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Abstract of my life

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- A new direction in **supersymmetric models** of elementary particles, based on the inclusion of semigroups is proposed (book, thesis). The concept of *semisupermanifold* having noninvertible transition functions (satisfying higher von Neumann regularity) is introduced, and its deviation from being an ordinary manifold is given by a newly defined variable, *obstructedness*. Based on this idea, the novel notions of *category regularization, regular topos, regular functor, higher regular braiding, regular Yang-Baxter equation and regular module, regular algebra and coalgebra, regular graded algebras* are presented, and their role in topological quantum field theory is outlined. Even- and odd-reduced supermatrices are introduced and considered on a par, being complementary in terms of the newely obtained *Berezinian addition formula*, and are unified into a kind of *"sandwich" semigroup*. A special subset of odd-reduced supermatrices represent *higher order rectangular bands* for which new generalized *"fine" Green's relations and egg-box diagrams* are constructed. *One-parameter semigroups of idempotent odd-reduced supermatrices* and corresponding superoperator semigroups are introduced and studied by the new *semigroup × semigroup method*. The linear idempotent superoperators and exponential superoperators are mutually dual in some sense, and the first gives rise to an additional noninvertible *non-exponential solutions to the initial Cauchy problem*. A novel *permanent-determinant symmetry* is found for even complex superplane. It is shown that the corresponding counterparts (*per analogs*) of the cross ratio, distance and harmonic set are invariant under the introduced *per mapping*, a special noninvertible subset of the fractional linear transformation. The per analogs of the *Laguerre formula for distance and Schwarzian derivative* are presented. An *additional superextension of complex structure* is uncovered, which is noninvertible and can correspond to another (odd) superanalog of Riemann surfaces and to the counterpart of *superconformal-like transformations which twist the parity of tangent space* and their *nonlinear realization*, which together with the ordinary ones form the *superconformal semigroup* having special unusual properties. A unique formula connecting *berezinian, permanent and determinant* is obtained. From a physical viewpoint, the above conceptions can lead to *semistatistics*, being *von Neumann regular analog* of the ordinary statistics.
- **Quantum groups**: a generalization of the Hopf algebra is introduced by relaxing the requirement for inverses of the generators of the Cartan subal-

gebra, which leads to a *regular quasi-R-matrix* structure. The classification of 6-vertex *constant solutions to Yang-Baxter equation over Grassmann algebra* is presented, including noninvertible ones which correspond to *von Neumann regular R-matrix*. The *actions of universal enveloping quantum algebras* on quantum planes (also of *arbitrary dimension*) are found. A novel *double-graded quantum superplane* and corresponding *double-graded Hopf algebra* are presented.

- **Singular theories** with degenerate Lagrangians are formulated *without involving constraints* using Clairaut equation theory and the corresponding generalized *Clairaut duality*. A new *antisymmetric bracket* (an analogue of the Poisson bracket) describing the time evolution of singular systems is built. A novel *partial Hamiltonian formalism* is constructed. It is shown that a *singular theory can be interpreted as the multi-time dynamics*.
- **Nonlinear gauge theories**: a generalized approach to nonlinear classical electrodynamics and supersymmetric electrodynamics is suggested, which takes into account all possible types of media and nonlocal effects, and is described in both Lagrangian and *non-Lagrangian* theories. First steps in the formulation of a general *nonlinear conformal-invariant electrodynamics* based on *nonlinear constitutive equations and conformal compactification* were made.
- **Gravity**: constitutive equations for *nonlinear gravito-electromagnetism* and an exact form of the Maxwell gravitational field equations are obtained. A general approach to describing the *interaction of multi-gravity models* in space-times of arbitrary dimension is formulated. The gauge gravity vacuum is investigated in the *constraintless Clairaut-type formalism* (as in QCD). A special *fermionic lineal gravity* model which differs from standard supersymmetry is presented.
- **Quantum computing** (book IOP, FrontMatter): a *novel conception of quantum computing* which incorporates an additional kind of uncertainty, vagueness/fuzziness, by introducing a new *"obscure" class of qudits/qubits*, is announced. A superqubit theory in super-Hilbert space is reconsidered, and a new kind of *superqubit carrying odd parity* is introduced. A new kind of quantum gates, namely *higher braiding gates*, is suggested, which lead to a special type of multiqubit entanglement that can speed up key distribution and accelerate various algorithms. A novel *visualization of quantum walks* in terms of newly defined objects, *polyanders*, is also proposed.
- **Polyadic structures** (book IOP, FrontMatter): *polyadization*, i.e. exchanging binary operations with higher arity ones, is proposed as a general new approach to the algebraic structures used in physics. A new form of the Hosszu-Gluskin theorem (giving the general shape of *n*-ary multiplication by the chain formula) in terms of polyadic powers is given, and its *"q-deformed" generalization* is found using the newly introduced *quasi-endomorphism*. A

polyadic analog of homomorphism, or *heteromorphism*, a mapping between algebraic structures of different arities, is introduced, which leads to the definition of a new kind of *n*-ary group representation, *multiplace representations, as well as multiactions* and a *polyadic direct product*. The *arity invariance principle*, a manifest expression of algebraic structure in terms of operations independent of their arity shape, is claimed. The relations of the von Neumann regular semigroups and the Artin braid group were found, and a higher arity generalization gave the *polyadic-binary correspondence*, which allowed the definition of the following new structures: *higher braid groups*, *higher degree analogs of Coxeter group and Artin braid group*. The following were also uncovered: unusual *polyadic rings and fields (which can, remarkably, be zeroless and nonunital)* having addition and multiplication of different arities, *polyadic integer numbers* and *p-adic integers*, *polyadic convolution products* having multiplication and comultiplication of different arities and their corresponding *polyadic Hopf algebra* and *n-ary R-matrix*, *polyadic multistar adjoints* and *polyadic operator C*-algebras and Cuntz algebras*. The *polyadic analogs of the Lander–Parkin–Selfridge conjecture and Fermat's Last Theorem* were formulated.

It is proposed that mediality as a principle is more natural, unique and universal than commutativity in generalizing the latter to *n*-ary algebras (in the binary case commutativity directly follows from mediality). This is called the *commutativity-to-mediality ansatz*, which is applied to obtain *almost medial n-ary graded algebras*, a new kind of tensor categories, *polyadic nonunital "groupal" categories* with *"quertors"* (analogs of querelements in *n*-ary groups), *"medialed" tensor categories and querfunctors*. A principally new mechanism of additional *"continuous noncommutativity"*, governed by a special *"membership deformation" of commutativity* for algebras with the underlying set as obscure/fuzzy set, is introduced. Using the membership deformation factor together with the ordinary graded commutation factor, the almost commutative graded (*n*-ary) algebras and Lie algebras with *double commutativity* are obtained, and their projective representations are studied. As a first step towards a the *polyadic algebraic K-theory*, the *Grothendieck construction* of the completion group for a monoid is generalized to the case, where both are of different, higher arities. As opposed to the binary case, an identity is not necessary for the initial *m*-ary semigroup to obtain a class *n*-ary group, which in turn need not contain an identity. A new (infinite) class of division algebras, the *hyperpolyadic algebras*, which correspond to the (only 4) binary division algebras R, C, H, O (reals, complex numbers, quaternions, octonions) are defined. A *polyadic analog of the Cayley-Dickson construction* is proposed, and a new iterative process gives *"half-quaternions"* and *"half-octonions"*. A novel *polyadic product of vectors* in any vector space is defined, which is

consistent with the *polyadization* procedure using *vectorization*. Endowed with newly introduced product, the vector space becomes a polyadic algebra which is a division algebra. *New polyadic algebras with higher brackets* which have (as opposed to *n*-ary Lie algebras) different arity from the initial *n*-ary algebra multiplication, are introduced. The *sigma matrices and the Pauli group* are generalized to *higher arities*. Using them, a toy model of one-dimensional supersymmetric quantum mechanics was constructed, as a first example of *polyadic supersymmetry*, which is specially extended in a way different from the *new multigraded SQM* previously proposed.

The fundamental notion of number theory, the *positional numeral system*, is generalized from binary integer number ring $Z=Z_{2,2}$ to nonderived polyadic rings $Z_{m,n}$ whose addition takes m arguments and multiplication takes n. Our key contributions include: 1) Demonstrating that every commutative polyadic ring supports a place-value expansion that respects fixed operation patterns. 2) Establishing a lower bound on digit counts based on the arity of addition. 3) Identifying a representability gap where only a subset of elements have finite expansions, determined by structural invariants. These findings enable novel approaches to arithmetic, data encoding, and hardware design that extend beyond conventional binary logic.

In this paper we introduce and systematically develop the theory of polyadic group rings, a higher arity generalization of classical group rings R[G]. We construct the fundamental operations of these structures, defining the m-ary addition and n-ary multiplication for a polyadic group ring $R_{\mathbf{m,n}}=R_{m,n}G_{ng}$ built from an m,n-ring and an n_g-ary group. A central result is the derivation of the «quantization» conditions that interrelate these arities, governed by the *arity freedom principle*, which also extends to operations with higher polyadic powers. We establish key algebraic properties, including conditions for total associativity and the existence of a zero element and identity. The concepts of the *polyadic augmentation* map and augmentation ideal are generalized, providing a bridge to the classical theory. The framework is illustrated with explicit examples, solidifying the theoretical constructions. This work establishes a new foundation in ring theory with potential applications in cryptography and coding theory, as evidenced by recent schemes utilizing polyadic structures.

This article develops a comprehensive theory of *multiary graded polyadic algebras*, extending the classical concept of group-graded algebras to higher-arity structures. The notion of grading by multiary group is introduced, and various compatibility conditions between the arity of algebra operations and grading group operations are investigated. Key results include *quantization rules connecting arities*, *classification of graded homomorphisms*, and concrete examples including *ternary superalgebras* and polyno-

mial algebras over n-ary matrices. The theory reveals fundamentally new phenomena not present in the binary case, such as the existence of higher power gradings and nontrivial constraints on arity compatibility.

- **Cryptography**: We present a novel encryption and decryption method that combines polyadic algebraic structures with signal processing techniques. The approach begins by encoding information into signals with integer amplitudes which are then transformed into structured integer sequences using polyadic operations. Decryption involves applying tailored rules and solving dedicated systems of equations to accurately reconstruct the original message. The foundation of our approach is the construction of polyadic integers - congruence classes of ordinary integers endowed with such m-ary and n-ary operations. A key innovation is the parameter-to-arity mapping $\Phi(a,b)=(m,n)$, which links the parameters (a,b) defining a congruence class to the specific arities required for algebraic closure. This mapping is mathematically intricate: it is non-injective, non-surjective, and often multivalued, meaning a single (a,b) can correspond to multiple arity pairs (m,n), and vice versa. This complex, non-unique relationship forms the core of the proposed cryptosystem's security. We then present two concrete encryption procedures that leverage this structure by encoding plaintext within the parameters of polyadic rings and transmitting information via polyadically quantized analog signals. In one method, plaintext is linked to the additive arity m_i and secured using the summation of such signals; in the other, it is linked to a ring parameter a_i and secured using their multiplication. In both cases, the «quantized» nature of polyadic operations - where only specific numbers of elements can be combined---generates systems of equations that are straightforward for a legitimate recipient with the correct key (knowledge of the specific polyadic powers and functional dependencies used during encoding) but exceptionally difficult for an attacker without it. The resulting framework promises a substantial increase in cryptographic security. The complexity of the Φ-mapping, combined with the flexibility in choosing polyadic powers and representative functions, creates a vast and intricate key space. This makes brute-force attacks computationally infeasible and complicates algebraic cryptanalysis, as the underlying nonderived polyadic structures defy the linear properties and homomorphisms exploitable in conventional binary algebraic systems. This work establishes the theoretical foundation for this new class of encryption schemes, demonstrates their feasibility through detailed examples, and highlights their potential for constructing robust, next-generation cryptographic protocols.
- **DNA theory**: a new characteristic of nucleotides, the *determinative degree*, which is proportional to the dipole moment and the weight of hydra-

tion site, is unveiled. The physical characteristics of nucleotides such as *dipole moment, heat of formation and energy of the most stable formation* are newly computed by advanced methods. The concept of a *triander* is set up, which leads to a new method of visual sequence analysis and identification using *DNA walk diagrams*.

Scientific publications

All subjects: **207** items
PDF (1985-2026) mathematical physics, quantum computing, cryptography and DNA structure (176 items)
PDF (1980-1985) radiophysics and nuclear physics, particle physics and quantum chromodynamics (31 items)
HTML (1985-2008) with links to articles (105 items)
sIn total: **207** publications, among them **9** books and 198 articles.
In addition: 130 entries (table in PDF) in Concise Encyclopedia of Supersymmetry.

Listed in Universität Münster Highly Cited Researchers, (PDF, the final entry on the page).
Ukrainian National H-index Ranking
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