Obituary: Aristophanes Dimakis

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Abstract

The theoretical physicist and mathematician Aristophanes Dimakis passed away on July 8, 2021, at the age of 68, in Athens, Greece. We briefly review his life, career and scientific achievements.

We mourn the loss of a very close friend and esteemed colleague.

Figure 1: Aristophanes Dimakis in 2011 in his apartment in Athens.

1 Life and career of Aristophanes Dimakis

Aristophanes was born in Orestiada, Greece, on April 24, 1953. He attended elementary school in Orestiada and later in Kavala, then entered high school in Kavala, later in Athens, where he graduated from it in 1971. In autumn 1971 he passed the entrance examination of the National and Kapodistrian University of Athens and began to study physics.

February 1973 saw the rise of actions by students in Athens against the military dictatorship in those days, notably the occupation of the building of the Law School, and Aristophanes took part in it. All this escalated in the “Polytechnic uprising”. On November 14, 1973, hundreds of students occupied the National Technical University of Athens (Polytechnion), barricaded themselves in it and even built a radio station. The rebellion ended bloodily in the early morning of November 17, 1973, when a tank drove over the gate of the Polytechnic and snipers shot from the roofs of nearby buildings. Unlike many others, Aristophanes survived, was not even injured and managed to escape arrest. November 17 is still a commemoration day in Greece.

At the end of 1976 Aristophanes received a diploma in physics from the University of Athens. In spring 1977 he went to Göttingen, Germany, where he wanted to go ahead for receiving a PhD
degree. But a Greek diploma was rarely accepted in those days, so first he had to write another diploma thesis, for which he chose Professor Hubert Goenner as his supervisor, who headed a group at the Institute for Theoretical Physics, concentrating on topics in General Relativity and theories of gravitation. At this time, I also worked on a diploma thesis in the same group. We shared a room in the Institute for Theoretical Physics, in those days located in the Bunsenstrasse, and became friends and lifelong collaborators. We both received our PhD degrees in 1983. Aristophanes’ German diploma thesis was entitled “Newton’sche und post-Newton’sche Näherung im Rahmen einer Gravitationstheorie ohne minimale Kopplung” (Newtonian and post-Newtonian approximation in the framework of a theory of gravity without minimal coupling). His doctoral thesis had the title “Geometrische Behandlung von Clifford-Algebren und Spinoren mit Anwendungen auf die Dynamik von Spineilchen” (Geometric treatment of Clifford algebras and spinors with applications to the dynamics of particles with spin). From April 1978 to July 1980 he also worked as a tutor at the Institute for Theoretical Physics. In November 1981 he became a scientific employee, financed via a project funded by the Deutsche Forschungsgemeinschaft (DFG) and headed by Hubert Goenner.

So far Aristophanes had managed to postpone his military service in Greece. Finally he was able to reduce it to a few months which he completed at the end of 1987. He arranged this between some non-permanent positions at the Institute for Theoretical Physics in Göttingen. On February 16, 1990, Aristophanes took up a position at the Department of Mathematics at the University of Crete in Iraklion. In those days he has been particularly supported by Basilis Xanthopoulos, who was assassinated on November 27, 1990, during a seminar, which Aristophanes also attended. Yet another colleague was killed in this rampage of a student and Aristophanes has been lucky to survive this. I had visited him a year ago on Crete and remember that during a seminar delivered by Vladimir E. Zakharov we heard a loud shot. Just for fun I said “Oh, someone has been shot!” and learned later that guns are indeed not at all rare on this island, quite well-known for its vendettas.

On September 1, 1996, he joined the Aegean University on Samos and on September 25, 2000, he moved to the Department of Financial and Management Engineering on Chios, where he taught mathematics to future engineers and continued his research in mathematical physics. Almost at the age of fifty, on August 23, 2002, he finally received a permanent position as a full professor. He also served for many years as head of the department and retired in September 2020.

Aristophanes’ research started in General Relativity. Later he turned to Noncommutative Geometry and finally concentrated on mathematical aspects of Integrable Systems. The variety of ideas he developed in his publications is quite amazing.

Aristophanes died on July 8, 2021, in a hospital in Athens. In April he had been diagnosed with lung cancer that progressed rapidly. His appointment as “emeritus” had taken a while and only reached him when he was already under intensive care in the hospital.

Aristophanes was a very gentle person. Though not quite a sociable person (at least outside of Greece and his familiar environment of close friends), those who met him very much appreciated his good sense of humour and broad knowledge reaching far beyond the realm of science. He loved to tackle mathematical problems and often found an ingenious solution within a surprisingly short time, during which he worked with enormous concentration. Surely mathematics made up the main part of his life. He also had the attitude to quickly turn to a new topic, once he had revealed the secrets of the former. In this way, many of his results got somehow lost in his folders. In March 2021 he wrote to me “I feel empty of research ideas. This is not healthy.” He was steadily looking for new mathematical problems to tackle. Certainly we would have seen many more deep results had he not gone so early.

He left behind his spouse Aliki Lavranou, since 2020 professor at the School of Social Sciences of Panteion University in Athens. They had met in Göttingen in the early 80th and spent about 40 years together. Later they shared an apartment in Athens and for a long time both had to fly weekly back and forth between Athens and different Greek islands for delivering their teaching. I
have to thank Aliki for providing me with some data about Aristophanes’ life.

2 A résumé of his scientific work

After a short mathematical excursion to economics [1,2], Aristophanes addressed problems in General Relativity and its extensions with torsion, the simplest being Einstein-Cartan theory. Whereas classical particles cannot detect torsion, Dirac (spinor) fields, which model fermions like electrons and neutrinos, in principle can. In those days one studied the (speculative) possibility of classical Dirac fields as sources in Einstein’s equations. A special case occurs if a Dirac field does not contribute to the energy-momentum tensor, the source of the gravitational field. These “ghost” Dirac fields were studied in [3,4]. In [5], the Einstein-Cartan equation with vanishing energy-momentum tensor and a massive Dirac field was shown to reduce to covariant equations on the group $SL(2,\mathbb{R})$, a nice application of differential geometry on Lie groups.

Newton’s theory of gravity can be cast into a differential geometric form analogously to General Relativity. Between this Newton-Cartan theory and General Relativity exists an infinity of higher order approximations, which also have a geometric formulation. The publication [6] was mainly based on Aristophanes’ diploma thesis.

During his PhD work, Aristophanes became a top expert on Clifford algebras. His first publications [7,10] in this area were inspired by work of David Hestenes. In [13] a comprehensive formalism based on Clifford algebras was developed, in particular (but not only) to ease complicated computations in the area of higher-dimensional gravity theories. The term “clifform” was coined to abbreviate the notion “Clifford-algebra-valued differential form”.

In [8,9] studies of the initial value problem for theories of gravity with torsion was presented.

The work [11] has been motivated by Edward Witten’s famous spinor-based proof of the positive energy theorem in General Relativity. A condition considered by James M. Nester to select a convenient orthonormal frame field on a three-dimensional Riemannian manifold was shown to be equivalent to the (linear) Dirac equation. In [12] a proof of the positive energy theorem was presented using orthonormal frame fields instead of spinors.

Though Aristophanes and I did not publish any work about quantum gravity, the problem of unifying General Relativity with Quantum Mechanics very much occupied our thoughts in those days. When “Noncommutative Geometry” came up, we regarded it as a promising framework for such a unification. But soon we realized that, before addressing such a goal, we had to get a deeper understanding of this essentially new mathematics. We decided to consider simpler applications.

Differential geometry underlies General Relativity, as well as the gauge theories that form the crucial structure of electrodynamics and elementary particle physics. The most basic structure is a manifold, or better the commutative associative algebra of (smooth) functions on it. Noncommutative Geometry generalizes it to a, in general, noncommutative (mostly still associative) algebra. Required in addition is an analog $\Omega$ of the algebra of differential forms and, in particular, an analogue of the exterior derivative $d$, acting on $\Omega$ such that the (graded) Leibniz rule still holds. Further geometric structures, like analogues of connections (gauge fields), symplectic structures, notions of distance and metrics, can then be introduced on $\Omega$.

In [14,17] it has been explored in which sense Quantum Mechanics can be understood as “noncommutative symplectic geometry”. When we then realized that commutative algebras can carry non-standard differential calculi, specified by non-trivial commutation relations between elements of the algebra and their differentials, this opened up a rich new world. For example, imposing

\[ [x, dx] = \ell \, dx \quad \ell \in \mathbb{R}, \quad \ell > 0, \]

on a commutative algebra generated by $x$, this generalizes to $f(x) \, dx = dx \, f(x + \ell)$ for any function
f of x. By using the Leibniz rule, one then easily deduces that

\[ df = dx \frac{1}{\ell} \left[ f(x + \ell) - f(x) \right] = \frac{1}{\ell} \left[ f(x) - f(x - \ell) \right] dx, \]

where left and right discrete derivatives show up. So this differential calculus can be thought of as living on a one-dimensional lattice with spacing \( \ell \). This calculus and its higher-dimensional version have been explored in [16, 21, 22]. More generally, differential calculi on finite sets, and geometric structures built on them, have been the subject of quite a number of further publications [20, 23, 25, 28, 30], apart from those by other authors. In particular, we made efforts to develop “discrete Riemannian geometry” in as close as possible analogy with differential geometry [45, 60, 61].

Relations of the form \( [x^i, dx^j] = C^j_{ik} dx^k \) with constants \( C^j_{ik} i,j,k = 1, \ldots, n \), were classified in [29] up to \( n = 3 \). An example from this class, different from (2.1), turned out to describe stochastic processes on manifolds [19, 24]. A framework for kinetic theory of open systems, based on this “noncommutative calculus” was developed in [31, 41, 55]. In [15] (also see [18]) we related this calculus to physical theories postulating two notions of time. We sent the manuscript to Nuclear Physics B, where it was delayed for about a year until we received a negative decision from an editor (without a report, but along with a negative general statement about Noncommutative Geometry). Anyway, we were proud of this work, but did not submit it again to a journal.

Many completely integrable PDEs admit a differential-geometric zero curvature formulation, which suggested to explore a noncommutative version of the latter. This led us again into a rich new world. Besides some first explorations [36], we came across chiral models,

\[ d \star (g^{-1} dg) = 0, \]

where \( g \) is an invertible matrix of functions on a 2-dimensional Riemannian space and \( \star \) the Hodge star operator. Such models were known to possess an infinite number of conserved currents, which is an integrability feature. The goal was to generalize them to a framework of Noncommutative Geometry, by generalizing the underlying differential calculus and the star operator, while preserving integrability. This was achieved in [32, 38, 39, 33]. For example, by deforming the standard differential calculus in one of the two dimensions to the lattice calculus (2.1) and using a star operator...
that corresponds to that of 2-dimensional Minkowski space, one obtains the famous Toda lattice, which thus turned out to be a chiral model with respect to a noncommutative geometry.

A variety of studies followed, on Noncommutative Geometry \[34, 35, 67\], discretization `a la Umbral calculus \[33\], Connes’ distance function on discrete sets \[42\], soliton equations on a “non-commutative space” \[52, 53, 58\], Moyal deformation of integrable models \[54, 56, 65, 66, 68, 69, 77\], automorphisms of real four-dimensional Lie algebras and characterization of four-dimensional homogeneous spaces \[62\], “functional representations” (generating equations) of integrable hierarchies \[72\], studies of KP and related hierarchies \[75, 76, 79, 80, 83, 84\], relations between different hierarchies via deformation of multiplication \[73\].

An excursion into nonassociativity was made in \[71, 74, 78, 81, 85\]. Let \( f \) freely generate a nonassociative algebra \( A \). Imposing the (“weak nonassociativity”) condition \( a((bc)d) - (a(bc))d = 0 \) for all \( a, b, c, d \in A \), the algebra admits an infinite sequence of derivations \( \delta_n \), \( n \in \mathbb{N} \), given by monomials in \( f \). These derivations satisfy identities which are, via \( \delta_n \rightarrow \partial/\partial t_n \), in correspondence with equations of the KP hierarchy, with dependent variable in a noncommutative associative algebra. The associative subalgebra of \( A \) is isomorphic to the algebra of quasi-symmetric functions and the latter carries the structure of an “infinitesimal bialgebra” \[85\]. I’m not sure that the beauty of these results reached the world around us ...

In the case of the abovementioned chiral models, the integrability feature was the existence of an infinite tower of conservation laws. Integrable models (notably soliton equations) typically possess powerful solution-generating methods, which we considered as more useful. They can often be derived from a parameter-dependent zero curvature (Zakharov-Shabat) condition. In the framework of Noncommutative Geometry, we therefore started to explore the case of a linear dependence on such a parameter, which led to a structure which we called “bidifferential calculus” and which can be thought of as a generalization of Frölicher-Nijenhuis theory from Differential to Noncommutative Geometry. It turned out that indeed many integrable models (though probably not all) can in fact be treated in this framework \[47, 51, 56, 57, 59, 62, 86, 91, 93, 97, 101\]. A crucial point was that integrability features could be formulated in an extremely general way, only using simple calculation rules of bidifferential calculus. Treating a concrete model, i.e., an integrable differential or difference equation, meant to find a suitable realization of the graded algebra and two linear operators acting on it with very simple properties. It took a while, and several less satisfactory publications, until we came up in \[93\] with a sufficiently general “abstract version” of what is known as a “binary Darboux transformation”, a powerful solution-generating method for integrable models.

Solitons of integrable equations like Korteweg-deVries (KdV) or the Nonlinear Schrödinger (NLS) equation are spatially localized wave solutions in two space-time dimensions. Taking the wave crest limit of a 2-soliton solution leads to a graph with two incoming and two outgoing lines and an interaction vertex. More generally, such a “particle picture” can be associated with solitons of certain integrable equations via a “tropical limit”, so named because of relations with tropical mathematics. This also works for solitons of the KP equation, which lives in three space-time dimensions. It possesses a subclass of soliton solutions for which, at a fixed time, the tropical limit graph has the form of a rooted binary tree. Surprisingly, the time evolution then corresponds to a sequence of what is known as a “right rotation” (of a “leg”, i.e., an edge) at some vertex. The concrete sequence of right rotations depends on parameters of the soliton solution. The various rooted binary trees with a fixed number of legs (corresponding to a fixed number of solitons) connected by single right rotations form a so-called Tamari lattice (see Fig. 3), a combinatorial structure expressing associativity relations. All Tamari lattices are thus realized by soliton solutions of the KP equation \[88\] (the latter work has been chosen for IOP Select). There are also relations of this kind between so-called higher Tamari orders and the KP hierarchy \[92\].

A follow-up work was the study \[95, 96\] of simplex and polygon equations. Similar to the known
Figure 3: A sequence of contour plots of a soliton solution of the KP equation at consecutive values of time. The second row displays more clearly the corresponding rooted binary trees. The KP equation describes fluid surface wave, but it is difficult to generate such waves in order to observe the tree rotation in nature. The right figure displays a Tamari lattice which contains the path shown in the left figure. Regions in the plane separated by legs of a rooted binary tree are consecutively numbered from left to right counterclockwise. A sequence of numbers shown in the Tamari lattice indicates which of these regions are involved in the respective rooted binary tree transition via a right rotation.

A relation between simplex equations (which include the Yang-Baxter equation) and higher Bruhat orders, there is a corresponding relation between polygon equations (which include the pentagon equation) and higher Tamari orders. Aristophanes’ contributions were the most crucial in these works. Moreover, he was a grandmaster of MATHEMATICA and used it in particular to generate a lot of beautiful illustrations for these publications. Aristophanes’ last publication [103], jointly with Igor Korepanov, presented a large class of solutions of simplex and polygon equations with maps acting between direct sums of vector spaces.

Bidifferential calculus does not only treat partial differential and difference equations on an equal footing, it is also suitable to deal with versions of integrable models, where the dependent variables take values in a noncommutative associative algebra. This includes matrix versions of soliton equations. Two asymptotically free matrix solitons will typically change their matrix data due to an interaction caused by the nonlinearity of the governing dynamical system. The 2-soliton interaction leads to a map \( R : S \times S \to S \times S \), where \( S \) is the set of allowed matrix data of a single soliton. It was known (for KdV and NLS) that such a map can be a solution of the (set-theoretic) Yang-Baxter equation, which makes a statement about a 3-soliton interaction. The tropical limit provides us with a tool to concretely realize the Yang-Baxter relation (see Fig. [4]). It turned out, however, that even in the KdV case there are different maps obtained from 2-soliton interactions, of which only one satisfies the Yang-Baxter equation. In general, a 3-soliton interaction is constrained.
Figure 4: Contour plots of a 3-soliton solution of a matrix KP equation in the $x,y$-plane, at a negative and a positive value of time. These line soliton configurations realize left and right hand side of a familiar graphical representation of the Yang-Baxter equation. (The parameters of the solution have been tuned such that the soliton lines are arranged in this optimal way.) The fact that these two configurations are deformed into each other by the time evolution, implies that the two associated compositions of three 2-soliton data maps, acting at the intersections (of soliton lines) ordered in vertical ($y$) direction, take initial matrix data to equal data, since the maps do not depend on the coordinates $x,y,t$. This means that the Yang-Baxter equation holds.

by a mixed ("intertwining") version of the Yang-Baxter equation, where also a map enters which is not a Yang-Baxter map [102]. More generally, in [98–100, 102] the interaction of solitons of the matrix KP equation has been explored.

This sketch of Aristophanes’ research surely conveys its variety and often striking novelty of underlying ideas and insights.

**Publications of Aristophanes Dimakis**

[1] A. Dimakis and Georgios Stamatis, Zur Linearit"{a}t der Relation zwischen dem Nominallohnssatz und der Profitrate bei post factum gezahlten L"ohnen (On the Linearity of the w-r-Relation under Post Factum Paid Wages), Jahrb"ucher f"ur National"okonomie und Statistik, vol. 196, no. 2 (1981), pp. 147-169.

[2] A. Dimakis, Ein mathematischer Beitrag zur Theorie der Produktionspreise, Hefte f"ur Politische "Okonomie 1 (1980) 101.

[3] A. Dimakis and F. M"uller-Hoissen, Massive ghost Dirac fields in Einstein-Cartan theory, Phys. Lett. A 92 (1982) 431-432.

[4] A. Dimakis and F. M"uller-Hoissen, Ghost Dirac fields in theories with torsion. In: B.Bertotti et al. (eds), 10th International Conference on General Relativity and Gravitation, Contributed Papers, Padova, Italy (1983), pp. 505-506.

[5] A. Dimakis and F. M"uller-Hoissen, Solutions of the Einstein-Cartan-Dirac equations with vanishing energy-momentum tensor, J. Math. Phys. 26 (1985) 1040-1048.

[6] A. Dimakis, Gauge theory of the post-Galilean groups, J. Math. Phys. 26 (1985) 1298-1307.

[7] A. Dimakis, A new representation for spinors in real Clifford algebras. In: Chisholm J.S.R., Common A.K. (eds) Clifford Algebras and Their Applications in Mathematical Physics. NATO ASI Series (Series C: Mathematical and Physical Sciences), vol 183. Springer, Dordrecht (1986) pp. 49-60.

[8] A. Dimakis, The initial value problem of the Poincaré gauge theory in vacuum I. Second order formalism, Annales de l’I.H.P. Physique théorique 51 (1989) 371-388.
[9] A. Dimakis, The initial value problem of the Poincaré gauge theory in vacuum II. First order formalism. Annales de l'I.H.P. Physique théorique 51 (1989) 389-417.

[10] A. Dimakis, A new representation of Clifford algebras. J. Phys. A: Math. Gen. 22 (1989) 3171-3193.

[11] A. Dimakis and F. Müller-Hoissen, On a gauge condition for orthonormal three frames. Phys. Lett. A 142 (1989) 73-74.

[12] A. Dimakis and F. Müller-Hoissen, Spinor fields and the positive energy theorem. Class. Quantum Grav. 7 (1990) 283-295.

[13] A. Dimakis and F. Müller-Hoissen, Clifform calculus with applications to classical field theories. Class. Quantum Grav. 8 (1991) 2093-2132.

[14] A. Dimakis and F. Müller-Hoissen, Quantum mechanics as noncommutative symplectic geometry. J. Phys. A: Math. Gen. 25 (1992) 5625-5648.

[15] A. Dimakis and F. Müller-Hoissen, Noncommutative differential calculus, gauge theory and gravitation. preprint GOET-TP 33/92.

[16] A. Dimakis and F. Müller-Hoissen, Quantum mechanics on a lattice and q-deformations. Phys. Lett. B 295 (1992) 242-248.

[17] A. Dimakis and F. Müller-Hoissen, Noncommutative symplectic geometry and quantum mechanics. In: Proceedings of the XXI International Conference on Differential Geometric Methods in Theoretical Physics, Tianjin (China), June 1992, Int. J. Mod. Phys. A (Proc. Suppl.) 3A (1993) 214-217.

[18] A. Dimakis and F. Müller-Hoissen, A noncommutative differential calculus and its relation to gauge theory and gravitation. In: Proceedings of the XXI International Conference on Differential Geometric Methods in Theoretical Physics, Tianjin (China), June 1992, Int. J. Mod. Phys. A (Proc. Suppl.) 3A (1993) 474-477.

[19] A. Dimakis and F. Müller-Hoissen, Stochastic differential calculus, the Moyal ∗-product, and noncommutative geometry. Lett. Math. Phys. 28 (1993) 123-137.

[20] A. Dimakis and F. Müller-Hoissen, Differential forms and gauge theory on discrete sets and lattices. In: International Workshop on Symmetry Methods in Physics (in memory Ya. A. Smorodinsky), vol. 2. Dubna, July 1993, pp. 351-357.

[21] A. Dimakis, F. Müller-Hoissen and Timothy Striker, From continuum to lattice theory via deformation of the differential calculus. Phys. Lett. B 300 (1993) 141-144.

[22] A. Dimakis, F. Müller-Hoissen and T. Striker, Noncommutative differential calculus and lattice gauge theory. J. Phys. A: Math. Gen. 26 (1993) 1927-1949.

[23] A. Dimakis and F. Müller-Hoissen, Differential calculus and gauge theory on finite sets. J. Phys. A: Math. Gen. 27 (1994) 3159-3178. arXiv:hep-th/9401149

[24] A. Dimakis and F. Müller-Hoissen, Noncommutative differential calculus: quantum groups, stochastic processes, and the antibracket. Advances in Applied Clifford Algebras (Proc. Suppl.) 4(S1) (1994) 113-124. arXiv:hep-th/9401151
[25] A. Dimakis and F. Müller-Hoissen, Differential calculus and discrete structures. In: H.-D. Doebner, V.K. Dobrev and A.G. Ushveridze (eds), Generalized Symmetries in Physics, World Scientific, Singapore, 1994, pp. 213-218. [arXiv:hep-th/9401150]

[26] A. Dimakis and F. Müller-Hoissen, Discrete differential calculus: Graphs, topologies, and gauge theory. J. Math. Phys. 35 (1994) 6703-6735. [arXiv:hep-th/9404112]

[27] A. Dimakis, F. Müller-Hoissen and Francois Vanderseypen, Discrete differential manifolds and dynamics on networks. J. Math. Phys. 36 (1995) 3771-3791. [arXiv:hep-th/9408114]

[28] A. Dimakis and F. Müller-Hoissen, Discrete differential manifolds and physics. In: H.-D. Doebner, V.K. Dobrev and P. Nattermann (eds), Nonlinear, Deformed and Irreversible Quantum Systems. World Scientific, 1995, pp. 469-474.

[29] A. Dimakis, F. Müller-Hoissen and Hanno Baehr, Differential calculi on commutative algebras. J. Phys. A 28 (1995) 3197-3222. [preprint MPI-PhT/94-83] [arXiv:hep-th/9412006]

[30] Klaus Bresser, A. Dimakis, F. Müller-Hoissen and Andrzej Sitarz, Non-commutative geometry of finite groups. J. Phys. A 29 (1996) 2705-2735. [arXiv:q-alg/9509004]

[31] A. Dimakis and Constantinos Tzanakis, Non-commutative geometry and kinetic theory of open systems. J. Phys. A: Math. Gen. 29 (1996), 577-594. [arXiv:hep-th9508035]

[32] A. Dimakis and F. Müller-Hoissen, Integrable discretizations of chiral models via deformation of the differential calculus. J. Phys. A: Math. Gen. 29 (1996) 5007-5018. [arXiv:hep-th/9512007]

[33] A. Dimakis, F. Müller-Hoissen and Timothy Striker, Umbral calculus, discretization, and quantum mechanics on a lattice. J. Phys. A 29 (1996) 6861-6876. [arXiv:quant-ph/9509014]

[34] A. Dimakis and John Madore, Differential calculi and linear connections. J. Math. Phys. 37 (1996) 4647-4661. [arXiv:q-alg/9601023]

[35] A. Dimakis, A note on Connections and Bimodules. [arXiv:q-alg/9603001]

[36] A. Dimakis and F. Müller-Hoissen, Soliton equations and the zero curvature condition in noncommutative geometry. J. Phys. A 29 (1996) 7279-7286. [arXiv:hep-th/9608009]

[37] C. Tzanakis and A. Dimakis, On the uniqueness of the Moyal structure of phase-space functions. [arXiv:q-alg/9605018]

[38] A. Dimakis and F. Müller-Hoissen, Noncommutative geometry and integrable models. Lett. Math. Phys. 39 (1997) 69-79. [arXiv:hep-th/9601024]

[39] A. Dimakis and F. Müller-Hoissen, A generalization of sigma-models and complete integrability. In: H.-D. Doebner, W. Scherer and C. Schulte (eds), GROUP21, Physical Applications and Mathematical Aspects of Geometry, Groups, and Algebras. Vol. 2, World Scientific, 1997, pp. 602-606.

[40] A. Dimakis and F. Müller-Hoissen, Deformations of classical geometries and integrable systems. Submitted to the proceedings of the workshop “Quantum Groups, Deformations and Contractions”, Bogazici University, Istanbul, September 1997, but apparently never appeared in print. [arXiv:physics/9712002]
A. Dimakis and C. Tzanakis, Noncommutative geometry and its relation to stochastic calculus and symplectic mechanics. In: N. K. Artemiadis and N. K. Stephanidis (eds), Proceedings of the 4th International Congress of Geometry, Academy of Athens and Aristotle University of Thessaloniki, Thessaloniki, 1997. [arXiv:q-alg/9606011]

A. Dimakis and F. Müller-Hoissen, Connes’ distance function on one-dimensional lattices. Int. J. Theor. Phys. 37 (1998) 907-913. [arXiv:q-alg/9707016]

A. Dimakis and F. Müller-Hoissen, Noncommutative geometry and a class of completely integrable models. Czech. J. Phys. 48 (1998) 1319-1324. [arXiv:math-ph/9809023]

A. Dimakis and F. Müller-Hoissen, Some aspects of noncommutative geometry and physics. In: L. Brink and R. Marnelius (eds), Novelties in String Theory, World Scientific, 1999, 327-347. [arXiv:physics/9712004]

A. Dimakis and F. Müller-Hoissen, Discrete Riemannian geometry. J. Math. Phys. 40 (1999) 1518-1548. [arXiv:gr-qc/9808023]

A. Dimakis and F. Müller-Hoissen, Pseudo-Riemannian metrics in models based on noncommutative geometry. Czech. J. Phys. 50 (2000) 45-52. [arXiv:gr-qc/9908022]

A. Dimakis and F. Müller-Hoissen, Bi-differential calculi and integrable models. J. Phys. A: Math. Gen. 33 (2000) 957-974. [arXiv:math-ph/9908015]

A. Dimakis and F. Müller-Hoissen, Bi-differential calculus and the KdV equation. Rep. Math. Phys. 46 (2000) 203-210. [arXiv:math-ph/9908016]

A. Dimakis and F. Müller-Hoissen, Bicomplexes and finite Toda lattices. In: H.-D. Doebner, V.K. Dobrev, J.-D. Hennig and W. Lücke (eds), Quantum Theory and Symmetries, World Scientific, 2000, 545-549. [arXiv:solv-int/9911006]

A. Dimakis and F. Müller-Hoissen, Bicomplexes, integrable models, and noncommutative geometry. Int. J. Mod. Phys. B 14 (2000) 2455-2460. [arXiv:hep-th/0006005]

A. Dimakis and F. Müller-Hoissen, Bicomplexes and integrable models. J. Phys. A: Math. Gen. 33 (2000) 6579-6591. [arXiv:nlin/0006029 [nlin.SI]]

A. Dimakis and F. Müller-Hoissen, A noncommutative version of the nonlinear Schrödinger equation. [arXiv:hep-th/0007015]

A. Dimakis and F. Müller-Hoissen, The Korteweg-de-Vries equation on a noncommutative space-time. Phys. Lett. A 278 (2000) 139-145. [arXiv:hep-th/0007074]

A. Dimakis and F. Müller-Hoissen, Moyal deformation, Seiberg-Witten map, and integrable models. Lett. Math. Phys. 54 (2000) 123-135. [arXiv:hep-th/0007160]

A. Dimakis and C. Tzanakis, Dynamical evolution in non-commutative discrete phase space and the derivation of classical kinetic equations. J. Phys. A: Math. Gen. 33 (2000) 5267-5301. [arXiv:math-ph/9912016]

A. Dimakis and F. Müller-Hoissen, Bicomplex formulation and Moyal deformation of (2+1)-dimensional Fordy-Kulish systems. J. Phys. A: Math. Gen. 34 (2001) 2571-2581. [arXiv:nlin/0008016 [nlin.SI]]
[57] A. Dimakis and F. Müller-Hoissen, Bicomplexes and Bäcklund transformations, J. Phys. A: Math. Gen. 34 (2001) 9163-9194. [arXiv:nlin/0104071 [nlin.SI]]

[58] A. Dimakis and F. Müller-Hoissen, Noncommutative NLS equation, Czech. J. Phys. 51 (2001) 1285-1290.

[59] A. Dimakis and F. Müller-Hoissen, On generalized Lotka-Volterra lattices, Czech. J. Phys. 52 (2002) 1187-1193. [arXiv:nlin/0207010 [nlin.SI]]

[60] A. Dimakis and F. Müller-Hoissen, Differential geometry of group lattices, J. Math. Phys. 44 (2003) 1781-1821. [arXiv:math-ph/0207014]

[61] A. Dimakis and F. Müller-Hoissen, Riemannian geometry of bicovariant group lattices, J. Math. Phys. 44 (2003) 4220-4259. [arXiv:math-ph/0212054]

[62] A. Dimakis, T. Christodoulakis and G. O. Papadopoulos, Automorphisms of real four-dimensional Lie algebras and the invariant characterization of homogeneous 4-spaces, J. Phys. A: Math. Gen. 36 (2003) 427-441. , Corrigendum: J. Phys. A: Math. Gen. 36 (2003) 2379. [arXiv:gr-qc/0209042]

[63] A. Dimakis and F. Müller-Hoissen, five contributions to: S. Duplij, W. Siegel and J. Bagger (eds), Concise Encyclopedia of Supersymmetry, Kluwer, Dordrecht, 2004.

[64] A. Dimakis and F. Müller-Hoissen, Automorphisms of associative algebras and noncommutative geometry, J. Phys. A: Math. Gen. 37 (2004) 2307-2330. [arXiv:math-ph/0306058]

[65] A. Dimakis and F. Müller-Hoissen, Extension of noncommutative soliton hierarchies, J. Phys. A: Math. Gen. 37 (2004) 4069-4084. [arXiv:hep-th/0401142]

[66] A. Dimakis and F. Müller-Hoissen, Explorations of the extended ncKP hierarchy, J. Phys. A: Math. Gen. 37 (2004) 10899–10930. [arXiv:hep-th/0406112]

[67] A. Dimakis and F. Müller-Hoissen, Differential calculi on quantum spaces determined by automorphisms, Czech. J. Phys. 54 (2004) 1235-1242. [arXiv:math/0407273 [math.QA]]

[68] A. Dimakis and F. Müller-Hoissen, Extension of Moyal-deformed hierarchies of soliton equations. In: C. Burdik, O. Navratil and S. Posta (eds), XI International Conference Symmetry Methods in Physics, Joint Institute for Nuclear Research, Dubna, 2004. [arXiv:nlin/0408023 [nlin.SI]]

[69] A. Dimakis and F. Müller-Hoissen, An algebraic scheme associated with the noncommutative KP hierarchy and some of its extensions, J. Phys. A: Math. Gen. 38 (2005) 5453-5505. [arXiv:nlin/0501003 [nlin.SI]]

[70] A. Dimakis and F. Müller-Hoissen, Algebraic identities associated with KP and AKNS hierarchies, Czech. J. Phys. 55 (2005) 1385-1390. [arXiv:math-ph/0507024]

[71] A. Dimakis and F. Müller-Hoissen, Nonassociativity and integrable hierarchies. [arXiv:nlin/0601001 [nlin.SI]]

[72] A. Dimakis and F. Müller-Hoissen, Functional representations of integrable hierarchies, J. Phys. A: Math. Gen. 39 (2006) 9169-9186. [arXiv:nlin/0603018 [nlin.SI]]

[73] A. Dimakis and F. Müller-Hoissen, From AKNS to derivative NLS hierarchies via deformations of associative products, J. Phys. A: Math. Gen. 39 (2006) 14015-14033. [arXiv:nlin/0603048 [nlin.SI]]
A. Dimakis and F. Müller-Hoissen, From nonassociativity to solutions of the KP hierarchy, Czech. J. Phys. 56 (2006) 1123-1130. [arXiv:nlin/0608017 [nlin.PS]]

A. Dimakis and F. Müller-Hoissen, Burgers and KP hierarchies: A functional representation approach, Theor. Math. Phys. 152 (2007) 933-947. [arXiv:nlin/0610045 [nlin.SI]]

Erratum: Theor. Math. Phys. 152 (2007) 1224.

A. Dimakis and F. Müller-Hoissen, With a Cole-Hopf transformation to solutions of the non-commutative KP hierarchy in terms of Wronski matrices, J. Phys. A: Math. Theor. 40 (2007) F321-F329. [arXiv:nlin/0701052 [nlin.SI]]

A. Dimakis and F. Müller-Hoissen, A new approach to deformation equations of noncommutative KP hierarchies, J. Phys. A: Math. Theor. 40 (2007) 7573-7596. [arXiv:math-ph/0703067]

A. Dimakis and F. Müller-Hoissen, Weakly nonassociative algebras, Riccati and KP hierarchies. In S. Silvestrov, E. Paal, V. Abramov and A. Stolin (eds), Generalized Lie Theory in Mathematics, Physics and Beyond, Springer, 2008, pp. 9–27. [arXiv:nlin/0701010 [nlin.SI]]

A. Dimakis and F. Müller-Hoissen, Dispersionless limit of the noncommutative potential KP hierarchy and solutions of the pseudodual chiral model in 2+1 dimensions, J. Phys. A: Math. Theor. 41 (2008) 265205. [arXiv:0706.1373 [nlin.SI]]

A. Dimakis and F. Müller-Hoissen, From the Kadomtsev-Petviashvili equation halfway to Ward’s chiral model, J. Gen. Lie Theory Appl. 2 (2008) 141-146. [arXiv:0712.3689 [nlin.SI]]

A. Dimakis and F. Müller-Hoissen, Weakly non-associative algebras and the Kadomtsev-Petviashvili hierarchy, Glasgow Math. J. 51A (2009) 49–57.

A. Dimakis and F. Müller-Hoissen, Bidifferential graded algebras and integrable systems, Discrete and Continuous Dynamical Systems (DCDS) Supplements 2009, 208–219. [arXiv:0805.4553 [nlin.SI]]

A. Dimakis and F. Müller-Hoissen, BKP and CKP revisited: The odd KP system, Inverse Problems 25 (2009) 045001. [arXiv:0810.0757 [nlin.SI]]

A. Dimakis and F. Müller-Hoissen, Multicomponent Burgers and KP hierarchies, and solutions from a matrix linear system, SIGMA 5 (2009) 002. [arXiv:0811.0110 [nlin.SI]]

A. Dimakis and F. Müller-Hoissen, Quasi-symmetric functions and the KP hierarchy, J. Pure and Applied Algebra 214 (2010) 449–460. [arXiv:0901.2562 [math-ph]]

A. Dimakis and F. Müller-Hoissen, Solutions of matrix NLS systems and their discretizations: A unified treatment, Inverse Problems 26 (2010) 095007. [arXiv:1001.0133 [nlin.SI]]

A. Dimakis and F. Müller-Hoissen, Bidifferential calculus approach to AKNS hierarchies and their solutions, SIGMA 6 (2010) 055. [arXiv:1004.1627 [nlin.SI]]

A. Dimakis and F. Müller-Hoissen, KP line solitons and Tamari lattices, J. Phys. A: Math. Theor. 44 (2011) 025203, IOPselect [arXiv:1009.1886 [math-ph]]

A. Dimakis, Nils Kanning and F. Müller-Hoissen, Bidifferential calculus, matrix SIT and sine-Gordon equations, Acta Polytechnica 51 (2011) 33–37. [arXiv:1011.1737 [nlin.SI]]

Takayuki Tsuchida and A. Dimakis, On a (2+1)-dimensional generalization of the Ablowitz-Ladik lattice and a discrete Davey-Stewartson system, J. Phys. A: Math. Theor. 44 (2011) 325206. [arXiv:1103.4953 [nlin.SI]]
[91] A. Dimakis, Nils Kanning and F. Müller-Hoissen, The non-autonomous chiral model and the Ernst equation of General Relativity in the bidifferential calculus framework, SIGMA 7 (2011) 118. [arXiv:1106.4122 [gr-qc]]

[92] A. Dimakis and F. Müller-Hoissen, KP solitons, higher Bruhat and Tamari orders. In: F. Müller-Hoissen, J. Pallo and J. Stasheff (eds), Associahedra, Tamari Lattices and Related Structures, Tamari Memorial Festschrift, Progress in Mathematics 299, Birkhäuser, 2012, 391-423. [arXiv:1110.3507 [math.CO]]

[93] A. Dimakis and F. Müller-Hoissen, Binary Darboux Transformations in Bidifferential Calculus and Integrable Reductions of Vacuum Einstein Equations, SIGMA 9 (2013) 009. [arXiv:1208.0462 [gr-qc]]

[94] A. Dimakis and F. Müller-Hoissen, KdV soliton interactions: a tropical view, J. Phys. Conf. Series 482 (2014) 012010. [arXiv:1308.1545 [nlin.SI]]

[95] A. Dimakis and F. Müller-Hoissen, Simplex and polygon equations, SIGMA 11 (2015) 042. [arXiv:1409.7855 [math-ph]]

[96] A. Dimakis and F. Müller-Hoissen, Higher Bruhat and Tamari orders and their realizations, J. Generalized Lie Theory Appl. 9 (2015) e103.

[97] A. Dimakis, Oleksandr Chvartatskyi and F. Müller-Hoissen, Self-consistent sources for integrable equations via deformations of binary Darboux Transformations, Lett. Math. Phys. 106 (2016) 1139-1179. [arXiv:1510.05166]

[98] A. Dimakis and F. Müller-Hoissen, Matrix Kadomtsev–Petviashvili equation: tropical limit, Yang-Baxter and pentagon maps, Theor. Math. Phys. 196 (2018) 1164-1173. [arXiv:1709.09848]

[99] A. Dimakis and F. Müller-Hoissen, Matrix KP: tropical limit and Yang-Baxter maps, Lett. Math. Phys. 109 (2019) 799-827. [arXiv:1708.05694]

[100] A. Dimakis, F. Müller-Hoissen and Xiao-Min Chen, Matrix Boussinesq solitons and their tropical limit, Phys. Scr. 94 (2019) 035206. [arXiv:1805.09711]

[101] A. Dimakis and F. Müller-Hoissen, Differential Calculi on Associative Algebras and Integrable Systems. In: S. Silvestrov, A. Malyarenko and M. Rančić (eds), Algebraic Structures and Applications, Springer Proceedings in Mathematics & Statistics 317, Springer, 2020, pp. 385-410. [arXiv:1801.00589]

[102] A. Dimakis and F. Müller-Hoissen, Tropical limit of matrix solitons and entwining Yang-Baxter maps, Lett. Math. Phys. 110 (2020) 3015-3051. [arXiv:2001.09688 [nlin.SI]]

[103] A. Dimakis and Igor Korepanov, Grassmannian-parameterized solutions to direct-sum polygon and simplex equations, J. Math. Phys. 62 (2021) 051701. [arXiv:2009.02352]