OMB No. 0925-0001 and 0925-0002 (Rev. 10/2021 Approved Through 01/31/2026)

BIOGRAPHICAL SKETCH

Provide the following information for the Senior/key personnel and other significant contributors..

NAME: **Denis BERNARD**

LINKS: Here are my homepage or Orcid page

POSITION TITLE: Directeur de recherche – C.N.R.S.

EDUCATION/TRAINING:

École Normale Supérieure (St. Cloud, France)		1980-85	Physics
Université Paris XI (France)	Ph.D.	1987	Physics
Princeton University (USA)	Post-doc	1987-88	Physics
Institute for Advanced Studies (Princeton, USA)	Post-doc	1988-89	Mathematics

A. Personal Statement

As a *Directeur de Recherche* (Exceptional Class) at the French *Centre National de la Recherche Scientifique* (CNRS), based at the *Laboratoire de Physique de l'École Normale Supérieure* in Paris, my research is driven by a commitment to addressing open and topical problems in theoretical physics. While my work often involves the development of new mathematical structures or methods, I firmly believe in the approach advocated by K. Wilson: "You shouldn't choose a problem on the basis of the tool. You start by thinking about the physics problem, [...] but it's very important to approach it starting from the physics because otherwise you get lost in the use of the tool, and lose track of where you're trying to go." Guided by this principle, I have explored diverse areas of theoretical physics at the interface with mathematics, including: conformal field theory and integrable systems, with applications in statistical physics; random geometry and spatial stochastic processes; turbulent systems and transport phenomena; out-of-equilibrium quantum systems. These investigations have led me to engage with a wide range of mathematical tools, from infinite-dimensional algebras and quantum groups to random matrices and stochastic processes. Beyond research, I am deeply committed to the scientific community. I have actively contributed to the administration and leadership of research structures, and I have extensive experience in organizing and managing collaborative, interdisciplinary projects.

B. Positions, Scientific Appointments, and Honors

Appointements :

2015-present	Directeur de recherche, classe exceptionnelle, CNRS.
2003-2015	Directeur de recherche, 1ere classe, CNRS.
1995-2003	Directeur de recherche, CNRS.
1988-1995	Chargé de recherche, CNRS.
In parallel :	
2019-present	Laboratoire de physique de l'École normale supérieure (LPENS) de Paris.
2006-2019	Laboratoire de physique théorique (LPT-ENS), École normale supérieure de Paris.
2002-2016	Professeur (part-time) at École polytechnique, France.
1995-1996	Institut des hautes études scientifiques (IHES), Bures-sur-Yvette, France.
1989-2005	Institut de physique théorique (IPhT), Saclay, France.

Awards

2004	CNRS Silver Medal.
1998	Paul Langevin Prize from the Société française de physique.
	CNRS scientific excellence award: 2009-2013, 2014-18 and 2020-23.

Synergistic activities

2025	Member of the review committee of the Bernoulli Center at EPFL, Switzerland.
2024	Member of the review panel of the school of theoretical physics of the Dublin institute for advanced studies, Ireland.
2022-present	Member of the scientific council of the SwissMAP research station, Switzerland.
2022-present	Member of the recruitment commission of the physics department of the Ecole Polytechnique, France.
2021-present	Member of the Scientific advisory committee of the Simons Center for Geometry and Physics (SCGP), Stony Brook, USA.
2019-2024	LPENS deputy director.
2013-2018	Member of the Scientific advisory board of the E. Schrödinger Institute, Vienna, Austria.
2012	Member of the Stat.Phys.25 steering committee, Seoul. Corea.
2010-14	LPT-ENS Deputy director.
2009-2013	Member of the Scientific council of the Federation de la recherche FRIF, Paris.
2009-2012	Scientific consultant for the French research minister (DGRI), Paris.
2004-2008	Member of the Comité national de la recherche scientifique (CoNRS), France.
2004-2009	Member of the Administrative board of the Institute Henri Poincaré, Paris.
2001-2005	Member of the Scientific council of IPhT-Saclay.
Regularly	Member or chairman of various evaluation or recruiting committees (in France or abroad). Member or chairman of various Ph.D. or Habilitation jury, Member of editorial boards. Co-organizer of various conferences, workshops, schools or thematic programmes.

Grants and contracts

2024-29	Simons Collaboration on “Probabilistic Paths to QFT”, Co-PI.
2022-26	Contract ANR-21-CE40-003, “CFT: constructive aspects and integrability”, Member.
2021-25	Contract ANR-20-CE47-0014, “Stochastic quantum evolutions”, Co-PI.
2014-19	Contract ANR-14-CE25-003, “Stochastic methods in quantum mechanics”, Co-PI.
2010-14	Contract ANR-2010-BLANC-0414, “Quantum transport in low dimensions”, Member.
2006-10	Contract ANR-BLAN06-3-134462, “Stochastic Loewner evolutions and applications”, PI.

C. Contributions to Science

Conformal Field Theories, Integrable Systems: Structures and Applications.

Conformal field theories (CFT) and integrable systems find applications to 2D phase transitions, to critical quantum systems, and they are closely related to string theories. I have been involved in the development of CFT methodological tools. Part of my work relies on deciphering and using quantum symmetries and their consequences, others have a more mathematical flavor related either to algebraic structures and to geometrical aspects of Riemann surfaces. In particular, my study of the so-called WZW conformal field theory led me to write the now called KZB equations, a series of differential equations on the moduli space of flat fiber bundles which had some echoes in other branches of mathematical physics. With collaborators, we also developed and applied techniques to deal with quantum group symmetries in in low dimensional quantum field theories.

- Bernard D., *“On the Wess-Zumino-Witten models on the torus”*, Nucl. Phys. B303, 77-93 (1988).
- Bernard D., *“On the Wess-Zumino-Witten models on Riemann surfaces”*, Nucl. Phys. B309, 145-174 (1988).
- Bernard D., Felder G., *“Fock representations and BRST cohomology in SL(2) current algebra”*, Commun. Math. Phys. 127, 145-168 (1990).
- Ahn C., Bernard D., Leclair A.*, “Fractional supersymmetries in perturbed coset CFTs and integrable soliton theory”,* Nucl. Phys. B346, 409-439 (1990).
- Bernard D., Leclair A., *“Quantum group symmetries and non-local currents in 2D QFT”*, Commun. Math. Phys. 142, 99-138 (1991).
- Bernard D., “*Hidden Yangians in 2D massive current algebras*”, Commun. Math. Phys. 137 (1991) 191-208.
- Haldane D., Ha Z., Talstra J., Bernard D., Pasquier V., *“Yangian symmetry of integrable quantum chains with long-range interactions and a new description of states in conformal field theory*”, Phys. Rev. Lett. 69, 2021 (1992).

Random Geometry, Random Spatial Processes.
Understanding random fractal patterns is at the core of many physical phenomena or mathematical structures, and the Brownian motion is a historical example of such structures. I participated to the understanding of newly constructed planar random curves or interfaces (called SLE), a theme which fits into random geometry. We developed bridges linking probabilistic approaches from mathematicians with those of physicists based on (conformal) field theories. Our work enlightens the role of (statistical) martingales in these relationships.

- Bauer M., Bernard D., *"SLE growth processes and conformal field theories",* Phys. Lett. B543 (2002) 135-138.
- Bauer M., Bernard D., *"Conformal field theories of stochastic Loewner evolutions"*, Commun. Math. Phys. 239 (2003) 493-521.
- Bauer M., Bernard D., *"SLE martingales and the Virasoro algebra"*, Phys. Lett. B557 (2003) 309-316.
- Bauer M., Bernard D., Kytola K., *"Multiple Schramm-Loewner evolutions and statistical mechanics martingales"*, J. Stat. Phys. 120 (2005) 1125-1163.

Turbulent Systems, Turbulent Transports.
Turbulent phenomena are ubiquitous in many every day phenomena, but still lack a complete theoretical understanding. I participated to the physical and mathematical collective understanding of intermittence phenomena in the (up-to-now) unique solvable model of turbulent transport. Our work on the passive scalar led to the notion of spontaneous stochasticity. I have also contributed to the identification of traces of conformal invariance in two-dimensional turbulence, one of the first example of emergent symmetry in turbulent systems.

- Bernard D., Gawedzki K., Kupiainen A., *"Anomalous scaling in the N-point functions of passive scalar"*, Phys. Rev. E 54, 2564-2572 (1996).
- Bernard D., Gawedzki K., Kupiainen A., *"Slow modes in passive advection"*, J. Stat. Phys. 90, 519-569 (1998).
- Bernard D., *"Influence of Friction on the Direct Cascade of the 2d Forced Turbulence"*, Europhys. Lett. 50, 333-339 (2000).
- Bernard D., Boffetta G., Celani A., Falkovich G., *"Conformal invariance in two-dimensional turbulence",* Nature Physics 2 (2006) 124-128.

Quantum Noises, Open and Out-of-Equilibrium Quantum Systems.
Experimental progresses in controlling quantum systems gave new impetus to study unexplored territory of quantum dynamics, and simultaneously to answer old questions of quantum mechanics. My research aims at studying quantum stochastic processes, their mathematical structures and their applications the physics of monitored or open quantum systems, in or out of equilibrium. To decipher the nature of a possible quantum extension of the macroscopic fluctuation theory, I introduced and analyzed an iconic model of stochastic quantum many-body dynamics, the quantum symmetric simple exclusion process. We revealed rich underlying structures in fluctuations of coherence governed by free probability.

- Bernard D., Doyon B., *"Energy flow in non-equilibrium conformal field theory"*, J. Phys. A 45, 362001 (2012).
- De Nardis J., Bernard D., Doyon B., *"Hydrodynamic Diffusion in Integrable Systems"*, Phys. Rev. Lett. 121, 160603 (2018).
- Bernard D., Jin T., *"Open Quantum Symmetric Simple Exclusion Process"*, Phys. Rev. Lett. 123, 080601 (2019), [arXiv:1904.01406].
- L. Hruza, D. Bernard, *"Coherent Fluctuations in Noisy Mesoscopic Systems, the Open Quantum SSEP and Free Probability"*, Phys. Rev. X 13, 011045 (2023).
- M. Fava, L. Piroli, T. Swann, D. Bernard, A. Nahum*, "Nonlinear sigma models for monitored dynamics of free fermions"*, Phys. Rev. X 13, 041045 (2023).

Publications: Here is my Google Scholar page.