

Diletta Burini

RTDB Researcher in Mathematical Physics (MATH-04/A)

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Research Interests

My research focuses on the mathematical modelling of complex systems, with particular emphasis on kinetic theory and multiscale methods. A central theme of my work is the study of how interactions at the individual level give rise to collective dynamics and emergent behaviours.

I develop kinetic and multiscale frameworks for systems of interacting entities, with particular attention to the connections between microscopic, mesoscopic, and macroscopic descriptions. Applications include learning and social dynamics, complex living systems, and mathematical biology, with recent work addressing immune and disease dynamics.

Academic and Institutional Service

2026	Membro effettivo della Commissione giudicatrice per l'ammissione al Dottorato di Ricerca in Matematica, Informatica, Statistica – XLII ciclo Università degli Studi di Firenze
2025–Present	Delegata del Direttore alla Comunicazione, Social Media e Relazioni esterne Dipartimento di Matematica e Informatica, Università degli Studi di Perugia
2025–Present	Referente per il Progetto Nazionale Liceo Matematico Dipartimento di Matematica e Informatica, Università degli Studi di Perugia
2025–Present	Componente della Commissione Ricerca Dipartimentale Dipartimento di Matematica e Informatica, Università degli Studi di Perugia

Education

2013	Ph.D. in Mathematics and Computer Science for Information and Knowledge Treatment Università degli Studi di Perugia Ph.D. Thesis: <i>Nonlinear Models in Fluid Dynamics</i> Supervisor: Prof. Silvana De Lillo
2009	Master's Degree in Mathematics Università degli Studi di Perugia
2007	Bachelor's Degree in Mathematics Università degli Studi di Perugia

National Academic Qualification

2020	Abilitazione Scientifica Nazionale a Professore di II Fascia Settore Concorsuale 01/A4 – Fisica Matematica
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Research Positions and Fellowships

2015–2016	Postdoctoral Research Fellow DISMA, Politecnico di Torino <i>Qualitative analysis and computational modeling of biological dynamics with mutation and Darwinian selection, with applications to immune competition</i> PRIN 2012 – Mathematical Problems in Kinetic Theory and Applications Scientific Supervisor: Prof. Elena De Angelis
2014–2015	Postdoctoral Research Fellow Department of Mathematics, Università degli Studi di Perugia <i>Physico-Mathematical Models of Polymer Chains</i> PRIN + INSTM (FIRB) Scientific Supervisor: Prof. Silvana De Lillo
2013–2014	Postdoctoral Research Fellow Department of Mathematics, Università degli Studi di Perugia <i>Study of Polymer Chains in Fluids: Propagation of Solitary Waves</i> PRIN 2010–2011 Scientific Supervisor: Prof. Silvana De Lillo
2011–2012	Research Fellow Department of Mathematics, Università degli Studi di Perugia <i>Physical-Mathematical Models for Elastic String Description, Biopolymers and Synthetic Polymers</i> PRIN 2008 Scientific Supervisor: Prof. Silvana De Lillo
2010–2011	Research Fellow Department of Mathematics, Università degli Studi di Perugia <i>Physical-Mathematical Models of Biological and Synthetic Polymers</i> Scientific Supervisor: Prof. Silvana De Lillo

International Academic Mobility

2026	University of Deusto, Bilbao, Spain Erasmus+ Staff Mobility for Training
2016	Universidad de Granada, Spain Departamento de Matemática Aplicada
2012, 2013	University of Colorado Boulder, USA Department of Applied Mathematics

Teaching Activity

Current Courses

2025–Present	Modelli Matematici per le Applicazioni Master's Degree in Mathematics, Università degli Studi di Perugia
2024–Present	Fisica Matematica I Bachelor's Degree in Mathematics, Università degli Studi di Perugia
2024–Present	Meccanica Razionale I Bachelor's Degree in Mathematics, Università degli Studi di Perugia

Previous Teaching

2016–2018	Istituzioni di Matematica Degree Programme in Primary Education, Università degli Studi di Perugia
2015–2016	Geometry – Co-teaching Degree Programme in Engineering, Politecnico di Torino
2007–2013	Tutoring in Mathematics and Mathematical Physics Università degli Studi di Perugia

Ph.D. Supervision

2017–2019	Co-supervision of Ph.D. students Nadia Chouhad, Cadi Ayyad University, Marrakech, Morocco Nisrine Outada, Cadi Ayyad University, Marrakech, Morocco, in co-tutelle with Laboratoire Jacques-Louis Lions, Paris, France Co-supervised with Prof. Nicola Bellomo
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Invited Talks and Conference Presentations

2026	Invited Seminar <i>Modelling Immune Dynamics in Coeliac Disease: A Multiscale Kinetic Approach</i> IKTrace Seminar (IMAT–CCM), Faculty of Engineering, University of Deusto, Bilbao, Spain
2017	Invited Talk BIOPHYS17 – Theoretical Physics Tools and Complex Network Physics Applied to Biology and Social Systems Pisa, Italy
2017	Conference Presentation Problems in Discrete Dynamics: From Biochemical Systems to Rare Events, Networks, Clustering and Related Topics II Arcidosso, Italy
2015	Conference Presentation NEEDS 2015 – Nonlinear Evolution Equations and Dynamical Systems Santa Margherita di Pula, Italy
2013	Conference Presentation PMNP 2013 – Physics and Mathematics of Nonlinear Phenomena Gallipoli, Italy
2011	Conference Presentation WASCOM 2011 – Waves and Stability in Continuous Media Brindisi, Italy

Selected Publications

1. **D. Burini**, D.A. Knopoff, *A Multiscale Kinetic Theory Approach to Viral-Immune Competition, Mathematical Models and Methods in Applied Sciences*, **36**(6), 1307–1324, 2026.
2. **D. Burini**, D.A. Knopoff, L. Serrano, *Multiscale Kinetic Model for Immune Reaction in Coeliac Disease, Mathematics*, **14**(8), 1333, 2026.
3. N. Bellomo, **D. Burini**, J. Liao, *New Trends in Kinetic Theory Toward the Complexity of Living Systems, Mathematical Models and Methods in Applied Sciences*, **36**(2), 341–397, 2026.

4. G. Bertaglia, A. Bondesan, **D. Burini**, R. Eftimie, L. Pareschi, G. Toscani, *New Trends on the Systems Approach to Modeling SARS-CoV-2 Pandemics in a Globally Connected Planet, Mathematical Models and Methods in Applied Sciences*, **34**(11), 1995–2054, 2024.
5. **D. Burini**, D.A. Knopoff, *Epidemics and Society—A Multiscale Vision from the Small World to the Globally Interconnected World, Mathematical Models and Methods in Applied Sciences*, **34**(8), 1567–1596, 2024.
6. N. Bellomo, **D. Burini**, V. Secchini, P. Terna, *Active Particles Methods: New Perspectives in the Interaction between Mathematics and Economics, Cambridge Elements in Complexity and Agent-Based Economics*, Cambridge University Press, 2024.
7. **D. Burini**, N. Chouhad, *Cross Diffusion Models in Complex Frameworks from Microscopic to Macroscopic, Mathematical Models and Methods in Applied Sciences*, **33**(9), 1909–1928, 2023.
8. **D. Burini**, N. Chouhad, N. Bellomo, *Waiting for a Mathematical Theory of Living Systems: From a Critical Review to Research Perspectives, Symmetry*, **15**(2), 351, 2023.
9. N. Bellomo, **D. Burini**, N. Outada, *Pandemics of Mutating Virus and Society: A Multi-Scale Active Particles Approach, Philosophical Transactions of the Royal Society A*, **380**(2224), 20210161, 2022.
10. **D. Burini**, N. Chouhad, *A Multiscale View of Nonlinear Diffusion in Biology: From Cells to Tissues, Mathematical Models and Methods in Applied Sciences*, **29**(4), 791–823, 2019.
11. **D. Burini**, S. De Lillo, L. Gibelli, *Collective Learning Modeling Based on the Kinetic Theory of Active Particles, Physics of Life Reviews*, **16**, 123–139, 2016.