Abstract booklet for Posters
Nonlinear Physics: Theory and Experiment. V

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Ranjeet Bhamber

Photonics Research Group, School of Engineering and Applied Science
Aston University, Birmingham, UK

Advanced Techniques in the Management of Transmission in Fibre-Optic Communication Systems

Through massive multi-dimensional space optimisation we have studied the impact of per-channel pre-compensation for 50 GHz-spaced 4x20-Gbit/s WDM RZ-DPSK transmission in NZDSF-based submarine systems.

Francesca Catino

Dipartimento di Fisica - Università del Salento
Lecce, Italy

On anomalous dimensions of twist sl(2) operators in N=4 SYM

The long range Bethe Ansatz solution of the mixing problem in N=4 SYM allows to compute in a very efficient way multiloop anomalous dimensions of various composite operators. An alternative approch is the Baxter approch. In my poster, I will present a method to expand at large spin the solution of the long range Baxter equation in twist-2 and 3 cases at two loops and in twist-3 case at three loops. I will also propose various sum rules for special singlet states at higher twist.

Arthemy V. Kiselev[(1)] **and Véronique Hussin**[(2)]

[(1)] *Mathematical Institute, University of Utrecht*
Utrecht, The Netherlands
[(2)] *Departement de Mathematiques et de Statistique, Université de Montréal*
Montréal, Québec H3C 3J7, Canada

Non-interacting Hirota's multi-soliton solutions of the $N = 2$ supersymmetric KdV equations

We prove that Mathieu's $N = 2$ supersymmetric Korteweg–de Vries equations with $a = 1, 4$ admit n-supersoliton solutions which exhibit a nonlinear superposition while overlapping, but contain no interaction terms in Hirota's exponentials, and hence acquire no phase shifts when the solitons become distant and restore their original profiles.

A. Lavagno[1,3], **G. Gervino**[2,3]

[1]*Dipartimento di Fisica, Politecnico di Torino, I-10129 Torino, Italy*
[2]*Dipartimento di Fisica, Università di Torino, I-10126 Torino, Italy*
[3]*INFN, Sezione di Torino, I-10126 Torino, Italy*

Nonlinear and nonextensive quantum mechanics

On the basis of generalized classical kinetic equations, reproducing the stationary distribution of the Tsallis nonextensive thermostatistics, we postulate a nonlinear generalized Schrödinger equation. Such a dynamical equation satisfies the basic assumptions of the quantum mechanics under an appropriate generalization of the operator properties. In this framework, we apply the relativistic extension of the above introduced nonlinear equations to a phenomenological study of observable measured in the relativistic heavy-ion collisions experiments.

Staffan Lundberg

Department of Mathematics
Lulea University of Technology - SE-97187 Lulea, Sweden

On the Classification of Evolution Equations and Reciprocal Transformations

We demonstrate the use of reciprocal transformations for the classification of 3rd- and 5th-order symmetry integrable evolution equations.

Susan R. Macfarlane

University of Glasgow, Department of Mathematics
Glasgow, UK

Quasideterminants and the noncommutative Davey-Stewartson equations

The notion of a quasideterminant was introduced by Gelfand and Retakh in 1971, and provide a useful way to define the determinant of a matrix with noncommutative entries. We derive a noncommutative version of the Davey-Stewartson (DS) equations, before calculating and verifying the quasideterminant solution. We then consider the dromion solutions to these equations, and obtain plots of the one-dromion solution in the commutative case.

Marcella Palese

Department of Mathematics - University of Torino
Via C. Alberto 10 I-10123 TORINO - ITALY

Families of nonlinear PDEs and truncated algebraic skeletons

We relate integrable nonlinear partial differential equations to realizations of truncated algebraic skeletons, in particular as Kač–Moody algebras endowed with a loop structure.

Oktay K. Pashaev and Z.N. Gurkan

Department of Mathematics, Izmir Institute of Technology,
Urla-Izmir, 35430, Turkey

Two Qubit Entanglement in Magnetic Chains with DM Antisymmetric Anisotropic Exchange Interaction

In the present paper we study influence of the anisotropic antisymmetric exchange interaction, the Dzialoshinskii-Moriya (DM) interaction, on entanglement of two qubits in various magnetic spin models, including the most general one the XYZ model. We find that in all cases, inclusion of the DM interaction creates (when it does not exist) or strengthens (when it exists) entanglement. We give physical explanation of this result by studying ground state of the system at T=0. The nonanalytic dependence of the concurrence on DM interaction and its relation with quantum phase transition is indicated. In addition we find that time evolution generated by DM interaction can implement the SWAP gate. Our results show that spin models with DM coupling have some potential applications in quantum computations where DM interaction could be an efficient control parameter of entanglement.

Oktay K. Pashaev$^{(1)}$ **and Jyh-Hao Lee**$^{(2,*)}$

$^{(1)}$*Department of Mathematics, Izmir Institute of Technology, Turkey*
$^{(2)}$*Institute of Mathematics, Academica Sinica, Taipei 11529, Taiwan*
**The author will present the poster presentation*

Chiral Solitons in Quantum Potential

We will make a brief report on the problem of chiral solitons in quantum potential as a dimensional reduction of 2+1 dimensional anyons . We show that integrable version of the model is described by the Resonant Derivative Nonlinear Schrödinger equation. For the strength of quantum potential $s > 1$,the resonance character of chiral soliton interaction is found. The goal of this paper is to study the dimensional reduction of the Chern- Simons gauged nonlinear Schrödinger equation with the quantum potential. The model after reduction becomes $1 + 1$ dimensional nonlinear field theory describing chiral solitons in quantum potential.

Anna Perelomova

Gdansk University of Technology
Gdansk, Poland

Projecting technique in nonlinear acoustics: advances in the streaming theory

The examination is performed by means of orthogonal idempotent operators and concerns to the streaming caused by an acoustic beam in the thermoviscous fluid. An acoustic field is not supposed certainly periodic in time. The instantaneous governing equation for the longitudinal streaming velocity is derived with accuracy up to the second-order nonlinear terms inclusively. The acoustic force represents a sum of three parts, one is the classic one, which being averaged over the sound period coincides to the well-known expression. The second one is connected to the periodicity of the sound, it becomes exact zero after averaging for the strictly periodic sound but is not zero for other acoustic wave. The last term comes from the sound divergence. All terms are nonlinear and proportional to the overall attenuation, manifesting in this way that both nonlinearity and damping are the origins of acoustic streaming.

Keywords: Acoustic streaming, acoustic radiation force, nonlinear hydrodynamics

Fabio Paladini and Luigi Renna

Dipartimento di Fisica - Unversità del Salento
Lecce, Italy

A Dissipative web map with multiple coexisting periodic attractors

We study the qualitative behaviour of a periodically kicked mechanical oscillator with a small amount of damping. The model yields a two-dimensional map that may possess a large number of coexisting attractors, depending on damping and forcing parameters. Without damping we obtain the widely studied area-preserving map introduced by Zaslavsky. We find the regions in parameters space where these coexisting periodic attractors appear and disappear.

M. Maldonado, J. Prada and M.J. Senosiain

Departamento de Matemáticas. Facultad de Ciencias
Universidad de Salamanca. 37008, Salamanca. Spain.

On linear differential operators: an application of Hermite polynomials

Sequences of polynomials play a fundamental role in applied mathematics and physics.

An important class is formed by the Hermite polynomials which play a key role in the Brownian motion and the Schrödinger wave equation.

It is very well-known that this class of polynomials is a powerful tool in the solution of many problems. In particular, the Hermite functions (intimately related to Hermite polynomials) form an orthonormal basis for the space $L^2(\mathbb{R})$ and we will use this fact to present a method that would help to solve, at least in some concrete examples, a problem what is described below.

One problem that has long been of interest is that of the "equivalence" of differential operators. In the sense adopted in the present paper the idea is due to Delsarte, in [1], where he introduced the notion of "opérateur of transmutation".

Given two differential operators A and B on a space H, an operator X is called an "operateur de transmutation" (transformation operator) if X is an isomorphism and $BX = XA$. This notion depends, obviously, on the two operators and the space. The first result in this direction is due to Delsarte, taking A and B to be two differential operators of order two and H a space of functions of one variable defined for $x \geq 0$.

When the domain of the functions is complex, it is always possible to transform A in B if both differential operators are of the same order and $\mathcal{H}(\mathbb{C})$, the space of entire functions of one complex variable [2].

We present our approach in the context of the space $\mathcal{C}^\infty_{2\pi}(\mathbb{R})$ of all 2π-periodic $\mathcal{C}^\infty$-functions on $\mathbb{R}$. This example has been studied for linear differential operators with constant coefficients in [3]. The application of the method to the space $S(\mathbb{R})$ of rapidly decreasing functions (Schwartz class of functions) gives some surprising results, being our intention to study the question more deeply in the near future.

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Michele Romeo

Dipartimento di Fisica - Università del Salento
Lecce, Italy
permanent e-mail address: michele.romeo.mr@gmail.com

From Grad-Shafranov Equations set to a pseudo-general form of the Non-Linear Schrodinger Equation

About the validity conditions of some general transformation functionals of the free fields in the Grad-Shafranov Equations

In the year 2003 a paper by G. Lapenta [1] demonstrated that there is "new class of soliton-like solutions for the Grad-Shafranov Equations (GSE)". The author determined an appropriate pair of transformations of the free fields p (fluid field of hydrodynamical pressure) and B_z (z-component of magnetic induction field) that leads from the Helmholtz Equation to the Non-Linear Schrodinger Equation (NLSE) with cubic non-linearity. In the following year (2004), the work of Lapenta was opposed by G.N. Throumoulopoulos et al. [2], who criticized his idea of the field transformations as a mathematically incoherent choice; contextually the authors suggested a new point of view for this one. In his response, in the same year, G. Lapenta carried out numerical simulations [3] that showed the existence of solitonic structures in a Magnetohydrodynamical (MHD) plasma-context. In the present work I want to demonstrate a *critical condition* for a 'complex' poloidal flux function Ψ_p in a plane framework (x, y) that leads to a class of pseudo-general NLSEs which establishes the validity of both G.Lapenta and G.N. Throumoulopoulos et al. choices for the field transformation functionals.

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Maria Santos Bruzón Gallego

Departamento de Matemáticas Universidad de Cádiz
Cadiz, Spain

Exact Solutions for a Generalized Boussinesq Equation

Similarity reductions for a Generalized Boussinesq Equation are investigated by the symmetry method. As a result, many different classes of solutions are obtained in terms of Jacobi elliptical functions, trigonometric functions, exponential functions, hyperbolic functions and other types of functions.

Raffaele Vitolo

Dipartimento di Matematica - Università del Salento
Lecce, Italy

Symmetries of distributions and equation of particle motion

Any determined system of second order ordinary differential equations defines a 1-dimensional distribution on the first jet space. A remarkable class of such systems consists of the equations of particle motion in relativistic mechanics. We study symmetries of distributions associated to such equations.
Joint work with G. Manno and F. Pugliese.

Ekkehart Winterroth

Department of Mathematics - University of Torino
Via C. Alberto 10 I-10123 TORINO - ITALY

Canonical Connections in Gauge-Natural Field Theories

We investigate canonical aspects concerning the relation between symmetries and conservation laws in gauge-natural field theories. In particular, we find that a *canonical spinor connection* can be selected by the simple requirement of the global existence of canonical superpotentials for the Lagrangian describing the coupling of gravitational and Fermionic fields. In fact, the naturality of a suitably defined variational Lagrangian implies the existence of an associated energy-momentum conserved current. Such a current defines a Hamiltonian form in the corresponding phase space; we show that an associated Hamiltonian connection is canonically defined along the kernel of the generalized gauge-natural Jacobi morphism and uniquely characterizes the canonical spinor connection.

This is joint work with M. Ferraris, M. Francaviglia, M. Palese.

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