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PAOLO GRIGOLINI

UNT PROFESSOR OF PHYSICS,

EDUCATION TRAINING

	Degree	Year
Diploma di Maturita' Classica, Liceo E. Repetti, Carrara, Italy.		1959
Laurea in Fisica at the University of Pisa, Italy,	Ph. D.	1969
CNR Fellowship, Pisa Italy	Post-doctoral Training	1969-1972

PROFESSIONAL EXPERIENCE

1990 to present, Professor of Physics at the Department of Physics of the University of North Texas

1980-1990, CNR Researcher, at the Physics Department, University of Pisa (Italy)

1972-1980, CNR Researcher, at Chemistry Department, University of Pisa (Italy)

1969 –1972 Fellowship of CNR Chemistry Department, University of Pisa (Italy)

PROFESSIONAL ACTIVITIES

From January 15, 2007 US editor of Chaos, Solitons and Fractals

Organizer of the Workshop: Self-organized temporal criticality: sociological, neuro-physiological, economical applications, Stany'Anna Institute of Economics, Pisa, July 17-19, (2017).

Organizer of the ARO supported Denton Workshop: Evolutionary game theory of small

groups and their larger societies, Denton, December 2016.

Organizer of the Denton Workshop of August 16-21, 2005, *In Search of a Theory of Complexity*

Co-organizer, with P. Hamilton, J. Roberts and B. J. West of the Denton Workshop of October 13–19, 2002, *Non-Stationary Time Series: a Theoretical, Computational and Practical Challenge*.

Co-organizer with I. Prigogine, L. Reichl and B. J. West, of the Austin Workshop of October 2001, *Mechanisms for Decoherence—Theory and Applications to Nanotechnology and Quantum Information Science*.

Co-organizer, with C. Tsallis and B. J. West, of the Denton Workshop of April 2000, *Classical and Quantum Complexity and non-extensive thermodynamics*

1972-1980 Coordinator and instructor of advanced research courses at the Department of Physics of the University of Pisa on the Statistical properties of Processes of Chemical Physics interest.

1980-1990, Scientific coordinator, at University of Pisa, of a research group on the behavior of complex systems, the molecular dynamics of liquids, and especially associated liquids. A detailed account of this research work can be found in *Memory function Approaches to stochastic Problems in Condensed Matter*, volume 62 of Advances in Chemical Physics (1985), fully devoted to the illustration of the results of the research activities coordinated by Paolo Grigolini.

Co-author with W.T. Coffey and M.W. Evans of the book *Molecular Diffusion and Spectra*, J. Wiley, New York, 1984.

Co-author with M.W. Evans, W. T. Coffey and G.J. Evans of the book Molecular Dynamics, J. Wiley, New York , 1982.

Author of the book: *Quantum Irreversibility and Measurement*, World Scientific, Singapore 1993 .

Co-author, with B. J. West and M. Bologna of the book, “Physics of Fractal Operators”, Springer-Verlag, New York (2003).

On the Editorial Board, J. Molec. Liquids , 1980-

Referee: Physical Review Letters, Physical Review A, Physical Review E, Journal of Molecular Liquids, Physica A, J. of Physical Chemistry, Physica Scripta, Physics Letters A, Nuovo Cimento, Journal of Theoretical Biology, Europhysics Letter, Europhysics Journal B, Journal of Chemical Physics.

Authors of 366 publications: mainly articles in international refereed journals and 4 books.

RESEARCH SPECIALIZATION, FUNDING AND RELATED TEACHING ACTIVITIES, February 5, 2007

Paolo Grigolini (PG) devoted the first years of his research work, from 1972 to 1989 at the University of Pisa, to the field of stochastic nonlinear physics, where he laid the foundation of theoretical techniques based on memory function formalism. He held several graduate courses to introduce the students of the Department of Physics, now Enrico Fermi Department of Physics of the University of Pisa, to the main principles of non-equilibrium statistical physics, a subject not very well known at the time to the Pisa scientific community. PG has also encouraged his co-workers to explore new techniques for the analysis of non-linear stochastic processes, based on analog simulation as well as on numerical calculations, inspired by the principle of *learning through doing*. The results of these teaching activities turned out to be successful: some of PG's students are now internationally famous scholars in non-equilibrium statistical physics, and especially in the field of stochastic resonance. On the other hand, the results of PG's research work became internationally known, and this allowed him to establish direct contacts and cooperation with some of the world leaders in this field of research, M. H. Lee, K. Lindenberg, F. Moss, V. M. Kenkre and especially B. J. West.

In 1990, PG, as UNT professor of physics, began working in the field of classical and quantum chaos, for the main purpose of founding a satisfactory dynamic approach to thermodynamics, thereby giving fundamental contributions to the subject, and extending the network of his connections with other scientists, at national and international level. In 1994, Dr. B. J. West founded the UNT Center of Nonlinear Science, thereby making PG devote his attention to interdisciplinary studies in the field of Complexity, with special emphasis on biological processes. The key ideas of this research work is to turn into benefits the conceptual difficulties that are still preventing physicists from completing the Boltzmann project, of making thermodynamics compatible with dynamics. In fact, the research work of PG pointed out the limitation of ordinary statistical approaches to properly account for unpredictable and random events.

In 2000 PG directed the research group of the UNT Center of Nonlinear Science to making discoveries in two main directions. The first significant achievement, which attracted the ARO funds, has been the development of a technique of analysis of time series, called Diffusion Entropy method, whose main purpose is to reveal the occurrence of crucial events, regardless of whether they are visible or invisible due to the camouflage action of a cloud of irrelevant events. This discovery has been successfully applied, among many other applications, to evaluate the mortality risk after a heart attack and to detect in time the presence of poisonous intoxicants in the environment. This technique is now used by an increasing number of researchers, especially in India and China, for many applications including atmospheric and geophysical processes. The second significant result, which has been awarded by a Welch grant, is the discovery that the intermittent fluorescence in nano-systems and single-molecule spectroscopy, is generated by non-Poisson renewal processes.

More recently, with the help of his CNS co-workers PG has discovered the cooperative roots behind the emergence of these crucial events, and he has established that complex systems exchange information by means of a new phenomenon that has

been termed *Complexity Matching Effects* (CME), a kind of generalization of the stochastic resonance phenomenon. PG has recently illustrated the CME at the Conference *Critical Phenomena and Diffusion in Complex Systems*, December 5-7, 2006, NNSU, Nizhny Novgorod, Russia. The response of the researchers in the field of complexity to this new effect has been very encouraging. On the one hand, CME may be used to control the intermittent fluorescence of blinking quantum dots: PG has been invited to give an invited lecture at the Workshop *Fluorescence Intermittency in Molecules, Quantum Dots and Quantum Wires*, sponsored by the Institute for Theoretical Sciences, a Joint Institute of Argonne National Laboratory and the University of Notre Dame, April 2-3. On the other hand, the CME is attracting the interest of ARO. In fact, Paolo Grigolini has also been invited to give one hour talk on CME at the ARO Workshop: *Towards a Science of Networks*, on August 29-30, 2007, at the Adelphi, MD facility. For all these reasons, PG is currently focusing his teaching and research activities on the CME and Complex Networks. PG plans to use the CME effect to shed light on the response of human brain to acoustic and visual excitations, with emphasis on therapeutic applications. This project is based on an expanding network of interdisciplinary activities, whose central node is Denton, with links to Taiwan, for production of complex sounds, Nizhny Novgorod (Russia), for the interaction and synchronization of neurons, Trento (Italy), for the EEG recording, and finally to Paris (France), for the study of neuro-physiological processes. To create an efficient team contributing to the progress of this research project, Paolo Grigolini is training a group of UNT graduate students, with proper advanced courses and group meetings, still inspired by the principle of learning by doing.

List of Publications

- [1] P. Grigolini and R. Moccia, “Vibrational and Other Corrections to the Nuclear Quadrupole Moment of 14 N in Ammonia”, J. Chem. Phys. 57, 1369 (1972).
- [2] P. Grigolini, “Second Moment of Dipolar Interaction for Arbitrary Directions of Magnetic Field and Arbitrary Spin Values in NQR”, J. Chem. Phys. 56, 5930 (1972).
- [3] R. Ambrosetti, A. Colligiani, P. Grigolini, F. Salvetti, “Conformation of the Group in a Single Crystal of P-Chloroaniline as Determined by Combined Zeeman Effects on the Nuclear Quadrupole Resonances”, J. Chem. Phys. 60, 459 (1974).
- [4] R. Ambrosetti, A. Colligiani, P. Grigolini, “Combined Zeeman Effects on the Nuclear Quadrupole Resonances in a Sige Crystal of N, N'-Dideuterated Para-Chloroaniline”, Proceedings of the Second International Symposium on NQR Spectroscopy, 244 (1975).

- [5] P. Grigolini, "Theory of Line Narrowing by Double-Frequency Irradiation in NQR", J. Chem. Phys. 61, 1874 (1974).
- [6] P. Grigolini, "A Perturbative Formalism for the Spontaneous Emission by Excited Systems", Molec. Phys. 30, 1229 (1975).
- [7] P. Grigolini, "A Perturbative Formalism for the Spontaneous Emission by Excited Systems II. Decay in the Presence of Classical Irradiation Fields and Memory Effects", Molec. Phys. 31, 1717 (1976).
- [8] P. Grigolini, "A "Reduced" Model Theory for Molecular Decay Processes", Chem. Phys. Letters, 47, 483 (1977).
- [9] P. Grigolini and A. Lami, "Preparation and Decay of Unstable Molecular States Undergoing Memory Effects: Excitation by Coherent Electromagnetic Pulses of Arbitrary Strength", Chem. Phys. 30, 61 (1978).
- [10] P. Grigolini and A. Lami, "A Theoretical Approach to the Detection of Intramolecular Relaxation in Molecular Systems Undergoing Rabi Oscillations", Chem. Phys. Letters, 55, 152 (1978).
- [11] P. Grigolini, "Preparation and Decay of Excited Molecular States: The Influence of Dephasing Relaxation and Pulse Fall Time", Chem. Phys. Letters, 58, 185 (1978).
- [12] P. Grigolini, "Intramolecular Memory Effects in Second-Order Optical Processes", Chem. Phys. Letters 58, 191 (1978).
- [13] P. Grigolini, "Emission Spectrum in the Presence of Strong Driving Fields as a New Tool for the Study of both "Intramolecular" and "external" relaxation ", Chem. Phys. 38, 389 (1979).
- [14] M. Ferrario and P. Grigolini, "The Non-Markovian Relaxation Process as a "Contraction" of a Multidimensional one of Markovian Type", J. Math. Phys. 20, 2567 (1979).
- [15] M. Ferrario and P. Grigolini, "A Generalization of the Kubo-Freed Relaxation Theory", Chem. Phys. Letters, 62, 100 (1979).
- [16] M. Ferrario and P. Grigolini, "Role of Rotational Thermal Bath Excitation on the EPR Transient Regime: A Theoretical Discussion", J. Chem. Phys. 74, 235 (1981).
- [17] P. Grigolini and M. Benfatto, "Molecular Excitation Processes by Fluctuating Light", Chem. Phys. Letters, 65, 531 (1979).
- [18] P. Grigolini and V. Rosato, "A New Approach to Radiationless Decay Phenomena

by Generalization of the Mori Theory", Adv. in Molec. Relax. and Interaction Processes, 21, 131 (1981).

[19] P. Grigolini, "Non-Markovian Excitation-Relaxation Processes", Il Nuovo Cimento, 63B, 17 (1981).

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[21] M.W. Evans, P. Grigolini, L. Resca, "A Generalization of the Bixon and Zwanzig Hydrodynamic Approach Resulting in Correct short Time Behaviour", Chem. Phys. Letters, 69, 97 (1980).

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- [38] P. Grigolini, "Brownian Motion of Harmonic Systems with Fluctuating Parameters: a Discussion in Terms of "virtual" Heat Baths", *Phys. Letters*, 84A, 301 (1981).
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Processes: the Influence of Pumping on Relaxation", Z. Phys. 55B, 257 (1984).

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Chem. Phys. Letters, 95, 48 (1983).

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the Low-Friction Limit: Theory and Analog Simulation", J. Stat. Phys. 41, 85 (1985).

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