

Curriculum vitae of Carlo Massimo Casciola

Proposed primary ERC subfields: PE8_5 Fluid mechanics; PE8_4 Computational engineering.

Proposed secondary ERC subfields: PE3_14 Fluid dynamics (physics); PE3_16 Physics of biological systems.

PERSONAL DETAILS

Family name and first names: Casciola, Carlo Massimo

ORCID: 0000-0001-8795-4517

Publication profile: <https://scholar.google.com/citations?user=iLiWpyoAAAAJ>

Education and key qualifications

1986 Master
Faculty of Engineering/ Department of Mechanical and Aerospace Engineering, Sapienza University of Rome, Italy.

Current positions

2007 - present Full Professor of Fluid Mechanics, DIMA, Sapienza University of Rome, Italy.

2022 - present Dean of the Faculty of Civil and Industrial Engineering, Sapienza University of Rome, Italy.

2025 - present President of the Italian Academy of Engineering and Technology (ITATEC).

Previous positions

2000 - 2007 Associate Professor of Fluid Mechanics, DIMA, Sapienza University of Rome, Italy.

1992 - 2002 Researcher in Fluid Mechanics, DIMA, Sapienza University of Rome, Italy.

1990 - 1992 Adjunct Professor of Gas Dynamics, University of Perugia, Italy.

1986 - 1992 Researcher, INSEAN, National Ship Hydrodynamics Research Centre, Italy.

Research profile

Fluid mechanics researcher working across turbulence, complex fluids, phase transitions and micro- and nanofluidics. His research combines theory, numerical simulation and experiment, linking atomistic and mesoscale descriptions to macroscopic flows and to applications in materials, biology and medicine.

Coordinates a research group typically comprising 15-20 permanent researchers, associate professors, postdoctoral researchers and PhD students. Research methods include direct numerical simulation, molecular dynamics, free-energy and rare-event methods, phase-field modelling, fluctuating hydrodynamics and microfluidic fabrication.

RESEARCH ACHIEVEMENTS AND PEER RECOGNITION

Research achievements

His research addresses energy transfer and scaling in turbulence, polymer-induced drag reduction, liquid-vapour nucleation and cavitation, surface wettability, and the mechanics of lipid membranes. A complementary experimental programme uses microfluidic devices to investigate bubble dynamics and the permeability of biological barriers.

Major projects and technological outputs

As principal investigator of the ERC Advanced Grant BIC (2013 call; funded 2014-2018; grant 339446), he led the development of multiscale simulation approaches to bubble nucleation, from atomistic descriptions to mesoscale models. The project also addressed nucleation under nanoscale confinement and intrusion-extrusion in nanoporous materials, and produced a photonic pressure sensor for shock waves induced by bubble collapse.

The ERC Proof of Concept INVICTUS (2017 call; grant 779751) supported a blood-vessel-on-a-chip platform containing a living, functional endothelial layer. The platform was designed to study how

ultrasound-driven microbubbles enhance endothelial permeability, with potential applications in targeted drug delivery and blood-brain barrier opening. He also led the microfluidics research unit of the PON NEON project (2018-2023) for theranostic applications.

Bibliometric indicator: Scopus h-index 41 (11 October 2026).

Selected research outputs

1. M. Gallo, F. Occhioni, R. Daniele and C. M. Casciola. *Hydrodynamical pathways in the phase change of real fluids*. Communications Physics (2026).

Focus and role: Examines hydrodynamic pathways involved in phase change in real fluids. Role: research leader.

2. F. Serafini, F. Battista, P. Gualtieri, R. Benzi and C. M. Casciola. *Mean effective viscosity theory in polymer turbulent flows*. Europhysics Letters 156(1), 13002 (2026).

Focus and role: Develops a theoretical description of effective viscosity in turbulent polymer flows. Role: research leader.

3. A. de J. Rivera, F. Serafini, P. Gualtieri, F. Battista, A. T. Franco and C. M. Casciola. *Numerical experiments of polymer-induced fluctuating states in a parallel channel flow*. Physics of Fluids 38(9) (2026).

Focus and role: Investigates polymer-induced fluctuating flow states through numerical experiments. Role: research leader.

4. V. Garbin, D. Bothe, G. Brenn, C. M. Casciola, C. Colin, M. Marengo, F. Risso, G. Tryggvason and D. Lohse. *Bubbles and bubbly flows*. International Journal of Multiphase Flow, 105240 (2025).

Focus and role: Addresses bubble dynamics and bubbly flows within a broad collaboration in multiphase fluid mechanics. Role: research leader.

5. M. Bottacchiari, M. Gallo, M. Bussoletti and C. M. Casciola. *Diffuse interface model for fluid lipid vesicles with area-difference elasticity*. Meccanica, published online 10 February 2025.

Focus and role: Extends diffuse-interface modelling of lipid vesicles to include area-difference elasticity. Role: research leader.

6. M. Gallo and C. M. Casciola. *Vapor bubble nucleation in flowing liquids*. International Journal of Multiphase Flow 179, 104924 (2024).

Focus and role: Connects vapour bubble nucleation with the dynamics of flowing liquids. Role: research leader.

7. D. Abbondanza, M. Gallo and C. M. Casciola. *Collapse of microbubbles over an elastoplastic wall*. Journal of Fluid Mechanics 999, A72 (2024).

Focus and role: Studies bubble collapse near a deformable wall, relevant to cavitation-induced material response. Role: research leader.

8. M. Bottacchiari, M. Gallo, M. Bussoletti and C. M. Casciola. *The diffuse interface description of fluid lipid membranes captures key features of the hemifusion pathway and lateral stress profile*. PNAS Nexus 3(8) (2024).

Focus and role: Uses diffuse-interface modelling to describe membrane hemifusion and lateral stresses. Role: research leader.

9. F. Serafini, F. Battista, P. Gualtieri and C. M. Casciola. *Polymers in turbulence: any better than dumbbells?* Journal of Fluid Mechanics 987, R1 (2024).

Focus and role: Examines the representation of polymers in turbulent-flow models. Role: research leader.

10. M. Gallo, F. Magaletti, A. Georgoulas, M. Marengo, J. De Coninck and C. M. Casciola. *A nanoscale view of the origin of boiling and its dynamics*. Nature Communications 14(1) (2023).

Focus and role: Investigates the onset and dynamics of boiling from a nanoscale perspective. Role: research leader.

11. P. Pfeiffer, M. Shahrooz, M. Tortora, C. M. Casciola, R. Holman, R. Salomir, S. Meloni and C.-D. Ohl. *Heterogeneous cavitation from atomically smooth liquid-liquid interfaces*. Nature Physics 18(12) (2022).
Focus and role: Investigates heterogeneous cavitation at smooth liquid-liquid interfaces. Role: research leader.
12. M. Bottacchiari, M. Gallo, M. Bussoletti and C. M. Casciola. *Activation energy and force fields during topological transitions of fluid lipid vesicles*. Communications Physics 5(1) (2022).
Focus and role: Quantifies energetic and mechanical aspects of topological transitions in lipid vesicles. Role: research leader.
13. F. Serafini, F. Battista, P. Gualtieri and C. M. Casciola. *Drag reduction in turbulent wall-bounded flows of realistic polymer solutions*. Physical Review Letters 129(10) (2022).
Focus and role: Investigates turbulent drag reduction using models of realistic polymer solutions. Role: research leader.
14. F. Magaletti, M. Gallo, C.M. Casciola. *Water Cavitation From Ambient to High Temperatures*, Scientific Reports 11.20801 (2021).
Focus and role: Computation and validation of cavitation pressure in an extended temperature range. Role: research leader.
15. M. Tortora, S. Meloni, B.H. Tan, A. Giacomello, C.-D. Ohl, and C.M.Casciola. *The interplay among gas, liquid and solid interactions determines the stability of surface nanobubbles*, Nanoscale (2020).
Focus and role: Molecular dynamics investigation of nanobubble stability. Role: research leader.
16. G. Silvani, C. Scognamiglio, D. Caprini, L. Marino, M. Chinappi, G.Sinibaldi, G. Peruzzi, M.F. Kiani, C.M. Casciola, *Reversible USMB- induced junctional opening in an artificial endothelial layer*, Small (2019).
Focus and role: Realization of a living blood vessel to address endothelial cell junction opening. Role: research leader.
17. S. Marchio, S. Meloni, A. Giacomello, C.M. Casciola, *Wetting and recovery of nano-patterned surfaces beyond the quasi-static picture*, Nanoscale (2019).
Focus and role: Molecular dynamics investigation of wetting on complex nanopatterned surfaces. Role: research leader.
18. A. Tinti, A. Giacomello, Y. Grosu, and C.M. Casciola, “Intrusion and extrusion of water in hydrophobic nanopores”, Proceedings of the National Academy of Sciences USA 114(48) (2017).
Focus and role: Theoretical analysis of water intrusion processes. Role: research leader.
19. F. Magaletti, L. Marino, C.M. Casciola, *Shock formation in the collapse of a vapor nano-bubble*, Phys. Rev. Lett. 114, 064501 (2015).
Focus and role: First mesoscopic simulation of vapor bubble collapse. Role: research leader.
20. F. Magaletti, F. Picano, M. Chinappi, L. Marino, C.M. Casciola. *The sharp interface limit of the Cahn-Hilliard/Navier-Stokes model for binary fluids*, Journal Fluid Mech., 714, 95-126 (2013).
Focus and role: Scaling of diffuse interface models. Role: research leader.

Peer recognition

- 2017** ERC Proof of Concept award, INVICTUS, following the ERC Advanced Grant BIC.
- 2014 - 2020** Senior Fellow, Sapienza School for Advanced Studies (SSAS).
- 2013** ERC Advanced Grant award, BIC, for research on cavitation across scales.
- 2010** Sapienza Excellence Research Award.
- 2006 - present** Founding member, Sapienza Centre for Engineering Nanotechnology (CNIS).

2000 - present Member of the European Mechanics Society (EUROMECH).

Selected invited presentations

2026 Complex Transition Pathways in Boiling and Cavitation, 8th Cavitation and Multiphase Flow Workshop, Chania, Greece; Turbulence of Dilute Polymer Solutions, Simons Center, Stony Brook, USA; Turbulence of Dilute Solutions of Supramolecular Polymers, NEMD, Edinburgh, UK.

2025 How the Microstructure Can Influence the Macroscopic Response of a Complex System: Polymer-induced Drag Reduction, Massachusetts Institute of Technology, Boston, USA; High-Performance Computing: Bridging the Gap Between Micro- and Macroscale, Italian Research Day, Consulate General of Italy in Boston; On the Dynamics of Liquid/Vapor Phase Change, Accademia dei Lincei, Rome.

2024 Cavitation Physics in Microfluidic Devices, Institut de Biologie Physico-Chimique, CNRS, Paris; A Technological Challenge Posed by AI and HPC: Cooling Down a Supercomputer, MATCHES workshop, CNR, Rome.

ADDITIONAL INFORMATION

Other contributions to the research community

Academic and research leadership includes the presidency of ITATEC since 2025 and the deanship of Sapienza's Faculty of Civil and Industrial Engineering since 2022. ITATEC brings together researchers in engineering and technology and engages advisers from leading national companies.

2018 - 2025 Member of the Board of Directors, Italian Association of Theoretical and Applied Mechanics (AIMETA).

2012 - 2016 Director, Sapienza-IT CECAM Centre, supporting interdisciplinary research on advanced computational methods.

2008 - 2016 Director, Master's Programme in Nanotechnology Engineering, Sapienza.

2007 - 2017 Director, PhD Programme in Theoretical and Applied Mechanics, Sapienza.

Research infrastructure and funding leadership

Member of a EuroHPC Joint Undertaking panel since 2022; member of the PRACE Scientific Steering Committee (2014-2017). Served on CINECA procurement committees for PPI4HPC and FENIX/ICEI infrastructure. National coordinator of PRIN projects on interfaces and mesoscale models (2022), high-Reynolds-number wall turbulence (2008), and large-scale structures in wall turbulence (2005); PRIN research unit head in 2003.

Other contributions to the research community continued

Awarded PRACE computational resources for micro-cavitating systems (2021, 45 million cumulative core-hours), bubble dynamics across scales (BIMI, 2020, 35 million hours), hydrophobic nanoporous materials (POREH2O, 2016, 50 million hours), and superhydrophobic surfaces (WETMD, 2013, 31 million hours).

Additional research funding includes Sapienza Large Projects on bubble nucleation in brain tissue damage (2024), plants and plant-inspired microfluidics (2022), and biological and artificial lipid bilayer membranes (2020), alongside earlier projects and equipment grants in microfluidics, two-phase flows, microscopy and computational infrastructure.

Mentoring and teaching

Between 2000 and 2023, supervised 30 postdoctoral researchers, 42 PhD students and approximately 150 Master's students at Sapienza. Researchers mentored within his group include two ERC Starting Grant recipients, a Marie Skłodowska-Curie individual fellowship recipient, and nine academics who became associate or full professors in Italy and abroad.

Teaching includes Micro/nanofluidics and Turbulence since 2008, and Combustion and Turbulence since 2011. Previous courses include Vehicle Aerodynamics (2011-2018), Biofluid Dynamics (2011-2015), Gas Dynamics, Fluid Dynamics, Aerodynamics, Fluid Mechanics, Numerical Fluid Dynamics and related laboratory courses.

Delivered advanced and doctoral courses at CINECA and PRACE schools (2018-2021), UPMC-Sorbonne (2018), the MSCA MIGRATE network (2018), Imperial College London (2017), the Cargèse summer school (2011), and KTH's Linné Flow Centre (2008), among others.

Editorial service and scientific meetings

Editorial board or advisory board service: Microsystem Technologies (since 2021), International Journal of Multiphase Flow (since 2017), Flow, Turbulence and Combustion (since 2011), Acta Mechanica (since 2008), and Meccanica (2012-2018). Section editor for Molecular Modeling in the Encyclopedia of Nanotechnology (Springer, 2016). Referee for journals including Journal of Fluid Mechanics, Physical Review Letters, Nature, Nature Communications, ACS Nano and Lab on a Chip.

Served on the EUROMECH Turbulence Conference Steering Committee (2010-2015). Organised workshops on non-equilibrium statistical mechanics and turbulence (2016) and on superhydrophobicity, bubble stability and heterogeneous nucleation (2014). Contributed to the European Turbulence Conferences (2011 and 2013), Turbulence, Heat and Mass Transfer conferences (2012, 2015 and 2018), AIMETA 2009 and iTi 2008 through organising, scientific or advisory committees.

Technology transfer and outreach

Contributed to establishing a microfluidics laboratory for biological and medical applications and studies of cavitation-induced material damage. Research on cavitation and the ERC BIC project was communicated through television, radio and newspaper interviews. Invited presentations have also addressed engineering applications such as microfluidic drug delivery and cooling for high-performance computing.