrico, and I hope to be able to collaborate with him in future projects too.

Sincerely,
Anshuman Acharya

Dear hiring committee,

It is my pleasure to write an evaluation of Dr. Enrico Garaldi for your assistant professor vacancy. As a PhD Student at Max Planck Institute of Astrophysics from 2019 to 2021, I got the chance to work in the same group of Enrico.

Responsible and particularly bright, Enrico was among the Post Docs who co-supervised my project , and I absolutely endorse his qualification and his skill set. During my time at Max Planck, we have collaborated and discussed about my project, a study of the impact of binary systems on the Epoch of Reionization. Being inquisitive and intuitive by nature, he played a role of huge importance since he has always been able to answer my questions giving me new insights on fine physical interpretations. He expertly assisted me and gave truly special advices about general experiences across the academic spectrum, serving his extensive knowledge also to motivate junior peers.

I have also witnessed the exceptional contributions that Enrico has made to the Max Planck community. Not only is he an excellent researcher, but he would engage his peers and juniors in lively scientific discussions during group and Institute meetings. He is dedicated to the concept of education indeed, and has an amazing sense of restraint and balance that allows this to work in his favor.

Enrico has my enthusiastic recommendation. He is a smart and strong person who has a clear sense of direction and purpose. I am confident that he will bring the same support, insight, and commitment to your institution.

Please do not hesitate to contact me for any further information.

Thanks, and best regards,

Silvia Fiaschi

To whom it may concern,

I am very pleased to write about the experience which I had with Dr. Enrico Garaldi as my M.Sc. thesis co-supervisor. In fact, the core idea of the thesis itself derives from a paper in which he is first author; therefore, his help was crucial for the good result of my work. Since I first started my thesis project in May 2022, Enrico has always been ready to promptly answer my many doubts and concerns. Even in the limited timeframe in which I have worked with him, I was able to realize that Enrico's experience in the topic of cosmological simulations was invaluable, not only because he provided the core framework for my thesis, but also because of the many ideas and remarks that he proposed along the way. In fact, he also provided a vast amount of practical resources, ranging from full N-body codes to access to computing clusters. In the latter case, Enrico also offered to explain to me thoroughly and in full detail how to operate these clusters, saving me the trouble of searching those informations myself.
As for the proofreading of my dissertation, Enrico's comments were mostly precise and on point, and he also often provided full-on sentences to integrate the text with. Moreover, he was always willing to further discuss any comments and remarks that were unclear to me, patiently answering every single question in my extremely long and frequent emails.
I would also like to mention that Enrico's helping hand did not stop there. During my thesis project, I had moments where unexpected issues and results made me lose motivation and confidence; during these moments, Enrico provided moral support on top of the practical advice to address the issues, and remarked that I should be proud of my work when I felt underwhelmed by results that I deemed sub-optimal at first glance.
In summary, I value my experience with Enrico as my co-supervisor as an extremely positive one, and I hope to work again with him in the future, as I firmly believe that collaborating with people like Enrico will make me a better researcher just as it made me a better student.

Sincerely,

Riccardo Zangarelli
Master's degree student in Astrophysics and Cosmology
University of Bologna

October 20, 2022

To whom it may concern,

From 22 August 2022 to 14 October 2022, at the end of the first year of my undergraduate studies in physics, I completed an internship at the Max Planck Institute for Astrophysics under the supervision of Dr. Enrico Garaldi.

During the internship, Enrico taught me about the epoch of reionization and about a radiation-magneto-hydrodynamical simulation of this epoch, among other things. He greatly helped me develop both general and specific skills essential to a career in research.

Throughout my internship, he was available to answer my questions at any point and took his time to thoroughly explain everything I needed for my project, and more. I am especially impressed with his ability to explain physical and computational concepts in such a comprehensive ways that even someone who is just starting out on the field has no trouble understanding them. While his explanations never required more prior knowledge that could reasonable be expected, they nevertheless explained the concepts at hand in such detail that I had no problems applying them to my project.

Enrico is a very approachable person and I had absolutely no trouble reaching out to him when I had any concerns. I always looked forward to our meetings, which were both inspiring and insightful. I sincerely enjoyed working with him and would very much appreciate the opportunity to do so again in the future.

Sincerely,

Verena Bellscheidt

Grenoble, 30/08/2023

To whom it may concern,

From 17 April 2023 to 25 August 2023, I did an internship at the Max Planck Institute for Astrophysics supervised by Dr. Enrico Garaldi, on the topic of numerical simulations of galaxy formation during the reionization.

Enrico was a very involved supervisor, being very available when I needed help for a coding problem or a physical interpretation. His explanations were always very clear and made even complex phenomena easy to understand. Thanks to him, I learned many interesting things about computational methods in astrophysics and the epoch of reionization.

Besides, working with Enrico was a pleasure as he was very nice and patient. He was also very attentive to my scientific interests, for example by asking to know which points I wanted to deepen the most. Moreover, he gave me valuable advice about working on numerical simulations in astrophysics as well as on a career in research in general, and helped me greatly to develop my scientific skills.

To sum up, working with Enrico was very interesting and enriching, and if the opportunity arose I would be very happy to do it again.

Yours sincerely,

Marie Boussard