



Tommaso Ruggeri

Emeritus Professor of Mathematical Physics

Alma Mater Studiorum - University of Bologna
tommaso.ruggeri@unibo.it | www.dm.unibo.it/~ruggeri/

Accademico Nazionale dei Lincei

2025 G. I. Taylor Medal - Society of Engineering Science

RESEARCH PROFILE

Tommaso Ruggeri is a mathematical physicist whose work centers on nonlinear wave propagation, hyperbolic systems of balance laws, continuum thermomechanics, and non-equilibrium thermodynamics in classical and relativistic media. He made foundational contributions to the symmetrization of hyperbolic balance laws through convex entropy and to the theory of acceleration waves, shocks, and sub-shocks.

A particularly important contribution concerns General Relativity: in collaboration with Yvonne Choquet-Bruhat, he proved the hyperbolicity of the 3+1 system of Einstein equations, contributing to the mathematical formulation of the Cauchy problem in General Relativity (Communications in Mathematical Physics 89, 269–275, 1983).

He is one of the founders of Rational Extended Thermodynamics (RET), developed in close collaboration with Ingo Müller and subsequently extended to polyatomic and non-polytropic gases, dense gases, mixtures, and relativistic systems. His recent research develops thermodynamically consistent hyperbolic models for nonlinear viscoelastic solids and non-Newtonian fluids with finite relaxation time.

Scientific output: more than 280 publications, including major monographs and textbooks. Citation counts and h-index are deliberately not frozen on this page; current values are available through the live profiles in the sidebar.

APPOINTMENTS

- Emeritus Professor, University of Bologna, since 2019.
- Adjunct Professor, Department of Civil, Chemical, Environmental, and Materials Engineering, University of Bologna.
- Alma Mater Professor, University of Bologna, 2017–2019.
- Full Professor of Mathematical Physics, University of Bologna, 1980–2017.
- Adjunct Professor of Rational Mechanics (historical Italian position: Professore incaricato stabilizzato), University of Bologna, 1973–1980.
- Assistant Professor of Rational Mechanics, University of Messina, 1969–1973.
- Master's Degree in Theoretical Physics, magna cum laude, University of Messina, 1969.

HONOURS AND DISTINCTIONS

- 1977 - Bonavera Prize, Accademia delle Scienze di Torino.
- 1999 - Elected Member, Accademia Nazionale dei Lincei; National Member since 2016.
- 2007 / 2017 - International WASCOM conferences dedicated to his 60th and 70th birthdays.
- 2009 - Accademico Benedettino, Accademia delle Scienze dell'Istituto di Bologna; inaugural lecture for the 922nd Academic Year of the University of Bologna.
- 2013 - National Member, Accademia di Scienze Fisiche e Matematiche di Napoli.
- 2018 - International "Angiola Gili e Cataldo Agostinelli" Prize, Accademia delle Scienze di Torino.
- 2019 - Emeritus Professor, University of Bologna.
- 2021 - Academia Europaea; European Academy of Sciences and Arts; European Academy of Sciences (EurASc).
- 2025 - G. I. Taylor Medal, Society of Engineering Science.

SELECTED RECENT PUBLICATIONS - 2024–2026

- T. Ruggeri, S. Taniguchi, "Flow-index universality and critical regime transitions of shock thickness in a power-law fluid model within rational extended thermodynamics," Physics of Fluids 38, 083105 (2026).
- P. Biscari, T. Ruggeri, G. Saccomandi, M. Vianello, Rational Mechanics, UNITEXT, Springer, 2026.
- T. Ruggeri, "Acceleration waves and the K-condition in viscoelastic solids and non-Newtonian fluids," Ricerche di Matematica (2026).
- T. Arima, T. Ruggeri, "A symmetric hyperbolic non-isothermal model for viscoelastic solids and non-Newtonian fluids," International Journal of Engineering Science 222, 104491 (2026).
- T. Arima, T. Ruggeri, S. Taniguchi, "Shock Wave Structure and Sub-Shock Formation in a Hyperbolic Nonlinear Viscoelastic Model," Journal of Elasticity 158, 13 (2026).
- M. Amabili, T. Arima, T. Ruggeri, "Stress relaxation and viscous energy in nonlinear viscoelasticity: A rational extended thermodynamics framework," Journal of the Mechanics and Physics of Solids 196, 106033 (2025).

- T. Ruggeri, "Rational Extended Thermodynamics for non-Newtonian fluids with finite relaxation time," *Physics of Fluids* 37, 111702 (2025).
- G.-C. Bae, S.-Y. Ha, G. Hwang, T. Ruggeri, "On the comparison between phenomenological and kinetic theories of gas mixtures with applications to flocking," *Physica D* 469, 134321 (2024).
- T. Arima, A. Mentrelli, T. Ruggeri, "A Novel ES-BGK Model for Non-polytropic Gases with Internal State Density Independent of the Temperature," *Journal of Statistical Physics* 191, 95 (2024).
- T. Ruggeri, "A Nonlinear Approach to Viscoelasticity via Rational Extended Thermodynamics," *International Journal of Non-Linear Mechanics* 160, 104658 (2024).

SELECTED LANDMARK PUBLICATIONS

- G. Boillat, T. Ruggeri, "Reflection and transmission of discontinuity waves through a shock wave. General theory including also the case of characteristic shocks," *Proceedings of the Royal Society of Edinburgh* 83-A, 17–24 (1979).
- T. Ruggeri, A. Strumia, "Main field and convex covariant density for quasi-linear hyperbolic systems. Relativistic fluid dynamics," *Annales de l'Institut Henri Poincaré A* 34, 65–84 (1981).
- Y. Choquet-Bruhat, T. Ruggeri, "Hyperbolicity of the 3+1 system of Einstein equations," *Communications in Mathematical Physics* 89, 269–275 (1983).
- T. Ruggeri, "Symmetric hyperbolic system of conservative equations for a viscous conducting fluid," *Acta Mechanica* 47, 167–183 (1983).
- I.-S. Liu, I. Müller, T. Ruggeri, "Relativistic thermodynamics of gases," *Annals of Physics* 169, 191–219 (1986).
- T. Ruggeri, "Galilean Invariance and Entropy Principle for Systems of Balance Laws. The Structure of the Extended Thermodynamics," *Continuum Mechanics and Thermodynamics* 1, 3–20 (1989).
- G. Boillat, T. Ruggeri, "Hyperbolic Principal Subsystems: Entropy Convexity and Subcharacteristic Conditions," *Archive for Rational Mechanics and Analysis* 137, 305–320 (1997).
- G. Boillat, T. Ruggeri, "Moment Equations in the Kinetic Theory of Gases and Wave Velocities," *Continuum Mechanics and Thermodynamics* 9, 205–212 (1997).
- G. Boillat, T. Ruggeri, "On the Shock Structure Problem for Hyperbolic System of Balance Laws and Convex Entropy," *Continuum Mechanics and Thermodynamics* 10, 285–292 (1998).
- T.-P. Liu, T. Ruggeri, "Entropy production and admissibility of shocks," *Acta Mathematicae Applicatae Sinica* 19, 1–12 (2003).
- T. Ruggeri, D. Serre, "Stability of constant equilibrium state for dissipative balance law systems with a convex entropy," *Quarterly of Applied Mathematics* 62, 163–179 (2004).
- S.-Y. Ha, T. Ruggeri, "A thermodynamically consistent model for emergent behavior in flocks and comparison with multitemperature mixtures of fluids," *Archive for Rational Mechanics and Analysis* 223, 1397–1425 (2017).
- S.-Y. Ha, J. Kim, T. Ruggeri, "From the relativistic mixture of gases to the relativistic thermomechanical Cucker–Smale flocking," *Archive for Rational Mechanics and Analysis* 235, 1661–1706 (2020).
- T. Ruggeri, Q. Xiao, H. Zhao, "Nonlinear waves in relativistic gases of massive particles with Synge energy," *Archive for Rational Mechanics and Analysis* 239, 1061–1109 (2021).

BOOKS

- I. Müller, T. Ruggeri, *Extended Thermodynamics*, Springer Tracts in Natural Philosophy 37, Springer, 1993.
- I. Müller, T. Ruggeri, *Rational Extended Thermodynamics*, 2nd ed., Springer Tracts in Natural Philosophy 37, Springer, 1998.
- T. Ruggeri, M. Sugiyama, *Rational Extended Thermodynamics Beyond the Monatomic Gas*, Springer, 2015.
- T. Ruggeri, M. Sugiyama, *Classical and Relativistic Rational Extended Thermodynamics of Gases*, Springer, 2021.
- T. Ruggeri, *Introduction to the Thermomechanics of Continua and Hyperbolic Systems*, Springer, 2024.
- P. Biscari, T. Ruggeri, G. Saccomandi, M. Vianello, *Rational Mechanics*, UNITEXT, Springer, 2026.

ACADEMIC LEADERSHIP AND SERVICE

- Director, GNFM Summer School in Mathematical Physics, Ravello, 2018–2025.
- President, Scientific Committee of INdAM, 2011–2019.
- Director, National Group for Mathematical Physics (GNFM–INdAM), 2000–2017.
- Member, INdAM Scientific Committee, 2000–2019.
- Scientific Coordinator, Alma Mater Research Center on Applied Mathematics (AM2), 2014–2021.
- Vice Dean, Faculty of Engineering, University of Bologna, 1995–2001.
- Director, CIRAM, University of Bologna, 1991–1997.

EDITORIAL ACTIVITY

Current or recent editorial boards: Philosophical Transactions of the Royal Society A, International Journal of Non-Linear Mechanics, Ricerche di Matematica, Rendiconti Lincei - Matematica e Applicazioni, Le Matematiche, and Entropy.

Refereeing: regular referee for leading journals in mathematical physics, continuum mechanics, hyperbolic PDEs and thermodynamics.

VISITING POSITIONS AND INVITED LECTURES

Selected visiting appointments: Brown University (C. M. Dafermos), Paris (Y. Choquet-Bruhat), Berlin/WIAS (I. Müller), Stanford (T.-P. Liu), Nagoya (M. Sugiyama), Seoul (S.-Y. Ha), Konstanz (H. Freistühler), Westlake University, Hangzhou (M. Amabili), and institutions in Marseille, Hong Kong, Sydney, Chengdu, Shanghai, Wuhan, Taipei, Novi Sad, Tomakomai and Aachen.

Selected invited lectures: Oberwolfach, Collège de France, IHES, Brown University, Stanford, JAXA Sagami-hara, Accademia Nazionale dei Lincei, and major international meetings in Europe, Asia, Australia and the Americas.

TEACHING AND MENTORSHIP

- Taught Rational Mechanics for Engineering for 44 years, from 1973.
- Since 2006, taught Mathematical Physics in the Master's programme in Civil Engineering and continues to contribute to teaching as Emeritus Professor.
- Delivered PhD courses in Bologna and Messina, and internationally in Nagoya and Seoul.
- Supervised master's, doctoral and research-grant students; former students and postdoctoral collaborators hold academic positions in Italy and abroad.

Previous students

- A. Strumia (Full Professor, Bari)
- A. Muracchini (Full Professor, Bologna)
- A. Mentrelli (Associate Professor, Bologna)
- L. Seccia (Associate Professor, Bologna)
- F. Brini (Associate Professor, Bologna)

Foreign postdoctoral fellows

- J. Au (Industrial Engineer, Berlin)
- S. Simic (Full Professor, Novi Sad)
- J. Lou (Full Professor, Shanghai)
- N. Zhao (Full Professor, Chengdu)
- S. Taniguchi (Associate Professor, Kitakyushu)
- T. Arima (Associate Professor, Tomakomai)
- J. Kim (Assistant Professor, Seoul)

ONLINE PROFILES AND COMPLETE BIBLIOGRAPHY

- Complete bibliography: www.dm.unibo.it/~ruggeri/pubblicazioni.html
- Google Scholar: scholar.google.it/citations?user=u9bjPgYAAAAJ&hl=it
- ORCID: 0000-0002-7588-2074
- University of Bologna profile: www.unibo.it/sitoweb/tommaso.ruggeri
- Top Italian Scientists: listed in Mathematics
- Research.com: research.com/u/tommaso-ruggeri

Curriculum updated: August 2026.