

PierGianLuca Porta Mana CVRRICVLVMVITAE

presently at *Forschungszentrum Jülich, Germany*

pgl@portamana.org

<https://portamana.org/>

Orcid: 0000-0002-6070-0784

Synopsis

My experience and interests include, chronologically, general relativity (3 years), quantum theory (8 years), continuum thermomechanics (3 years), theoretical neuroscience (2 years). Bayesian probability calculus and differential geometry have been common denominators across these fields. I also have a passion for modern logic and history of physics. In each of the mentioned subjects I have published original research or given popularizing seminars and lectures.

My teaching and supervising experience ranges from ground-school children to PhD students, in academic institutions and as private tutor.

In research and in teaching, I believe in broadness and interdisciplinarity rather than specialization: the diverse fields in physics, mathematics, and the other sciences are just one, as one is the sky above us.

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Research and education

- 2014-11 – 2017-03: **Post-doctoral researcher**,
Institute of Neuroscience and Medicine 6, Forschungszentrum Jülich,
Germany.
Bayesian and maximum-entropy methods for detection of behaviour-related
patterns in neural activity and inference of Alzheimer disease from fMRI data.
Relations between finer & coarser theories of brain activity. Improvement of
neuronal simulator algorithms.
- 2011-11 – 2014-01: **Post-doctoral researcher**,
Climate and Ocean Physics group, University of Oxford, UK.
Deterministic & stochastic theories for geophysical fluid dynamics and
their numeric implementation. Relations between finer & coarser dynamical
theories. Maximum-entropy and autoregressive models.
- 2012-08: **Bayesian statistics consultant**,
The Guide Dogs for the Blind Association, UK.
Bayesian exchangeable models for estimation of the number of visually
impaired children in some UK counties, given data from nearby counties.
- 2008-10 – 2011-10: **Post-doctoral fellow**,
Quantum Foundations group, Perimeter Institute for Theoretical
Physics, Canada.
Foundations of quantum theory. Description of quantum phenomena via
stochastic continuum mechanics. Non-equilibrium statistical mechanics.
Continuum theories in general relativity. Theory of hybrid statistical models.
- 2007-08 – 2008-09: **Post-doctoral researcher**,
Non-Linear Physics research group, Umeå University, Sweden.
Quantum kinetic theory for plasmas with spin. Stochastic continuum ther-
momechanics. Non-equilibrium statistical mechanics.
- 2008-08: **PhD**, thesis on *Studies in plausibility theory, with applications to
physics* (<https://portamana.org/>).
- 2002-11 – 2007-06: **PhD studies**,
Quantum Electronics and Quantum Optics group, Royal Inst. of
Technology, Stockholm.
Quantum communication. Quantum optics. Beam- and fibre-based inter-

ferometry for time-bin entanglement. State estimation and tomography techniques. Bayesian statistical models for quantum and hybrid theories.

2002-09 – 2002-10: **Experimental collaborator**,
Quantum Electronics and Optics group, Royal Inst. of Technology, Stockholm.

Quantum communication. Quantum optics. Beam- and fibre-based interferometry for time-bin entanglement.

2001-01 – 2002-08: **Graduate studies**,
Department of Theoretical Physics, Royal Inst. of Technology, Stockholm.

General relativity. Quantum communication theory. Non-linear differential equations.

2000-04: **Italian Laurea** in theoretical physics,
Cagliari University, awarded with maximum grades “cum laude”.
Thesis on *Asymptotic symmetries of anti-de Sitter space in two and three dimensions* (<https://portamana.org/>).

Dilatonic general relativity and its Hamiltonian formulation.

Pedagogical experience

Post-secondary education:

2004 – 2006: **Teacher**, Department of Microelectronics and Applied Physics, Royal Inst. of Technology, Stockholm.

Exercise module of the course *Electromagnetism and waves* (20–30 students); preparation and graduation of written examinations.

2000: **Course tutor**, Department of Biology, Cagliari University.
Physics Laboratory course.

1996 – 1997: **Undergraduate tutor** for junior physics students, Department of Physics, Cagliari University.

1995 – 1996: **Undergraduate teacher**, Department of Physics, Cagliari University.

Introductory lectures in mathematics and physics for first-year undergraduate students (70–150 students).

Phd, Msc, Bsc supervision:

2014 – present: **Co-supervisor** for several PhD students, Forschungszentrum Jülich, Germany.

Projects on maximum-entropy methods, Bayesian models and inference in neuroscience, state-space analysis of neuronal models.

2013: **Assistant supervisor for MPhys thesis**, University of Oxford.

2011 – 2012: **Full supervisor for BSc thesis**, Perimeter Institute for Theoretical Physics, Canada; Royal Inst. of Technology, Stockholm; University of Oxford.

Thesis on *Obtaining Entropy via Coarsening: Microscopic Restrictions on Continuum-mechanical constitutive Equations*. The student Veronica Wallängen obtained maximum grades with distinction for her thesis.

2010: **Supervisor for BA project**, Perimeter Institute for Theoretical Physics, Canada, and Franklin W. Olin College of Engineering, MA, USA.

Project on *The relationships between plausibility theory and logic*.

Secondary education:

2009 – 2011: **Summer-school teacher**, International Summer School for Young Physicists, Perimeter Institute for Theoretical Physics, Canada.

Short courses on *Probability theory as extended logic: elements and fundamental questions*; *Feynman-diagram techniques in classical physics: quantum field theory without “particles”*; and *Pictorial introduction to even and odd vectors and covectors*.

Other pedagogical activity:

1990 – 2000: **Private tutor** in physics, mathematics, Latin; Italy.

Pupils varying from ground-school children to graduating students.

2009 – 2011: **Pedagogical papers**, Perimeter Institute for Theoretical Physics, Canada.

On probability theory and differential geometry.

2003 – 2004: **Pedagogical papers and informal lectures**, Royal Inst. of Technology, Stockholm.

On probability theory, differential geometry, thermomechanics.

2006: Course attendance, **Basic communication and teaching**, Royal Inst. of Technology, Stockholm.

Memberships & associations

Society for Natural Philosophy (<http://www.ms.uky.edu/~snp/>),
2004 – present.

Electronic Frontier Foundation (<https://www.eff.org/>),
2016 – present.

Computational & modelling experience

Coding of time- & event-driven spike-based neuron models (NEST, C++).
Coding and analysis of geophysical-fluid-dynamical models with several timestepping schemes and stochastic components, in Fortran (finite differences) with parallel computing (MPI), and in FEniCS/Dolfin (finite elements).

Programming: very proficient with **Mathematica** (integration, solution of differential equations, data analysis, 3D & 4D plotting, symbolic manipulation, neural-network dynamics), **Matlab** (big data analysis, plotting), **Maple** (3D & 4D plotting); fairly proficient with **Python** (data analysis, plotting, stochastic dynamics), **Fortran** (solution of partial differential equations, finite-difference simulations), **FEniCS/Dolfin** (solution of partial differential equations, finite-elements simulations), **LabView** (interferometric data recording and analysis), **NEST** (neural-network dynamics), and parallel programming (**MPI**). My **C** (and variants) and **Lisp** are a bit rusty but functioning.

Laboratory experience

Experience in a quantum-optics laboratory and knowledge of its standard maintenance routines and safety measures. Use and care of equipment like lasers, optical elements, and other instruments (oscilloscopes, interferometers, modulators, etc.). I have specific experience with the construction and set-up of a fibre-based interferometer and a beam-based one for detection of time-bin entanglement, including construction

of parts of the metal frame, beam-fibre coupling maximization and stability, beam alignment and collimation, power monitoring and stabilization, placement of a thermal-stabilization and -monitoring system, coupling and programming (LabView) of various measuring and monitoring hardware and software.

Grants

Kempe foundations, Örnsköldsvik, Sweden: EUR 29 100/ USD 45 200 (SEK 275 000), for post-doctoral research in non-linear physics (2007).

*Foundation *Blanceflor Boncompagni-Ludovisi, née Bildt*, Stockholm: EUR 8 500/ USD 13 200 (SEK 80 000), for graduate research in quantum communication theory (2002).*

*Foundation *Angelo Della Riccia*, Florence: EUR 6 900/ USD 10 700 (SEK 65 000), for graduate research in theoretical physics (2001).*

Journal refereeing

Referee for: *Acta Physica Polonica A*, *American Journal of Physics*, *Annals of Physics*, *Foundations of Physics*, *International Journal of Theoretical Physics*, *Journal of Physical Chemistry*, *Journal of Physical Oceanography*, *New Journal of Physics*, *Quantum Information & Computation*, *Proceedings of the Royal Society A*, *Studies in History and Philosophy of Modern Physics*.

Languages & interests

Languages: **Italian**, mother tongue. **English**, fluent, spoken and written. **Swedish**, fluent, spoken and written. **French**, good reading and writing proficiency. **German**, fair reading and writing proficiency (mainly scientific writings). **Latin**, fair reading and writing proficiency. **Esperanto**, fair reading and writing proficiency. Beginner **Japanese**.

Other interests: *Buster Keaton*, *Swing dancing*, *martial arts*, *parkour*, *literature*, *music*, *languages*, *flying*, *art*, *philosophy*, *typography*, *odradek & Urusei Yatsura*.

Referees

Supervisors and mentors

(alphabetically)

Ingemar Bengtsson ingemar@fysik.su.se +46-(0)8-5537-8732
Professor, *Quantum Information & Quantum Optics* group
Stockholm University, Fysikum
Roslagstullsbacken 21, SE-104 06 Stockholm, Sweden

Mariano Cadoni mariano.cadoni@ca.infn.it +39-070675-4908
Professor, *Theoretical and High-energy Physics* group
Cagliari University & Istituto Nazionale di Fisica Nucleare
Cittadella Universitaria di Monserrato, IT-09042 Cagliari, Italy

Lucien Hardy lhardy@perimeterinstitute.ca +1-(519)-569-7600 x7521
Faculty, *Quantum Foundations* group
Perimeter Institute for Theoretical Physics,
31 Caroline St. N, Waterloo, ON N2L 2Y5 Canada

Moritz Helias m.helias@fz-juelich.de +49-(0)246161-9467
Professor, *Theory of Multi-scale Neuronal Networks* group
Forschungszentrum Jülich, Inst. for Neuroscience and Medicine-6
Wilhelm-Johnen-Straße, DE-52425 Jülich, Germany

Abigail Morrison a.morrison@fz-juelich.de +49-(0)246161-9805
Professor, *Functional Neural Circuits and Human Brain Model* groups
Bernstein Center Freiburg
Hansastraße 9a, DE-79104 Freiburg i.Br., Germany

Laure Zanna Laure.Zanna@physics.ox.ac.uk +44-(0)18652-72925
Professor, *Climate and Ocean Physics* group
University of Oxford, AOPP Clarendon Laboratory
Parks Road, OX1 3PU Oxford, UK

Former students

Vahid Rostami (PhD supervision)
v.rostami@fz-juelich.de +49-(0)1777792282
Forschungszentrum Jülich, INM-6,
Wilhelm-Johnen-Straße, DE-52425 Jülich, Germany

Tomos W. David (MPhys supervision)

tomos.david@jesus.ox.ac.uk +44-(0)7587156574

University of Oxford, AOPP Clarendon Laboratory,
Parks Road, OX1 3PU Oxford, UK

Veronica Wallängen (BSc supervision)

vwal@kth.se +46-(0)707774732

University of California Berkeley & Stockholm University
Roslagstullsbacken 21, SE-104 06 Stockholm, Sweden

Daniel Franz (summer-school mentoring)

kwantumo@gmail.com +1-2266006784

Waterloo University,
61 C Eby St. S, Kitchener, ON N2G 3K9 Canada

Cyndia Yu (summer-school mentoring)

cyndiayu@college.harvard.edu +1-(480)-729-2937

Harvard College, Department of Physics,
524 Winthrop Mail Center, Cambridge MA 02138, USA

Publications & talks

Papers and conference proceedings

Electronic copies available at <https://portamana.org/>

[33] J. Krishnan, **P.G.L. Porta Mana**, M. Helias, M. Diesmann, E. Di Napoli: *Perfect spike detection via time reversal*, [arXiv:1706.05702](https://arxiv.org/abs/1706.05702), submitted to Front. Neuroinf. (2017).

[32] **P.G.L. Porta Mana**: *Geometry of maximum-entropy proofs: stationary points, convexity, Legendre transforms, exponential families*, osf.io/vsq5n (2017).

[31] **P.G.L. Porta Mana**: *Maximum-entropy from the probability calculus: exchangeability, sufficiency*, [arXiv:1706.02561](https://arxiv.org/abs/1706.02561) (2017).

[30] L. Zanna, **P.G.L. Porta Mana**, J. Anstey, T. David, T. Bolton: *Scale-aware deterministic and stochastic parametrizations of eddy-mean flow interaction*, in

Ocean Modelling (2017); <http://dx.doi.org/10.1016/j.ocemod.2017.01.004>.

- [29] **P.G.L. Porta Mana**, C. Bachmann, S. Buttler, A. Morrison: *Bayesian models for inference of Alzheimer's disease from fMRI data and graph-theoretic measures*, in preparation; draft available upon request (2017).
- [28] C. Bachmann, H. Jacobs, **P.G.L. Porta Mana**, K. Dillen, S. Buttler, A. Morrison: *Graph properties of the functionally connected brain under the influence of Alzheimer's disease*, in preparation. Summary presented as a poster at the Twelfth Göttingen Meeting of the German Neuroscience Society (NWG) (2017).
- [27] **P.G.L. Porta Mana**, I. Bengtsson: *The beauty of Graßmann spaces*, in preparation; draft available upon request (2017).
- [26] V. Rostami, **P.G.L. Porta Mana**, M. Helias: *Pairwise maximum-entropy models and their Glauber dynamics: bimodality, bistability, non-ergodicity problems, and their elimination via inhibition*, [arXiv:1605.04740](https://arxiv.org/abs/1605.04740), accepted for publication in PLoS Comp. Biol. (2016).
- [25] J. Jordan, **P.G.L. Porta Mana**: *Assumptions behind Poisson models in neuroscience: exchangeability and statistical models by sufficiency*, in preparation (2016).
- [24] **P.G.L. Porta Mana**: *Eppur ruota: disappearance of rotational momentum upon coarsening to geophysical scales*, in preparation; draft available upon request (2016).
- [23] **P.G.L. Porta Mana**: *Mass, inertia, metric in Newtonian relativity and general relativity*, in preparation; draft available upon request (2016).
- [22] **P.G.L. Porta Mana**, E. Torre, V. Rostami: *Inferences from a network to a subnetwork and vice versa under an assumption of symmetry*, <http://biorxiv.org/content/early/2015/12/11/034199>, to appear in Network Neuroscience (2015).
- [21] **P.G.L. Porta Mana**, L. Zanna: *Toward a stochastic parametrization of ocean mesoscale eddies*, in Ocean Modelling (2014); <https://portamana.org/linko.php?w=portamanaea14.pdf>.

- [20] **P.G.L. Porta Mana**, Peter G. Lewis: *On two recent conjectures in convex geometry*, [arXiv:1105.4641](https://arxiv.org/abs/1105.4641) (2011).
- [19] **P.G.L. Porta Mana**: *Conjectures and questions in convex geometry: of interest for quantum theory and other physical statistical theories*, [arXiv:1105.3238](https://arxiv.org/abs/1105.3238) (2011).
- [18] **P.G.L. Porta Mana**: *Notes on affine and convex spaces*, [arXiv:1104.0032](https://arxiv.org/abs/1104.0032) (2011).
- [17] **P.G.L. Porta Mana**: *In favour of the time variable in classical thermodynamics*, [arXiv:1012.3091](https://arxiv.org/abs/1012.3091) (2010).
- [16] **P.G.L. Porta Mana**: *On the relation between plausibility logic and the maximum-entropy principle: a numerical study*, [arXiv:0911.2197](https://arxiv.org/abs/0911.2197) (2009).
- [15] G. Brodin, M. Marklund, J. Zamanian, Å. Ericsson, **P.G.L. Porta Mana**: *Effects of the g-factor in semi-classical kinetic plasma theory*, [arXiv:0809.2382](https://arxiv.org/abs/0809.2382) (also published in Physical Review Letters) (2008).
- [14] **P.G.L. Porta Mana**: *Studies in plausibility theory, with applications to physics*, Ph.D. thesis, <https://portamana.org/linko.php?w=mana070106-thesis.pdf> (2007).
- [13] **P.G.L. Porta Mana**, A. Månsson, G. Björk: *The Laplace-Jaynes approach to induction*, [arXiv:physics/0703126](https://arxiv.org/abs/physics/0703126), [PhilSci:00003338](https://philsci-archive.pitt.edu/00003338/) (2007).
- [12] A. Månsson, **P.G.L. Porta Mana**, G. Björk: *Numerical Bayesian state assignment for a quantum three-level system. II. Average-value data with a constant, a Gaussian-like, and a Slater prior*, [arXiv:quant-ph/0701087](https://arxiv.org/abs/quant-ph/0701087) (2007).
- [11] A. Månsson, **P.G.L. Porta Mana**, G. Björk: *Numerical Bayesian state assignment for a three-level quantum system. I. Absolute-frequency data, constant and Gaussian-like priors*, [arXiv:quant-ph/0612105](https://arxiv.org/abs/quant-ph/0612105) (2006).
- [10] **P.G.L. Porta Mana**, A. Månsson, G. Björk: *'Plausibilities of plausibilities': an approach through circumstances*, [arXiv:quant-ph/0607111](https://arxiv.org/abs/quant-ph/0607111) (2006).

- [9] **P.G.L. Porta Mana**, A. Månsson, G. Björk: *On distinguishability, orthogonality, and violations of the second law: contradictory assumptions, contrasting pieces of knowledge*, [arXiv:quant-ph/0505229](https://arxiv.org/abs/quant-ph/0505229) (2005).
- [8] **P.G.L. Porta Mana**: *Distinguishability of non-orthogonal density matrices does not imply violations of the second law*, [arXiv:quant-ph/0408193](https://arxiv.org/abs/quant-ph/0408193) (2004).
- [7] G. Björk, **P.G.L. Porta Mana**: *Schrödinger-cat states: size classification based on evolution or dissipation*, in 'Proceedings SPIE: Fluctuations and Noise in Photonics and Quantum Optics II', vol. 5468, pp. 335-343, <http://dx.doi.org/10.1117/12.547048> (2004).
- [6] **P.G.L. Porta Mana**: *Probability tables*, [arXiv:quant-ph/0403084](https://arxiv.org/abs/quant-ph/0403084), also published in A. Yu. Khrennikov, ed.: 'Quantum Theory: Reconsideration of Foundations – 2' (Växjö University Press, 2004) (2004).
- [5] G. Björk, **P.G.L. Porta Mana**: *A size criterion for macroscopic superposition states*, [arXiv:quant-ph/0310193](https://arxiv.org/abs/quant-ph/0310193) (also published in Journal of optics B) (2003).
- [4] **P.G.L. Porta Mana**: *Why can states and measurement outcomes be represented as vectors?*, [arXiv:quant-ph/0305117](https://arxiv.org/abs/quant-ph/0305117) (2003).
- [3] **P.G.L. Porta Mana**: *Consistency of the Shannon entropy in quantum experiments*, [arXiv:quant-ph/0302049](https://arxiv.org/abs/quant-ph/0302049) (also published in Physical Review A and in Virtual Journal of Quantum Information) (2003).
- [2] M. Cadoni, **P.G.L. Porta Mana**: *Hamiltonians for a general dilaton gravity theory on a spacetime with a non-orthogonal, timelike or spacelike outer boundary*, [arXiv:gr-qc/0011010](https://arxiv.org/abs/gr-qc/0011010) (also published in Classical and Quantum Gravity) (2000).
- [1] **P.G.L. Porta Mana**: *Asymptotic symmetries of anti-de Sitter space in two and three dimensions*, Cagliari University; <https://portamana.org/linko.php?w=thesis.pdf> (2000).

Seminars and posters

- with C. Bachmann, H. Jacobs, S. Buttler, K. Dillen, G. R. Fink, J. Kukolja, A. Morrison: *Graph properties of the functionally connected brain under the influence of Alzheimer's disease*, poster at the 12th Meeting of the German Neuroscience Society (NWG), Göttingen, Germany (2017).
- *Einstein 1905, Euler 1753: the importance of semantics in science*, Forschungszentrum Jülich, Germany (2017).
- with V. Rostami, M. Helias: *Bimodality and inhibition in pairwise maximum-entropy models for neuroscience*, poster at the 9th Bernstein Sparks Workshop, Göttingen, Germany (2016).
- *The relation between theories on different scales: insights from geophysical fluid dynamics*, invited talk at Cagliari University, Italy (2016).
- *In search of a coarser theory of the brain not suggested by finer theories: lessons from continuum thermomechanics*, Forschungszentrum Jülich, Germany (2015).
- *Inference of variable-rate Poisson model from spike-train data: hidden assumptions and approach via exchangeability*, Forschungszentrum Jülich, Germany (2015).
- *Probability relations between neuronal networks and subnetworks*, Forschungszentrum Jülich, Germany (2015).
- *Introduction to probability logic (Bayesian theory) and its use in neuroscience*, Forschungszentrum Jülich, Germany (2015).
- *Geophysical fluid dynamics and coarse-scale brain activity: similarity of problems! similarity of solutions?*, invited talk at the Forschungszentrum Jülich, Germany (2014).
- *And yet it rotates! (The disappearance of rotational momentum on large scales: modelling large-scale water as a fluid with intrinsic spin)*, University of Oxford, UK (2014).
- *Stochastic parametrization of mesoscale eddies: is water at large scales a liquid polymer?*, University of Oxford, UK (2013).

- with L. Zanna: *Developing a stochastic parameterization of mesoscale eddies*, poster at the European Geosciences Union General Assembly, Austria (2013) and the IUGG Conference on Mathematical geophysics, UK (2012).
- *A critique of the maximum-entropy principle by one of its supporters*, invited talk at the 31st International Workshop on Bayesian Inference and Maximum Entropy Methods in Science and Engineering 'MaxEnt 2011', Waterloo, Canada (2011).
- *Vectors and affine forms, straight and twisted: with applications to electromagnetism and general relativity*, Perimeter Institute for Theoretical Physics, Canada (2011).
- *Parallels between truth logic and probability theory (a pseudo-historical, game-theoretic presentation)*, Perimeter Institute for Theoretical Physics, Canada (2010).
- *Metaphysical deductions and assumptions in quantum physics (or: there can't be only particles behind the wave function)*, invited talk, Perimeter Institute for Theoretical Physics, Canada (2008).
- *A historical review of the 'convex approach' to quantum theory, and an overview of the 'probability table' formalism*, invited talk at the workshop 'Operational probabilistic theories as foils to quantum theory', Department of Applied Mathematics and Theoretical Physics, Cambridge University (2007).
- *Plausibility theory as inductive logic*, Stockholm University (2006).
- *A review on non-completely-positive maps and evolution of non-isolated quantum systems*, Royal Inst. of Technology, Stockholm (2006).
- *Gravitomagnetism, and inertia as a real force. (With an appendix on the effects of weightlessness on the human body)*, Royal Inst. of Technology, Stockholm (2005).
- *Probability theory as an extension of formal logic*, Royal Inst. of Technology, Stockholm (2005).
- with G. Björk: *Uncertainty, information and entropy*, invited talk at the 'Ninth International Conference on Squeezed States and Uncertainty Relations', Besançon, France (2005).

- *Non-orthogonality of statistical matrices and violations of the second law of thermodynamics*, Royal Inst. of Technology, Stockholm (2004).
- *Probability tables: the convex approach to quantum theory*, invited talk at the conference 'Quantum Theory: Reconsideration of Foundations – 2', Växjö University (2004).
- *Notes on entropy assignments, statistical mechanics, and convex sets, for classical and quantum mechanics*, Stockholm University (2004).
- *A panoramic picture of modern rational thermodynamics and thermomechanics*, Royal Inst. of Technology, Stockholm (2004).
- *In between classical and quantum systems: Visualising the convex properties of sets of states and measurements*, Stockholm University and Royal Inst. of Technology, Stockholm (2003).
- *On experimental data tables, sets of states and measurement outcomes, distinguishability, and the boundary between classical and quantum systems*, Royal Inst. of Technology, Stockholm (2003).
- *Maximum-entropy method in statistical mechanics and negative temperatures*, Royal Inst. of Technology, Stockholm (2003).
- *Conceptual adequacy of the Shannon entropy in quantum measurements*, Royal Inst. of Technology, Stockholm, and Cagliari University (2002).
- *Reproduction of quantum phenomena by a deck of cards*, Royal Inst. of Technology, Stockholm, and Cagliari University (2002).
- *Tomography of quantum states*, Royal Inst. of Technology, Stockholm, and Cagliari University (2001).
- *Runge-Kutta methods for nonlinear differential equations and Hopf algebras*, Royal Inst. of Technology, Stockholm (2001).