Jérôme Benoit

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Website
rezozer.net

Citizenship
French

ORCID iD
0000-0003-1226-6757

Research Experience

2020/07– research scholar at Ronin Institute (Montclair, USA) [1];
2017/01–20/07 research associate at New-York University Abu Dhabi (Abu Dhabi, UAE) [1–4,15,20–22];
2011/09– independent researcher [16,17];
2011/09–14/06 invited to Laboratory of Mathematics at Besançon (Besançon, France);
2009/08–11/01 research fellow at Nanyang Technological University (Singapore, Singapore) [5,6];
2006/09–09/07 postdoctoral associate at National Central University (Jhongli, Taiwan) [7,18,19,23];
2004/10–06/07 postdoctoral associate at University of Lisbon (Lisbon, Portugal) [8,24];
2002/04–04/02 postdoctoral associate at National Hellenic Research Foundation (Heraklion, Greece) [7,9];
2001/04–02/03 postdoc at University of Jena (Jena, Germany) [9];
2000/01–00/09 invited to Los Alamos National Laboratory (Los Alamos, USA) [10].

Computing and Information Technology Experience

2016/09–16/12 Debian specialist developer at Logilab;
2015/04–16/03 Debian specialist developer at IMAGINARY.org;
2012/02– Debian package contributor [26–28];
2008/10–09/07 small cluster installation and maintenance (Debian) at National Central University;
1999/09– Debian user;
1990/09– alongside, writes scientific code or hacks anything that compiles (or not).

Supervision Experience

2010–11 informal doctoral student guidance (Singapore, Singapore): Li Na Zhao [5,6];
2001–02 informal doctoral student guidance (Jena, Germany): Elizabeth von Hauff [9].

Teaching Experience

2010 Teaching Assistant [one quarter] at Nanyang Technological University (Singapore, Singapore);
1999 Teaching Assistant [one semester] at University of Cergy-Pontoise (Cergy-Pontoise, France).

Teaching Qualification

2012–16 "Assistant Professor Qualification" [eligibility for junior faculty positions] from the French National Council of Universities in Elementary Constituents (29^{th} section);
_____ in Dense Environments and Materials (28^{th} section).

Doctoral Education

1995–99 *Doctorate* in Theoretical Physics at University of Cergy-Pontoise with high honors, Laboratory for Theoretical Physics and Modeling (Cergy-Pontoise, France) [11–14]:
doctoral advisor: Rossen Dandoloff defence date: 29 June 1999
research topic: studying of frustrated spin systems with geometrical, topological tools
dissertation title: "Symmetry, Geometry, Topology and Spins: Heisenberg spins in the continuum limit/magnetic vesicles"
thesis keywords: antiferromagnetism, geometrical frustration, topological soliton;

1994–95 compulsory military service;

1993–94 *Master* (DEA — late French Advanced Studies Degree) in Theoretical Physics with honors [Fundamental Concepts in Physics (CFP): high energy physics, statistical physics, general relativity, quantum field theory, mathematical physics, ...; highly selective, reputed French *Master* intended for highly motivated students with a solid grounding in fundamental physics and mathematics] (ENS-Ulm/École Polytechnique/Paris-Sud/Paris-VI/Paris-Diderot, France) — awarded within *Orsay Fundamental Physics Magistère* course at Paris-Sud (Orsay, France).

Predoctoral Education

1991–94 *Orsay Fundamental Physics Magistère* with honors at Paris-Sud (Orsay, France) [selective, reputed three-year French course intended for well motivated students with a firm grounding in mathematics and physics];

1992–93 *Imperial College International Diploma* in Physics (London, United Kingdom), *Maîtrise* (former French European First Year Master Degree) in Fundamental Physics with high honors at Paris-Sud (Orsay, France) — both awarded within the *Magistère* course;

1991–92 *Licence* (former French European Bachelor Degree) in Fundamental Physics with honors at Paris-Sud (Orsay, France) — awarded within the *Magistère* course;

1990–91 French Electrical and Mechanical National Engineering School (ENSEM) (Nancy, France).

Secondary and Undergrad Education

1988–90 *Preparatory School Classes* (Classe Préparatoire aux Grandes Ecoles) — Maths Spéc P' [pure Mathematics and advanced higher Physics] — at Lycée Carnot (Dijon, France);

1987–88 *Preparatory School Classes* — Maths Sup prepa X=Polytechnique [pure Mathematics and higher Physics; highly selective, reputed, rigorous French course intended for highly motivated, talented students] — at Prytanée National Militaire de La Flèche (France);

1987 *Baccalauréat* in Sciences — Bac C [Mathematics and Physics] — (La Flèche, France);

1984–87 *secondary education* at Prytanée National Militaire de La Flèche (France).

Grants and Scholarships

1998 grant for completing doctorate at University of Cergy-Pontoise;

1995–98 doctoral fellowship from the French Ministry of Higher Education and Research;

1993–94 masteral scholarship from the French Ministry of Higher Education and Research;

1992–93 ERASMUS exchange program scholarship for studying at Imperial College London.

Laboratory Internships

1994/06 at Laboratory for Theoretical Physics and Statistical Models (LPTMS) at University of Paris-Sud on *percolation theory*, supervised by Xavier Campi (Paris-Sud, France);

1994/01 at The City of Paris Industrial Physics and Chemistry Higher Educational Institution (ESPCI) on *glycerin-water mirage measurements*, supervised by Philippe Petitjeans (Paris, France);

1993/06–07 at The Blackett Laboratory at Imperial College London on *atomic orbital collapses*, supervised by Jean-Patrick Connerade (London, United-Kingdom);

1992/06–07 at Laboratory of Theoretical Physics at University of Paris-Sud on *spin glasses*, supervised by Henk-Jan Hilhorst (Paris-Sud, France);

1991/08 woker internship at `Alstom` at Belfort in a factory of large electric generators (Belfort, France).

Professional Networking

https://zenodo.org/communities/jgmbenoit
https://www.researchgate.net/profile/Jerome_BENOIT
https://independent.academia.edu/JeromeBENOIT
https://www.linkedin.com/in/jgmbenoit

Community Networking

https://savannah.gnu.org/users/jgmb
https://qa.debian.org/developer.php?login=calculus@rezozer.net
https://gitlab.com/jgmbenoit
https://github.com/jgmbenoit

Soft Skills

Troubleshooting, Problem solving,
Self-Teaching, Critical thinking, Creative thinking,
Mathematically minded, Analytical thinking,
Thinking out of the box, Community-oriented,
Team player, Cross-cultural understanding.

Hard Skills

Theoretical Physics	nonlinearity, symmetries, field theory, geometric (topological) integrable systems, information physics, geometrical frustration, small-world networks, epidemiology, nonlinear σ-model, sine-Gordon equation, power-laws, ...
Mathematics	mathematical modelling, numerical analysis, statistics, (nonlinear) analysis, differential geometry, geometrical topology, knot theory, information theory, network theory, Galois lattices, (very) special functions, quaternions, numerical experiences, ...
Computing	software development (autotools machinery, API+ABI+`tests`, *backend*+CLI+ +`modules`), object-oriented programming, scripting, symbolic computing, (human/non-human) code generation, C metaprogramming, ...
Computer	batch job processing, packaging (Debian), cluster management (Debian), building my own specific Linux kernels, hardware hacking, ...

Computing Knowledge

Simulation Tools	Surface Evolver
Software Packages	GSL, libXML2, GMP, MPFR, Arb, Maple/OpenMaple, GTS, GRTensorII, ...
Core Languages	C (*proficient*), Maple (*near-proficient*), C++, D (*acquiring*), ...
Script Languages	Maple (*near-proficient*), BASH (*fluent*), Python, Perl, DASH, D (*acquiring*), ...
Markup Languages	TEX/LATEX, XML
Geometric Languages	METAPOST
Parallel Computation	LAM-MPI, OpenMP (*acquiring*), `pthread` (*acquiring*)
Programming Tools	autotools, make, flex/bison, Maple, CWEB, ...
Debugging/Profiling Tools	valgrind
Patch Tools	patch, quilt
Version Control Systems	GIT
Job Scheduling Systems	SLURM
Operating Systems	Linux (Debian GNU/Linux)
Document Typesetting	LATEX 2_ε, TEX, METAPOST, BIBTEX, ...

Responsibilities

Referee	*'Journal of Physics A: Mathematical and Theoretical'*;
Open Source	shared scientific software development as part of the GNU Project [25]; package maintenance [26,28], patch submissions, and bug reports for the Debian distribution; direct patch submissions via `email` or *pull requests* via GITHUB/GITLAB to upstream maintainers for fixing bugs or sanitizing build machineries.

Language Proficiency

French	native language;
English	professional working proficiency.

Referees

Rossen Dandoloff (research and teaching referee; doctoral advisor)
<rdandoloff@yahoo.com>
Department of Condensed Matter Physics and Microelectronics
Faculty of Physics, Sofia University *"St. Kliment Ohridski"*
15, Tsar Osvoboditel Boulevard
Sofia, Bulgaria

Avadh Saxena (research referee; postdoctoral advisor)
<avadh@lanl.gov>
Theoretical Division and Center for Nonlinear Studies
Los Alamos National Laboratory
P. O. Box 1663
Los Alamos, New Mexico 87545, United States of America

Tuong Truong (research and teaching referee; informal doctoral mentor)
<tuong.truong@u-cergy.fr>
Laboratoire de Physique Théorique et Modélisation
Université de Cergy-Pontoise, Site Saint Martin 2
2, Avenue A. Chauvin
F-95302 Cergy-Pontoise, France

Saif Eddin Jabari (most recent employer)
<sej7@nyu.edu>
Experimental Research Building
New York University Abu Dhabi (NYUAD)
Saadiyat Island - P. O. Box 129188
Abu Dhabi, United Arab Emirates

Featured Publications

[9] Jérôme Benoit, Elizabeth von Hauff and Avadh Saxena
Self-dual bending theory for vesicles
Nonlinearity **17** (2004), no. 1, 57–66
IOP Select-ed article
arXiv:cond-mat/0210441

We present a self-dual bending theory that may enable a better understanding of highly nonlinear global behavior observed in biological vesicles. Adopting this topological approach for spherical vesicles of revolution allows us to describe them as frustrated sine-Gordon kinks. Finally, to illustrate an application of our results, we consider a spherical vesicle globally distorted by two polar latex beads.

Selected Publications

[1] Jérôme Benoit and Saif Eddin Jabari
On equilibrium Metropolis simulations on self-organized urban street networks
Appl. Netw. Sci. **6** (2021), 33
arXiv:1911.08358 [physics.soc-ph]

Urban street networks of unplanned or self-organized cities typically exhibit astonishing scale-free patterns. This scale-freeness can be shown, within the maximum entropy formalism (MaxEnt), as the manifestation of a fluctuating system that preserves on average some amount of information. Monte Carlo methods that can further this perspective are cruelly missing. Here we adapt to self-organized urban street networks the Metropolis algorithm. The *"coming to equilibrium"* distribution is established with MaxEnt by taking scale-freeness as prior hypothesis along with symmetry-conservation arguments. The equilibrium parameter is the scaling; its concomitant extensive quantity is, assuming our lack of knowledge, an amount of information. To design an ergodic dynamics, we disentangle the state-of-the-art street generating paradigms based on nonoverlapping walks into layout-at-junction dynamics. Our adaptation reminisces the single-spin-flip Metropolis algorithm for Ising models. We thus expect Metropolis simulations to reveal that self-organized urban street networks, besides sustaining scale-freeness over a wide range of scalings, undergo a crossover as scaling varies — literature argues for a small-world crossover. Simulations for Central London are consistent against the state-of-the-art outputs over a realistic range of scaling exponents. Our illustrative Watts-Strogatz phase diagram with scaling as rewiring parameter demonstrates a small-world crossover curving within the realistic window 2–3; it also shows that the state-of-the-art outputs underlie relatively large worlds. Our Metropolis adaptation to self-organized urban street networks thusly appears as a scaling variant of the Watts-Strogatz model. Such insights may ultimately allow the urban profession to anticipate self-organization or unplanned evolution of urban street networks.

Research Interests

Connection between complexity, nonlinearity and geometry in soft matter, condensed matter, and biologically inspired complex systems as well as other challenging fundamental problems in mathematical physics, social physics, mathematical biology, complex physics, and computational physics.

That is to say, contemporary problems that challenge the interface bridging between experimental or observational scientists and pure mathematicians: Mathematical/Theoretical Physics.

Research Activities

Mathematically inclined, I am a researcher in Mathematical/Theoretical Physics with cross interdisciplinary expertise and experience in socially or biologically inspired complex systems and in nanotechnologically inspired structures that involve geometric topology, network theory or information theory — and with developed skills in advanced computing.

Socially or Biologically Inspired Complex Systems

socially inspired entropic equilibrium: self-organized spatial networks

keywords: *maximum entropy formalism, statistical physics, complex system; Metropolis algorithm, statistical self-similarity, symmetry-conservation correspondence; scale-freeness, Pareto distribution; incidence relation, Galois lattice; asymptotic agent models, social physics; city science.*

Currently I am investigating the scaling coherence of self-organized spatial networks [1,3,15,20–22]. I envisage self-organized spatial networks as fluctuating systems that reach statistical equilibria [1,3,15] and I take as prior hypothesis statistical self-similarity [1]. Applying the maximum entropy principle along a symmetry-conservation argument shows that the order parameter is the scaling exponent [1]. The concomitant extensive entity is the logarithm of an extensive entity [1]. Lake of knowledge leads to take as extensive entity the number of configurations [1,3,15], so that the extensive entity associated to the scaling exponent becomes a measure of information [1,3,15]. The resulting model is a mesoscopic model which allows to recover the observed scaling coherence [1,3,15]. More interestingly, this model allows to adapt the Metropolis algorithm [1,20]. In other words, my approach brings to spatial network investigations all the knowledge of thermodynamics [1].

biologically inspired polygonal knots: protein folding

keywords: *protein folding; (polygonal) knot theory, White formula; geometrical phase; singularity theory; spherical trigonometry; rational geometry; rational numbers, rational interval arithmetic, continued fraction.*

I had investigated protein folding by considering the evolution of geometric topological entities inherited from knot theory [17]: as intermediate result, the *White formula* for close polygonal knots is being extended to open polygonal knots by adding a geometrical phase [17]. Ultimately my previous geometric work on vesicles should be brought to proteins.

biologically inspired networks: epidemics and biomolecules

keywords: *epidemiology, biomolecular network; small-world network, discrete dynamical network; phase diagram, pair approximation method; information theory, network module.*

Firstly I had focused on Susceptible-Infective-Recovered (SIR) epidemic models spreading on small-world networks which are meant to represent social networks [8,24]: a naive Correlated Pair Approximation (CPA) model for the demographic SIR epidemic model applicable along the ring of degree four or on the triangular lattice was investigated. I have also investigated on Boolean network models that mimic the dynamics of biomolecular networks [23]: a *"dynamical entropy"*, which may allow to organise such networks into small sub-networks (also called modules), has been found and is still under investigation.

biologically inspired surfaces: vesicles

keywords: *biological vesicles; bidimensional differential geometry; Bogomol'nyi technique; geometrical frustration; geometric integrable systems, genus (Euler characteristic), sine-Gordon solitons; special functions, elliptic functions*.

I have been working on problems that involve topology, curved geometry, soft/biological matter and both analysis as well as computation [7,9,10,18]. My main motivation has been to derive fine local descriptions from global behaviours. Applying the *fundamental theorem of surface theory* and imposing the observed global conformal invariance enables one to show that the bending Hamiltonian is subject to the Bogomol'nyi technique [10]: the suggested novel approach clearly reveals the topological nature of bending phenomena and shows that spontaneous bending contribution caused by any deformation falls in two distinct topological categories.

Nanotechnologically Inspired Structures

nanotechnologically inspired lattices: superconductivity

keywords: *antiferromagnetism; low dimensional regular lattice, real division algebras; topological gauge field; continuum limit method*.

In the second half of my doctoral experience, I analysed Heisenberg spins on a triangular lattice in the continuum limit [11,14]. The group representation theory allows one to introduce a novel order parameter defined up to an abelian gauge [11]. During the continuum limit computation, this topological gauge field should be explicitly considered and the Hopf term is expected. Such considerations hold for the square lattice and the honeycomb lattice as well. Furthermore, this analysis based on the real division algebras applies to low dimensional lattices.

nanotechnologically inspired surfaces: magneto-deformation

keywords: *nonlinear σ-model; bidimensional differential geometry; Bogomol'nyi technique; geometrical frustration; geometric integrable systems, topological charge, sine-Gordon solitons; special functions, elliptic functions, Lamé function; continued fraction*.

In the first half, I studied Heisenberg spins in the continuum limit (*i.e.* the nonlinear σ-model) on elastic surfaces [12–14]. The corresponding rigid model exhibits topological soliton configurations with geometrical frustration due to curvature. Assuming small and smooth deformation allows one to find shapes of the elastic support by relaxing the rigidity constraint and introducing the bending energy. This leads to a novel geometric effect: a global shrinking with swellings.

Peer-Reviewed Publications

[1] Jérôme Benoit and Saif Eddin Jabari
On equilibrium Metropolis simulations on self-organized urban street networks
Appl. Netw. Sci. **6** (2021), 33
arXiv:1911.08358 [physics.soc-ph]

[2] Jérôme Benoit and Saif Eddin Jabari
On the Metropolis algorithm for urban street networks
In *The 8th International Conference on Complex Networks and Their Applications: Book of Abstracts* (2019)
ISBN 978-2-9557050-3-2 (615–617)
arXiv:1909.08082 [physics.soc-ph]

[3] Jérôme Benoit and Saif Eddin Jabari
On the perturbation of self-organized urban street networks
Appl. Netw. Sci. **4** (2019), 49
arXiv:1903.06016 [physics.soc-ph]

[4] Jérôme Benoit and Saif Eddin Jabari
On the statistics of urban street networks
In *The 7th International Conference on Complex Networks and Their Applications: Book of Abstracts* (2018)
ISBN 978-2-9557050-2-5 (498–500)
arXiv:1810.04165 [physics.soc-ph]

[5] Li Na Zhao, See-Wing Chiu, Jérôme Benoit, Lock Yue Chew and Yuguang Mu
The effect of curcumin on the stability of Aβ dimers
J. Phys. Chem. B **116** (2012), no. 25, 7428–7435

[6] Li Na Zhao, See-Wing Chiu, Jérôme Benoit, Lock Yue Chew and Yuguang Mu
Amyloid β peptides aggregation in a mixed membrane bilayer: A molecular dynamics study
J. Phys. Chem. B **115** (2011), no. 42, 12247–12256

[7] Jérôme Benoit and Avadh Saxena
Spherical vesicles distorted by a grafted latex bead: An exact solution
Phys. Rev. E **76** (2007), no. 4, 041912
arXiv:cond-mat/0404250

[8] Jérôme Benoit, Ana Nunes and Margarida Telo da Gama
Pair approximation models for disease spread
Eur. Phys. J. B **50** (2006), no. 1-2, 177–181
arXiv:q-bio/0510005

[9] Jérôme Benoit, Elizabeth von Hauff and Avadh Saxena
Self-dual bending theory for vesicles
Nonlinearity **17** (2004), no. 1, 57–66
IOP Select-ed article
arXiv:cond-mat/0210441

[10] Jérôme Benoit, Avadh Saxena and Turab Lookman
Bogomol'nyi decomposition for vesicles of arbitrary genus
J. Phys. A: Math. Gen. **34** (2001), no. 44, 9417–9423
arXiv:cond-mat/0103004

[11] Jérôme Benoit and Rossen Dandoloff
A uniform approach to antiferromagnetic Heisenberg spins on low dimensional lattices
Phys. Lett. A **276** (2000), no. 1-4, 175–179
arXiv:math-ph/0004029

[12] Jérôme Benoit, Rossen Dandoloff and Avadh B. Saxena
Heisenberg spins on a cylinder section
Internat. J. Modern Phys. B **14** (2000), no. 19-20, 2093–2100
arXiv:cond-mat/9909095

[13] Jérôme Benoit and Rossen Dandoloff
Heisenberg spins on an elastic torus section
Phys. Lett. A **248** (1998), no. 5-6, 439–444
arXiv:cond-mat/9809266

Thesis

[14] Jérôme Benoit
Symmetry, Geometry, Topology and Spin:
Heisenberg spins in the continuum limit/magnetic vesicles
Ph. D. thesis, University of Cergy-Pontoise (June 1999)
arXiv:cond-mat/9909129

Submitted

[15] Jérôme Benoit and Saif Eddin Jabari
Structure entropy, self-organization and power laws in urban street networks
submitted (January 2019)
Cited in the TRANSPORTIST blog (March 2019 edition)
arXiv:1902.07663v2 [physics.soc-ph]

In Preparation

[16] Jérôme Benoit
Patial order of a blank paper with a tiny dot
in preparation (202N)

[17] Jérôme Benoit
On the writheless closure of open polygonal knots
in preparation (20NN)

Selected Oral Presentations

[18] Jérôme Benoit
Self-dual bending theory for vesicles (June 2008; Aspen, United States of America)
http://dx.doi.org/10.13140/2.1.4645.4086
Aspen Summer Workshop entitled 'Interfaces, Topological Defects and Flexible Packing: Applied Geometry in Condensed Matter'

[19] Jérôme Benoit
The SIRS disease model in quartic networks (November 2006; Jhongli, Taiwan)
http://dx.doi.org/10.13140/2.1.3137.5684
informal seminar at National Central University

Selected Posters

[20] Jérôme Benoit and Saif Eddin Jabari
On equilibrium Metropolis simulations on self-organized urban street networks (December 2019; Lisbon, Portugal)
https://dx.doi.org/10.13140/RG.2.2.35257.31848
Poster Session at the 8^{th} International Conference on Complex Networks and Their Applications

[21] Jérôme Benoit and Saif Eddin Jabari
On the statistics of urban street networks (December 2018; Cambridge, United Kingdom)
https://dx.doi.org/10.13140/RG.2.2.10591.92324
Poster Session at the 7^{th} International Conference on Complex Networks and Their Applications

[22] Jérôme Benoit and Saif Eddin Jabari
Structure entropy for urban street networks (June 2018; Lund, Sweden)
https://dx.doi.org/10.13140/RG.2.2.31298.68801
Poster Session at the 21^{st} AGILE Conference

[23] Jérôme Benoit and Pik-Yin Lai
Biological functional networks (January 2009; Hong Kong, China)
https://dx.doi.org/10.13140/2.1.1466.4006
International Workshop on 'Nonlinear Dynamics in Biological Systems'

[24] Jérôme Benoit, Ana Nunes and Margarida Telo da Gama
Pair approximation for models of disease spread in networks (August 2005; Crete, Greece)
https://dx.doi.org/10.13140/2.1.1804.3687
Poster Session at the third NEXT ΣΦ International Conference

Selected Collective Responsibilities

[25] Jérôme Benoit
http://savannah.gnu.org/users/jgmb
People at Savannah: Jerome Benoit Profile

[26] Jérôme Benoit
http://qa.debian.org/developer.php?login=calculus@rezozer.net
Debian Quality Assurance (QA): Packages Overview for Jerome Benoit

[27] Jérôme Benoit (December 2016)
https://nm.debian.org/person/calculus
Debian Developer (DD, uploading) application of Jerome Benoit

[28] Jérôme Benoit (May 2016)
https://lists.debian.org/debian-newmaint/2016/05/msg00031.html
Debian Maintainer (DM) application of Jerome Benoit: Declaration of intent (and Advocations)