

# Gian Paolo Beretta - Curriculum

## Affiliation:

Dipartimento di Ingegneria Meccanica e Industriale, Università di Brescia,  
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## Personal data:

Born in Monza on April 14, 1956.  
Father of Nicolò (1989) and Federica (1991).  
Married in second wedding (2011) with Giulia Invernizzi.

## Web pages (with details on research activities, scientific publications, administrative duties and various documents):

[www.gianpaoloberetta.info](http://www.gianpaoloberetta.info)

## Studies:

1979: Laurea in Ingegneria Nucleare, Politecnico di Milano  
1980: Master of Science in Mechanical Engineering, MIT  
1982: Doctor of Science, Massachusetts Institute of Technology

## Academic positions held:

1978-1981: Research Assistant, Department of Mechanical Engineering, MIT  
1981-1983: Postdoctoral Fellow, Progetto Finalizzato Energetica, CNR, Roma  
1981-1984: Assistant Professor of Mechanical Engineering, MIT  
1983-1987: Assistant Professor, Dipartimento di Energetica, Politecnico di Milano  
1984-1986: C.R. Soderberg Assistant Professor of Mechanical Engineering, MIT  
1987-1994: Associate Professor of Thermal and Fluid Sciences, Università di Brescia  
1994-today: Full Professor of Thermal and Fluid Sciences, Università di Brescia

## Visiting and temporary adjunct position held:

1986-1987: Visiting Associate Professor, Department of Mechanical Engineering, MIT  
1989-1990: Adjunct Professor, Corso di Energetica, Politecnico di Milano  
1991-1992: Visiting Associate Professor, Department of Mechanical Engineering, MIT  
2007-2008 (Fall term): Visiting Professor, Department of Mechanical Engineering, MIT  
2008-2009 (Sett-Ott): Visiting Professor, Dept. of Chemistry, NTNU, Trondheim, Norvegia  
2008-2009 (Nov-Dic): Visiting Professor, Dept. of Mech. Eng., Northeastern University, Boston  
2009-2010 (Fall term): Cariplo Visiting Professor, Department of Mechanical Engineering, MIT  
2010-2011 (Fall term): Cariplo Visiting Professor, Department of Mechanical Engineering, MIT  
2011-2012 (Fall term): Cariplo Visiting Professor, Department of Mechanical Engineering, MIT  
2012-2013 (Fall term): Cariplo Visiting Professor, Department of Mechanical Engineering, MIT  
2014-2015 (Fall term): Visiting Professor, Dept. of Mech. Eng., Northeastern University, Boston

## Administrative positions held:

- Director of UniBS PhD program DRIMI (PhD program in Mechanical and Industrial Engineering) (2012-2016)
- Director of UniBS PhD program TESEIM (PhD program in Technologies and Energy Systems for Mechanical Industries) (2011-2015)
- UniBS co-Director (with MIT co-Director Ahmed Ghoniem) of the Faculty Exchange Program "CARIPLO UniBS--MIT-MechE Visiting Professors" (2009-2013)
- Director of Undergraduate and Graduate Studies in Mechanical Engineering at UniBS (1998-2001)
- Director of Undergraduate and Graduate Studies in Mechanical Engineering, Materials Engineering, and Industrial Automation at UniBS (2001-2004)
- UniBS Delegate Member of National Committee for the Formulation and Administration of the National Admission Tests to Engineering and Architecture Studies (1997-2005)
- Board of Directors and Scientific Committee of CISIA (Interuniversity Consortium for the Admission Tests to Engineering and Architecture Studies) (2005-2007)
- Director of the UniBS Admission Test to Engineering Studies (1997-2007)
- Director of Class Scheduling for the UniBS School of Engineering (1994-1999)
- Member of Teaching Laboratories Committee of the UniBS School of Engineering (1998-2000)
- Member of Steering Committee of the UniBS Department of Mechanical Engineering (1998-2000)
- Head of "Energy" Section in Undergraduate and Graduate Studies in Mechanical Engineering at UniBS (1994-2009)
- Member of Academic Committee of UniBS PhD program in Technologies and Energy Systems for the Mechanical Industry (2006-2012)
- Member of Academic Committee of PoliMI (Politecnico di Milano) PhD program in Energy Technology (2006-2007)
- Member of Academic Committee of UniBG (Università di Bergamo) PhD program in Energy and Environment Technology (2006-2012)

## Teaching activities:

- Acted as thesis advisor for 75 students (see the detailed list at: [http://gianpaolo-beretta.unibs.it/gian\\_paolo\\_beretta\\_theses\\_supervised.htm](http://gianpaolo-beretta.unibs.it/gian_paolo_beretta_theses_supervised.htm)).
- Teaching duties at Brescia University (1989-current) have included: Thermal Sciences (Thermodynamics and Heat Transfer Fundamentals), Advanced Fluid Mechanics, Advanced Thermodynamics, Industrial Usage of Energy.
- Teaching duties at the Politecnico di Milano (1984-1989) have included: recitations for Energetica with Prof. Mario Silvestri, 1984-1989; Thermodynamics: Equilibrium and Nonequilibrium, for PhD students of PoliMI, UniBS and UniBG, from 2010 to 2016.
- Teaching duties at the Massachusetts Institute of Technology (1981-1986) have included: recitations for undergraduate Thermodynamics with prof. Joseph Smith (1982-1987) co-teaching of graduate General Thermodynamics (1981-1987) and Quantum Thermodynamics (1982-1986) with prof. Elias Gyftopoulos; graduate special topic Quantum Thermodynamics in 2007.
- Teaching duties as Visiting Professor at Northeastern University have included: graduate General Thermodynamics (2008 and 2014) and Quantum Thermodynamics (2008).

## Scientific production:

Author of over 150 scientific publications in the fields of thermodynamics, heat transfer, combustion, and energy. These include:

56 articles published in international journals (detailed list and pdf's available at: [http://gianpaolo-beretta.unibs.it/gian\\_paolo\\_beretta\\_main\\_publications.htm](http://gianpaolo-beretta.unibs.it/gian_paolo_beretta_main_publications.htm)) among which 20 are single-author and 25 with international coauthors;

72 articles in proceedings of international conferences (detailed list and pdf's available at: [http://gianpaolo-beretta.unibs.it/gian\\_paolo\\_beretta\\_proceedings.htm](http://gianpaolo-beretta.unibs.it/gian_paolo_beretta_proceedings.htm)) among which 21 are single-author and 27 with international coauthors;

23 articles in proceedings of national (italian) conferences (detailed list and pdf's available at: [http://gianpaolo-beretta.unibs.it/gian\\_paolo\\_beretta\\_proceedings\\_national.htm](http://gianpaolo-beretta.unibs.it/gian_paolo_beretta_proceedings_national.htm));

5 patents, 8 small textbooks and 10 other publications in italian (detailed list at: [http://gianpaolo-beretta.unibs.it/gian\\_paolo\\_beretta\\_publications\\_in\\_italian.htm](http://gianpaolo-beretta.unibs.it/gian_paolo_beretta_publications_in_italian.htm));

He coauthored the reference textbook E.P. Gyftopoulos & G.P. Beretta, Thermodynamics. Foundations and Applications, first edition: Macmillan, New York, 1990; second and third edition: Dover Publications, Mineola, NY, 2005, 2010.

## Scientific responsibility of sponsored research projects (last 20 years):

Local PI for MIUR Project PRIN97 - Grant prot.9709116510\\_002 - Heat transfer and fluid dynamics of steel solidification in open cavities in presence of forced and natural convection of the liquid phase - 1/11/1997-15/03/2000 (€71,788).

Local PI for MIUR Project PRIN99 - Grant prot.9909113125\\_011 - Numerical simulations on: a) Free convection with solidification in a cavity (includes experimental activities in a steel making plant); b) Free convective heat transfer from small disks and plates; c) Convection induced by rotating disks and cylinders in rotor-stator systems - 1/11/1999-13/12/2001 (€72,304).

Local PI for MIUR Project PRIN01 - Grant prot.2001094741\\_003 - Heat transfer and fluid dynamics of binary mixtures under solidification with application to ingot and sand casting - 1/12/2001-09/01/2004 (€56,294).

Local PI for MIUR Project PRIN04 - Grant prot.2004098758\\_005 - Core-annular flow of oil and water in horizontal pipes - 30/11/2004-22/12/2006 (€ 61,800).

UniBS coDirector of the Faculty Exchange Program "CARIPL0 UniBS--MIT-MechE Visiting Professors" and UniBS delegate for the corresponding Faculty Exchange Agreement between UniBS and MIT - 1/6/2009-30/6/2013 (€500,000, bando "Promuovere la formazione di capitale umano d'eccellenza", Fondazione Cariplo, Grant 2008-2290). The program supported 18 stages at MIT of UniBS faculty of three engineering departments for periods between 21 and 90 days each, 4 stages of 90 days each at MIT for UniBS PhD students, and 11 visits of MIT professors at UniBS for periods of 14 days each; these stages have generated over 30 publications with joint UniBS-MIT coauthors in prestigious international journals, plus several other beneficial activities.

Local PI for MIUR Project PRIN09 - Grant prot.20093JPM5Z\_002 -Experimental and theoretical investigation of fundamental aspects of liquid-liquid mixing and demixing (€84,000).

PI for Project AOARD (Asian Office of Aerospace R&D, US Air Force) FA2386-10-1-4146 (Heat transfer enhancement in small-scale devices: a collaborative experimental/numerical approach (\$119,000)

PI for Projects AOARD (Asian Office of Aerospace R&D, US Air Force) FA2386-10-1-4146 and EOARD (European Office of Aerospace R&D, US Air Force) FA8655-11-1-3068 Microscale heat

transfer enhancement using spinodal decomposition of binary liquid mixtures: a collaborative modeling/experimental approach (\$276,000)

## **Honors and other engagements:**

Calvin W. Rice Award, ASME (American Society of Mechanical Engineers), 2011

Life member ASME, dal 2011

Fellow ASME, elected in 2006 (member since 1986)

Italian Delegate in the European Committee for the assignment of the Prigogine Prize in Thermodynamics, since 2008

Member of the Board of Directors of municipal utility company ASM Brescia, November 1992 - December 1994

Member of the Assignment Committee of Eurotherm Young Scientist Prize and Award, 1996

Member of the Assignment Committee of AICARR National Fellowship, 2002-2004

Member of the Assignment Committee of Roberto Rocca Scholarships, 2008, 2010-2013

Delegate for UniBS in Scientific Committee CILEA Computational Modeling, 1995-1998

Member of Scientific Committees of International Congresses ECOS06, ECOS07, ECOS08 on Efficiency, Costs, Optimization, Simulation and Environmental Impact of Energy Systems, 2005-2008

Member of Scientific Committees of International Congresses JETC09, JETC11, JETC13, JETC15, Joint European Thermodynamics Conference Series, 2008-2015

Member of Scientific and Organizing Committee, and co-Editor of book of proceedings, International Symposium "Meeting the Entropy Challenge", MIT, October 2007

Chair of Scientific and Organizing Committee, 28<sup>th</sup> UIT Heat Transfer Congress, UIT2010, Brescia, June 2010

Chair of Scientific and Organizing Committee, 12<sup>th</sup> Joint European Thermodynamics Conference, JETC2013, Brescia, July 2013

## **Acted as Referee for various journals (over 60 reviews in the last 10 years):**

Physical Review Letters

Physical Review A

Physical Review E

Energy, the International Journal

Applied Energy

Journal of Energy Resources Technology

Journal of Chemical Physics

Combustion and Flame

Journal of Propulsion and Power

International Journal of Heat and Technology

Journal of Heat Transfer

Entropy

Journal of Non-Equilibrium Thermodynamics

Oil and Gas Science and Technology

Journal of Mathematical Physics

Il Nuovo Cimento B

Journal of Statistical Mechanics: Theory and Experiment

Mathematical Reviews

Foundations of Physics  
Physica A  
Physics Letters A  
Journal of Physics A: Mathematical and General  
Journal of Physics D: Condensed Matter  
Acta Mechanica  
International Journal of Thermal Sciences  
Industrial and Engineering Chemistry Research  
Applied Thermal Engineering  
Journal of Geometry and Physics  
International Journal of Thermodynamics  
American Society of Mechanical Engineers, ASME Transactions  
National Research Council, U.S. Army Basic Scientific Research

**Selection of 30 main journal publications (numbers refer to the list in:  
[http://gianpaolo-beretta.unibs.it/gian\\_paolo\\_beretta\\_main\\_publications.htm](http://gianpaolo-beretta.unibs.it/gian_paolo_beretta_main_publications.htm)):**

55. G.P. Beretta, M. Janbozorgi, and H. Metghalchi  
Degree of Disequilibrium Analysis for Automatic Selection of Kinetic Constraints in the Rate-Controlled Constrained-Equilibrium Method  
Combustion and Flame, in press, available online (2016).  
<http://dx.doi.org/10.1016/j.combustflame.2016.02.005>
54. A. Montefusco, F. Consonni, and G.P. Beretta  
Essential equivalence of the general equation for the nonequilibrium reversible-irreversible coupling (GENERIC) and steepest-entropy-ascent models of dissipation for nonequilibrium thermodynamics  
Physical Review E, Vol.91, 042138 (2015).  
<http://dx.doi.org/10.1103/PhysRevE.91.042138>
53. S. Cano-Andrade, G.P. Beretta, and M.R. von Spakovsky  
Steepest-entropy-ascent quantum thermodynamic modeling of decoherence in two different microscopic composite systems  
Physical Review A, Vol. 91, 013848 (2015).  
<http://dx.doi.org/10.1103/PhysRevA.91.013848>
45. G.P. Beretta, P. Iora, and A.F. Ghoniem  
Allocating resources and products in multi-hybrid multi-cogeneration: What fractions of heat and power are renewable in hybrid fossil-solar CHP?  
Energy: the International Journal, Vol. 78, pp. 587-603 (2014).  
<http://dx.doi.org/10.1016/j.energy.2014.10.046>
44. G.P. Beretta  
Steepest Entropy Ascent Model for Far-Non-Equilibrium Thermodynamics. Unified Implementation of the Maximum Entropy Production Principle  
Physical Review E, Vol. 90, 042113 (2014).

<http://dx.doi.org/10.1103/PhysRevE.90.042113>

43. E. Zanchini and G.P. Beretta

Recent Progress in the Definition of Thermodynamic Entropy  
Entropy, Vol. 16, pp. 1547-1570 (2014).

<http://dx.doi.org/10.3390/e16031547>

42. G.P. Beretta, P. Iora, and A.F. Ghoniem

Allocating electricity production from a hybrid fossil-renewable power plant among its multi primary resources

Energy: the International Journal, Vol. 60, pp. 344-360 (2013).

<http://dx.doi.org/10.1016/j.energy.2013.07.047>

41. G.P. Beretta, P. Iora, and A.F. Ghoniem

Novel approach for fair allocation of primary energy consumption among cogenerated energy-intensive products based on the actual local-area production scenario

Energy: the International Journal, Vol. 44, pp. 1107-1120 (2012).

<http://dx.doi.org/10.1016/j.energy.2012.04.047>

39. G.P. Beretta, J.C. Keck, M. Janbozorgi, and H. Metghalchi

The Rate-Controlled Constrained-Equilibrium Approach to Far-From-Local-Equilibrium Thermodynamics

Entropy, Vol. 14, pp. 92-130 (2012)

<http://dx.doi.org/10.3390/e14020092>

38. F. Di Fede, P. Poesio, and G.P. Beretta

Heat transfer enhancement in a small pipe by spinodal decomposition of a low viscosity, liquid-liquid, strongly non-regular mixture

International Journal of Heat and Mass Transfer, Vol. 55, pp. 897-906 (2012).

<http://dx.doi.org/10.1016/j.ijheatmasstransfer.2011.10.019>

37. G.P. Beretta

Quantum thermodynamic Carnot and Otto-like cycles for a two-level system

Europhysics Letters, Vol. 99, 20005 (2012).

<http://dx.doi.org/10.1209/0295-5075/99/20005>

34. G.P. Beretta

Nonlinear Quantum Evolution Equations to Model Irreversible Adiabatic Relaxation With Maximal Entropy Production and Other Nonunitary Processes

Reports on Mathematical Physics, Vol. 64, pp. 139-168 (2009).

[http://dx.doi.org/10.1016/S0034-4877\(09\)90024-6](http://dx.doi.org/10.1016/S0034-4877(09)90024-6)

33. P. Poesio, G.P. Beretta, and T. Thorsen

Dissolution of a Liquid Microdroplet in a Nonideal Liquid-Liquid Mixture Far from Thermodynamic Equilibrium

Physical Review Letters, Vol. 103, 064501 (2009).

<http://dx.doi.org/10.1103/PhysRevLett.103.064501>

28. P. Poesio and G.P. Beretta  
Minimal dissipation rate approach to correlate phase inversion data  
International Journal of Multiphase Flow, Vol.34, 684-689 (2008).  
<http://dx.doi.org/10.1016/j.ijmultiphaseflow.2007.12.006>
27. P. Poesio, A.M. Lezzi, and G.P. Beretta  
Evidence of convective heat transfer enhancement induced by spinodal decomposition  
Physical Review E, Vol. 75, 066306 (2007).  
<http://dx.doi.org/10.1103/PhysRevE.75.066306>
25. G.P. Beretta  
World energy consumption and resources: an outlook for the rest of the century  
International Journal of Environmental Technology and Management, Vol. 7, 99-112 (2007).  
<http://dx.doi.org/10.1504/ijetm.2007.013239>
22. P. Poesio, G. Cominardi, A.M. Lezzi, R. Mauri, and G.P. Beretta  
Effects of quenching rate and viscosity on spinodal decomposition  
Physical Review E, Vol. 74, 011507 (2006).  
<http://dx.doi.org/10.1103/PhysRevE.74.011507>
21. G.P. Beretta  
Nonlinear model dynamics for closed-system, constrained, maximal-entropy-generation  
relaxation by energy redistribution  
Physical Review E, Vol. 73, 026113 (2006).  
<http://dx.doi.org/10.1103/PhysRevE.73.026113>
19. G.P. Beretta and E.P. Gyftopoulos  
Thermodynamic derivations of conditions for chemical equilibrium and of Onsager reciprocal  
relations for chemical reactors  
Journal of Chemical Physics, Vol. 121, pp. 2718-2728 (2004).  
<http://dx.doi.org/10.1063/1.1756576>
18. G.P. Beretta and E. Malfa  
Flow and heat transfer in cavities between rotor and stator disks  
International Journal of Heat and Mass Transfer, Vol. 44, pp. 2715-2726 (2003).  
[http://dx.doi.org/10.1016/S0017-9310\(03\)00065-6](http://dx.doi.org/10.1016/S0017-9310(03)00065-6)
17. A.M. Lezzi, G.P. Beretta, E. Comini, G. Faglia, G. Galli, and G. Sberveglieri  
Influence of gaseous species transport on the response of solid state gas sensors within  
enclosures  
Sensors and Actuators B, Vol. 78, pp. 144-150 (2001).  
[http://dx.doi.org/10.1016/S0925-4005\(01\)00805-X](http://dx.doi.org/10.1016/S0925-4005(01)00805-X)
16. E.P. Gyftopoulos, M.I. Flik, and G.P. Beretta  
What is diffusion?  
Journal of Energy Resources Technology, Vol. 116, pp. 136-139 (1994).

<http://dx.doi.org/10.1115/1.2906018>

13. A. Niro and G.P. Beretta  
Boiling regimes in a closed two-phase thermosyphon  
International Journal of Heat and Mass Transfer, Vol. 33, pp. 2099-2110 (1990).  
[http://dx.doi.org/10.1016/0017-9310\(90\)90112-8](http://dx.doi.org/10.1016/0017-9310(90)90112-8)

12. G.P. Beretta, A. Niro, and M. Silvestri  
Solid slider bearings lubricated by their own melting or sublimation  
Journal of Tribology, Vol. 109, pp. 296-300 (1987).  
<http://dx.doi.org/10.1115/1.3261355>

11. G.P. Beretta  
Quantum thermodynamics of nonequilibrium. Onsager reciprocity and dispersion-dissipation relations  
Foundations of Physics, Vol. 17, pp. 365-381 (1987).  
<http://dx.doi.org/10.1007/BF00733374>

10. G.P. Beretta  
Steepest entropy ascent in quantum thermodynamics  
Lecture Notes in Physics, Vol. 278, pp. 441-443 (1987).  
[http://dx.doi.org/10.1007/3-540-17894-5\\_404](http://dx.doi.org/10.1007/3-540-17894-5_404)

9. G.P. Beretta  
A theorem on Lyapunov stability for dynamical systems and a conjecture on a property of entropy  
Journal of Mathematical Physics, Vol. 27, pp. 305-308 (1986).  
<http://dx.doi.org/10.1063/1.527390>

6. G.P. Beretta, E.P. Gyftopoulos, and J.L. Park  
Quantum thermodynamics. A new equation of motion for a general quantum system  
Nuovo Cimento B, Vol. 87, pp. 77-97 (1985).  
<http://dx.doi.org/10.1007/BF02729244>

3. G.P. Beretta  
On the relation between classical and quantum thermodynamic entropy  
Journal of Mathematical Physics, Vol. 25, pp. 1507-1510 (1984).  
<http://dx.doi.org/10.1063/1.526322>

2. G.P. Beretta, J.C. Keck and M. Rashidi  
Turbulent flame propagation and combustion in spark-ignition engines  
Combustion and Flame, Vol. 52, pp. 217-245 (1983).  
[http://dx.doi.org/10.1016/0010-2180\(83\)90135-9](http://dx.doi.org/10.1016/0010-2180(83)90135-9)



## Main textbook activities:

E.P. Gyftopoulos and G.P. Beretta

Thermodynamics: Foundations and Applications

Macmillan Publishing Co., New York, pp. 1-658 (1991), with Solutions' Manual, pp. 1-143 (1991)

Reissued by Dover Publications, 2005 and 2010. 756 pages. ISBN 0-486-43932-1.

Book Review by P.T. Landsberg in Nature, Vol. 356, 28 (1992)

Book Review by M. Silvestri in Int. J. Theor. Appl. Mechanics, Vol.28, 354 (1993)

Translation in Greek, published by Tziolas Publications, Thessaloniki, Greece, 2007, 1015 pages, ISBN: 978-960-418-137-7.

G.P. Beretta, A.M. Lezzi e M. Pilotelli

Raccolta di temi d'esame svolti di Fisica Tecnica

Editrice Snoopy, Brescia, pp. 1-360 (2014).

G.P. Beretta

Le nozioni analitiche di base della Dinamica dei Fluidi e della Termofluidodinamica

Editrice Snoopy, Brescia, pp. 1-228 (2005).

G.P. Beretta

Termodinamica

Editrice Snoopy, Brescia, pp. 1-182 (2002).

G.P. Beretta

Termodinamica Generale

Pubblicato in collaborazione fra Massachusetts Institute of Technology, Department of Mechanical Engineering e Consiglio Nazionale delle Ricerche, Progetto Finalizzato Energetica, pp. 1-600 (1982).