Curriculum vitæ et Studiorum

Vittorio Loreto, PhD.

Name Vittorio LORETO

Date and place of birth August 2nd 1967 - Frosinone ITALY

Nationality Italian

Academic Age 20 years

Family status Married, two children

Permanent address V. Ugo Ojetti 79 00137 Rome ITALY

Tel. +39.06.49.91.34.61

fax +39.06.44.63.158

e-mail loreto@roma1.infn.it vittorio.loreto@gmail.com

web http://samarcanda.phys.uniroma1.it/vittorioloreto/

web http://www.socialdynamics.it

web http://www.kreyon.net

Languages In addition to Italian as a mother tongue, I have a very good knowledge, written and spoken, of English and French.

Military Service Until the 1.10.1992 I have served in the Italian Army as Second Lieutenant of the Technical Services.

Education:

1985 Secondary School certificate at the Scientific Lyceum "E. Severi" with final grade **60/60**.

1990 Undergraduate studies in Physics at the University of Rome *La Sapienza*. Doctor in Physics with final grade *110/110* cum laude (13/12/1990).

'92-'95 Ph.D. studies at the University of Rome *La Sapienza*.

Present positions:

Full Professor (from September 1st 2016) at the Physics Dept. of Sapienza University of Rome.

Research Leader at the Institute of Scientific Interchange (ISI) foundation, Turin,Italy. Coordinator of the *Information Dynamics* group.

Research Associate to the Institute for Complex Systems of the Consiglio Nazionale delle Ricerche (CNR-ISC), Rome, Italy.

Contents

1 Positions

'91-'93 Teacher of mathematics and physics in several secondary schools from 15.1.1991 to 13.6.1991 and from 7.11.1991 to June 1993.

'92-'95 Ph.D. student at the University of Rome "La Sapienza" under the supervision of Prof. L. Pietronero. Dissertation presented February the 28th 1996, approved October the 17th 1996.

'93-'98 Researcher (permanent position) at the ENEA Research Center, Portici, Naples (ITALY).

'96-'98 EEC Post-Doc position at the *École Supérieure de Physique et Chimie Industrielles*, Paris (FRANCE), in the group of Prof. H.J. Herrmann.

'99 CNRS Researcher (Centre National de la Recherche Scientifique) at the *École Supérieure de Physique et Chimie Industrielles*, Paris (FRANCE).

'99-'07 Researcher at Sapienza University of Rome.

2004 Winner of the Comparative Evaluation for a position of Associate Professor in Condensed Matter at the *Bicocca* University in Milan.

2004 Invited research position at the Laboratorie de Physique Théorique, Université de Paris Sud, Orsay, France (August-December 2004).

2009 Invited professor position at the Centre de Physique Théorique, Marseille, France (June 2009).

2007-2016 **Associate Professor** at the Physics Dept. of Sapienza University of Rome.

2007-present **Research Leader** at the Institute of Scientific Interchange (ISI) foundation, Turin, Italy. Coordinator of the *Information Dynamics* group.

2008-present **Research Associate** to the Institute for Complex Systems of the Consiglio Nazionale delle Ricerche (CNR-ISC), Rome, Italy.

2013 Visiting Research Associate Professor at the Physics Dept. of Northeastern University, College of Science, July 22nd to September 11th 2013.

2013 Qualification (*Abilitazione Scientifica Nazionale*) as Full Professor (Professore Ordinario) for Theoretical Condensed Matter Physics.

2014-2015 On sabbatical leave as **Invited Senior Researcher** at the SONY Computer Science Lab (SONY-CSL) in Paris.

2016-present **Full Professor** at the Physics Dept. of Sapienza University of Rome.

2 Scientific activity

Abstract

My scientific activity is mainly focused on the interdisciplinary applications of complex systems science to the dynamics of social, biological and technological systems. In the last few years, in particular, I have been intensively working on the investigation of the so-called techno-social systems, which mix in an unpredictable way, cognitive and social elements with Information and Communication Technologies (ICT). On these themes I recently coordinated the EU project EveryAware that integrates environmental monitoring, awareness enhancement and behavioural change by creating a new technological platform combining sensing technologies, networking applications, data-processing and modelling tools. I'm presently coordinating a project founded by the Templeton Foundation for the period (2014-2017). The project addresses the dynamics of novelties - a fundamental factor in the evolution of human societies, biological systems and technology - with the aim to unfold and quantify the underlying mechanisms through which creativity emerges and innovations diffuse, compete and stabilise.

I started my scientific career as Ph.D. student in Rome in 1992 under the supervision of Prof. Luciano Pietronero, focusing on the statistical physics of self-organised critical systems. This choice of Ph.D. subject represented a significant departure from my undergraduate studies where I focused on the quantum optics of free-electron lasers. At that time, there was a great interest for **systems self-tuning themselves to a critical state**. I became interested in these subjects and I contributed to elucidating the statistical physics of these systems by revealing the existence of hidden control parameters corresponding to an extreme separation of time-scales. In particular, with A. Vespignani and S. Zapperi, we introduced a novel real-space renormalisation scheme (Dynamically Driven Renormalisation Group), which was published in Journal of Statistical Physics.

By the end of my Ph.D, I had already obtained a permanent position at the ENEA research centre in Naples. However, after a few months, I realised that I would not have the opportunity to fully develop my ideas at ENEA. After a few months I obtained a Marie-Curie individual fellowship to join Prof. H.J. Herrmann's group in Paris. The project for which I received funding was about the **physics of granular media**, and the three and a half years I have spent in Paris, as a Marie-Curie fellow first and after as a CNRS invite researcher, have strongly affected my career. My first relevant contribution to the field of granular media has been the introduction of the Tetris model, of a new class of microscopic models, published in Physical Review Letters (129 citations), where the crucial physical ingredient is the geometrical frustration felt by the grains. These kind of models turned out to be able to reproduce correctly most of the phenomenology of dense granular media: slow compaction, segregation, ageing, memory effects an response properties. On the basis of these results, it has been possible to address more difficult questions: the existence of a pseudo-temperature for these "non-thermal" systems, its definition by means of the Fluctuation-Dissipation relations and the possibility of constructing a satisfactory "thermodynamics". These ideas appeared first in Phys. Rev. Lett. (146 citations) and triggered my interest for an experimental check of the theoretical predictions. I started a collaboration with Prof. G. D'Anna at the EPFL in Lausanne and together we devised a series of experiment aimed at studying the glassy behaviour and the response properties in dense granular media as well as the possibility of defining a set of statistical ensembles suitable to describe their out-of-equilibrium phenomenology. These studies were published in Nature (126 citations) and were featured in the cover page and in the News and Views section, a News feature and an extensive press coverage.

After leaving Paris, I moved to Sapienza University of Rome as Ricercatore (Assistant Professor) in 1999 first in the group of Prof. Pietronero and then, from 2004 onwards, building my own group.

My move to the University of Rome coincided with the opening of new research lines.

At Sapienza University of Rome I became interested in problems related to an **information theory** approach to the notion of **complexity**. The first problem I considered was that of measuring the similarity between sequences of characters. Together with Dario Benedetto and Emanuele Caglioti I have introduced (and patented) an automatic method for context classification of sequences of characters. This method, first published in Physical Review Letters (87 citations) exploits concepts of information theory, and in particular tools borrowed from data compression techniques, to address the fundamental problem of identifying and defining the most suitable tools to extract, in a automatic and unsupervised way, information from a generic string of characters. At the same time I became interested in the rapidly growing field of **Complex Networks** and I became proficient with the tools used in this area. The specific angle I took in this area was to focus on looking for algorithms for the detection of communities in large graphs. On this topic I supervised the undergraduate Laurea research of Filippo Radicchi and the ensuing work appeared in the Proceedings of the National Academy of Sciences (766 citations). Since then complex networks represent an important tool in my whole research activity.

Below I summarize my main scientific interests in the last few years.

2.1 Statistical Physics of Social Dynamics

Key papers:

V. Loreto and L. Steels, *Emergence of language*, *Nature Physics*, **3**, 758-760 (2007).

A. Puglisi, A. Baronchelli and **V. Loreto**: *Cultural route to the emergence of linguistic categories*, *Proc. Natl. Acad. Sci. USA (PNAS)*, **105**, 7936-7940 (2008).

C. Castellano, S. Fortunato and **V. Loreto**, *Statistical physics of social dynamics*, *Rev. Mod. Phys.*, **81** 591-646 (2009).

T. Gong, A. Baronchelli, A. Puglisi and **V. Loreto**, *Modelling the emergence of universality in color naming patterns*, *Proc. Natl. Acad. Sci. USA (PNAS)*, **107**, 2403-2407 (2010).

V. Loreto, A. Mukherjee and F. Tria, *On the origin of the hierarchy of colour names*, *Proc. Natl. Acad. Sci. USA (PNAS)*, **109(18)**, 6819-6824 (2012).

F. Tria, **V. Loreto**, V.D.P. Servedio and S.H. Strogatz and, *The dynamics of correlated novelties*, *Nature Scientific Reports* **4: 5890** doi:10.1038/srep05890 (2014).

Statistical mechanics has proven to be a very fruitful framework to describe phenomena outside the realm of traditional physics. The last years have witnessed the attempt by physicists to study phenomena which heavily rely on human behaviour, like the dynamics of financial markets and the emergence of collective organization in social systems. Stochastic dynamics, phase transitions, scaling, metastability and other concepts and tools of statistical physics have then come into play in the study of social phenomena. Microscopic models have been devised, where each individual is represented by few degrees of freedom, which quantify its relevant attributes, and simple rules for the interaction of the individuals with their peers determine the dynamics. In the last few years I have been focusing on three major research lines, i.e. opinion dynamics, cultural dynamics and the emergence and evolution of language. On these subjects I wrote a review article in Reviews of Modern Physics (1032 citations).

Language dynamics In many biological, technological and social systems, a crucial problem is that of the communication among the different components, i.e., the elementary units of the

systems, typically called agents. The agents interact among themselves and with the environment in a sensorial and non-symbolic way, their communication system not being predetermined nor fixed from a global entity. The communication system emerges spontaneously as a result of the interactions of the agents and it could change continuously due to the mutations occurring in the agents, in their objectives as well as in the environment. An important question concerns how communication can arise, which kind of communication systems are possible and what are the prerequisites for such an emergence to occur. Other important questions concern which functions are made possible to a collective level from specific communication systems and what is the role of the topology in the interactions between agents. Examples of systems like the ones described range from animal communication to human language, from the communication among biological elements to that among elements of technological systems. Language dynamics is an emerging field that focuses on all processes related to the emergence, evolution and extinction of languages and communication systems. Recently the study of the self-organization and evolution of language and meaning has recently led to the idea that a community of language users can be seen as a complex dynamical system that collectively solves the problem of developing a shared communication framework through the back-and-forth signalling between people. On these subjects I coordinated the Italian team of the EU Integrated Project (IP) ECAgents. I have presently an extensive activity focused on investigating how language structures of increasing complexity emerged and evolved: emergence of names, categories, syntactic and grammar structures. In parallel I co-coordinated (together with Claudio Castellano) the *DRUST: Digging at the Roots of Understanding* project of the European Science Foundation, focused on the understanding the origins and evolution of consensus and misunderstanding. This is a challenging question that touches on all aspects of cognition as well as of social interactions. As such it stimulates creative thinking and casts many fundamental issues in a new light. The theoretical activity is paralleled both by large-scale data analyses to ground the models' predictions and an experimental activity through the realisation of targeted games/experiments using the platform Xtribe for social computing and web-gaming (see below for a description of it).

Opinions and norms dynamics Opinion dynamics concerns social processes through which populations or groups of individuals agree or disagree on specific issues. As such, modelling opinion dynamics represents an important research area that has been progressively acquiring relevance in many different domains. Existing approaches have mostly represented opinions through discrete binary or continuous variables by exploring a whole panoply of cases: e.g., independence, noise, external effects, multiple issues. In most of these cases the crucial ingredient is an attractive dynamics through which similar or similar enough agents get closer. Only rarely the possibility of explicit disagreement has been taken into account (i.e., the possibility for a repulsive interaction among individuals' opinions). My research in this area concerns the investigation of the interplay between the possibility of explicit disagreement, modulated in a self-consistent way by the existing opinions' overlaps between the interacting individuals, and the effect of external information on the system. Opinions are modelled as a vector of continuous variables related to multiple possible choices for an issue. Information can be modulated to account for promoting multiple possible choices. Key points addressed involve: why extreme information results in segregation and has a limited effect on the population? Why milder messages may have better success and a cohesion effect? The theoretical analysis is more and more paralleled by specifically devised web-based experiments (see below the Social Computation section) to gather reliable data in controlled experimental settings. The last experiment realised in this area, LaPensoCosì, concerned the monitoring of positive and negative opinions about political subjects during the last Italian political elections.

Another related area of research focuses on how norms or conventions may arise as emergent phenomena and evolve in somewhat predictable trajectories, and how these may be modelled from various perspectives, i.e., from computational to data-driven to experimental perspectives. I am interested in particular in exploring how the norms or norm-like behaviours emerge from repeated interactions among agents, and subsequently pinpoint the important factors in determining the trajectories of the norm-like interaction behaviour. The cognitive level of sophistication of the agents might affect the dynamic patterns of the interaction behaviours, thus the 'ecology' in which the whole process plays out might be a central parameter.

Innovation dynamics A universal feature of evolution, whether in biology, culture, language, or technology, is that one innovation sets the stage for another. Lipid bilayers ultimately led to cell membranes; the transistor paved the way, through subsequent innovations large and small, to the integrated circuit, personal computers, and the World Wide Web. By opening new possibilities, one novelty can pave the way for others in a process that Kauffman has called "expanding the adjacent possible". Though the creative power of this expansion into the adjacent possible is widely appreciated at an anecdotal level, it remains poorly understood theoretically and undocumented empirically. In this area, in collaboration with F. Tria, V.D.P. Servedio and S.H. Strogatz, I proposed the first mathematical model of innovation via the adjacent possible and derive testable, quantitative predictions from it. We tested these predictions on four data sets of human activity: the edit events of Wikipedia pages, the emergence of tags in annotation systems, the sequence of words in texts, and listening to new songs in online music catalogues. By quantifying the dynamics of correlated novelties, our results provide a starting point for a deeper understanding of the ever-expanding adjacent possible. From this perspective this work is giving raise to many spin-off research lines as for the emergence and diffusion of innovation in biology, linguistics, cultural and technological evolution. On these themes I'm presently coordinating the already mentioned KREYON Project (www..kreyon.net) for the period 2014-2017. Funded by the John Templeton Foundation, KREYON aims to unfold and quantify the underlying mechanisms through which creativity emerges and innovations diffuse, compete and stabilise. The project is timely due to the availability of extensive longitudinal records of human, social, biological and technological evolution. KREYON is exploiting the unique opportunity offered by the combination of ICT tools for social computation with powerful analytical and modelling tools, by blending, in a unitary interdisciplinary effort, three main activities: web-based experiments, data science and theoretical modelling. Through this experimental, mathematical and computational framework we aim at providing the scientific community with a quantitative understanding of the determinants of creativity and innovation as well as a solid overarching scientific framework describing creativity in a quantitative and operational way.

2.2 Information dynamics in Techno-social systems

Key papers:

C. Cattuto, **V. Loreto** and L. Pietronero, *Semiotic Dynamics and Collaborative Tagging*, *Proc. Natl. Acad. Sci. USA (PNAS)*, **104**, 1461-1464 (2007).

C. Cattuto, A. Barrat, A. Baldassarri, G. Schehr and **V. Loreto**, *Collective dynamics of social annotation*, *Proc. Natl. Acad. Sci. USA (PNAS)*, **106**, 10511-10515 (2009).

R. Conte, N Gilbert, C. Cioffi-Revilla, G. Deffuant, J. Kertesz, **V. Loreto**, S. Moat, J.-P. Nadal, A. Sanchez, A. Nowak, A. Flache, M. San Miguel, D. Hekbing, *Manifesto of Computational*

Social Science, *European Physical Journal - Special Topics* **214**, 325–346 (2012).

M. Becker, S., D. Fiorella, L. Francis, P. Gravino, M. Haklay, A. Hotho, **V. Loreto**, J. Mueller, F. Ricchiuti, V.D.P. Servedio, A. Sîrbu, F. Tria, *Awareness and learning in participatory noise sensing*, *PLoS ONE* **8(12)**, e81638 (2013).

Alina Sirbu, Martin Becker, Saverio Caminiti, Bernard De Baets, Bart Elen, Louise Francis, Pietro Gravino, Andreas Hotho, Stefano Ingarra, **Vittorio Loreto**, Andrea Molino, Juergen Mueller, Jan Peters, Ferdinando Ricchiuti, Fabio Saracino, Vito D. P. Servedio, Gerd Stumme, Jan Theunis, Francesca Tria, Joris Van den Bossche, *Participatory patterns in an international air quality monitoring initiative*, *PLoS ONE* **10(8)**, e0136763. doi:10.1371/journal.pone.0136763 (2015).

Since 2005 I have being investigating information dynamics in techno-social systems, coupling the theoretical modelling ad the statistical data analysis with innovative data gathering tools and the design and realisation of web-based experiments.

Online social systems The rise of Web 2.0 has dramatically changed the way we view the relation between on-line information and on-line users and prompts a new research agenda which complements the "Web Science" vision with analytical tools and modelling paradigms from the theory of complex networks. Many popular Web applications are now exploiting user-driven information networks built by means of social annotations. Social annotations are freely established associations between Web resources and metadata (keywords, categories, ratings) performed by a community of Web users with little or no central coordination. A mechanism of this kind which has swiftly become well-established is that of collaborative tagging, whereby Web users associate free- form keywords called "tags" with on-line content such as Web pages, digital photographs, bibliographic references and other media. On these subjects I have coordinated one of the first European project in this new area, TAGora, whose aim was that of investigating how from the uncoordinated actions of millions of users a loose categorisation system emerged, commonly referred to as folksonomy, that displays an emergent semantics and can be effectively used to navigate through a large and heterogeneous body of resources. Two early papers in the field were published in the Proceedings of the National Academy of Sciences.

Social computation In the last few years the Web has been progressively acquiring the status of an infrastructure for "social computing" that allows to coordinate the cognitive abilities of human agents in online communities, and steer the collective user activity towards predefined goals. Social computation holds a tremendous potential to solve a variety of problems in novel and interesting ways. Human ability to easily solve tasks which are difficult to solve by setting up efficient algorithms has been largely exploited for instance for labelling images (e.g., the ESP collaborative game), language translators, etc. This general trend is also triggering the adoption of web-based games as a very interesting laboratory to run experiments in the social-sciences and whenever the contribution of human beings is crucially required for research purposes. To this end I have introduced a novel general purpose web-based platform for social computation, XTribe. XTribe is aimed at both gathering otherwise separate efforts to use web resources for scientific purposes and at providing the community with a tool to design experiments on the web, bypassing much of the 'hard work'. The benefit is twofold: on the one hand, it allows virtually any researcher to realise his own experiment with minimal effort, paving the way of the use of the web as a standard 'laboratory' to perform experiments. On the other hand, it can be a strong basin of attraction for people willing to participate to experiments, making in this way recruitment much more easier

than for single-experiment platforms.

ICT, participatory sensing and citizen science There is now overwhelming evidence that the current organisation of our economies and societies is seriously damaging biological ecosystems and human living conditions in the very short term, with potentially catastrophic effects in the long term. A lot can and must be done from the technology and policy point of view: for example building passive houses, developing renewable energy, and so on. However, it is only when people become fully aware of their particular environmental situation and its future consequences that the needed behavioural changes will truly happen. With a growing realisation that only through bottom-up actions we can deal with today's challenges, there is an urgent need to create an ICT fabric that can support the local actions of citizens by supporting collaborative monitoring, exposing actionable local information, and enabling an evidence-based dialogue among stakeholders. On these subjects I recently coordinated the EU STREP Project EveryAware. The goal of this project is to enhance social awareness about environmental issues emerging in urban habitats through the use of ICT tools especially designed to gather user-generated and user-mediated information. The idea is that the availability of locally-relevant digital data, together with their analysis, processing and visualisation should trigger a bottom-up improvement of social strategies. EveryAware combines digital technologies to gather data and opinions with established and novel theoretical methods to analyse them, with the ultimate goal of providing real-time, user-centred results through standard and largely available communication networks. The integration of participatory sensing with the monitoring of subjective opinions is novel and crucial, as it exposes the mechanisms by which the local perception of an environmental issue, corroborated by quantitative data, evolves into socially-shared opinions, and how the latter, eventually, drive behavioural change. Currently two main case studies are ongoing: one focused on Noise Pollution and one on Air Quality through a suitably constructed and calibrated Sensor Box: a portable device that measures concentrations of pollutants in the air and localise them through a GPS. A large scale International challenge is currently ongoing.

2.3 Information Theory and Complexity

Key papers:

D. Benedetto, E. Caglioti and **V. Loreto** : *Language Trees and Zipping*, *Phys. Rev. Lett.* **88**, 048702 (2002).

A. Puglisi, D. Benedetto, E. Caglioti, **V. Loreto** and A. Vulpiani, *Data Compression and Learning in time sequences analysis*, *Physica D* **180**, 92 (2003).

A. Baronchelli, D. Benedetto, E. Caglioti and **V. Loreto**: *Artificial sequences and complexity measures*, *J. Stat. Mech.*, P04002 (2005).

In nature many systems and phenomena are often represented in terms of sequences or strings of characters. In experimental investigations of physical processes, for instance, one typically has access to the system only through a measuring device which produces a time record of a certain observable, i.e. a sequence of data. On the other hand other systems are intrinsically described by string of characters, e.g. DNA and protein sequences, language.

In this area I have introduced a new automatic method for the extraction of information codified as sequences of characters. Together with Dario Benedetto and Emanuele Caglioti I have patented an automatic method for context classification of sequences of characters. The method follows a data-compression oriented information theory approach to define a concept of remoteness between

pairs of sequences or strings of characters on the basis of their relative information content (relative entropy). The notion of remoteness between two bodies of knowledge is the key point to implement suitable algorithms for context recognition (e.g., for a text, recognition of the language in which it is written, the subject treated and its author) as well as context classification, i.e. a hierarchical organization of corpora of sequences on the basis of the mutual entropic content of pairs of elements in the corpus. This body of work triggered an extensive press coverage.

2.4 Phylogeny and evolution

Key papers:

F. Tria, E. Caglioti, **V. Loreto** and A. Pagnani, *A Stochastic Local Search algorithm for distance-based phylogeny reconstruction*, *Molecular Biology and Evolution*, **27**, 2587-2595 (2010).

S. Pompei, **V. Loreto** and F. Tria, *Phylogenetic properties of RNA viruses*, *PLoS ONE* **7**, e44849 (2012).

L. Taggi, F. Colaiori, **V. Loreto** and F. Tria, *Dynamical correlations in the escape strategy of Influenza A virus*, *Europhys. Lett.* **101**, 68003 (2013).

F. Tria, S. Pompei and **V. Loreto**, *Dynamically correlated mutations drive human Influenza A evolution*, *Nature Scientific Reports* **3**, 2705 (2013).

While the traditional aim of phylogeny reconstruction is that of classifying a set of species (viruses, bacteria, languages) sharing a common origin, a more recent trend is that of uncovering the evolutionary relatedness among those species through the visualisation of their phylogenetic tree. The analysis of statistical properties of phylogenetic trees, e.g., their topological properties, expresses deep information about the evolutionary process who gave birth to the differentiation of the species. In this scenario, the challenges are, on the one hand, developing suitable algorithms for the analysis of large data-sets, in order to perform robust statistical analyses. On the other hand, a quantitative analysis of phylogenetic properties of populations of pathogens (viruses, bacteria), offer a precious validation tool for the discrimination of theoretical predictions for different evolutionary models. In this area I worked along the following main directions.

New algorithms for phylogeny reconstruction We introduced a new distance-based algorithm, named SBiX, along with its fast implementation, *Fast-SBiX*, for the inference of phylogenetic trees, particularly suitable for the inference of trees with thousands of taxa. The algorithm has been successfully tested against state-of-art distance based methods, by means of artificially generated data-sets as well as real-world data (for instance classifications of languages made by experts in historical linguistic as a benchmark for inferred phylogenetic trees of languages).

Phylogenetic structure of RNA viruses Phylogenetic properties have been highlighted as interesting signatures of epidemic features of RNA viruses, such selection mediated by the host immune response, and transmission mechanisms among hosts. In particular, on a qualitative level, it has been observed that selection driven by the host immune response induces an uneven survival ability among co-existing strains, which is reflected in the imbalance level of the phylogenetic tree. I contributed to design new mathematical tools for the quantification of the imbalance level of the topology of phylogenetic trees, which correctly reflects the level of the immune-driven selection acting on RNA viruses.

Modelilng the evolution of Influenza A virus The modelization of the evolution of the Human Influenza A virus (subtype H3N2) at the sequence level has a crucial importance for vaccine preparation as well as for the theoretical challenges it offers to understand the driving forces of its peculiar evolutionary dynamics. The major molecule to which the immune system makes its humoral response is the haemagglutinin (HA). We introduced a modeling scheme to investigate the mapping of the genotypic properties of co-existing strains into antigenic clusters. We focused in particular on the possible role of dynamical epistatic interaction between sites in the HA coding region.

Evolutionary dynamics of neisseria meningitidis The evolutionary dynamics of Neisseria meningitidis (Nm), a deadly human pathogen, feature an high-level of homologous recombination. Recent analysis of molecular data on a limited number of chromosomal loci, however, have shown that (Nm), is structured in distinct phylogenetic lineages. The mechanisms resulting in the evolution of these lineages, their persistence in time, and the implications for the pathogenicity of the bacterium are not yet completely understood. In this area we introduced an evolutionary model for Nm, where we investigate the possible role of different sets of restriction modification systems coexisting in the bacteria population, as the main cause for the emergence of phylogenetic lineages.

3 Coordination and management activities

I have an extensive experience in coordinating research groups both scientifically and strategically. This includes all the activities from fund raising (at the National and mostly at the international level), selecting and hiring people, coordinating the activities of several working groups in a timely and efficient way, enforcing delivery deadlines, supervising junior and experienced researchers.

3.1 Coordination of research groups

- I am responsible of the *Information Dynamics* group, composed by 4 Post-Docs and 1 Ph.D student, at the Institute for the Scientific Interchange (ISI) in Turin.
- I have my own group at the Physics Dept. of Sapienza University, composed by 2 Post-Docs, 1 Web-developer, 1 Game developer, and several undergraduate students.
- In the academic year 2014-2015 I coordinated the Social Dynamics group at the Computer Science Lab SONY-CSL in Paris.
- I am coordinating the development and deployment of the Experimental Tribe (www.xtribe.eu) platform, devoted to Web-gaming and social computation.

3.2 Research projects coordination

- General Coordinator of the project *KREYON Unfolding the dynamics of creativity, novelties and innovation* funded by the Templeton Foundation (2014-2017) (650 KEUR). The project addresses the dynamics of novelties - a fundamental factor in the evolution of human societies, biological systems and technology - with the aim to unfold and quantify the underlying mechanisms through which creativity emerges and innovations diffuse, compete and stabilise.
- General European Coordinator of the European STREP project *EveryAware* (2011-2014) (2 Millions Euros). EveryAware intends to integrate environmental monitoring, awareness enhancement and behavioural change by creating a new technological platform combining sensing technologies, networking applications and data-processing tools. From this perspective the management have to be timely and careful in order to perfectly integrate all the needed components: electronics for the sensing technologies, software for mobile apps and web-gaming platforms, data gathering, storage and analysis tools, modelling and analytical techniques.
- Co-coordinator of the ESF EUROUNDERSTANDING project *DRUST: Digging at the Roots of Understanding* (2011-2014) (100 KEuro). DRUST collaborative research project (CRP) brings together eminent European research groups that cover the full breadth of Cognitive Science, Artificial Intelligence, Linguistics, Physics and Computer Science in an interdisciplinary examination of how different types of common ground support interpersonal and intercultural understanding. Communication plays a key role for such an understanding but only to the extent that dialog partners have sufficient common ground. Misunderstandings occur because most dimensions on which common ground can exist are not universally shared and not a priori present. In this framework our Unit is providing the data analysis and modelling support borrowed from the experience gathered in modelling social dynamics phenomena.

- Coordinator of the Sapienza Ateneo project *Sistemi complessi classici e quantistici* (2010-2013) (120 KEuro). This project was articulated in two main research lines, one devoted to complex classical systems and one focused on quantum complex many-body systems. Though apparently far apart, both topics have an intrinsic unity due to the theoretical and numerical tools adopted to investigate the emerging collective properties of both classical and quantum systems.

- Coordinator for the Physics Dept. of the PRIN project *Information dynamics in techno-social systems*, funded by the Italian Ministry for University and Research (2008-2010).

- General European Coordinator of the European STREP project *TAGora* (2006-2009) (2 Millions Euros). TAGora has been the very first project dealing with the dynamics of online social communities. Back in 2005 a new paradigm was quickly gaining impact in large-scale information systems: Social Tagging. In applications like Flickr, Connotea, Citeulike, Delicious, etc. people no longer made passive use of online resources - they took on an active role and enrich resources with semantically meaningful information. Such information consisted of terminology (or tags") freely associated by each user to resources and shared with users of the online community. Despite its intrinsic anarchist nature, the dynamics of this terminology system spontaneously led to patterns of terminology common to the whole community or to subgroups of it. Surprisingly, this emergent and evolving semiotic system provided and still does a very efficient navigation system through a large, complex and heterogeneous sea of information. TAGora proposed visionary and high risk research aimed at giving a scientific foundation to these developments, so contributing to the growth of the new field of Semiotic Dynamics. Semiotic Dynamics studies how semiotic relations can originate, spread, and evolve over time in populations, by combining recent advances in linguistics and cognitive science with methodological and theoretical tools of complex systems and computer science.

- Coordinator for the Physics Dept. of *Sapienza* Univ. of the European Integrated Project *ECAgents* (2004-2008) (280 KEuro). ECAgents proposed visionary and high risk research to provide better understanding of the role of communication in collections of embodied and situated agents using the methodological and theoretical tools of complex systems science and computer science. The aim was that of studying how communication arises, what different types of communication systems there are or can be, what the different pre-conditions are that must be satisfied for the emergence of different types of communication systems, what kind of performances at the collective level are made possible by different communication systems, what is the role of network communication topology in such performances. The project investigates basic properties of different communication systems, from simple communication systems in animals to human language and technology-supported human communication, to clarify the nature of existing communications systems and to provide ideas for designing new technologies based on collections of embodied and communicating devices.

- Coordinator for the Physics Dept. of *Sapienza* Univ. of the European Project *ATACD* (2006-2009) (20 KEuro).

- National coordinator of the PRIN project *Meccanica statistica dei sistemi complessi*, funded by the Italian Ministry for University and Research (2005-2007) (220 KEuro).

- Coordinator for the Physics Dept. of *Sapienza* Univ. of the FIRB project *Rheological and*

dynamical properties of granular matter, funded by the Italian Ministry for University and Research (80 KEuro).

3.3 Conference Organization

- 1998: Meeting *GdR Milieux Granulaires SEC*, École Supérieure de Physique et Chimie Industrielles, Paris (FRANCE), 12 June 1998.
- 2001: Workshop *Viellissement et matière desordonnée*, Carry-le-rouet, France 5-7 June 2001 (organized with D. Bideau and E. Charlaix).
- 2002: International Workshop *Aspect of Complexity and its applications*, Rome 23-25 September 2002 (organized with M. Falcioni, E. Marinari and A. Vulpiani).
- 2004: Workshop on *Theoretical and Methodological Foundations of ECAgents*, Rome, 20th September 2004.
- 2005: International Conference: *Semiotic Dynamics, Language, and Complexity*, Erice, 12-16 December 2005.
- 2005: Workshop on *Semiotic Dynamics of Language Games*, Bagnovignoni (Siena - Italy) 9-12 November 2005
- 2006: II Bagnovignoni workshop on *Semiotic Dynamics: Grammar*, Bagnovignoni (Siena - Italy) 23-26 October 2006
- 2007: Vice-chairman of STATPHYS23, the 23rd International Conference on Statistical Physics of the International Union for Pure and Applied Physics (IUPAP), to be held in Genova, Italy, from July 9 to 13, 2007.
- 2007: International School on Complexity: Course on *Statistical Physics of Social Dynamics: Opinions, Semiotic Dynamics, and Language*. Directors: Vittorio Loreto and Luc Steels, Ettore Majorana Foundation and Center For Scientific Culture Erice, 14-19 July 2007, Satellite Workshop of STATPHYS2.
- 2008: Session leader for the session on *Information and Communication Technologies* at the European Conference on Complex Systems ECCS08, Jerusalem, 10-19 September 2008.
- 2009: Track chair at the Hypertext 2009 conference, 29th June - July 1st 2009, Torino, Italy.
- 2009: TAGora workshop at the Hypertext 2009 conference, 29th June - July 1st 2009, Torino, Italy.
- 2010: *Paths in Complexity: Fractals, Superconductivity and Galaxies*: conference to celebrate the 60th birthday of Luciano Pietronero, Rome, 23-24 September 2010.
- 2011: Workshop PRIN on *Information dynamics in complex data structures*, Bagnovignoni 23-25 February 2011.
- 2011: *Everyaware* Kick-off meeting, Torino, 14-15 March 2011.
- 2012: Program Co-Chair of IWSOS 2013, the seventh International Workshop on Self-Organizing Systems, Palma de Mallorca, Spain, 8-10th May 2013.

- 2014: Workshop on *On the emergence of consensus and misunderstanding*, Rome 24-25th February 2014. Co-chair with C. Castellano, C. Cuskley and L. Steels.
- 2015-2017: Member of the Steering Committee of the European Conference of Complex Systems (ECCS).
- 2015: Organizer of the "Complex Systems" Session of the 101st National Congress of the Italian Physics Society (SIF), Rome, 21-25 September 2015.
- 2015: Organizer and coordinator of the 1^{st} KREYON Day, September $13^{th} - 14^{th}$, Palazzo delle Esposizioni in Rome and Physics Dept. of Sapienza University in Rome.
- 2016: Co-Chair of the Workshop on "Creativity and innovation in the evolution of language", to be held in the framework of the EVOLANG 11 Conference, New orleans 21-24 March 2016.
- 2016: Local Chair of the COMPLEXIS 2016, 1st International Conference on Complex Information Systems (http://www.complexis.org/), 22-24 April 2016.
- 2016: Co-director for the International Summer school on "Creativity and Evolution: Games, Language, Robots, Life, Art", Como, 5-9 September 2016. (co-director L. Steels). (http://caes.lakecomoschool.org/)
- 2016: Co-director for the Workshop on "Determinants of creativity and innovation in science, art and technology", satellite workshop of the 2016 Conference on Complex Systems, Amsterdam, September the 20th 2016. (http://www.kreyon.net/ccs2016).
- 2016 Organizer and coordinator of the 2^{st} edition of the KREYON DAYS, October $26^{th}-30^{th}$, Palazzo delle Esposizioni in Rome and Physics Dept. of Sapienza University in Rome.

4 Teaching activity

'91-'93 Teaching activity of Mathematics and Physics in several secondary Schools.

'07-present Supervisor of **16 Laurea students (triennale)** Simone Pompei 2007, Giorgio Gosti 2007, Lorenzo Pucci 2007, Guido Uguzzoni 2007, Nicola Catenacci 2008, Riccardo Balzan 2008, Alessandro Cerocchi 2008, Andrea Lanciano 2009, Eis Annavini 2009, Valerio Ciotti 2013, Viviana Paga 2014, Valerio Cappuccio 2014, Lancia 2015, Alessandro Del Franco 2015, Pietro Pasanisi 2015, Giulio Macilenti 2015.

'94-present Supervisor of **26 Laurea students (Magistrale, specialistica e vecchia laurea)** Riccardo Hallgass 1994, Luigi Ciofi degli Atti 1999, Vittoria Colizza 2000, Alessandro Taloni 2000, Andrea Baronchelli 2002, Valentina Alfi 2002, Filippo Radicchi 2004, Riccardo Balzan 2006, Simone Pompei 2009, Lorenzo Pucci 2009, Pietro Gravino 2009, Lorenzo Taggi 2010, Martina Pugliese 2011, Luca Gramaglia 2011, Davide Colombi 2011, Roberta Amato 2011, Giovanna Chiara Rodi 2013, Marco Pietrosanto 2013, Pierpaolo Mastroianni 2013, Bruno Campanelli 2013, Stefano Vaccari 2013, Pietro Pugliese 2014, Greta Greco 2015, Leonardo Zavojanni 2015, Flavia D'Arpino 2015, Lorenzo Lancia 2015.

'04-present Supervisor **11 Ph.D students** Andrea Baronchelli 2004; Patrick Mayor 2005, Ph.D. student EPFL- Switzerland; Giuliano Pascucci 2007-2010; Alessio Ansuini 2006-2009; Miguel Ibanez de Berganza 2006-2009, Simone Pompei 2010-2013, Pietro Gravino 2010-2015, Martina Pugliese 2011-2015, Bernardo Monechi 2011-2015, Suman Maity 2013-2015, Giovanni Chiara Rodi 2013-present.

'07-present Mentor of **20 post-docs researchers**: Tao Gong 2007-2008; Ramon Ferrer y Cancho 2006-2007; Andrea Baldassarri 1997 and 2005-2011; Andrea Capocci 2007-2011; Vito D.P. Servedio 2006-present; Ciro Cattuto 2006-2009; Xavi Castello 2008; Animesh Mukherjee 2009-2011; Francesca Tria 2009-2010; Alina Sîrbu 2011-2014; Saverio Caminiti 2011-2014; Christine Cuskley 2012-present; Stefano Ingarra 2011-2014; Fabio Saracino 2012-2014; Alváro Ruiz-Serrano 2014-2015; Bernardo Monechi 2015-present; Cesare Bianchi 2015-present; Indaco Biazzo 2015-present; Pietro Gravino 2015-present; Jason Sakellariou, 2015-2016.

1999-2000 Assistant professor for the course of Fisica Generale I (Prof. R. Bizzarri), Undergraduate studies in Physics, Sapienza University of Rome.

2000-2001 Assistant professor for the course of Fisica Generale II (Prof. R. Bizzarri), Undergraduate studies in Physics, Sapienza University of Rome.

2001-2005 Assistant professor for the course of Classical Mechanics and Mechanics of Continuous Systems (Prof. G. Bachelet), Undergraduate studies in Physics, Sapienza University of Rome.

2005-2010 Course of Computational physics (Laboratorio di Calcolo), Undergraduate studies in Physics, Sapienza University of Rome.

2007-2014 Course of Fisica Generale I, Undergraduate studies in Chemistry, Sapienza University of Rome. For this course I wrote a book published in 2012 by Mc-Graw-Hill.

2009-2014 Course of Physics of Complex Systems, Undergraduate and graduate studies in Physics, Sapienza University of Rome.

2015- Course of Fisica Generale I, Undergraduate studies in Chemistry, Sapienza University of Rome. For this course I wrote a book published in 2012 by Mc-Graw-Hill.

2015- Course of Physics of Complex Systems, Undergraduate and graduate studies in Physics, Sapienza University of Rome.

2012- Member of the Ph.D. committee in Mathematics, Sapienza University of Rome.

5 Referee activity

As of 2016 I serve in the advisory board of a book series at Springer, entitled "Computational Synthesis and Creative Systems".

As of 2015 I serve in the Council of Complex Systems Society and in the Steering Committee of the Conference on Complex Systems.

As of 2008 I serve the European Commission and several National and International Institutions as a consultant expert for future programs and reviewer for project proposals: e.g., FET-Open projects for the EU, Israel Science Foundation, Université unifié Sorbonne Paris Cité, Swiss National Science Foundation, Singapore NRF Competitive Research Programme.

As of 1993 I do referee activity for several international journals among which: PLoS ONE, Nature, Nature Physics, Nature Scientific Reports, PNAS, Physical Review and Physical Review Letters, Physics A, Physica D, Journal of Geophysical Research, Adaptive Behaviour, Advances in Complex Systems, International Journal of Modern Physics C, Europhysics Letters, JSTAT.

6 Scientific outcomes

6.1 Patents

Sistema informatizzato di gestione di informazione rappresentata in forma codificata, E. Caglioti, D. Benedetto, and V. Loreto, Università di Roma "La Sapienza" (2001), IT1323407.

6.2 Impact of the publications

The publications received a total of roughly 4600 citations (4485 without self-citations) with an H-index of 29 (source: ISI, Web of Science, as of March 2016 2015). As for Google Scholar the H-index is 39 and the total number of citations is above 9000. Total number of articles on ISI is 135, total number of articles in the last ten years: 92 (source: ISI, Web Of Science). The paper G. D'Anna, P. Mayor, A. Barrat and V. Loreto, Nature, vol. 424, 909 (2003) has been featured in the cover page of Nature; News and views: *Shaken sand: a granular fluid?*, P. Umbanhovar, Nature vol. 424, 886 (2003). News feature: *Think outside the box*, M. Buchanan, Nature, vol. 425, 556 (2003).

Impact in the media: More than 100 among press releases, TV and radio broadcasts in the last few years, among which the most important on New York Times, The Economist, BBC, Scientific American, Physics Today, New Scientist, Nature Science Update, Science NOW, Prospect Magazine, LiveScience, Libération, Il Sole 24 Ore, La Stampa, Corriere, Radio Rai 3, Rai Educational, Radio 24, Radio Capital, Eco Radio, Rai 3 - TG Leonardo. Among the most important are (see `http://samarcanda.phys.uniroma1.it/vittorioloreto/press/` for the full list):

- *Granular Games*, Nature, Physics portal, Research Highlight November 2001.
  (`http://physics.nature.com/`)
- Andrew Watson, *A gift for language*, New Scientist, 15 December 2001.
  (`http://www.newscientist.com/`)
- Philip Ball, *Algorithm makes tongue tree*, Nature Science Update, 22 January 2002.
  (`http://www.nature.com/nsu/020121/020121-2.html`)
- Sharmila Sohoni, *The elements of style*, The Economist, 7 February 2002.
  (`http://www.economist.com/science/displayStory.cfm?story_id=975770`)
- Bruce Schecther *Fun With Your Zip Program: SortThrough Texts, and More*, New York Times, 30th april 2002.
  (`http://www.nytimes.com/2002/04/30/science/physical/30ZIP.html`)
- Luigi Dell'Aglio *Nel mondo dei granelli di sabbia*, Il Sole 24 Ore, 11th September 2003.
  (`http://www.neteconomy24.ilsole24ore.com/fc?cmd=art&artId=286151&chId=16&artType=Articolo&back=0`)
- Luigi Dell'Aglio *Le sfide: non-equilibrio e complessità*, Il Sole 24 Ore, 11th September 2003.
  (`http://www.neteconomy24.ilsole24ore.com/fc?cmd=art&artId=286152&chId=16&artType=Articolo&back=0`)

- Italian Radio, Rai - Radio 3, *Sotto lo zip, l'autore*, Le oche di Lorenz, 11th march 2002. (http://www.radio.rai.it/radio3/scienze/mostra_evento.cfm?Q_EV_ID=27397)
- TV broadcast, April 2004: EXPLORA, La TV delle scienze, RAI Educational. Discussion on *Networks* with Castellano C. (ECAgents), Di Bernardo D., Loreto V. (ECAgents), Parisi D. (ECAgents). (http://www.explora.rai.it)
- TV broadcast, April 2005: EXPLORA, La TV delle scienze, RAI Educational. Discussion on *Complexity* with P.-L. Luisi, V. Loreto, G. Parisi and L. Pietronero. (http://www.explora.rai.it)
- ScienceNOW Daily News, 23rd January 2007: *Folk Wisdom for Web Sites*, by John Bohannon. (http://sciencenow.sciencemag.org/cgi/content/full/2007/123/5)
- Scientific American, 23rd January 2007: *Tag, You're It: Scientists Describe Collaborative Tagging Sites like Del.icio.us*. (www.sciam.com/article.cfm?articleID=5021D304-E7F2-99DF-33DDD86F3B3ECA20)
- Italian Radio, Rai - Radio 3 Scienza, *La fisica dei sistemi complessi*, 20th September 2007. (http://www.radio.rai.it/radio3/view.cfm?Q_EV_ID=226108)
- Italian Radio, Rai - Radio 3 Scienza, *La lingua batte dove la fisica vuole*, 23rd October 2007. (http://www.radio.rai.it/radio3/view.cfm?Q_EV_ID=229258)
- Italian Radio, Rai - Radio 3 Scienza, *Complessita' senza complessi*, 24th April 2008. (http://www.radio.rai.it/radio3/view.cfm?Q_EV_ID=249235)
- Radio 24, Moebius, *Sulla formazione delle categorie*, 16th August 2008. (http://www.moebiusonline.eu/trasmissioni/080816trasmissione.shtml)
- Babel's dawn: speech, community and power, by Blair Bolles, 22nd June 2008. (http://ebbolles.typepad.com/babels_dawn/2008/06/are-languages-r.html)
- "La supermente del mondo", Focus, n. 197, February 2009. (http://www.focus.it/In_edicola/default.aspx?ide=27121)
- "Tutta la complessità del social tagging", CNR-INFM press release, June 2009.
- "Tag anti spam", Galileonet, July 3rd 2009. (http://www.galileonet.it/news/11701/tag-anti-spam?print=1)
- "La strategia del tag", Oggiscienza, July 3rd 2009. (http://oggiscienza.wordpress.com/2009/07/03/la-strategia-del-tag/)
- "Model sheds light on the language of color", Physics Today, March 2010. (http://ptonline.aip.org/journals/doc/PHTOAD-ft/vol_63/iss_3/20_1.shtml)
- "Così imparammo a dire rosso", Gabriele Beccaria, Tuttoscienze, La Stampa, February 2012. (http://www3.lastampa.it/scienza/sezioni/news/articolo/lstp/442621/)

- "Interactive maps help pygmy tribes fight back", New Scientist, One Per Cent, 21st February 2012.

  (http://www.newscientist.com/blogs/onepercent/2012/02/interactive-maps-help-pygmy-tr.html)

- "Hierarchy of Color Naming Matches the Limits of Our Vision System". Charles Choi, LiveScience, 16th April 2012.

  (http://www.livescience.com/19704-colors-names-human-vision.html)

- "Hierarchy of Color Naming Matches the Limits of Our Vision System". Scientific American, 16th April 2012.

  (http://www.scientificamerican.com/article.cfm?id=how-colors-get-their-name)

- "Na wit en zwart komt altijd rood". Hilde Van den Eynde, De Standaard, 17th April 2012.

  (http://www.standaard.be/artikel/detail.aspx?artikelid=FA3OQMJT)

- "Come nascono i nomi dei colori". Martina Saporiti, Galileonet, 20th April 2012

  (http://www.galileonet.it/articles/4f90049f72b7ab0f9a000002)

- "Colours: Differing points of hue". Philip Ball, Under the radar, BBC - Future, 27th April 2012.

  (http://www.bbc.com/future/story/20120427-when-is-a-colour-not-a-colour)

- Moebius, Radio 24, June the 2nd 2012, EveryAware project.

  (http://www.moebiusonline.eu/trasmissioni/120602trasmissione.shtml)

- Colorful language, Doctordisruption, 6th June 2012.

  (http://www.doctordisruption.com/language/colourful-language/)

- Radio 3 Scienza, June the 13th 2012, Intervista con Rossella Panarese.

  (http://www.radio3.rai.it/dl/radio3/programmi/puntata/
  ContentItem-51e48255-52eb-4917-b454-214d2a9140dc.html)

- "Riddled with irregularities: Why are languages so different and disorderly?" Philip Ball, Prospect Magazine, 22 August 2012.

  (http://www.prospectmagazine.co.uk/magazine/riddled-with-irregularity/)

- Radio Capital, September 1st 2012, Interview with Fabiana Bisulli.

  (http://www.capital.it/capital/home)

- ECO Radio, September 4th 2012, Interview on the EveryAware project with Francesco Pompilio.

  (http://www.ecoradio.it/?option=com_frontpage&Itemid=1)

- "Energie sensibili", September 12th, Interview on the EveryAware project with Federica Ionta.

  (http://www.energiesensibili.it/numero-60-2/sviluppo-sensibile/
  eco-tecnologia-per-uneuropa-pi-sensibile)

- "Lo zainetto misura smog", Maria Rosa Pavia, Corriere.it, August 31st 2012
  (http://www.corriere.it/ambiente/12_agosto_08/
  zainetto-misura-smog_ea32bb6c-e132-11e1-9040-4b74873c03cd.shtml)
- "Veleni, arriva lo zainetto antismog", Livia Ermini, Il Venerdì di Repubblica, August 31st 2012.
- "Laboratorio in spalla", TG Leonardo, November 8th 2012.
- "L'umore degli elettori social in un gioco online", La Stampa, January the 30th 2013.
- "laPENSOcosì: esperimento scientifico per misurare l'umore degli elettori", LINKIESTA, M. Boscolo and E. Tola, January the 30th 2013.
- "Scopri la tua anima di elettore con gli algoritmi sul Web", Tuttoscienze, La Stampa, February the 2nd 2013.
- Interview on Ecoradio about Widenoise, Luciana Biondi, February the 5th 2013.
- Interview on Ecoradio about laPENSOcosì, Luciana Biondi, February the 26th 2013.
- "Torino, in giro con Everyaware a controllare la qualità dell'aria", S. Bencivelli, La Stampa, TUTTOGREEN, September 2013.
- "Io e i miei studenti in giro a misurare lo smog" (My students and me, monitoring smog around), S. Bencivelli, La Repubblica, February the 24th 2014.
- The Mathematics of Novelties and Innovations. Samuel Arbesman, 08.06.14 Wired
  (http://www.wired.com/2014/08/themathematicsofnoveltiesandinnovations/)
- The mathematics of discovering new things. Rachel Feltman, The Washington Post, August 1, 2014. (http://tinyurl.com/pqs6wnu)
- News Picks: Mathematical model explores evolution through correlated novelties, Physics Today 04 agosto 2014.
  (http://tinyurl.com/nquljx7)
- Mathematics of Novelty and Innovation, ASTD.org, by Ryann K. Ellis, August the 6th 2014.
  (https://www.td.org/Publications/Blogs/Science-of-Learning-Blog/2014/08/Mathematics-of-Novelty-and-
- Le dinamiche sociali nell'era di internet, by Cinzia Belmonte, Sapere, June 2015.
- La magia dei numeri e le bolle ghiacciate per scoprirsi creativi, Corriere della Sera, by Natalia Distefano, September the 13th 2015.
  (http://bit.ly/1P2UEOj)
- Kreyon Day: creatività e innovazione a Roma, Le Scienze, by Giulia Alice Fornaro, September the 11th 2015.
  (http://bit.ly/1LVNwPx)
- Fra creatività e innovazione al Kreyon Day di Roma, Ansa, September the 7th 2015.
  (http://bit.ly/1P2V9rM)

- Kreyon Day, una giornata di creatività condivisa, Oggiscienza, by Valentina Tudisca, September the 10th, 2015.

  (`http://bit.ly/1Nysklf`)

- Kreyon Day, la creativit in mostra, Galineonet.it, September the 11th, 2015.

  (`http://bit.ly/1S7JKXp`)

- Kreyon Day, giornata dedicata alla creatività, Sapere Scienza, September the 13th 2015.

  (`http://bit.ly/1LVPBuE`)

- Il Kreyon Day, Radio 3 Scienza, by Marco Motta, September the 12th 2015.

  (http://bit.ly/1OVpNov)

- Siamo Noi, TV2000, January the 20th 2016. Interview about Everyaware.

  (https://goo.gl/8dWX00)

6.3 20 selected publications

1) **V. Loreto**, L. Pietronero, A. Vespignani and S. Zapperi: *Renormalization group approach to the critical behaviour of the Forest-Fire model*, *Physical Review Letters* **75**, 465 (1995). [PDF]

2) E. Caglioti, **V. Loreto**, H.J. Herrmann, and M. Nicodemi, *A "Tetris-like" Model for the Compaction of Dry Granular Media*, *Phys. Rev. Lett.* **79**, 1575 (1997). [PDF]

3) E. Caglioti, **V. Loreto**, *Entropy for relaxation dynamics in granular media*, *Phys. Rev. Lett.* **83**, 4333 (1999). [PDF]

4) A. Barrat, J. Kurchan, **V. Loreto** and M. Sellitto, *Edwards' Measures for Powders and Glasses*, *Phys. Rev. Lett.* **85**, 5034 (2000). [PDF]

5) A. Baldassarri, S. Krishnamurthy, **V. Loreto** and S. Roux, *Coarsening and Slow-Dynamics in Granular Compaction*, *Phys. Rev. Lett.* **87**, 224301-1 (2001). [PDF]

6) D. Benedetto, E. Caglioti and **V. Loreto** : *Language Trees and Zipping*, *Phys. Rev. Lett.* **88**, 048702 (2002). [PDF]

7) G. D'Anna, P. Mayor, A. Barrat, **V. Loreto** and F. Nori, *Observing Brownian motion in vibro-fluidized granular matter*, *Nature*, **424**, 909 (2003). Featured in the cover page and in the *News & Views* paper: P. Umbanohwar, *Shaken sand - a granular fluid?*, *Nature* **424**, 886 (2003). [PDF]

8) F. Radicchi, C. Castellano, F. Cecconi, **V. Loreto** and D. Parisi: *Defining and identifying communities in networks*, *Proc. Natl. Acad. Sci. USA (PNAS)* **101**, 2658-2663 (2004). [PDF]

9) **V. Loreto** and L. Steels, *Emergence of language*, *Nature Physics*, **3**, 758-760 (2007). [PDF]

10) C. Cattuto, **V. Loreto** and L. Pietronero, *Semiotic Dynamics and Collaborative Tagging*, *Proc. Natl. Acad. Sci. USA (PNAS)*, **104**, 1461-1464 (2007). [PDF]

11) A. Puglisi, A. Baronchelli and **V. Loreto**: *Cultural route to the emergence of linguistic categories*, *Proc. Natl. Acad. Sci. USA (PNAS)*, **105**, 7936-7940 (2008). [PDF]

12) C. Castellano, S. Fortunato and **V. Loreto**, *Statistical physics of social dynamics*, *Rev. Mod. Phys.*, **81** 591-646 (2009). [PDF]

13) C. Cattuto, A. Barrat, A. Baldassarri, G. Schehr and **V. Loreto**, *Collective dynamics of social annotation*, *Proc. Natl. Acad. Sci. USA (PNAS)*, **106**, 10511-10515 (2009). [PDF]

14) T. Gong, A. Baronchelli, A. Puglisi and **V. Loreto**, *Modelling the emergence of universality in color naming patterns*, *Proc. Natl. Acad. Sci. USA (PNAS)*, **107**, 2403-2407 (2010). [PDF]

15) F. Tria, E. Caglioti, **V. Loreto** and A. Pagnani, *A Stochastic Local Search algorithm for distance-based phylogeny reconstruction*, *Molecular Biology and Evolution*, **27**, 2587-2595 (2010). [PDF]

16) **V. Loreto**, A. Mukherjee and F. Tria, *On the origin of the hierarchy of colour names*, *Proc. Natl. Acad. Sci. USA (PNAS)*, **109(18)**, 6819-6824 (2012). [PDF]

17) F. Tria, B. Galantucci and **V. Loreto**, *Naming a structured world: a cultural route to duality of patterning*, *PLoS ONE*, **7(6)**, e37744 (2012). [PDF]

18) A. Baronchelli, **V. Loreto**, F. Tria (Eds.), *Language Dynamics*, Special Issue of *Advances in Complex Systems* **15** (3 & 4) (2012). [LINK]

19) R. Marchetti, A. Taloni, E. Caglioti, **V. Loreto**, and L. Pietronero, *Stationary growth and unique invariant harmonic measure of cylindrical DLA*, *Phys. Rev. Lett* **109**, 065501, (2012). [PDF]

20) F. Tria, **V. Loreto**, V.D.P. Servedio and S.H. Strogatz and, *The dynamics of correlated novelties*, *Nature Scientific Reports* **4**, 5890, doi:10.1038/srep05890 (2014).

6.4 5 most cited publications

1) C. Castellano, S. Fortunato and **V. Loreto**, *Statistical physics of social dynamics*, *Rev. Mod. Phys.*, **81** 591-646 (2009). **Citations: 1032**

2) F. Radicchi, C. Castellano, F. Cecconi, **V. Loreto** and D. Parisi: *Defining and identifying communities in networks*, *Proc. Natl. Acad. Sci. USA (PNAS)* **101**, 2658-2663 (2004). **Citations: 766**

3) A. Barrat, J. Kurchan, **V. Loreto** and M. Sellitto, *Edwards' Measures for Powders and Glasses*, *Phys. Rev. Lett.* **85**, 5034 (2000). **Citations: 146**

4) G. D'Anna, P. Mayor, A. Barrat, **V. Loreto** and F. Nori, *Observing Brownian motion in vibro-fluidized granular matter*, *Nature*, **424**, 909 (2003). **Citations: 134**

5) E. Caglioti, **V. Loreto**, H.J. Herrmann, and M. Nicodemi, *A "Tetris-like" Model for the Compaction of Dry Granular Media*, *Phys. Rev. Lett.* **79**, 1575 (1997). **Citations: 129**

6.5 Invited and Contributed talks

1997 *Dix-septieme Rencontre de Physique Statistique*: Paris 30-31 January 1997: *Contributed talk Geometrical Frustration and Logarithmic Relaxations in Dry Granular Media.*

1997 *XVI Congresso di Fisica Teorica e Struttura della Materia* : Fai della Paganella, 23-26 March 1997: *Invited talk Modelli di Meccanica Statistica per la Sismicità.*

1997 *European Geophysical Society General Assembly*, Vienna 21-25 april 1997: *Contributed talk*: *Fractal Geometry and Earthquakes Statistics.*

1997 Workshop: *Interdisciplinary Theoretical Physics*, Torino, Villa Gualino, 5-12 April 1997: *Contributed talk.*

1997 *Convegno Nazionale di di Meccanica Statistica*, Parma, 23-26 June 1997: *Invited talk.*

1997 *Adriatico Research Conference: "The Dynamics of Complexity"*, 26-29 August 1997: *Contributed talk*: *Tetris-like model for Compaction and Segregation in Dry Granular Media.*

1997 *International Conference in honor of Giovanni Paladin: "Disorder and Chaos"*, Rome, 22-24 September 1997.

1997 *V Latin American Workshop on Nonlinear Phenomena*, Canela, Brazil 28/9-3/10 1997: *Contributed talk.*

1997 *Dry Granular Media meeting*: Paris 28.11.1997: *Contributed talk About the role of entropy in granular media.*

1998 XX^{th} *IUPAP International Conference on Statistical Physics - STATPHYS 20, Paris, 20-24 Luglio 1998:* Contributed talk.

1998 Workshop on Physics of Granular Matter, 22 - 24 October, 1998, Scuola Normale Superiore, Pisa (Italy) *Invited talk* INFM-FORUM and CNR-GNSM

1999 Workshop on non-equilibrium dynamic systems, 7 - 11 Giugno, 1999, Dipartimento di Fisica, Università di Porto, Porto, (Portogallo), *Contributed talk.*

2001 *VI Convegno Nazionale di Fisica Statistica*, Parma, 29-31 May 2001: *Invited talk.*

2001 XXI^{th} IUPAP International Conference on Statistical Physics - STATPHYS 21, Cancun MEXICO, 15-21 Luglio 2001: *Contributed talk.*

2001 *Research Workshop on "Challenges in Granular Physics"* 7 - 11 August, 2001 Miramare, Trieste, Italy. *Invited talk Towards a thermodynamical description of dense granular media.*

2002 *7th Granada Seminar Computational and Statistical Physics* 2-7 September 2002, Granada, Spain. *Invited talk A Data Compression Approach to Information Retrieval.*

2003 *VIII Latin American Workshop on Nonlinear Phenomena*, Salvador, Brazil 28/9-3/10 2003: *Contributed talk.*

2004 *Journees de la Matiere Condensee*, Nancy, France 31/8-3/9/2004: *Invited talk Thermodynamique des systèmes granulaires*

2005 *Workshop: Stochasticity and nonlinearity on three continents*, Santa Fe, USA march 2005, *Invited Speaker*.

2005 *Workshop: Semiotic dynamics in Language Games*, Bagnovignoni, 9-12 November 2005, *Invited Speaker*.

2005 *Workshop: Semiotic Dynamics and Emergent Grammar. One-day satellite Workshop related to the European Conference on Complex Systems*, Paris, 18 November 2005, *Invited Speaker*.

2006 *Workshop on New Directions in Complex Systems*, Istanbul, 3-9 September 2006, Turkey *Contributed Speaker*.

2006 *Workshop on Language simulations*, Warsaw, 11-14 September 2006, Poland *Invited Speaker*.

2006 Conference on: *Complex systems from physics to biology and social sciences*, Lisbon, 22-25 November 2006, *Invited Speaker*.

2007 DPG Conference, Working Group Physics of Socio-Economic Systems, *Contributed Talk Non-equilibrium phase transitions in negotiation dynamics*, Spring Meeting of the German Physical Society (DPG), Regensburg (Germany), March 26-30th, 2007.

2007 *Cultural route to the emergence of linguistic agreement*, EPFL, Lausanne, November 13, 2006 *Invited Seminar*.

2007 *Language Games: a physicist point of view*, Seminar on Language, Evolution, and the Brain (SLEB), International Institute of Advanced Studies (IIAS), Kyoto (Japan), April 23-27th, 2007 *Invited Speaker*.

2007 *Cultural route to the emergence of linguistic categories*, Language Engineering Group, Chinese University of Hong Kong, Hong Kong, May 4th, 2007 *Invited Seminar*.

2007 *Conventions and opinions formation in negotiation dynamics*, Workshop IACIA, Interacting Agents, Complexity and Inter-Disciplinary Applications, 5th October 2007, Dresden, Germany *Invited Speaker*.

2007 *Convention and opinion formation in negotiation dynamics*, Bologna, Mathematics Dept., 18th October 2007, *Invited Seminar*.

2007 *Dinamica dell'informazione nelle comunità on line*, Convegno *Conoscere la complessià: viaggio tra le scienze*, CSI-Piemonte, 22nd-23rd November 2007 Torino, Italy. *Invited Speaker*.

2007 *La nascita del consenso*, Secondo ciclo di conferenze sul tema *Armonie del cosmo: le "due culture"*, Teatro dell'Opera, Roma, Italy, 31st May 2007.

2008 *Complessità, informazione e altre storie*, Secondo ciclo di conferenze sul tema *Armonie del cosmo: le "due culture"*, Teatro dell'Opera, Roma, Italy, 15th May 2008.

2008 *Cultural route to the emergence of names and linguistic categories*, *International workshop on Sociophysics, Status and Perspectives*, ISI Foundation, 26th-29th May 2008, Torino, Italy. *Invited Speaker*.

2008 EU-China Summer School on *Internet, Sciences, and Society*, 1st-4th June 2008, Warsaw, Poland. *Invited Speaker*.

2008 Workshop on "Coarse thinking and decision making", Venice, 25-26 June 2008. *Invited speaker.*

2008 *Collective dynamics of social annotation*, European Conference on Complex Systems ECCS'08, Jerusalem, 10-19 September 2008. *Invited Speaker.*

2009 Conference on Statistical Mechanics of Game Theory, Mariehamn, Aland, Finland, 27-20 May 2009 *Invited Speaker.*

2009 Workshop on: *At the roots of Complexity: The emergence of structures in Matter, Brain, Life, Language*, 22-24th June 2009, Torino, Italy, *Invited Speaker.*

2009 Convegno Nazionale di Meccanica Statistica, 24-26th May 2009, Parma, Italy, *Invited Speaker.*

2009 Conference TextGraphs-4: Graph-based Methods for Natural Language Processing, 6-7th August 2009, Singapore *Invited Speaker.*

2009 Conference Changing Cultures: Cultures of Change 10-12th December 2009 University of Barcelona, Barcelona, Spain *Invited Speaker.*

2010 *Collective dynamics of social annotation*, Workshop Monumentum.doc, Universita' di Torino, 11-12th January 2010 *Invited Speaker.*

2010 *On the origin of universal categorization patterns: an in-silico experiment*, One-day seminar on experimental approaches to the study of communication and sign-use, Center for Semiotics, Aarhus, Denmark, 26th March 2010 *Invited Speaker.*

2010 *Statistical physics of social dynamics*, Invited seminar at the Dept. of Statistics, Sapienza Univ. of Rome, 19th April 2010.

2010 *Consenso e dissenso in comunita' sociali*, Invited tall at the workshop on *Gossip: aspetti cognitivi, computazionali e sociali*, Istituto di Scienze e Tecnologie della Cognizione, Roma, June the 14th 2010.

2011 *Statistical physics of language dynamics*, Yeshiva University, New York Galantucci 14th April 2011, *Invited Seminar.*

2011 *Statistical physics of language dynamics*, ETH Zurich, CCSS Colloquium, 3rd May 2011, *Invited Colloquium.*

2011 *Collective behaviour and opinion shifts*, The Internet Of Things For A Sustainable Future, ESF Exploratory Workshop, Vielsalm 9-13 May 2011, *Invited Speaker.*

2011 *Statistical physics of language dynamics*, Torino University, 20/5/2011, *Invited Colloquium.*

2011 *Statistical physics of language dynamics*, workshop on Complexity in Language: Developmental and Evolutionary Perspectives, Collegium de Lyon, ENS, May 23-25 2011, *Invited Speaker.*

2011 *New avenues for social dynamics*, LUISS University, 27th June Rome, 2011, *Invited Seminar.*

2011 *EveryAware: Enhancing environmental awareness through social information technologies*, 1st Dialogue on Platforms for collective awareness and action, Brussels September the 9th. *Invited Short Talk.*

2012 *New developments in language dynamics*. Modelli Matematici per le Applicazioni (MOMA) Seminars, Mathematics Dept. Sapienza University of Rome, *Invited Seminar*.

2012 *Citizen Science in the EU project EveryAware*, The 2nd Citizen Cyberscience Summit, London Feb 16th-18th, 2012, *Invited Talk*.

2012 *New platforms for web-gaming and social computation*, Workshop on Web Epistemics ZIF Bielefeld, February 15th-17th, 2012. *Invited Talk*.

2012 *On the Origin of the Hierarchy of Color Names*, Evolang IX Kyoto, The 9th International Conference on the Evolution of Language, Kyoto, Japan, 13-16 March 2012. *Contributed Talk*.

2012 *Consensus in Language Dynamics*, Meeting of the ESF-funded DRUST project, Bologna 10-11 April 2012. *Invited Talk*.

2012 *A Cultural Route to the Emergence of Duality of Patterning*, 28th ALTENBERG WORKSHOP IN THEORETICAL BIOLOGY, *Origins of Complex Communication and Language: Epigenetic Modeling and Ethological Observation*, Altenberg, Austria, July 5-8 2012. *Invited Talk*.

2012 *Participation, awareness and learning*, First Open Global Systems Science Conference, Brussels, November 8 10th 2012. *Invited Plenary Talk*.

2012 *A Cultural Route to the Emergence of Duality of Patterning*, Conference "Modeling Linguistic Networks: from Language Structures to Communication", Goethe-University Frankfurt am Main, Germany, December 9 12th 2012. *Invited Talk*.

2013 *Participation, awareness and learning*, Workshop on Urban Development and Global Systems Science, European Commission, Brussels February 13-14th 2013. *Invited Contribution*.

2013 *On the emergence of linguistic conventions*, Modelling Emerging Norms workshop, Interacting Minds Centre, Aarhus University, March 6-8 2013. *Invited Talk*.

2013 *Modelling innovation as expansion into the adjacent possible*, Deutsche Physikalische Gesellschaft (DPG) conference, SOE: Fachverband Physik sozio-ökonomischer Systeme Regensburg, March 11-15th 2013. *Invited Talk not delivered for health reasons*.

2013 *Environmental awareness and learning: a race against time*, 14th Swiss Global Change Day, Bern, April 16th 2013. *Invited Talk*.

2013 *Consensus dynamics in social systems*, University of Liverpool, April 23rd 2013. *Invited Seminar*.

2013 *The dynamics of correlated novelties*, Northeastern University, Boston, USA, September 4th 2013. *Invited Seminar*.

2013 *The dynamics of correlated novelties*, Wolfram Data Summit, Washington DC, USA, 5-6th September 2013. *Invited Plenary Talk*.

2013 *Analyzing Language Dynamics using Complex Systems Science*, International Summer School on Agent-based Computational Models of Creativity, Cortona, Italy, 15-20th September 2013. *Invited Talk*.

2013 *Participatory sensing and social computation*, INSITE Workshop: Games, Science & Society October 10-11, 2013 International Institute Applied Systems Analysis, Laxenburg, Austria. *Invited Talk*

2013 *Games, prediction and Learning*, International Game Competition for Education and Research, Paris, December 14-15th 2013. *Invited Talk*

2014 *Participatory sensing and social computation*, Conference on *Citizens Science and Smart Cities Summit*, Ispra, Italy, February 5-7th, 2014. *Invited Talk*

2014 *Modelling the emergence of creoles languages*, Conference on *Time and space in linguistics: interdisciplinary computational approaches*, Aarhus, Denmark, January 15-16, 2014. *Invited Talk*

2014 *Gaming for learning*, STOA Workshop on *New learning and teaching technology options* at the European Parliament, Brussels, Belgium, April 8th 2014. *Invited Talk*

2014 Participatory science, awareness and learning, Event *Borsa della Ricerca*, panel on *Comunicare la scienza: l'importanza della ricerca partecipata*, Bologna, Italy, May 14th 2014. *Invited Talk*

2014 *Triggering novelty and innovation in human activities*, Workshop on *Creativity and universality in language and music*, Paris, France, June 16-20, 2014. *Invited Talk*

2015 *Participatory science, awareness and learning*, Invited lecture at the Zentrum fr Kunst und Medientechnologie Karlsruhe (ZKM) of Karlsruhe, February the 10th, 2015. *Invited Lecture*

2015 *Triggering novelties and innovation in human activities*, Invited seminar at the London Institute for Mathematical Sciences, London, February the 11th, 2015. *Invited Talk*

2015 *Lo studio delle dinamiche sociali nell'era di Internet*, Caffe' Scienza in Rome, Libreria Assaggi, March the 17th 2015. *Invited public event*

2015 *Triggering novelties and innovation in human activities*, School for Advanced Studies in the Social Sciences, Paris, March the 27th, 2015. *Invited Seminar*

2015 *Modeling the emergence of contact languages*, Interactions: Mathematical sciences to the proof of human and social sciences. Faculté de Droit du Panthéon, Université de Paris Panthéon-Sorbonne, Paris, May 28-29th, 2015. *Invited Speaker*

2015 *Optimal learning paths in information networks*, Workshop on *Language Dynamics*, Ca' Foscari University, Venice, 17-19th September 2015. *Invited Speaker*

2015 Series of invited lectures on *Participation, gaming and learning* at the Lipari School on Computational Complex Systems, Jacob T. Schwartz International School for Scientific Research, Lipari, 12-18th July 2015. *Invited Speaker*

2015 *Creativity, Innovation and Learning*, 3rd Chess Palace International Teachers Conference, Budapest, October the 17th 2015. *Invited Speaker*

2016 *Gaming, innovation and learning: new tools to face societal challenges*, Invited seminar at IIASA, International Institute for Applied Systems Analysis, Wien, February the 26th, 2016. *Invited Seminar*

2016 *Creativity, innovation and learning*, Visions for Complexity, Opening Conference of the Complexity Science Hub Vienna, May 23rd 2016, *Invited Speaker*

7 Full publications list

7.1 International Reviews

1) G. Dattoli, **V. Loreto**, C. Mari, M. Richetta e A. Torre: *Biunitary Transformations and Ordinary Differential Equations - I*, *Il Nuovo Cimento* Vol. **106 B**, N. 12, 1991.

2) G. Dattoli, **V. Loreto**, C. Mari, M. Richetta e A. Torre: *Biunitary Transformations and Ordinary Differential Equations - II*, *Il Nuovo Cimento* Vol. **106 B**, N. 12, 1991.

3) G. Dattoli, **V. Loreto**, C. Mari, M. Richetta e A. Torre: *Biunitary Transformations and Ordinary Differential Equations - III*, *Il Nuovo Cimento* Vol. **106 B**, N. 12, 1991.

4) G. Dattoli, L.Giannessi, **V. Loreto** e C. Mari: *Cavity Length Adjustment and Output FEL Intensity Optimization*, *IEEE Journal of Quantum Electronics*, Vol.**27**, N.11, 1991.

5) G. Dattoli, S. Cabrini, L. Giannessi, **V. Loreto**: *Exact Treatment of Spontaneous Emission in Helical and Solenoidal Magnetic Field*, *Il Nuovo Cimento* Vol.**14***D*, N.7, 1992.

6) G. Dattoli, L. Giannessi, S. Cabrini, **V. Loreto**: *Gain Saturation in Bunched Free Electrons Lasers*, *Physical Review A* Vol.**45**, 8842 (1992).

7) G.Dattoli, S. Cabrini, L. Giannessi, **V. Loreto**, C. Mari: *Gain Saturation in free-electron lasers*, *Nuclear Instruments and Methods in Physics Research* **A318**, 495-499 (1992).

8) R. Cafiero, **V. Loreto**, L. Pietronero, A. Vespignani and S. Zapperi: *Local Rigidity and self-organized criticality for avalanches*, *Europhys. Lett.* **29**, 111-116 (1995).

9) **V. Loreto**, L. Pietronero, A. Vespignani and S. Zapperi: *Renormalization group approach to the critical behavior of the Forest-Fire model*, *Physical Review Letters* **75**, 465 (1995).

10) E. Caglioti and **V. Loreto**: *Dynamical characterization of a class of Self-Organized Critical models of non-linear coupled oscillators*, unpublished (1995).

11) **V. Loreto**, A. Vespignani and S. Zapperi: *Renormalization scheme for the Forest-Fire model*, *Journal of Phys. A: Math. Gen.* **29**, 2981-3004 (1996).

12) E. Caglioti and **V. Loreto**: *Dynamical properties and predictability in a class of Self-Organized Critical Models*, *Physical Review E* **53**, R2953 (1996).

13) A. Ben Hur, R. Hallgass, **V. Loreto**: *A Renormalization procedure for Directed Sandpile models*, *Phys. Rev. E* **54**, 1426 (1996).

14) **V. Loreto**, G. Paladin, and A. Vulpiani: *Concept of complexity in random dynamical systems*, *Physical Review E*, **53** 2087 (1996).

15) V. De Rubeis, R. Hallgass, **V. Loreto**, G. Paladin, L. Pietronero and P. Tosi: *Self-affine Asperity Model for earthquakes*, *Physical Review Letters*, **76**, 2599 (1996).

16) A. Vespignani, S. Zapperi and **V. Loreto**: *Renormalization of Non-Equilibrium Systems with Critical stationary State*, *Phys. Rev. Lett.* **77**, 4560 (1996).

17) **V. Loreto**, G. Paladin, M. Pasquini and A. Vulpiani: *Characterization of Chaos in Random Maps*, *Physica A* **232**, 189-200 (1996).

18) R. Hallgass, **V. Loreto**, O. Mazzella and G. Paladin: *Earthquakes statistics and Fractal Faults*, *Phys. Rev. E* **56**, 1346 (1997).

19) A. Vespignani, S. Zapperi and **V. Loreto**: *Dynamically Driven Renormalization Group*, *J. Stat. Phys.* **88**, 47 (1997).

20) **V. Loreto**, L. Pietronero, A. Vespignani and S. Zapperi, *Phys. Rev. Lett.* **78**, 1393 (1997).

21) E. Caglioti, **V. Loreto**, H.J. Herrmann, and M. Nicodemi, *A "Tetris-like" Model for the Compaction of Dry Granular Media*, *Phys. Rev. Lett.* **79**, 1575 (1997).

22) R. Chierchia, S. Loreti, **V. Loreto**, L. Mariucci, C. Minarini and A. Mittiga, "A critical assessment of different models of the metastability in $a - Si : H$", *Jpn. J. Appl. Phys.* **37**, 1736 (1998).

23) **V. Loreto**, P. Prosini and R. Cafiero: *Anisotropy and Non-Universality in Kinetic Roughening*, *Europhys. Lett.* **42**, 389 (1998).

24) E. Caglioti, A. Coniglio, H.J. Herrmann, **V. Loreto**, and M. Nicodemi, *Segregation of granular mixtures in presence of compaction*, *Europhys. Lett.* **43**, 591 (1998).

25) A. Puglisi, **V. Loreto**, U. Marini Bettolo, A. Petri and A. Vulpiani, *Clustering and non-gaussian behavior in granular matter*, *Phys. Rev. Lett.* **81**, 3848 (1998).

26) A. Puglisi, **V. Loreto**, U. Marini Bettolo, A. Petri and A. Vulpiani: *Granular Gases: where standard kinetic theory fails*, INFM Highlights 1998/1999.

27) E. Caglioti, A. Coniglio, H.J. Herrmann, **V. Loreto**, and M. Nicodemi, *Cooperative Length Approach for Granular Media*, *Physica A* **265**, 311 (1999).

28) Erwan Hascoët, Hans J. Herrmann and **V. Loreto**, *Shock propagation in a granular chain*, *Phys. Rev. E* **59**, 3202 (1999).

29) E. Caglioti, **V. Loreto**, *Entropy for relaxation dynamics in granular media*, *Phys. Rev. Lett.* **83**, 4333 (1999).

30) S. Khrishnamurthy, **V. Loreto**, H.J. Herrmann, M. Nicodemi and S. Roux, *Internal avalanches in models of granular media*, Fractals **7**, No. 1 p.51-58 (1999).

31) S. Khrishnamurthy, **V. Loreto**, H.J. Herrmann, S.S. Manna and S. Roux, *Self-Structuring of Granular Media under Internal*, *Phys. Rev. Lett.* **83**, 304 (1999).

32) A. Puglisi, **V. Loreto**, U. Marini Bettolo and A. Vulpiani, *Kinetic approach to granular gases*, *Phys. Rev. E* **59**, 5582 (1999).

33) E. Caglioti, S. Khrishnamurthy and **V. Loreto** *Random Tetris Model*, unpublished (1999).

34) S. Khrishnamurthy, **V. Loreto** and S. Roux, *Bubbling and large-scale structures in avalanche dynamics*, *Phys. Rev. Lett.* **84**, 1039 (2000).

35) M. Piccioni, **V. Loreto** and Stéphane Roux, *Criticality of the "critical state" of granular media: Dilatancy angle in the Tetris model*, *Phys. Rev. E* **61**, 2813 (2000).

36) A. Barrat and **V. Loreto**, *Response properties in a model for granular matter*, *J. Phys. A: Math. and Gen.* **33**, 4401-4426 (2000).

37) A. Barrat, J. Kurchan, **V. Loreto** and M. Sellitto, *Edwards' Measures for Powders and Glasses*, *Phys. Rev. Lett.* **85**, 5034 (2000).

38) A. Baldassarri, S. Krishnamurthy, **V. Loreto** and S. Roux, *Coarsening and Slow-Dynamics in Granular Compaction*, *Phys. Rev. Lett.* **87**, 224301-1 (2001).

39) A. Barrat, J. Kurchan, **V. Loreto** and M. Sellitto, *Edwards' measures: a thermodynamic construction for dense granular media and glasses*, *Phys. Rev. E* **63**, 051301 (2001).

40) A. Barrat and **V. Loreto**, *Memory in aged granular media*, *Europhysics Letters* **53**, 297 (2001).

41) D. Benedetto, E. Caglioti and **V. Loreto** : *Language Trees and Zipping*, *Phys. Rev. Lett.* **88**, 048702 (2002).

42) V. Colizza, A. Barrat and **V. Loreto** : *Definition of temperature in dense granular media*, *Phys. Rev. E Rapid Communication* **65**, 050301 (2002).

43) A. Barrat, V. Colizza and **V. Loreto** : *Fluctuation-Dissipation Relations in Compact Granular Media*, *Phys. Rev. E* **66**, 011310 (2002).

44) S. Ciliberti, G. Caldarelli, **V. Loreto** and L. Pietronero, *Local rigidity in sandpile models*, *Phys. Rev. E* **66**, 016133 (2002).

45) L. Ciofi degli Atti, **V. Loreto** and L. Pietronero: *Statistical Measures for Aftershocks*, unpublished (2002).

46) A. Puglisi, A. Baldassarri and **V. Loreto**, *Fluctuation-Dissipation relations in 2D Driven Granular Gases*, *Phys. Rev. E* **66**, 061305 (2002).

47) G. D'Anna, G. Grémaud, P. Mayor, A. Barrat and **V. Loreto**, *Extreme events driven glassy behaviour in granular media*, *Europhys. Letters* **61**, 60 (2003).

48) D. Benedetto, E. Caglioti and **V. Loreto**: *Zipping out relevant information*, Invited column "Computing Prescriptions" in the AIP/IEEE journal *Computing in Science and Engineering* gennaio-febbraio (2003).

49) D. Benedetto, E. Caglioti and **V. Loreto**, *Phys. Rev. Lett.* **90**, 089803 (2003).

50) A. Puglisi, D. Benedetto, E. Caglioti, **V. Loreto** and A. Vulpiani, *Data Compression and Learning in time sequences analysis*, *Physica D* **180**, 92 (2003).

51) G. D'Anna, P. Mayor, A. Barrat, **V. Loreto** and F. Nori, *Observing Brownian motion in vibro-fluidized granular matter*, *Nature*, **424**, 909 (2003). Featured in the cover page and in the *News & Views* paper: P. Umbanohwar, *Shaken sand - a granular fluid?*, *Nature* **424**, 886 (2003).

52) A. Barrat, **V. Loreto** and A. Puglisi: *Temperature probes in binay granular gases Physica A* **334**, 513 (2004).

53) F. Radicchi, C. Castellano, F. Cecconi, **V. Loreto** and D. Parisi: *Defining and identifying communities in networks*, *Proc. Natl. Acad. Sci. USA (PNAS)* **101**, 2658-2663 (2004).

54) C. Castellano, F. Cecconi, **V. Loreto** and D. Parisi and F. Radicchi, *Self-contained algorithms to detect communities in networks*, *European Physical Journal B (EPJB)* **38**, 311 (2004).

55) A. Baronchelli, E. Caglioti, **V. Loreto** and E. Pizzi: *Dictionary based methods for information extraction*, *Physica A* **342**, 294-300 (2004).

56) D. Alderuccio, L. Bordoni and **V. Loreto**: *A Data Compression Approach to Monolingual GIRT Task: an Agnostic Point of View*, *Lecture Notes in Computer Science* **3237**, 391 (2004). Proc. of the CLEF 2003 Workshop 21-22 August, Trondheim, Norway. C. Peters (Ed.) (Springer-Verlag).

57) P. Tosi, V. De Rubeis, **V. Loreto** and L. Pietronero: *Space-time combined correlation integral and earthquake interactions*, *Annals of Geophysics*, **47**, 1849 (2004).

58) P. Mayor, G. D'Anna, A. Barrat and **V. Loreto**, *Observing Brownian motion and measuring temperatures in vibro-fluidized granular matter*, *New Journal of Physics*, **7**, 28 (2005). Focus issue on Brownian Motion and Diffusion in the 21st Century.

59) A. Baronchelli, D. Benedetto, E. Caglioti and **V. Loreto** : *Artificial sequences and complexity measures*, *J. Stat. Mech.*, P04002 (2005).

60) A. Baldassarri, A. Barrat, G. D'Anna, **V. Loreto**, P. Mayor and A. Puglisi, *What is the temperature of a granular medium?*, *J. Physics: Condensed Matter*, **17**, S2405 (2005).

61) C. Castellano, **V. Loreto**, A. Barrat, F. Cecconi, D. Parisi, *Comparison of voter and Glauber ordering dynamics on networks*, *Phys. Rev. E* **71**, 066107 (2005).

62) A. Baronchelli, E. Caglioti and **V. Loreto**, *Measuring complexity with zippers*, *Eur. J. Phys.* **26**, 5 S69-S77 (2005).

63) A. Baronchelli and **V. Loreto**, *Ring structures and mean-first passage time in networks*, *Phys. Rev. E* **73**, 026103 (2006).

64) A. Baronchelli, L. Dall'Asta, A. Barrat and **V. Loreto**, *Topology induced coarsening in Language Games*, *Phys. Rev. E* **73**, 015102 (2006).

65) L. Dall'Asta, A. Baronchelli, A. Barrat and **V. Loreto**, *Agreement dynamics on small-world networks*, *Europhys. Lett.* **73**, 969 (2006).

66) P. Canettieri, **V. Loreto**, M. Rovetta and G. Santini, *Ecdotics and Information Theory*, *Rivista di Filologia Cognitiva*, `http://w3.uniroma1.it/cogfil/ecdotica.html` (2006).

67) P. Canettieri, **V. Loreto**, M. Rovetta and G. Santini, *Higher criticism and Information Theory*, *Rivista di Filologia Cognitiva*, `http://w3.uniroma1.it/cogfil/attribuzioni.html` (2006).

68) C. Cattuto, **V. Loreto** and V.D.P. Servedio, *A Yule-Simon model with long-term memory*, *Europhys. Lett.* **76** 208-214 (2006).

69) A. Baronchelli, L. Dall'Asta, A. Barrat and **V. Loreto**, *Nonequilibrium dynamics of language games on complex networks*, *Phys. Rev. E.* **74** 036105 (2006).

70) A. Baronchelli, M. Felici, E. Caglioti, **V. Loreto** and L. Steels, *Sharp Transition towards Shared Vocabularies in Multi-Agent Systems*, *J. Stat. Mech.* P06014 (2006).

71) M. Ibanez de Berganza, E.E. Ferrero, S.A. Cannas, **V. Loreto** and A. Petri, *Phase separation of the Potts model in square lattice*, *EPJ Special Topics* **143**, 273 (2006).

72) A. Taloni, E. Caglioti and **V. Loreto**, *Conformal approach to cylindrical DLA*, *J. Stat. Mech.* P09004 (2006).

73) C. Cattuto, **V. Loreto** and L. Pietronero, *Semiotic Dynamics and Collaborative Tagging*, *Proc. Natl. Acad. Sci. USA (PNAS)*, **104**, 1461-1464 (2007).

74) A. Barrat, A. Baronchelli, L. Dall'Asta and **V. Loreto**: *Agreement dynamics on interaction networks with diverse topologies*, *Chaos* **17**, 026111 (2007).

75) C. Cattuto, C. Schmitz, A. Baldassarri, V.D.P. Servedio, **V. Loreto**, A. Hotho, M. Grahl, G. Stumme, *Network Properties of Folksonomies*, AICOM Special Issue on *Network Analysis in Natural Sciences and Engineering*, **20**, 245-262 (2007).

76) M. Ibanez de Berganza, **V. Loreto** and A. Petri, *Phase ordering and symmetries of the Potts model*, *Philosophical Magazine* **87**, 779 (2007).

77) M. Ibanez de Berganza, **V. Loreto** and A. Petri, *Dynamics metastability in the two-dimensional Potts model*, eprint arXiv:0706.3534 (2007).

78) A. Petri, M. Ibanez de Berganza and **V. Loreto**, *Ordering dynamics in the presence of multiple phases*, em Philosophical magazine **88**, 3931-3938 (2008).

79) A. Baronchelli, L. Dall'Asta, A. Barrat and **V. Loreto**, *The role of topology on the dynamics of the Naming Game*, *EPJ Special Topics* **143**, 233-235 (2007).

80) A. Baronchelli, L. Dall'Asta, A. Barrat and **V. Loreto**, *Non-equilibrium phase transition in negotiation dynamics*, *Phys. Rev. E.* **76**, 051102 (2007).

81) **V. Loreto** and L. Steels, *Emergence of language*, *Nature Physics*, **3**, 758-760 (2007).

82) P. Tosi, V. De Rubeis, **V. Loreto** and L. Pietronero: *Space-time correlations of earthquakes*, *Geophysical Journal International*, **173**, 932-941 (2008).

83) A. Baronchelli, **V. Loreto** and L. Steels, *In-depth analysis of the Naming Game dynamics: the homogeneous mixing case*, *Int. J. Mod. Phys. C*, **19**, 785-812 (2008).

84) A. Puglisi, A. Baronchelli and **V. Loreto**: *Cultural route to the emergence of linguistic categories*, *Proc. Natl. Acad. Sci. USA (PNAS)*, **105**, 7936-7940 (2008).

85) C. Cattuto, A. Baldassarri, V.D.P. Servedio, **V. Loreto**, *Emergent Community Structure In Social Tagging Systems*, *Advances in Complex Systems*, **11** 597-608 (2008).

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