

Giulio Giuseppe Giusteri

Contact Information

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Summary

I am a **researcher and an educator** in the fields of **Mathematics** and **Physics**. With a broad background and research experience across different areas, I work with several colleagues to develop **innovative mathematical perspectives** for a better **understanding of physical phenomena**. I have been producing and transmitting knowledge in over seven years of activity.

Education

2012 **Ph.D. in Pure and Applied Mathematics**, January 13th, 2012, at **Università degli studi di Milano-Bicocca**.

Thesis: *Higher-gradient theories for fluids and concentrated effects*. Advisor: *Alfredo Marzocchi*.

Developed the mathematical theory of second-gradient linear isotropic liquids. After framing it within a general theory of higher-gradient continua, I proved the well-posedness of fluid-structure interaction problems involving one-dimensional immersed bodies. Also showed how higher-gradient models can capture concentrated effects that would be otherwise ignored by classical models.

2009 **Master's degree in Physics cum laude**, January 8th, 2009, at Facoltà di Scienze Matematiche, Fisiche e Naturali - **Università Cattolica del Sacro Cuore**, Brescia, Italy.

With a thesis on the dynamics of a model for second-gradient fluids. This work was under the supervision of *Alfredo Marzocchi*, and, as for numerical simulations, of *Edie Miglio* (MOX - **Politecnico di Milano**).

2007 **Master's degree in Mathematics cum laude**, July 12th, 2007, at Facoltà di Scienze Matematiche, Fisiche e Naturali - **Università Cattolica del Sacro Cuore**, Brescia, Italy.

With a thesis on the existence of vortex-like solutions to the nonlinear Klein–Gordon–Maxwell equations, studied by means of topological methods and critical point theory. Advisor: *Marco Degiovanni*.

2006 **Bachelor's degree in Physics cum laude**, September 29th, 2006, at Facoltà di Scienze Matematiche, Fisiche e Naturali - **Università Cattolica del Sacro Cuore**, Brescia, Italy.

With a thesis on the Wilczek–Zee phase and holonomic quantum computation. Advisor: *Fausto Borgonovi*.

Academic Experience

2015–present **Postdoctoral Researcher** at the Mathematics, Mechanics, and Materials Unit (formerly Mathematical Soft Matter Unit), **Okinawa Institute of Science and Technology**, Japan.

- Active on a spectrum of topics, with 8 published papers.
- Serving as Postdoctoral Researchers' Representative.
- Contributing to OIST outreach activities such as Open Campus and Science Festival.

2012–2017 **Researcher** (RTD-A L. 240/2010, *on leave since September 2015*) at the Department of Mathematics and Physics “Niccolò Tartaglia”, **Università Cattolica del Sacro Cuore**, Brescia, Italy.

- Postdoctoral position with duties of Assistant Professor in Mathematical Physics.
- Active on a spectrum of topics, with 5 published papers and several presentations.
- Instructor for various courses, thesis supervisor for 12 undergraduate and 7 graduate students.
- Serving on several Evaluation Committees for Bachelor's and Master's degrees.
- Contributing to outreach activities such as Open Campus and Math Contest for high schools.

- 2014 **Visiting Researcher** at the Mathematical Soft Matter Unit, **Okinawa Institute of Science and Technology Graduate University**, Japan.
- Short invited visit for scientific collaboration.
- 2012 **Visiting Lecturer (with research duties)** at the Department of Mechanical Engineering, **University of Washington**, Seattle, United States.
- Six-month visit that generated 2 scientific papers.
- 2009–2015 **Adjunct Professor** at the Department of Mathematics and Physics “Niccolò Tartaglia”, **Università Cattolica del Sacro Cuore**, Brescia, Italy.
- Instructor for courses in Fluid Mechanics, Stochastic Processes, and Mathematics Education Lab.

Research Interests and Collaborations

My research focuses on **applying and developing mathematical theories to describe and understand basic physical phenomena**, ranging from the mechanical behavior of soft matter to the dynamics in disordered quantum networks to general systems of interactions. Answering questions like “*What’s the best mathematics for talking about this phenomenon?*”, I strive to enhance our understanding of nature.

Building on my broad background in Mathematics and Physics, I enjoy bringing together ideas from disparate fields to produce innovative and effective approaches to the problems that capture my attention. I worked on **nonsimple fluids and concentrated interactions**, linking the kinematics on Banach manifolds of generalized continua to the types of interactions that can be modeled and coupling dimensional reduction techniques for slender bodies and effective fluid models. I also investigated questions about **cooperative effects in open quantum systems**, using Itô’s calculus and other techniques to study possibly nonlocal interactions and the limit of validity of well-established models in the strong-coupling limit.

More recently, I turned my attention to **continuum mechanical models** for rods and fluids and on the **relation between continuum mechanics and statistical mechanics**. I published two papers on mathematical models for liquid films spanning flexible frames and a paper on the derivation of continuum equations for systems with a microscopic dynamics based on extended Hamiltonians. I am also working on a theoretical framework for steady-state rheometry and dense suspensions. Based on these experiences, I am extremely interested in building a reliable framework to deduce continuum models from non-equilibrium statistical mechanics.

A further exciting project that I conceived concerns a **spacetime-free approach to fundamental interactions**. Based on my interest in the interplay between interactions and geometry in various physical systems, I want to explore how it is possible to let the geometry of spacetime emerge from a coherent organization of the statistical information that we can collect about fundamental interactions. In this project measure theory, probability, and differential geometry coordinate to offer an innovative point of view on one of the outstanding issues in Mathematical Physics.

Collaborations:

- A. Marzocchi, A. Musesti (**Università Cattolica**, Brescia, Italy) on *Mathematical Fluid Mechanics*.
- F. Borgonovi (**Università Cattolica**, Brescia, Italy), G. L. Celardo (**Benemérita Universidad Autónoma de Puebla**, Mexico), G. Schaller (**Technische Universität Berlin**, Germany) on *Transport in Open Quantum Systems*.
- E. Fried (**Okinawa Institute of Science and Technology**, Japan), A. N. Hirani (**University of Illinois, Urbana-Champaign**, United States), L. Lussardi (**Politecnico di Torino**, Italy) on *Fluid Membranes and Filaments*.
- P. Podio-Guidugli (**Accademia Nazionale dei Lincei**, Roma) on *Foundations of Continuum Mechanics*.
- R. Seto (**Okinawa Institute of Science and Technology**, Japan) on *Rheology and Models for Dense Suspensions*.

Grants and Awards

- 2016 Contributed to **proposal design and writing** for the competitive internal funding program *OIST Mini Symposia 2016*. Principal Organizer: Eliot Fried (¥ 3,500,000).
- 2013 Contributed to **research design and proposal writing** for the call *Università Cattolica del Sacro Cuore Competitive Funding for Research Projects 2013*. Principal Investigator: Alessandro Musesti (€ 65,000).
- 2013 **Travel grant** from *GNFM-INDAM Young Researchers Projects 2013* (€ 2,000).
- 2008 Master’s degree **thesis award** from the foundation *Ateneo di Brescia*.

Scientific Publications

Submitted

- G. G. GIUSTERI, R. SETO. [A theoretical framework for steady-state rheometry in generic flow conditions](http://arxiv.org/abs/1702.02745). <http://arxiv.org/abs/1702.02745>

Papers in peer-reviewed journals

16. G. G. GIUSTERI, E. FRIED. [Importance and effectiveness of representing the shapes of Cosserat rods and framed curves as paths in the special Euclidean algebra](#), *J. Elast.*, (2017), doi:10.1007/s10659-017-9656-z.
15. R. SETO, G. G. GIUSTERI, A. MARTINIELLO. [Microstructure and thickening of dense suspensions under extensional and shear flows](#), *J. Fluid Mech.*, 825 (2017), R3.
14. G. G. GIUSTERI, F. RECROSI, G. SCHALLER, G. L. CELARDO. [Interplay of different environments in open quantum systems: Breakdown of the additive approximation](#), *Phys. Rev. E*, 96(1) (2017), 012113.
13. G. G. GIUSTERI, P. PODIO-GUIDUGLI, E. FRIED. [Continuum balances from extended Hamiltonian dynamics](#), *J. Chem. Phys.*, 146 (2017), 224102.
12. G. G. GIUSTERI, L. LUSSARDI, E. FRIED. [Solution of the Kirchhoff–Plateau problem](#), *J. Nonlinear Sci.*, 27(3) (2017), 1043–1063.
11. G. SCHALLER, G. G. GIUSTERI, G. L. CELARDO. [Collective couplings: Rectification and super-transmittance](#), *Phys. Rev. E*, 94(3) (2016), 032135.
10. G. G. GIUSTERI, P. FRANCESCHINI, E. FRIED. [Instability paths in the Kirchhoff–Plateau problem](#), *J. Nonlinear Sci.*, 26(4) (2016), 1097–1132.
9. G. G. GIUSTERI, F. BORGONOV, G. L. CELARDO. [Optimal efficiency of quantum transport in a disordered trimer](#), *Phys. Rev. E*, 93(3) (2016), 032136.
8. G. G. GIUSTERI, F. MATTIOTTI, G. L. CELARDO. [Non-Hermitian Hamiltonian approach to quantum transport in disordered networks with sinks: Validity and effectiveness](#), *Phys. Rev. B*, 91(9) (2015), 094301.
7. G. G. GIUSTERI, A. MARZOCCHI, A. MUSESTI. [Steady free fall of one-dimensional bodies in a hyperviscous fluid at low Reynolds number](#), *Evol. Equat. Control Theory*, 3(3) (2014), 429–445.
6. G. G. GIUSTERI, A. MARZOCCHI, A. MUSESTI. [Nonlinear free fall of one-dimensional rigid bodies in hyperviscous fluids](#), *Discrete Contin. Dyn. Syst. Ser. B*, 19(7) (2014), 2145–2157.
5. G. L. CELARDO, G. G. GIUSTERI, F. BORGONOV. [Cooperative robustness to static disorder: Superradiance and localization in a nanoscale ring to model light-harvesting systems found in nature](#), *Phys. Rev. B*, 90(7) (2014), 075113.
4. G. G. GIUSTERI, E. FRIED. [Slender-body theory for viscous flow via dimensional reduction and hyperviscous regularization](#), *Meccanica*, 49(9) (2014), 2153–2167.
3. G. G. GIUSTERI. [The multiple nature of concentrated interactions in second-gradient dissipative liquids](#), *Z. Angew. Math. Phys. ZAMP*, 64(2) (2013), 371–380.
2. G. G. GIUSTERI, A. MARZOCCHI, A. MUSESTI. [Nonsimple isotropic incompressible linear fluids surrounding one-dimensional structures](#), *Acta Mech.*, 217(3-4) (2011), 191–204.
1. G. G. GIUSTERI, A. MARZOCCHI, A. MUSESTI. [Three-dimensional nonsimple viscous liquids dragged by one-dimensional immersed bodies](#), *Mech. Res. Commun.*, 37(7) (2010), 642–646.

Proceedings

- A. MUSESTI, G. G. GIUSTERI, A. MARZOCCHI. [Predicting Ageing: On the Mathematical Modelization of Ageing Muscle Tissue](#), in G. Riva et al. (Eds.), *Active Ageing and Healthy Living*, Chapter 17.
- G. L. CELARDO, A. BIELLA, G. G. GIUSTERI, F. MATTIOTTI, Y. ZHANG, L. KAPLAN. [Superradiance, disorder, and the non-Hermitian Hamiltonian in open quantum systems](#), *AIP Conf. Proc.*, 1619 (2014), 64–72.

Scientific Communications

16. April 14th, **2017** - *Mathematical modeling and characterization of non-Newtonian viscous fluids*, Nonlinear Analysis Seminar, Kanazawa University.
15. January 13th, **2017** - *Paths in the special Euclidean algebra and rod shapes*, at NCTS (Taipei).
14. October 15th, **2016** - *The shapes of a rod are traced in a Lie algebra*, during the workshop Geometry and Materials Sciences (Okinawa).
13. May 23rd, **2016** - *Instability paths in the Kirchhoff–Plateau problem*, at EPFL (Lausanne).
12. July 1st, **2015** - *Optimal energy transfer in disordered quantum networks*, during QuEBS 2015 (Florence).
11. September 4th, **2014** - *Modeling the morphogenesis of brain cortex*, during CIME–CIRM course on Mathematical Models and Methods for Living Systems (Levico Terme).
10. May 23rd, **2014** - *Modeling the sedimentation of filaments in viscous fluids via dimensional reduction and hyperviscous regularization*, at Okinawa Institute of Science and Technology (Okinawa).
9. March 20th, **2014** - *Modeling the sedimentation of filaments in viscous fluids with a second-gradient dissipation functional*, during EUROMECH Colloquium 563 (Cisterna di Latina).
8. May 23rd, **2013** - *LHI-RC complexes of Rhodobacter Sphaeroides: Superradiance, high efficiency, and adaptability*, during the workshop Transport in Open Quantum Systems (Porquerolles).
7. April 6th, **2013** - *Hyperviscous regularization of the Navier-Stokes equation and the motion of slender swimmers*, during the IV International Conference on New Trends in Fluid and Solid Models (Vietri sul Mare).
6. February 26th, **2013** - *Concentrated interactions in second-gradient dissipative liquids*, at the international research center M&MoCS (Cisterna di Latina).
5. October 5th, **2012** - *Slender-body theory for viscous flow via dimensional reduction and hyperviscous regularization*, during the annual meeting of GNFM (Montecatini).
4. September 22nd, **2011** - *Non-simple liquids dragged by 1D structures*, during GNFM summer school (Ravello).
3. June 1st, **2011** - *A variational approach to the p -Laplace equation on metric measure spaces*, during HCDTE (Trieste).
2. September 2nd, **2010** - *Non-simple linear fluids surrounding 1D structures*, during STAMM 2010 (Berlin).
1. September 24th, **2009** - *Quantum computation by polarized excitons*, during GNFM summer school (Ravello).

Organization and Service

- 2017 **Organizer** of the workshop *Viscoelasticity and Dissipative Dynamics of Rods and Membranes*.
- 2016 Postdoctoral Researchers' **representative** in the OIST Faculty Assembly.
- 2016 Grant Writing **Peer Support Group** for OIST researchers.
- 2015–2016 OIST **Open Campus** and **Science Festival**.
- since 2011 **Peer reviewer** activity certified on [my Publons profile](#). Reviewer for Mathematical Reviews.
- 2009–2015 **Evaluation Committee** for approximately a hundred Bachelor's and Master's degrees.
- 2009–2015 **Organizing Committee** of *Disfida Matematica*, a math contest for high-school students.

Teaching Activity

School of Mathematical, Physical, and Natural Sciences - Università Cattolica del Sacro Cuore

- 2009–2015 *Instructor for **Fluid Mechanics*** (~10 students per year).
Course offered to **undergraduate students in Physics** and **graduate students in Applied Mathematics**, it covered various topics such as ideal and viscous fluids, hydrodynamic stability, turbulence modeling, and boundary layer theory.
- 2011–2015 *Instructor for **Stochastic Processes*** (~10 students per year).
Course offered to **graduate students in both Physics and Mathematics** (Pure and Applied), it covered topics such as basic notions in probability, percolation, random walk, elasticity of the rubber, Wiener's process, Itô's calculus, Stochastic Differential Equations, numerical simulations of stochastic processes, applications to finance.
- 2013–2015 *Instructor for **Mathematics Education Lab*** (~100 attendees per year).
Course offered to **teachers of the secondary school**, it presented practical activities aimed at introducing to younger students, in an engaging way, the basics of some advanced topics such as geometric topology and group theory.
- 2012–2015 *Teaching Assistant for **Rational Mechanics*** (Undergraduate course, ~40 students per year).
- 2010–2012 *Teaching Assistant for **Galois Theory*** (Graduate course, ~10 students per year).
- 2008–2009 *Teaching Assistant for **Mathematical Models and Methods for Applications*** (Undergraduate course, ~10 students).

School of Engineering - Università degli Studi di Brescia

- 2009–2010 *Teaching Assistant for **Statistics and Calculus*** (Undergraduate course, ~80 students).

Secondary School "Istituto Cesare Arici"

- 2007–2009 *Teacher of **Science***.

Mentoring

- 2010–2015 **Undergraduate students.** Supervised and co-supervised a total of **twelve Bachelor's theses** on topics related to Quantum Transport, Fluid Mechanics, and Dynamical Systems.
- 2012–2016 **Graduate students.** Eight Master's theses supervised.
- Three theses on financial applications of stochastic differential equations: Dario Fontana (PhD in Economics, Applied Mathematics and Operational Research, University of Bergamo), Annalisa Bonetti (Business Analyst at Prima.it), Elisabetta Benzi (Quantitative Analyst at Banco Popolare)
 - A thesis on the gradient-flow formulation of the Fokker-Planck equation and its applications: Giada Ronchi
 - A thesis on the motion of deformable bodies in viscous fluids: Filippo Recrosi (PhD student at Gran Sasso Science Institute)
 - A thesis on the remodeling of poroelastic continua: Simone D'Arco (OCS SpA, Brescia)
 - A thesis on cooperative phenomena in open quantum systems: Filippo Recrosi (PhD student at Gran Sasso Science Institute)
 - A thesis on Stokesian dynamics for extensional rheology: Antonio Martiniello (applying for PhD programs)

Memberships

- since 2010 *National Group for Mathematical Physics* of Istituto Nazionale di Alta Matematica “F. Severi” (Italy).
- since 2013 International Research Center for Mathematics & Mechanics of Complex Systems (M&MoCS).
- since 2014 *Group Dynamics and non-equilibrium states of complex systems: Mathematical methods and physical concepts* of Istituto Nazionale di Fisica Nucleare (Italy).

Professional Development

- 2016 **Certified Course:** *Communicating Effectively in English: Building Linguistic and Cultural Strategies for Scientists.*
- 2016 **Certified Course:** *Introduction to Project Management.*

Attended Scientific Workshops, Schools, and Courses

- Jan 14–15, 2017 **Workshop:** Analysis and Partial differential equations (NTU, Taipei).
- Oct 15–17, 2016 **Workshop:** Geometry and Materials Sciences (OIST, Okinawa).
- May 23–26, 2016 **Workshop:** Marrying continuum and molecular physics: the Andersen-Parrinello-Rahman method revised into a scale bridging device (CECAM, Lausanne).
- Jan 13–15, 2016 **Workshop:** Mathematical Modeling and Analysis of Protein Cages (OIST, Okinawa).
- Jun 29–Jul 2, 2015 **Workshop:** Quantum Effects in Biological System 2015 (Florence).
- May 25–29, 2015 **School:** Interaction of Microscopic Structures and Organisms with Fluid Flows (CISM, Udine).
- Feb 2–6, 2015 **School:** Recent Breakthroughs in Singular Stochastic PDEs (Milano-Bicocca).
- Sept 9, 2014 **Workshop:** Mechanobiology of the Cell and Tissues Morphogenesis (Milan).
- Sept 1–5, 2014 **CIME–CIRM course** on Mathematical Models and Methods for Living Systems (Levico Terme).
- Feb 3–5, 2014 **Course:** Thin Elastic Structures (Brescia).
- Mar 16–21, 2014 **Workshop:** EUROMECH Colloquium 563 (Cisterna di Latina).
- Sept 29–Oct 4, 2013 **Workshop:** Evolution Problems for Material Defects: Dislocations, Plasticity, and Fracture (SISSA, Trieste).
- May 21–25, 2013 **Workshop:** Transport in Open Quantum Systems: Experiment and Theory (Porquerolles).
- Apr 4–6, 2013 IV International **Conference** on New Trends in Fluid and Solid Models (Vietri sul Mare).
- Feb 6–8, 2012 **Course:** Smart Elasticity (Brescia).
- Oct 22–24, 2012 **SNP Workshop** 2012: New Materials and New Problems in Continuum Mechanics (Udine).
- Sept 21–22, 2012 International **Workshop** on Quantum Transport and Quantum Effects in Photosynthetic Systems (Brescia).
- May 14–18, 2012 **BIRS Workshop:** Connections Between Regularized and Large-Eddy Simulation Methods for Turbulence (Banff).
- Apr 19–20, 2012 **Workshop:** New concepts on active materials and actuators and bioinspired sensing-actuation control (Seattle).
- Oct 10–14, 2011 **ERC Workshop** on Geometric Analysis on sub-Riemannian and Metric Spaces (Pisa).
- Sept 19–30, 2011 XXXVI GNFM Summer **School** on Mathematical Physics (Ravello).
- Jun 20–23, 2011 **Workshop:** Interfaces and discontinuities in solids, liquids and crystals (Gargnano).
- May 30–Jun 3, 2011 **HCDTE courses:** Variational approach to the Euler equation (A. Figalli), Optimal transportation on manifolds (K.-T. Sturm), at SISSA (Trieste).
- Feb 14–19, 2011 **School and Workshop** on Mathematical Methods in Quantum Mechanics (Bressanone).
- Jan 31–Feb 2, 2011 **Course:** Mathematical Models in Cardiac Physiology (Brescia).
- Sept 21, 2010 Early Stage Researchers **Workshop** in Stochastic Control (Milano).
- Sept 6–11, 2010 CIME-EMS Summer **School** in Applied Mathematics: Topics in mathematical fluid-mechanics (Cetraro).
- Aug 30–Sep 2, 2010 **Workshop:** STAMM 2010 (Berlin-Schmoeckwitz).
- Jul 12–16, 2010 **School:** Variational Models and Methods in Solid and Fluid Mechanics (CISM, Udine).
- Sept 14–26, 2009 XXXIV GNFM Summer **School** on Mathematical Physics (Ravello).
- Jun 9–11, 2009 **Workshop:** Mathematical Models and Analytical Problems for Special Materials (Brescia).

Language Skills

- **Italian:** full professional proficiency (mother tongue).
- **English:** full professional proficiency.
- **Japanese:** basic oral proficiency.
- **French:** basic oral proficiency.

Teamwork Skills

I enjoy **discussing ideas** and advancing projects in **collaboration** with other scientists. My various experiences with students and colleagues in **international settings** has led me to value **diversity, constructive feedback**, and the creation of a **friendly working environment**. Participating in projects as either a collaborator or a coordinator I also developed **management skills** aimed at enhancing the efficiency of the team.

Computer Skills

I currently work in **GNU/Linux** as well as proprietary environments. As for programming languages, I use **Fortran** and **Python** for scientific computing and **C/C++** for other applications.

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