

PERSONAL INFORMATION



**Guido Caldarelli**

 Istituto dei Sistemi Complessi CNR, via dei Taurini 19, 00185 Rome, Italy

 +39 - 0649937495  +39 - 3289047533

 [Guido.Caldarelli@cnr.it](mailto:Guido.Caldarelli@cnr.it)

 <http://www.GuidoCaldarelli.com>

 [Twitter @GuidoCaldarelli](https://twitter.com/GuidoCaldarelli)

Gender Male | Date of birth 08/04/1967 | Nationality Italian

WORK EXPERIENCE

- (2024 – now) **Director Institute of Complex Systems, National Research Council of Italy**
- (2020 – now) **Full Professor in Theoretical Physics (PHYS02)**  
Ca' Foscari, Venice, Italy
- (2014 - 2020) **Full Professor in Theoretical Physics (FIS03 02/B2)**  
IMT Alti Studi Lucca, Italy
- (2012 - 2014) **Associate Professor in Theoretical Physics (FIS03 02/B2)**  
IMT Alti Studi Lucca, Italy
- (2007 - 2012) **Senior Researcher (Primo Ricercatore)**  
Institute of Complex Systems, CNR, Rome Italy
- (2004 - 2007) **Research Assistant (Ricercatore)**  
Institute of Complex Systems, CNR, Rome Italy
- (1998 - 2007) **Research Assistant (Ricercatore)**  
Centre SMC, INFN, National Institute for Condensed Matter, Rome Italy
- (1997 - 1998) **Associate Researcher**  
TCM Group Cavendish Lab, Cambridge University, Cambridge UK
- (1997 - 1998) **Associate Researcher**  
Department of Physics, University of Manchester, Manchester UK
- (1996 - 1996) **Visitor Researcher**  
University Fribourg, Fribourg Switzerland

EDUCATION AND TRAINING

- 24/10/1996 **PhD Physics, Condensed Matter, final rank *laude at* SISSA/ISAS, Trieste (Italy)**
- 14/10/1994 **MPhil Physics, final rank *30/30 cum laude at* SISSA/ISAS, Trieste (Italy)**
- 16/07/1992 **Degree in Physics final rank *110/110 cum laude at* Univ. "Sapienza", Rome (Italy).**

BIBLIOMETRIC INDICATORS

- Publications** >230 papers, 3 books as author, 3 as editor
- Presentations** 40-50 Contributions to Conferences worldwide (STATPHYS, NETSCI, ECCS)
- Projects** Coordinator of 2 STREP's (COSIN, FOC) and 1 IP (MULTIPLEX), participation to other projects for a total amount of about 3.3 million Euros (Locally, for my group)
- Conferences** Chairman of NETSCI07, ECCS14, NETSCI20, NETSCI-X-2024
- Seminars** 40-50 Contributions to Conferences world-wide (STATPHYS, NETSCI, ECCS)
- Honours and awards**
  - Service Prize of the Complex Systems Society (2023)
  - APS Fellowship (2020)
  - Service Prize of the Network Science Society (2020)
  - Elected Member of the European Academy of Science (2020)
  - Fellowship of the Network Science Society (2019)

Memberships	Founder and Board of Network Science Society, Ex President, Ex Vice-President and Board of Complex Systems Society, Founder and Board of Italian Society of Statistical Physics, >27000 on Google Scholar, h-index 73
Citations	General Physics, Mathematical Methods for Physics, Physics of Complex Systems,
Courses	Introduction to Network theory, Stochastic Processes, Networks, Physics for Environmental Sciences

## SCIENTIFIC ACTIVITY

---

Network Theory Foundations	I made my contribution in the onset and development of network theory starting from my first paper of 2000 on the statistical properties of the internet ( <a href="#">The fractal properties of Internet, <i>Europhysics letters</i>, 52, 386 (2000)</a> ). In this paper I introduced a way to measure scale invariance in technological systems that later has been used to describe the flow of information.
Fitness and Disorder	I have been able to explain how the quenched disorder of elements contributes to the development of a scale-invariant network. This is outlined in the paper <a href="#">Scale-free networks from varying vertex intrinsic fitness <i>PRL</i>, 89, 258702 (2002)</a> . Later in my career I showed the generality of scale invariance of networks in the paper "True scale-free networks hidden by finite-size effects. Proceedings of the National Academy of Sciences, 118(2), e2013825118". The stream originated by this research allowed me to get the APS Fellowship with the motivation " <i>For major contributions to understanding the disorder effects in self-similar phenomena, particularly in real scale-free networks and in theoretical models</i> ".
DebtRank	I contributed to the definition of a centrality measure in financial networks. This assesses from a macroscopic level the probability of breakdown of the financial system. Such measure is known as DebtRank ( <a href="#">DebtRank: Too Central to Fail? Financial Networks, the FED and Systemic Risk. <i>Sci Rep</i> 2, 541 (2012)</a> . <a href="https://doi.org/10.1038/srep00541">https://doi.org/10.1038/srep00541</a> ). The method is currently used in stress tests in various central banks as Bank of England, ECB, Central Bank of Mexico (see Macroprudential stress - test models: a survey, BoE staff paper 1037 (2023) <a href="https://www.bankofengland.co.uk/-/media/boe/files/working-paper/2023/macroprudential-stress-test-models-a-survey.pdf">https://www.bankofengland.co.uk/-/media/boe/files/working-paper/2023/macroprudential-stress-test-models-a-survey.pdf</a> )
Statistical Physics of Networks	I contributed to the description of the ensemble space of networks contributing to define the statistical physics of complex networks. The use of fitness model became even more important when considering factorisation of the probability of a graph into the product of the probabilities of the state of the vertices. This is described here and in the references therein <a href="#">The Statistical Physics of Real-World Networks <i>Nat. Rev. Phys.</i> 1, 58-71 (2019)</a> .

## SELECTED PUBLICATIONS

---

1. THE ROLE OF COMPLEXITY FOR DIGITAL TWINS OF CITIES  
**G. Caldarelli** et al.  
[Nature Computational Sciences 3, 374-381 \(2023\)](#).
2. LAPLACIAN RG FOR HETEROGENEOUS NETWORKS,  
P. Villegas Gongora, T. Gili, **G. Caldarelli**, A. Gabrielli,  
[Nature Physics 19, 445-450 \(2023\)](#).
3. PHYSICS OF FINANCIAL NETWORKS,  
M. Bardoscia, P. Barucca, S. Battiston, F. Caccioli, G. Cimini, D. Garlaschelli,  
F. Saracco, T. Squartini, **G. Caldarelli**  
[Nature Reviews Physics 3, 490-507 \(2021\)](#).
4. SCALE-FREE NETWORKS REVEALED FROM FINITE-SIZE SCALING  
M. Serafino, G. Cimini, A. Maritan, S. Suweis, J. R. Banavar, A. Rinaldo,  
**G. Caldarelli**

- PNAS* **118**, e2013825118 (2021).
5. THE STATISTICAL PHYSICS OF REAL-WORLD NETWORKS  
G. Cimini, T. Squartini, F. Saracco, D. Garlaschelli, A. Gabrielli, **G. Caldarelli**  
*Nature Reviews Physics* **1**, 58-71 (2019).
  6. PHYSICS OF HUMANS, PHYSICS FOR SOCIETY  
**G. Caldarelli**, S. Wolf, Y. Moreno  
*Nature Physics* **14**, 870 (2018).
  7. RIVER LANDSCAPES AND OPTIMAL CHANNEL NETWORKS  
P. Balister, J. Balogh, E. Bertuzzo, B. Bollobás, **G. Caldarelli**, A. Maritan, R. Mastrandrea, R. Morris, and A. Rinaldo  
*PNAS* **115**, 6548-6553 (2018).
  8. PATHWAYS TOWARDS INSTABILITY IN FINANCIAL NETWORKS  
M. Bardoscia, S. Battiston, F. Caccioli, **G. Caldarelli**,  
*Nature Communications* **8**, 14416 (2017).
  9. THE PRICE OF COMPLEXITY IN FINANCIAL NETWORKS,  
S. Battiston, **G. Caldarelli**, R. May, T. Roukny, J.E. Stiglitz  
*PNAS* **113**, 10031-10035 (2016).
  10. THE SPREADING OF MISINFORMATION ONLINE  
M. Del Vicario, A. Bessi, F. Zollo, F. Petroni, A. Scala, **G. Caldarelli**, H.E. Stanley,  
W. Quattrocchi  
*PNAS* **113**, 554-559 (2016)
  11. QUANTIFYING RANDOMNESS IN COMPLEX NETWORKS  
C. Orsini, M. Mitrović Dankulov, A. Jamakovic, P. Mahadevan, P. Colomer-de-Simón,  
A. Vahdat, K. E. Bassler, Z. Toroczkai, M. Boguñá, **G. Caldarelli**, S. Fortunato,  
D. Krioukov  
*Nature Communications* **6**, 8627 (2015)
  12. RECONSTRUCTING A CREDIT NETWORK  
**G. Caldarelli**, A. Chessa, A. Gabrielli, F. Pammolli, M. Puliga  
*Nature Physics* **9**, 125 (2013).
  13. COMPLEX DERIVATIVES  
S. Battiston, **G. Caldarelli**, C-P Georg, R. May, J. Stiglitz  
*Nature Physics* **9**, 123 (2013).
  14. SELF-ORGANIZED NETWORK EVOLUTION COUPLED TO EXTREMAL DYNAMICS  
D. Garlaschelli, A. Capocci, **G. Caldarelli**,  
*Nature Physics* **3**, 813-817 (2007).
  15. IP AND CRITICAL TRANSIENT IN THE BARABÁSI MODEL OF HUMAN DYNAMICS  
A. Gabrielli, **G. Caldarelli**,  
*Physical Review Letters* **98**, 208701 (2007).
  16. UNIVERSAL SCALING RELATIONS IN FOOD WEBS  
D. Garlaschelli, **G. Caldarelli**, L. Pietronero,  
*Nature* **423**, 165 (2003).
  17. SCALE-FREE NETWORKS FROM VARYING VERTEX INTRINSIC FITNESS  
**G. Caldarelli**, A. Capocci, P. De Los Rios, M.A. Muñoz,  
*Physical Review Letters* **89**, 258702 (2002).
  18. PERTURBATIVE APPROACH TO THE BAK AND SNEPPEN MODEL  
M. Felici, **G. Caldarelli**, A. Gabrielli, L. Pietronero,  
*Physical Review Letters* **86**, 1896 (2001).
  19. ANGULAR STRUCTURE OF LACUNARITY AND RENORMALIZATION GROUP  
R.C. Ball, **G. Caldarelli**, A. Flammini,  
*Physical Review Letters* **85**, 5134 (2000).
  20. SELF ORGANIZATION AND ANNEALED DISORDER IN FRACTURING PROCESSES  
**G. Caldarelli**, F. Di Tolla, A. Petri,  
*Physical Review Letters* **77**, 2503-2508 (1996).

LANGUAGE SKILLS

Mother tongue(s) Italian

Other language(s)	UNDERSTANDING		SPEAKING		WRITING
	Listening	Reading	Spoken interaction	Spoken production	
English	C2	C2	C2	C2	C2
Spanish	A2	B2	A1	A2	B1

Levels: A1/A2: Basic user - B1/B2: Independent user - C1/C2 Proficient user  
[Common European Framework of Reference for Languages](#)

English Level certified by Ca'Foscari University to allow me to teach in Laurea Magistrale

Communication skills • good communication skills gained through my experience as book writer and professor

MANAGEMENT SKILLS

Management of Research I have been the Founder and Leader of the Network UNIT at IMT for 8 years  
**I have been in the Board of Statistical and Nonlinear Physics of EPS**  
 I am the Editor in Chief of Cambridge Elements on Networks  
 I have been Founder and Board (Giunta) of Società Italiana Fisica Statistica

People Management  
*Conferences* I have organised the largest conferences in the community, in particular:
 

- the Conference in Complex Systems in Lucca 2014 (~750 people)
- NETSCI Conference in Venice in 2009 (~300 people)
- NETSCI Conference 2020, this first started as onsite conference in Rome and after because of COVID we transformed in an online one (double expenses)
- NETSCI-X-2024 Winter conference of NETSCI Society Venice (450 people)

*Administration*

- I have been in the Board (Consiglio di Amministrazione) of IMT for 5 years
- I have been Delegato alla Ricerca of Department of Molecular Sciences and Nanosystems, Ca' Foscari University of Venice 2022-2024

*Research* I have been the coordinator of large project consortia, in particular:
 

- COSIN (3 years, 7 nodes, ~40 people)
- FOC (4 years, 10 nodes worldwide (Eu + Boston +Tokyo) ~ 80 people)
- MULTIPLEX (5,5 years 23 nodes ~ 100-120 people)
- I have been Vice-President of Network Science Society
- I have been Vice-President of Complex Systems Society
- I have been President of Complex Systems Society
- I participated in founding and operating the London Institute of Mathematical Sciences ([www.lims.ac.uk](http://www.lims.ac.uk))

Evaluation of Research I have been positively evaluated as Researcher with maximum score in the latest VQR (Italian Research Evaluation).  
 The Network Unit in IMT Lucca that I was coordinating during that period scores amongst the first three "Physics Departments" in Italy for FIS03.

TECHNOLOGICAL TRANSFER

I am the founder of RARA Foundation ([www.rarafoundation.it](http://www.rarafoundation.it))  
 The first goal of the Rara Foundation - Sustainable Materials and Technology will be to eliminate the need for rare earth elements from the microelectronics industry, but the same approach can be used to replace any material in any application.

*According to law 679/2016 of the Regulation of the European Parliament of 27<sup>th</sup> April 2016, I hereby express my consent to process and use my data provided in this CV*

Signatur