

# CURRICULUM VITAE



## PERSONAL INFORMATION

Name: **Tommaso RUGGERI**

- Place and Date of Birth: Messina, 31/07/1947
- Website: <http://www.dm.unibo.it/~ruggeri/>
- Email: [tommaso.ruggeri@unibo.it](mailto:tommaso.ruggeri@unibo.it)
- ORCID: 0000-0002-7588-207

## CURRENT POSITION AND AFFILIATION

- Alma Mater Professor - Bologna University – since 1 November 2017

## PREVIOUS POSITIONS

- Assistant professor of Rational Mechanics –University of Messina 1969-1973
- Associate professor of Rational Mechanics –University of Bologna 1973-1980
- Full Professor of Mathematical Physics. Department of Mathematics – University of Bologna 1980- until 31 October 2017

## EDUCATION

- Master in Theoretical Physics 30/6/1969 – University of Messina

## SCIENTIFIC AND ACADEMIC POSITIONS

- President of the Scientific Committee of the Istituto Nazionale di Alta Matematica (INdAM) since 2011.
- Director of the National Group of Mathematical Physics (GNFM) of INdAM 2000-2017.
- Member of the Scientific Committee of the Istituto Nazionale di Alta Matematica (INdAM) since 2000.
- Scientific Coordinator of the Alma Mater Research Center on Applied Mathematics AM<sup>2</sup> of University of Bologna since 2014.
- Member of the Executive Committee of the International Society for the Interaction of Mechanics and Mathematics (ISIMM) 2008-2014.
- Vice Dean of Engineering Faculty of University of Bologna 1995-2001.
- Director of Interdepartmental Research Centre of Applied Mathematics (CIRAM) 1991-1997.

## **AWARDS:**

- 1975: Bonavera prize of the Accademia delle Scienze Torino for the best research in Applied Mathematics for young researchers.
- 1999: Elected Member of the National Accademia dei Lincei in the class of Mechanics and Applied Mathematics.
- 2001: Elected Member of the Accademia Peloritana dei Pericolanti di Messina.
- 2003: Invited to give the opening lecture to the Unione Matematica Italiana Meeting (Milan).
- 2007: An international scientific conference was dedicated to him for his 60 years – *Waves and Stability in Continuous Media* (WASCOM 2007) Baia Samuele, Sicily organized by INdAM.
- 2009: Elected Member of the Accademia delle Scienze dell'Istituto di Bologna (Accademico Benedetto).
- 2009: Invited to give the inaugural lecture (prolusione) to the 922 Academic Year of the University of Bologna.
- 2012: Prize of KIWANIS International - Messina Nuovo Ionio.
- 2013: Elected National Member of the Accademia di Scienze Fisiche e Matematiche di Napoli.
- 2017: An international scientific conference was dedicated to him for his 70 years in Bologna *Waves and Stability in Continuous Media* (WASCOM 2017) organized by Alma Mater Studiorum University of Bologna and the Mathematical Department of Bologna University with the participation of the Rector of University Prof. Francesco Ubertini (<https://events.unibo.it/wascom2017>).

## **RESEARCH FUNDINGS**

2000-02, 2003-05, 2005-07 National Coordinator of the Project of the National Interests of MURST: *Nonlinear Mathematical Problems of Wave Propagation and Stability in Models of Continuous Media*.

FARB 2012-2014 Project: *Extended Thermodynamics of Non-Equilibrium Processes from Macro- to Nano-Scale*.

Progetto Premiale MATHTECH CNR-INdAM 2015.

## **VISITING POSITIONS AND LECTURES:**

He has been invited to deliver lectures at several international meetings and in many Universities as Visiting Professor, in particular:

### **Visiting:**

Providence – Brown University - (1984) invited by Prof. Dafermos;

Paris (1984) invited by Prof. Y. Choquet-Bruhat;

Berlin (1985, 1990, 1996, 2000) invited by Prof. Mueller;

Marseille (2001, 2003, 2007, 2008, 2009,2010) invited by Prof. H. Gouin;

Novi-Sad (2003, 2005, 2006, 2009, 2015) invited by Proff. S. Simic and T. Atanacković;

Nagoya (2003, 2006, 2008, 2010,2013, 2014, 2015, 2016) invited by Prof. M. Sugiyama;

Hong Kong (2007, 2008, 2010, 2011) invited by Prof. C. Rogers;

Sydney (2007) invited by Prof. C. Rogers;

Birmingham (2008) invited by Prof. Y. D. Shikhmurzaev;  
Chengdu (2008, 2010, 2011) invited by Prof. N. Zhao;  
Mumbai (2009) invited by Prof. V. D. Sharma;  
Stanford (2010) invited by Prof. Tai Ping Liu;  
Shanghai – Fudan University (2011) invited by Prof. Zongmin Wu;  
Kitakiushu (2015, 2017) invited by Prof. Shigheru Taniguchi;  
Yokoyama (2017) invited by Dr. Takashi Arima;  
Seul (2014, 2016) invited by Prof. Seung Ha.  
Shanghai (2017) invited by Prof. Jie Lou.

### **General invited Lectures:**

University of Texas (Dallas 1980), WASCOM Meetings (from 1981 to 2015 every 2 years), Oberwolfach (1981, 1983, 1985, 1992, 1996, 1997, 2000, 2002, 2004, 2008), College de France (Paris 1984), Brown University (1984), Minnesota (Minneapolis 1984), Toronto (1984), Accademia dei Lincei (1984, 1986, 1988, 2016), Berlin (1985, 1998, 2005, 2011), Paris (1988, 1993), Warsaw (1990, 1996, 2005), IPERXX Meetings (from 1993 to 2011), Blauberun (2000), Seehim-Jugenheim (2001), Potsdam (2001), Heidelberg (2001), Marseille (2001, 2003, 2007, 2008, 2013), Nagoya (2003, 2006, 2008, 2010, 2013), Kyoto (2003, 2006, 2013), Osaka (2004, 2006), Xi'an (2004), Shanghai (2005, 2017), Clermont-Ferrand (2005), Belgrade (2006), Koriyama (2006), Tallin (2006), China-Italian Meeting (2004, 2006, 2008, 2010, 2012, 2014, 2016), Dublin (2006), Hong Kong (2007, 2010), Sydney (2007), Melbourne (2007), Birmingham (2008), Chongqing (2008), Chengdu (2008, 2010), Palic (2009), Mumbai (2009), Stanford (2010), Providence (Brown University) (2011), Taipei (2012), JAXA –Sagamihara (2013), IHES- Bures-sur-Yvette (Paris, 2014, 2015), Fukuoka (2014, 2017), Novi Sad (2014, 2015), Seoul (2014, 2015, 2016), Rio de Janeiro (2016).

### **ORGANISATION OF CONFERENCES, WORKSHOPS, SCHOOLS:**

Wascom series Conferences, GNFM Ravello Summer Schools (every year from 2000) and many others see web page.

### **MEMBER OF THE EDITORIAL BOARD:**

Member of the Editorial board of Cont. Mech. and Thermody. (Springer) 1989-2006.  
Member of the Editorial board of Rend. Lincei, Matematica ed Applicazioni (EMS) since 1999.  
Member of the Editorial board of Ricerche di Matematica (Springer) since 2005.  
Member of the Editorial board of BUMI since 2007-2013.  
Member of the Editorial board of International Journal of Non-Linear Mechanics (Elsevier) since 2012.  
Member of the Editorial board of Springer INdAM Series since 2013

### **JOURNAL REFEREEING:**

Journal of Mathematical Physics, Physical Review A, Physical Review B, Physical Review E; Physics of Fluids, Physics Letters, Physica D: Nonlinear Phenomena; Annals of Physics; Journal of Physics A: Mathematical and General; Nuovo Cimento; Meccanica; Annali Matematica Pura ed Applicata; Bollettino Unione Matematica Italiana; Rendiconti del Circolo Matematico di Palermo; Wave Motion; Zeitschrift fur Angewandte Mathematik und Physik, International Journal of Mathematics and Mathematical Sciences; Acta Mechanica, Journal of Mathematical Analysis and Applications, Archive Rational Mechanics and Analysis, Continuum Mechanics and Thermodynamics, Comptes Rendus de

l'Académie des Sciences; International Journal of Engineering Science; Applied Mathematical Modelling; Applied Mathematics and Computation; Chaos, Solitons & Fractals; Computers and Mathematics with Applications; European Journal of Mechanics - B/Fluids; International Journal of Engineering Science; International Journal of Non-Linear Mechanics; Physics Letters A. Mechanics Research Communications.

## **AFFILIATIONS**

He's member of:

I.S.I.M.M. (International Society for the Interaction of Mechanics and Mathematics);

G.N.F.M. (Gruppo Nazionale Fisica Matematica);

I.N.F.N (Istituto Nazionale di Fisica Nucleare);

U.M.I. (Unione Matematica Italiana);

A.M.S (American Mathematical Society);

S.I.M.A.I. (Società Italiana Matematica Applicazioni Industriali).

## **LANGUAGE SKILLS**

- Italian
- English

## **SCIENTIFIC DISSEMINATION**

Prof. Ruggeri is Coordinator of the Bologna Section of "*I Lincei per una Didattica nelle Scuole: Una rete Nazionale*" organized by the Accademia Nazionale dei Lincei. Moreover he gave several conferences for scientific dissemination: Festival della Scienza (Palermo 2009); Summer School "Fisica in Moto" (Ducati – Bologna 2011); Conferenze della Facoltà di Ingegneria (Bologna 2011); VIII Festival Scienza e Filosofia (Foligno 2017).

## **CITATIONS:**

- Google Scholar Citations: <http://scholar.google.it/citations?user=u9bjPgYAAAAJ&hl=it>
- Researchgate: [https://www.researchgate.net/profile/Tommaso\\_Ruggeri](https://www.researchgate.net/profile/Tommaso_Ruggeri)
- Top Italian Scientist: [http://www.topitalianscientists.org/top\\_italian\\_scientists.aspx](http://www.topitalianscientists.org/top_italian_scientists.aspx)

## **SCIENTIFIC ACTIVITY:**

Professor T. Ruggeri is author of 224 publications , among which there are 3 books and 3 monographs. The research developed are devoted to several Mathematical Physics problems, and in particular non-linear wave propagation problems for hyperbolic systems and thermo mechanics of continuous media (classical and relativistic).

In the first field, he has produced original contributions concerning the symmetrisation of hyperbolic systems of balance laws with convex entropy density and in the theory of acceleration and shock waves. In the field of non-equilibrium thermodynamics, he has been one of the founders of the field of modern Extended Thermodynamics and has written, jointly with Ingo Mueller, the well know book *Rational Extended Thermodynamics* (Springer-Verlag, 1988, 2nd edition). Recent papers are devoted to a new approach of non-equilibrium thermodynamics that include polytropic gas, moderate dense gas and mixture of gas. These results are collected in a recent book written jointly with Masaru Sugiyama *Rational Extended Thermodynamics beyond Monatomic Gas*, (Springer-Verlag, 2015).

## PREVIOUS STUDENTS:

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

*Foreign Post Doc:* J. Au (Industrial Engineer Berlin), S. Simic (Full Professor – Novi Sad), J. Lou (Associate Professor- Shanghai ), N. Zhao (Full Professor- Chengdu), S. Taniguchi (Associate Professor, Kitakyushu), T. Arima (Assistant Professor, Yokohama ).

## TEACHING ACTIVITIES

- Rational Mechanics (since 1973) and Mathematical Physics (since 2001)

**PRINCIPAL PUBLICATIONS** (for the full bibliography see: [http://www.dm.unibo.it/~ruggeri/bib\\_ruggeri2.html](http://www.dm.unibo.it/~ruggeri/bib_ruggeri2.html) ).

### Books:

MUELLER I, RUGGERI T., "**Rational Extended Thermodynamics**", Springer Tracts in Natural Philosophy, **37**, pp.: 397, ISBN/ISSN: 0-387-98373-2, (1993, 1998).

RUGGERI T., SUGIYAMA M., "**Rational Extended Thermodynamics beyond Monatomic Gas**". Springer, pp. : 376, ISBN 978-3-319-13340-9, (2015).

### Chapters in Books:

RUGGERI T., "**Recent Results on Wave Propagation in Continuum Models**", in *Stability and Wave Propagation in Fluids and Solids*, G.P. Galdi, Ed. CISM Course and Lecture, Springer-Verlag., **344**, 104, ISBN/ISSN: 0-211-82687-4, (1995).

RUGGERI T., "**Extended Relativistic Thermodynamics** in the book of Yvonne Choquet Bruhat *General Relativity and the Einstein equations*, pp. 334-340. Oxford Univ. Press, ISBN 978-0-19-923072-3, (2009).

RUGGERI T., "**Some recent results on multi-temperature mixture of fluids**", in *Continuous Media with Microstructure*, B. Albers (Ed.), Springer –Verlag ISBN: 978-3-642-11444-1(2010).

### Papers:

BOILLAT G., RUGGERI T., "**Reflection and transmission of discontinuity waves through a shock wave. General theory including also the case of characteristic shocks**", *Proceedings of the Royal Soc. of Edinburgh*. 83-A, pp.17-24 (1979).

BOILLAT G., RUGGERI T., "**On the evolution law of the weak discontinuities for hyperbolic quasi-linear systems**", *Wave Motion*, 1, (2), pp.149-152 (1979).

RUGGERI T., STRUMIA A., "**Main field and convex covariant density for quasi-linear hyperbolic systems. Relativistic fluid dynamics**", *Ann. Inst. H. Poincaré*, **34**, pp.: 19, (1981).

CHOQUET BRUHAT Y., RUGGERI T., "**Hyperbolicity of the 3+1 system of Einstein equations**", *Comm. Math. Phys.*, **89**, pp. 269-275 (1983).

LIU I.S., MÜLLER I., RUGGERI T., "**Relativistic thermodynamics of Gases**", *Annals of Physics*, **169** (1), pp. 191-219 (1986).

RUGGERI T., "**Galilean Invariance and Entropy Principle for Systems of Balance Laws. The Structure of the Extended Thermodynamics**", *Continuum Mech. Thermodyn.*, **1**, pp. 17 (1989).

RUGGERI T., MURACCHINI A., SECCIA L., "**Continuum approach to phonon gas and shape changes of second sound via shock wave theory**", *Nuovo Cimento D*, **16** (1) pp.15-44 (1994).

BOILLAT G., RUGGERI T., "**Hyperbolic Principal Subsystems: Entropy Convexity and Subcharacteristic Conditions**", *Arch. Rat. Mech. Anal.*, **137**, pp.: 15 (1997).

BOILLAT G., RUGGERI T., "**Moment Equations in the Kinetic Theory of Gases and Wave Velocities**", *Continuum Mech. Thermodyn.* **9**, pp. 205-212 (1997).

LIU T.P., RUGGERI T., "**Entropy Production and Admissibility of Shocks**", *Acta Math. Appl. Sin., Engl. Ser.* **19** (1), pp. 1-12 (2003).

RUGGERI T., SERRE D., "**Stability of Constant Equilibrium State for Dissipative Balance Laws System with a Convex Entropy**", *Quart. of Appl. Math.*, **62** (1), pp. 163-179 (2004).

MÜLLER I., RUGGERI T., "**Stationary Heat Conduction in Radially Symmetric Situations - An Application of Extended Thermodynamics**", *J. Non Newtonian Fluid Mech.*, **119**, pp. 139-143 (2005).

RUGGERI T., "**Global existence of smooth solutions and stability of constant state for dissipative Hyperbolic Systems with applications to the Extended Thermodynamics**", *Trends and Applications of Mathematics to Mechanics (STAMM 2002)*, pp. 215-224, Springer Verlag (2005).

LOU J., RUGGERI T., TEBALDI C., "**Modeling Cancer in HIV-1 Infected Individuals: Equilibria, Cycles and Chaotic Behavior**", *Mathematical Biosciences and Engineering*, **3** (2), pp. 313-324 (2006).

RUGGERI T., SIMIC S., "**On the hyperbolic system of a mixture of Eulerian Fluids: A comparison between single- and multi-temperature models**", *Math. Meth. Appl. Sci.*, **30**, pp. 827-849 (2007).

MENTRELLI A., RUGGERI T., SUGIYAMA M. and ZHAO N., "**Interaction between a shock and an acceleration wave in a perfect gas for increasing shock strength**". *Wave Motion*, **45**, pp. 498 - 517. (2008).

GOUIN H., RUGGERI T., "**Identification of an average temperature and a dynamical pressure in a multi temperature mixture of fluids**". *Phys. Rev. E* **78**, 016303-1, 016303-7 (2008).

RUGGERI T., SIMIC S., "**Average Temperature and Maxwellian Iteration in Multi-temperature Mixtures of Fluids**". *Phys. Rev. E* **80**, 026317 (2009).

RUGGERI T., LOU J., "**Heat Conduction in multi-temperature mixture of fluids: the role of the average temperature**". *Phys. Letters A* **373**, 3052 (2009).

LOU J., RUGGERI T., "**The dynamics of spreading and immune strategies of sexually transmitted diseases on scale-free network**". *Journal of Mathematical Analysis and Applications* **365** (1), 210-219 (2010).

ZHAO N., MENTRELLI A., RUGGERI, T., and SUGIYAMA M., [Admissible shock waves and shock-induced phase transitions in a van der Waals fluid](#). *Physics of Fluids* **23**, 086101-1, 086101-18 (2011).

ARIMA T., TANIGUCHI S., RUGGERI, T. and SUGIYAMA M., “**Extended thermodynamics of dense gases**”, *Continuum Mech. Thermodyn.* **24** 271-292 (2012).

ARIMA T., TANIGUCHI S., RUGGERI T. and SUGIYAMA M., “**Extended thermodynamics of real gases with dynamic pressure: An extension of Meixner’s theory**”, *Phys. Lett. A* **376** 2799-2803 (2012).

RUGGERI T., “**Can Constitutive Relations be represented by non-local equations?**”, *Quart. Appl. Math.* **70**, 597-611 (2012).

PAVIC, M., RUGGERI, T. and SIMIC S., “**Maximum entropy principle for rarefied polyatomic gases**”, *Physica A* **392**, 1302-1317 (2013).

ARIMA T., TANIGUCHI S., RUGGERI T. and SUGIYAMA M., “**Thermodynamic theory of the shock wave structure in a rarefied polyatomic gas: Beyond the Bethe-Teller theory**”. *Phys. Rev. E* **89**, 013025, (2014).

ARIM, T., TANIGUCHI S., RUGGERI T. and SUGIYAMA M. “**Effect of the dynamic pressure on the shock wave structure in a rarefied polyatomic gas**. *Physics of Fluids* **26**, 016103, (2014).

ARIMA T., MENTRELLI A., RUGGERI, T. “**Molecular extended thermodynamics of rarefied polyatomic gases and wave velocities for increasing number of moments**”. *Annals of Physics* **345** 111–140 (2014).

ARIMA, T., TANIGUCHI S., RUGGERI T. and SUGIYAMA M., “**Nonlinear extended thermodynamics of real gases with 6 fields**”. *International Journal of Non-Linear Mechanics* **72** 6–15 (2015).

HA S-Y., RUGGERI T. “**A thermodynamic consistent model for emergent behavior in Flocks and comparison with multitemperature mixture of fluids**”. *Arch. Rational Mech. Anal.* **223**, 1397–1425 (2017).

PENNISI S., RUGGERI T. “**Relativistic Extended Thermodynamics of Rarefied Polyatomic Gases**”. *Annals of Physics*, **373**, 414-445 (2017).

ARIMA T., RUGGERI T., SUGIYAMA M. “**Duality Principle from rarefied to dense gas and Extended Thermodynamics with 6 fields**”. *Physical Review Fluids*, **2**, 013401 (2017).

ARIMA T., RUGGERI T., SUGIYAMA M. “**Rational Extended Thermodynamics of a Rarefied Polyatomic Gas with Molecular Relaxation Processes**”. *Phys Rev E* **96**, 042143-1, 042143-20 (2017).