MATHEMATISCHES FORSCHUNGSINSTITUT OBERWOLFACH

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Jordan-Algebren

14.8. bis 20.8.1988

An der Tagung über Jordan-Algebren, die unter der Leitung von K. McCrimmon (Charlottesville), K. Meyberg (München), H. P. Petersson (Hagen) und W. Kaup (Tübingen) stand, nahmen 54 Mathematikerinnen und Mathematiker aus der Bundesrepublik Deutschland, Großbritannien, Frankreich, Israel, Kanada, Spanien, der UDSSR und den USA teil. Die $^1/_2$- und 1-stündigen Vorträge wurden den 4 Gebieten

- Algebraische Jordan-Theorie
- Anwendung der Jordan-Algebren in der Analysis
- Lie-Algebren
- Verwandte Strukturen

zugeordnet.

Im breiten Spektrum der Themen zur algebraischen Theorie sind als Schwerpunkte die Vorträge über freie Jordan-Algebren, zur Klassifikation der JT-Systeme mittels Generatoren und Relationen und die Klassifikation der Jordan-Superalgebren anzusehen.

Die zahlreichen Vorträge zu den Anwendungen der Jordan-Theorie in der Analysis spiegeln die lebhafte Entwicklung dieses Gebietes in den letzten Jahren wider. In den Vorträgen wurde über zahlreiche neue Ergebnisse aus dem Bereich der Operator-Theorie (JB^*-Algebren, W^*-Algebren, Faktorisierung von Operatoren, Wiener-Hopf-Operatoren, die Quantisierung symmetrischer Räume, u.a.) berichtet.

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Zur Theorie der Lie - Algebren wurde über verschiedene Lie - Algebra - Konstruktionen, zur Cohomologie, über das Hasse - Prinzip für E_8 und insbesondere über die spektakulären Ergebnisse des vergangenen Jahres zur Klassifikation der einfachen modularen Lie - Algebren vorgetragen.

Zum Themenkreis "Verwandte Strukturen" wurden Vorträge gehalten zu Geometrien, die durch Kac - Moody - Algebren definiert werden, zu assoziativen, alternativen und strukturierbaren Algebren, zu nichtassoziativen Konstruktionen, sowie über Algebren, die viele Erzeugende benötigen.

Vortragsauszüge:

Allison, B.:
Quartic Cayley Algebras and Isotropic Lie Algebras of Type D_4

Let k be a field of characteristic ≠ 2 or 3. The split quartic Cayley algebra is an 8-dimensional algebra with involution that is an analog of the classical split Cayley algebra. A form of the split quartic Cayley algebra is called a quartic Cayley algebra (QCA). We show that any QCA is diagonally isotopic to an algebra CD(B,μ) obtained via the Cayley-Dickson process from a 4-dimensional separable associative commutative algebra B and a nonzero scalar μ. This result allows us, when k has characteristic 0, to use Kantor's Lie algebra construction to rationally construct all isotropic Lie algebras of type D_4 from algebras CD(B,μ) or from quadratic forms. We investigate the class of Lie algebras obtained from algebras CD(B,μ). In particular, we show that this class includes exceptional non-Jordan D_4's.

Arazy, J.:
Isometries of non-selfadjoint operator algebras

Let A be a unital subalgebra of a JB^*-algebra E. Let D be the open unit ball of A and let aut(D) be the set of all complete holomorphic vector fields on D. We show that $\mathrm{aut}(D)(0) = A \cap A^*$ and use this to show that the partial Jordan triple product of A (constructed via the holomorphy) is simply the restriction of the triple product of E.
Since (surjective) isometries preserve the partial Jordan triple product we get that a unital isometry of A is selfadjoint and multiplicative.
For $a \in D \cap A^*$ let φ_a be the Potapov-Möbius transformation. We show that φ_a preserve not just $D \cap A^*$ but also D itself. This implies that a biholomorphic automorphism of D is of the form $\psi\varphi_a$ where ψ is a linear isometry of A and $a = \psi^{-1}(a)$. We use these results to study isometries and hermitian operators on nest algebras.

Ayupov, Sh. A.:
Jordan operator algebras

Weakly closed Jordan algebras of bounded self-adjoint operators on Hilbert spaces are considered (so called JW-algebras). The connection between modularity properties of projection lattices in JW-algebra and its enveloping von Neumann algebra is studied. A new proof is given for the existence of a normal finite trace on modular JW-algebra. We show how the method of enveloping von Neumann algebra enables to obtain the Jordanized versions for several results from the theory of von Neumann algebras.

Barton, Th. J.:
Derivations of JB^*-triples

It is shown that an everywhere-defined derivation of a JB^* -triple is automatically continuous, and that a bounded derivation on a JB^* -triple can be approximated by inner derivations in the strong operator topology. A new topology for JBW^* -triples, the strong * topology, is introduced to enable a proof of the second statement above.
Regarding unbounded derivations, a means of finding scalar functions f which preserve the domains of generators δ of strongly continuous one parameter groups of surjective isometries is suggested by the formal identity $\delta\big(f(x)\big) = f'(x)\cdot\delta(x)$. Mention is made of recent progress in the study of scalar functions whose extensions to JB^* -triples via spectral calculus are differentiable, and which as a consequence preserve the domains of such generators.

Benkart, G.:
The Recognition Theorem for Simple Lie Algebras of Prime Characteristic

As part of a program for classifying simple Lie algebras over an algebraically closed field of prime characteristic, V. Kac proved the theorem, commonly referred to as "Kac's Recognition Theorem for Graded Lie Algebras". Block and Wilson make essential use of this theorem in their recent classification of the restricted simple Lie algebras. It is expected that their approach can be generalized to the nonrestricted setting. One useful ingredient in such a generalization is a Recognition Theorem without the hypothesis that G_{-1} is a restricted G_0 -module under the adjoint action. In joint work with T. Gregory we show that Kac's Theorem remains valid without this hypothesis.
If L is a finite-dimensional simple Lie algebra over an algebraically closed field of characteristic $p > 5$, and if L_0 is a maximal subalgebra, then a filtration $L = L_{-g} \supset \ldots \supset L_0 \supset \ldots \supset L_r \supset L_{r+1} = (0)$ can be defined so that in the associated graded algebra $G = \oplus_j G_j$ where $G_j = L_j / L_{j+1}$, G_{-1} is an irreducible G_0 -module and $[x, G_{-1}] = 0$ for $x \in G_j$ implies $x = 0$. As a consequence of our result we obtain:
<u>Theorem.</u> If L, L_0 are as above, and if in the associated graded algebra $G = \oplus_j G_j$, G_0 is classical reductive and $[x, G_1] = 0$ for $x \in G_{-j} \Rightarrow x = 0$, then L is classical or of Cartan type.

Bokut, L:
Some new results in ring theory

Recently A. R. Kemer gave the positive solution of Specht's problem: Every associative algebra over a field of characteristic zero has only a finite number of independent identities.

D'Amour, A.:
Hermitian Jordan triple systems

An ideal $G \lhd ST(X)$ of the free special Jordan triple system $ST(X)$ on an infinite set of indeterminates X is <u>hermitian</u> if it is closed under the symmetric product $\{\chi_1 \ldots \chi_n\} = \chi_1 \cdots \chi_n + \chi_n \cdots \chi_1$.
We extend Prof. Zel'manov's result on the structure of prime nondegenerate i-special Jordan triple systems T with $G(T) \neq 0$ (for some hermitian G), $\chi \neq 2,3$, to <u>all</u> <u>characteristics</u>; we show
<u>Theorem:</u> If T is a prime hereditarily-semiprime i-special JTS with $G(T) \neq 0$ (for some hermitian ideal $G \lhd ST(X)$), then $0 \neq G(T) \simeq H_0\ (R,*) \lhd T \subseteq H\big(Q(R),*\big)$ for some $*$-prime associative triple system (of the first kind) R with Martindale system of symmetric quotients $Q(R)$.

Dillon, M.:
Inner ideal geometries in representations of Kac-Moody algebras

An inner ideal is a subspace B of a triple system J such that $BJB \subset B$. If $\mathfrak{G}$ is an affine Lie algebra and M is an irreducible highest weight module over $\mathfrak{G}$ then we have a natural way of viewing M as a triple system. We also associate to M a group of automorphisms G. Then G permutes inner ideals and the orbits of inner ideals under the action of G are determined by the Dynkin diagram for G and some information about the highest weight of M. Each equivalence class then represents a type of object (e.g. point or line) in a geometry in which the inner ideals are the objects and G is a group of collineations.

Dzhumadil'daev, A. S.:
Extensions and deformations of modular Lie algebras

<u>Theorem 1.</u> For any Lie algebra L over the field of characteristic $p > 0$ and for any L-module M

i) there exist nonsplit left and right extension of M
ii) every right extension $0 \to S \to N \to M \to 0$ can be included in a split extension $0 \to \overline{S} \to \overline{N} \to M \to 0$ such that diagram

$$\begin{tikzcd} 0 \arrow[r] & S \arrow[r] \arrow[d] & N \arrow[r] \arrow[d] & M \arrow[r] \arrow[dl] & 0 \\ 0 \arrow[r] & \overline{S} \arrow[r] & \overline{N} & & \end{tikzcd}$$

will be commutative.

Theorem 2. Any Lie algebra L of dimension $n > 1$ ($p>0$)

i) has nonsplit abelian extension

ii) every solvable extension $0 \to R \to Q \to L \to 0$ can be included in split solvable extension $0 \to \bar{R} \to \bar{Q} \to L \to 0$ such that diagram

$$\begin{tikzcd} 0 \arrow[r] & R \arrow[r] \arrow[d] & Q \arrow[r] \arrow[d] & L \arrow[r] & 0 \\ 0 \arrow[r] & \bar{R} \arrow[r] & \bar{Q} \arrow[ur] & & \end{tikzcd}$$

will be commutative.

For the filtered Lie algebra $\mathfrak{L} = \mathfrak{L}_{-q} \supset \mathfrak{L}_{-q+1} \supset \ldots \supset \mathfrak{L}_r \supset 0$, we say that $\mathfrak{L}$ is a filtered deformation of $L = \bigoplus_{i=-q}^{r} L_i$, if $\mathrm{gr}\mathfrak{L} \cong \bigoplus_{i=-1}^{r} \mathfrak{L}_i/\mathfrak{L}_{i+1}$ is isomorphic to L. We say that L is rigid, if every $\{L_i\}$-deformation of L is trivial: $\mathrm{gr}\,\mathfrak{L} \cong L \Rightarrow \mathfrak{L} \cong L$.

Theorem 3. Over a perfect field Lie algebras of Cartan type $W_n(m)$, $K_{n+1}(m)$ ($p > 2$) are rigid.

Edwards, C. M.:
Jordan triple properties of W^*-algebras

Theorem 1. Let A be a W^*-algebra. Then the set of partial isometries with largest element $\{\omega\}$ adjoined in A forms a complete lattice $U(A)^{\sim}$ and there exists an order isomorphism

$$u \mapsto u + (1-uu^*)\, A_1(1-u^*u), \quad \omega \mapsto \emptyset$$

from $U(A)^{\sim}$ onto the complete lattice of weak $*$ closed faces of the unit ball A_1 in A.

Theorem 2. Let A be a W^*-algebra, and let P(A) be the complete orthomodular lattice of projections in A. Then the set CP(A) of pairs (e,f) of elements of P(A) such that the central support of e coincides with that of f forms a complete lattice and there exists an order isomorphism $(e,f) \to eAf$ from CP(A) onto the complete lattice of weak $*$ closed inner ideals in A.

Farnsteiner, R.:
Cohomology Groups of Lie Algebras

In this talk we provide several Lie theoretic analogues of Shapiro's Lemma. Let L be a finite dimensional Lie algebra over a field of positive characteristic $p > 0$. Suppose that $L_0 \subset L$ is a subalgebra. Given an L_0-module V, we define certain induced modules $U(L) \otimes_{O(L,L_0)} V$ relative to a subalgebra $O(L,L_0) \simeq F[x_1, \ldots x_n] \otimes_F U(L_0)$, $n := \dim_F L/L_0$, which for L, L_0 and V restricted coincide with the restricted generalized Verma modules. Let $\sigma : L_0 \to F$ be given by $\sigma(x) = \mathrm{tr}\left(\mathrm{ad}_{L/L_0}(x)\right)$ and define a module V_σ via $x \cdot v = xv + \sigma(x)v$ $\forall x \in L_0$ $\forall v \in V$.

Theorem 1: $H^n(L, U(L) \otimes_{O(L,L_0)} V) \cong \bigoplus_{p+q=n} \Lambda^p(L/L_0) \otimes_F H^q(L_0, V_{-r}) \ \forall n \geq 0.$

Theorem 2: If L, L_0, and V are restricted, then
$H_*^n(L, K(L) \otimes_{U(L_0)} V) \cong H_*^n(L_0, V_{-\sigma}) \ \forall n \geq 0.$

Corollary 3: Let L be a finite dimensional modular Lie algebra of dimension n. Then there exists an L-module M such that $H^k(L,M) \neq (0) \quad 0 \leq k \leq n$.

Faulkner, J. R.:
Some nonassociative constructions

Theorem 1: (Allison & Faulkner 1984) If J is a finite dimensional separable degree 4 Jordan algebra of char. $\neq 2$ with generic minimum polynomial $\lambda^4 - t(x)\lambda^3 + s(x)\lambda^2 - r(x)\lambda + n(x)$, $J_0 = \{x: t(x) = 0\}$, $t(x,y) = t(x \cdot y)$, then J_0, r, t satisfy $x^{\#\#} = r(x)x$, where $\partial_y r|_x = t(x^{\#}, y)$, $x, y \in J_0$. Thus (J_0, J_0) is a Jordan pair. If $J = H(A_4, \Gamma)$, $\Gamma = \mathrm{diag}(\gamma_1, \gamma_2, \gamma_3, \gamma_4)$, $\mu = \det\Gamma$, $B = CD(A, \mu)$, A associative composition algebra, $J' = H(B_3, \Gamma')$, $\Gamma' = \mathrm{diag}(\gamma_1, \gamma_2, \gamma_3)$, then $(J_0, J_0) \cong (J', J')$.

Theorem 2: If A is a finite dimensional separable degree 3 associative algebra of char. $\neq 3$, $\omega^2 + \omega + 1 = 0$ in F, with generic minimum polynomial $\lambda^3 - T(x)\lambda^2 + S(x)\lambda - N(x)1$, $A_0 = \{x: T(x) = 0\}$, $x_0 = x - \frac{1}{3} T(x)1$, then $S(a*b) = S(a)S(b)$, where $a*b = (\omega ab - \omega^2 ba)_0$. If $A = F_3$, $(F_3)_0$ is the split octonious relative to $a \square b = (u*a)*(b*u)$, where $u = \mathrm{diag}(2\varrho, -\varrho, \varrho)$, $\varrho = (\omega - \omega^2)^{-1}$.

Fernandez Lopez, A.:
Associative triple systems with nonzero socle

The socle of an associative triple system (defined to be the sum of all minimal inner ideals, equals the sum of all minimal right ideals) is a direct sum of simple ideals (result proved by McCrimmon for Jordan triple systems).
Here we present the structure of semiprime a.t.s. with essential socle (in particular, prime a.t.s. with nonzero socle). Some special types of a.t.s. with nonzero socle are also studied: strongly prime a.t.s. satisfying a generalized (or not) polynomial identity, compact B^*-triples and strongly regular Banach triples.

Ferrar, J. C.:
Hasse principle for E_8

In 1966, Harder proved a Hasse principle for all simply connected, semisimple groups with no E_8 factor. At that time he also reduced the proof for E_8 to one fairly technical Lemma. Recently Cernousov has announced a proof of a version of that Lemma, and thus of the Hasse principle for E_8.

In this talk I will first apply the Hasse principle to prove:

Classification Theorem: If L is an algebra of type E_8 over an algebraic number field k, then $L \cong T(C,J)$ (= Der C $\otimes$ $C_0 \otimes J_0 \otimes$ Der J), the Tits algebra constructed from a Cayley algebra C and an exceptional simple Jordan algebra J.

Secondly, I will sketch the proof of Cernousov's:

Theorem: If L is of type E_8 and split by a cyclic quintic extension K of k, then there is a finite extension F of k and a tower of quadratic extensions $F = F_n \supseteq \ldots \supseteq F_1 = k$ such that $L \otimes F$ has a proper, non-toral subalgebra.

Finston, D.:
Automorphism groups and group schemes of finite dimensional algebras

The dimension of the algebraic group of automorphisms of an n-dimensional algebra A of arbitrary arity over an algebraically closed field is bounded by $nr + n - r$, where r is the dimension of a null subalgebra of maximal vector space dimension. Furthermore, if the automorphism group is infinite, then A posseses nontrivial null subalgebras which are generalized inner ideals.
An algebra A is called rigid if its isomorphy class is Zariski-open in the variety of structure constants associated to the class of algebras to which A belongs. Finite dimensional semisimple complex Jordan algebras are rigid, and this result yields a new proof of the existence of formally real forms of such algebras.
A derivation which does not lie in the Lie algebras of the automorphism group is called obstructed. Some observations and questions pertaining to obstructed derivations are discussed, particularly with respect to Lie algebras in prime characteristic.

Gonzalez, S. and Martinez, C.:
Periodic Jordan rings

The usual order relation in boolean rings ($e \leq f$ if $ef = e$) is extended to reduced associative rings by Abian and Chacron, defining $x \leq f$ if $xy = x^2$. With this definition they can prove that the ring A is isomorphic to a direct product of fields if and only if A is hyperatomic and orthogonally complete. The same results are obtained by H. C. Myung and Jimenez for reduced alternative rings.
For Jordan rings we define $x \leq y$ if $xy = x^2$ and $xy^2 = x^3 = x^2y$. In a first paper we can prove that the above is an order relation for Jordan rings and the same structure theorem is true. In a second paper we solve the problem for quadratic Jordan unital algebras.
Since it is known that a periodic associative (Jordan) ring with only one idempotent is a periodic field we have tried to obtain some relations between the structure of a periodic ring and the set of its idempotent elements E(A).

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Hentzel, I. R.:
Identity processing by computers in non-associative algebras

The study of non-associative algebras through their identities is equivalent to the study of row spaces of matrices. By generating the appropriate large sparse matrix in a computer and reducing it to row-canonical form, we can easily see if two identities are equivalent, or if one implies the other. We can visualize how strong a particular identity is. For a proposed identity, we can see how close it is to being true.
We are currently studying commutative rings and asking under what conditions the additive span of all (x^2, y, x) is an ideal.
We mention effective ways of handling the large matrices, of processing them, and of displaying the results.

Hopkins, N. C.:
Noncommutative Jordan algebras and Lie Module Triple Systems

Suppose S is an anticommutative algebra over an infinite field k, char k $\neq$ 2, having a nondegenerate symmetric associative bilinear form B, suppose dim S > 1, and fix $s, t \in k$ such that $st \neq 0$.

Lemma: $\dim V \leq 1$ for $V = \{\alpha \in S \mid st\alpha(\nu\delta) = B(\alpha,\nu)\delta - B(\alpha,\delta)\nu$ and $st(\alpha\nu)\delta = B(\nu,\delta)\alpha - B(\alpha,\delta)\nu\}$. Moreover if S is the standard embedding of the Lie Module Triple System (LMTS) $(M, \{.,.,.\}, L, b, \varphi)$ for φ symmetric, then $\dim V = 0$ if $\dim M > 1$ and $\dim L > 1$.

If $\dim V = 1$, we define $E_\alpha \in \operatorname{Der} J$, $J = J(S, B, s, t)$ a noncommutative Jordan algebra defined from S by a process due to A. A. Sagle.

Theorem: (i) $G := \{(D_1, D_2) \in \operatorname{End} S \oplus \operatorname{End} S \mid \text{For } i \neq j \ \ B(\nu D_j, \delta) = -B(\nu, \delta D_i)$ and $(\nu\delta) D_i = (\nu D_j)\delta + \nu(\delta D_j)\} \subseteq \operatorname{Der} J$.
(ii) If $\alpha \in V$, $\alpha D_i = 0$ for all $(D_1, D_2) \in G$ and E_α is a central element of $G \oplus k E_\alpha$.

A description of $G_0 := \{(D_1, D_2) \in G \mid \sigma D_i \sigma = D_i,\ i = 1, 2\}$ for S the standard embedding of a LMTS is also given.

Horn, G.:
Classification of Banach Jordan triple systems with a predual

Banach Jordan triple systems with a predual (JBW*- triples) are uniquely decomposed into a discrete part which is generated by abelian tripotents and a continuous part containing no abelian tripotents. The indecomposable discrete JBW*- triples are precisely the Cartan factors. A discrete JBW*- triple is isometrically isomorphic to an ℓ^{∞}-sum of tensor products of abelian von Neumann algebras with Cartan factors. A continuous JBW*-triple is the direct sum of a weak-$*$-closed left ideal of a continuous von Neumann algebra and the fixed space of complex-linear involution on a continuous von Neumann algebra.

Iochum, B.:
Factorisation of operators on Jordan triples

The Banach space structure of a JB*-triple A has many properties of a C*-algebra even if it remains no order. In particular it is possible to characterize the weakly compact operators on A. As a consequence the following are equivalent on a quotient X of A: X has type 2, X is reflexive, $X \not\supset C_0$. Similarly $X \not\supset \ell_1$ is equivalent to X* has the Radon-Nikodym property. More globally it is possible to give a generalization of Grothendieck's theorem (Barton-Friedman) by a characterization of operators from A to a finite cotype Banach space: they factorize through an interpolation space associated to a functional φ on A, extending the work of Pisier.

Jacobson, N.:
Jordan algebras of real symmetric matrices

This paper gives a determination of the orbits of Jordan algebras of real symmetric matrices.

Kantor, I. L.: (presented by E. I. Zel'manov)
On terminal trilinear operations

For a ℓ-linear algebra $A(\ell = 2,3)$ consider its L-functor $L(A) = \sum_{i=-\infty}^{\infty} L(A)_i$; A is called terminal if $L(A)_i = (0)$ for $i \geq \ell$. Necessary and sufficient conditions are given for A to be terminal. An element $e \in A$ is a left quasi-unit if $[L_e, A] = -A, \Longleftrightarrow e(xy) - (ex)y - x(ey) = -xy$.

Theorem. Any simple finite-dimensional terminal algebra with left quasi-unit over algebraically closed field is either Jordan or W_n, or S_n, or H_n.

This theorem is also generalized to terminal trilinear operations (where some new types arise).

Martindale, W. S.:
Jordan homomorphisms onto nondegenerate special Jordan algebras

Let Φ be a field of char. $\neq 2$ and let J_0 and J be special Jordan algebras over Φ with J nondegenerate. Let R_0 be a $*$-envelope of J_0 and let R be a $*$-tight envelope of J. Let C_J and C be the respective extended centroids of J and R (Lemma: $C_J \subseteq C$), and let $K = JC_J$ and $A = RC$ be the respective central closures of J and R. Then one may write $K = K_1 \oplus K_2$, where the Zelmanov ideal of K is essential in K_1 and where K_2 satisfies $[x,y]^2$ central.

Theorem: If $\varphi : J_0 \to J$ is an onto Jordan homomorphism then $\varphi = \varphi_1 \oplus \varphi_2$, where $\varphi_i : J_0 \to K_i$ are Jordan homomorphisms such that φ_i can be lifted to an associative homomorphism $\sigma_1 : R_0 \to A$.

In general φ_2 cannot be lifted, but some positive results about φ_2 can be obtained. Our paper depends heavily on the fundamental work of Zelmanov and partially generalizes results obtained by McCrimmon in the case when J is prime.

McCrimmon, K.:
A Jordan triple miscellany

We reported on some miscellaneous results centered around Zelmanov's classification of Jordan triple systems.
(1) In joint work with Martindale we developed Amitsur's trick of sequential embedding to imbed nondegenerate systems in semiprimitive ones.
(2) We proved that the elements of strictly bounded index modulo an absorber in a Jordan system form an ideal, and as corollary derived Zelmanov's result on the nilness of the ideal generated by a quadratic absorber.
(3) We proved that semiprime ideals in prime systems are prime, using techniques involving semi-ideals, inner annihilators, and eventual annihilators.
(4) We developed a symmetric formulation of Martindale's ring of symmetric quotients for an associative algebra, showed that ideals and Jordan ideals retain a memory of the original algebra, and developed a Martindale quotient triple system.
(5) In joint work with A. D'Amour we proved G_8 and G_9 are equivalent, and
(6) We reported on work of John Magnus that there are no "eaters" in Lie algebras resembling the tetrad eaters of Jordan theory.

Medvedev, Y. A.:
Free Jordan algebras

Theorem 1. Every nil-element of a finitely generated free Jordan algebra over a field of characteristic zero generates a nilpotent ideal.

A - algebras are analogues of 27-dimensional simple exceptional Jordan algebras over an arbitrary ring of scalars.
Let $\mathbb{C}(J)$ denote the center of a algebra J.

Theorem 2. If some homomorphic image of a subring a Jordan ring J contains an A-algebra then J also contains an A-algebra A such that $\mathbb{C}(A) \subseteq \mathbb{C}(J)$.

Corollary. A free Jordan ring J[X] with more than two generators contains an A-subalgebra A such $\mathbb{C}(A) \subsetneq \mathbb{C}(J[X])$.

Muhly, P. S.:
Wiener-Hopf operators on homogeneous cones

Let P be a convex cone in $\mathbb{R}^n$ which is the closure of its interior. For $f \in L^1(\mathbb{R}^n)$, $W(f)$ denotes the operator on $L^2(P)$ (with Lebesgue-measure) defined by $W(f)\xi(t) = \int_P f(t-s)\,\xi(s)\,ds$, and $W(P)$ denotes the C^*-algebra generated by $\{W(f) \mid f \in L^1(\mathbb{R}^n)\}$. The basic problem we address is: Identify the spectrum of W(P). We outline a new approach to earlier work with Jean Renault (Trans. A.M.S. 274 (1982), 1-44) that depends on a recent paper by A. Nica (J.Op.Th. 18 (1987), 163-198), and which shows promise of describing the spectrum of W(P) when P is an arbitrary homogeneous cone. The main new result presented in the talk is the fact that W(P) is always a type I C^*-algebra.

Neher, E.:
Generators and relations

We will present generators and relations for
- Weyl groups of J-graded root systems
- semisimple Jordan pairs (finite dimensional, over algebraically closed fields)
- semisimple 3-graded Lie algebras (finite dimensional, over algebraically closed fields of characteristic 0)

They are phrased in terms of grid bases - a new type of base for 3-graded root systems.

J. M. Osborn
Simple Lie algebras of prime characteristic

We report on joint work with Georgia Benkart and Helmut Strade. Let L be a simple finite dimensional Lie algebra over a field F of characteristic p, and let T be an absolute maximal torus (see Strade's abstract for definitions). Let the subspace Q of L be defined by

(i) $Q^{(\alpha)} = L^{(\alpha)}$ if $L^{(\alpha)}/\mathrm{rad}\, L^{(\alpha)} \in \{0, \mathrm{sl}(2)\}$,

(ii) $Q^{(\alpha)} = \mathrm{rad}\, L^{(\alpha)} + W(1;1)_0$ if $L^{(\alpha)}/\mathrm{rad}\, L^{(\alpha)} = W(1;1)$, and

(iii) $Q^{(\alpha)} = \mathrm{rad}\, L^{(\alpha)} + H(2;1)_0^{(2)}\ (+F\partial')$ if $L^{(\alpha)}/\mathrm{rad}\, L^{(\alpha)} = H(2;1)^{(2)}\ (+F\partial')$.

Theorem 1. Q is a subalgebra of L. If $Q \neq L$, then Q is a maximal T-invariant subalgebra of L.

Theorem 2. The decomposition of L with respect to T satisfies one of the following:

A) All 1-sections are solvable.

B) $L(\alpha)/\mathrm{rad}(\alpha) \in \{0, sl(2)\}$ for all sections, but case A does not hold.

C1) There is a 1-section $L^{(\alpha)}$ with $L^{(\alpha)}/\mathrm{rad}\, L^{(\alpha)} \notin \{0, sl(2)\}$, but L does not have a 2-section of the types (6) or (7) from Strade's list which includes a 1-section $L^{(\alpha)}/\mathrm{rad}\, L^{(\alpha)} \notin \{0, sl(2)\}$.

C2) L contains a 2-section of types (6) or (7) containing a 1-section with $L(\alpha)/\mathrm{rad}\, L(\alpha) \notin \{0, sl(2)\}$.

Cases B and C1 have been shown to be classical or Cartan type Lie algebras, and some progress has been made on the other two cases.

Racine, M.:
Minimal identities of symmetric matrices

Let F<X> the free associative algebra over the field F,

$$Q(x_1, x_2, x_3, x_4, x_5, x_6) = \sum_{\substack{(123)\\(456)}} \{[x_1, x_2][x_3, x_4][x_5, x_6]\},$$ where (123) indicates the sum over cyclic permutations of 123;

$$T^1_k(x_1, \dots, x_k) = \sum_{\substack{\sigma \in S_k \\ \sigma^{-1}(1) \equiv 1,2 \bmod 4}} (-1)^\sigma x_{\sigma(1)} x_{\sigma(2)} \cdots x_{\sigma(k)} .$$

Theorem. T^1_{2n} is on identity for $n \times n$ symmetrix matrices. Q is an identity for 3×3 symmetric matrices.

These are of minimal degree and if the field has enough elements and under some characteristic restrictions, any minimal identity of symmetric matrices follow from T^1_{2n} $(n \neq 3)$, T^1_6 and $Q\,(n = 3)$.

Röhrl, H.:
Algebras that need many generators II

The main results are

Theorem 1: Let A be an algebra of strict complexity 1 over a field K of characteristic $\neq 2, 3$. If $\dim A \geq 4$ then

$$xy = \lambda(x)y + \mu(y)x + \varrho(x, y)b$$

where λ and μ are linear forms, ϱ is a bilinear form, and $b \in A$. If $\dim A = 3$ then, with L a finite field extension of K, $L \otimes_K A$ satisfies either the above relation or

$$xy = \lambda(x)y + + \mu(y)x + \varrho(x, y)b + [x, y]$$

where λ and μ are linear forms, ϱ is a symmetric bilinear form, $b \in A$, and $[\cdot, \cdot]$ is the product in $sl(2, L)$. λ, μ, ϱ, and b are unique up to scalar factors.

Complexity 1 means that the minimum number of generators of A is $\dim A - 1$; strict complexity 1 means that $L \otimes_K A$ has complexity 1 for any (finite) field extension L of K.

Theorem 2: Let A be an algebra over a field K of characteristic $\neq 2, 3$. Let $n = \dim A \geq 2$ and assume $n(n-2) < \dim \operatorname{Der} A < n(n-1)$. Then,

(a) $\dim \operatorname{Der} A = n(n-2)+1$ or $= n(n-2)+2$

(b) if A satisfies

either: $xy = \alpha_1 \nu(x)y + \alpha_2 \nu(y)x + \nu(x)\nu(y)\,b$
where $\alpha_1, \alpha_2 \in K$, ν is a linear form, $0 \neq b \in A$ with $\nu(b) \neq 0$

or: $\dim A = 5$ and $xy = \big(\mu(x)\,\nu(y) - \mu(y)\,\nu(x)\big)\,b$
where μ and ν are linear forms, $0 \neq b \in A$ with $0 = \mu(b) = \nu(b)$,

then $\dim \operatorname{Der} A = n(n-2)+1$.

(c) if A satisfies

either: $xy = \nu(x)\,\nu(y)\,b$
where ν is a linear form, $0 \neq b \in A$ with $\nu(b) = 0$

or: $\dim A = 4$ and $xy = \big(\mu(x)\,\nu(y) - \mu(y)\,\nu(x)\big)\,b$
where μ and ν are linear forms, $0 \neq b \in A$ with $0 = \mu(b) = \nu(b)$,

then $\dim \operatorname{Der} A = n(n-2)+2$.

(d) if $\dim A \geq 3$ and $n(n-2) < \dim \operatorname{Der} A < n(n-1)$ then over a suitable finite field extension L of K, $L \otimes_K A$ is one of the types listed in (b) or (c).

Rodriguez Palacios, A.:
Structurable H^*-algebras

We consider a complex (nonassociative) H^*-algebra A provided with a (linear) involution τ such that (A, τ) is a structurable algebra in the sense of B. N. Allison. No assumption of finite dimension is made and the assumption, in Allison's definition, of existence of a unit is avoided.
We develop a theory for structurable H^*-algebras which allows us to reduce the study of these algebras to the structurable H^*-algebras with no nonzero proper closed τ-invariant ideals and with the property that τ commutes with the H^*-algebra involution $*$. Finally we give a complete description of such algebras. (Joint work with M. Cabrera and J. Martinez.)

Schafer, R. D.:
Invariant forms on central simple structurable algebras

Let $(A, \bar{\ })$ be a finite-dimensional central simple structurable algebra over a field Φ of characteristic 0, and let g be an invariant symmetric bilinear form on $(A, \bar{\ })$ (defined by B. N. Allison in Math.Ann. 237 (1978), 133-156). Then g is a scalar multiple of any nonzero invariant form on $(A, \bar{\ })$. In particular, $g(x, y)$ is a scalar multiple of $\langle x, y\rangle = \operatorname{trace}\big(L_{x\bar{y} + y\bar{x}}\big)$.

Schwarz, Th.:
Triple systems and graded Lie algebras

A finite dimensional triple system A over a field F is called a K-ternary algebra iff A satisfies the 5-linear identity and admits a symmetric non degenerate bilinear form $\varkappa : A \times A \to F$ such that $L^T(a,b) = L(b,a)$, $R^T(a,b) = R(b,a)$ $(a, b \in A)$. Following Kac one can construct a $\mathbb{Z}$ graded Lie algebra $L(A)$ *) s.t.:

1) $L(A) = \dots L_{-n} \oplus \dots \oplus L_{-1} \oplus L_0 \oplus L_1 \oplus \dots \oplus L_n \oplus \dots$
   $L_{-1} \simeq A \simeq L_1$, to be more explicit: $A = L_{-1} = L_1$ as vector spaces $\{a,b,c\} = \left[[ab]c\right]$ for $a, c \in L_{\pm 1}$; $b \in L_{\mp 1}$; $L_0 = [L_{-1}, L_1]$ "inner derivations".
2) L_n is spanned by the n-fold Lie products of elements in L_1, L_{-n} by elements in L_{-1}.
3) There is an involution h on L, that reverses the grading, is the identity on L_0 and the "identity" map $L_1 \to L_{-1}$ and $L_{-1} \to L_1$.
4) There is a nondegenerate associative form $\eta : L \times L \to F$ s.t. $\eta(L_\nu, L_{-\mu}) = 0$ if $\nu \neq \mu$ $\eta(a,b) = \varkappa(a,b)$ for $a \in L_{\pm 1}$, $b \in L_{\mp 1}$.

If A is simple as a pair structure then we can generalize Moody's results for Kac - Moody algebras:

A) $(\exists a \in L_+ = L_0 \oplus L_1 \oplus \dots,\ a \neq 0,\ [a, L_1] = 0) \iff \dim(L) = \infty$.
B) There are no homogeneous ideals but the trivial ones in L.
C) All ideals of L are principal.

Comment to A): L is three graded (i.e. $L_n = 0$ for $|n| \geq 2$) iff A is Jordan.

*) "minimal enveloping Lie algebra of A"

Shestakov, I. P.:
Prime alternative superalgebras and the nilpotence of the radical of free alternative algebra

Let $\mathfrak{M}$ be a homogeneous variety of algebras, $A = A_0 + A_1$ be a Z_2-graded algebra, $G = G_0 + G_1$ be a Grassmann algebra with natural Z_2-grading. Then A is called an $\mathfrak{M}$-superalgebra if its Grassmann envelope $G(A) = G_0 \otimes A_0 + G_1 \otimes A_1$ belongs to $\mathfrak{M}$.

<u>Theorem 1.</u> Let $A = A_0 + A_1$ be a prime alternative superalgebra of characteristic $\neq 2, 3$. Then either A is associative or $A_1 = 0$, A_0 is a Cayley - Dickson ring.

This theorem is essentially used in proving the following

<u>Theorem 2.</u> Let $A = \mathrm{Alt}[x]$ be a free alternative algebra over a field of characteristic 0 on an arbitrary set of generators X. Then the quasiregular radical Rad A is nilpotent.

Skosyrsky, V.:
The structure of strongly prime noncommutative Jordan algebras

Let A be a strongly prime noncommutative Jordan algebra, then A belongs to one of the following four classes of prime algebras:

(1) Nondegenerate prime Jordan algebras.

(2) The center $Z(A) = Z(A^+) \neq 0$ and the central localization $Z(A)^{-1} A$ is a flexible quadratic algebra over the field $Z(A)^{-1} Z(A)$.

(3) The extended central localization is a quasiassociative prime algebra over the extended centroid $C(A)$.

(4.1) The extended central localization is the prime algebra of generalized Poisson brackets over the field $C(A)$ with characteristic zero.

(4.2) The algebra has characteristic $p > 2$ and $Z(A) \neq 0$ and central localization $Z(A)^{-1} A$ is a simple algebra of generalized Poisson brackets over the field $Z(A)^{-1} Z(A)$ with characteristic p.

Stachó, L.:
Algebraically compact elements of JBW*-triples

Let U be a JBW*-triple and τ a linear topology on U such that ω^* top $\leq \tau \leq$ norm top. An element $a \in U$ is said to be τ-compact if the quadratic map $a^* : x \mapsto \{x a^* x\}$ is $\omega^* \to \tau$ continous on the unit ball of U. A dynamical characterization of τ-compactness is given in terms of the associated unit ball automorphisms $\exp[1 - a^*]$ and a spectral decomposition analogous to that of classical compact Hilbert space operators is achieved. The factor projections of the family J_τ of τ-compact elements of U are precisely calculated and the ideal properties of J_τ are investigated.

Strade, H.:
The classification of simple modular Lie algebras

<u>Definition:</u> Suppose that G denotes a p-envelope of L.
$TR(L) := \max\{\dim T \mid T \text{ is a torus of } G/C(G)\}$ is called the <u>absolute toral rank of L.</u>

<u>Theorem:</u> Let L be a simple Lie algebra over an algebraically closed field of characteristic $p > 7$ and T a torus in some p-envelope L_p of L with maximal absolute toral rank. Then $C_{L_p}(T)^{(1)}$ acts nilpotently on L_p.

<u>Theorem:</u> Let L be a simple Lie algebra over an algebraically closed field of characteristic $p > 7$. Assume that $TR(L) \leq 2$. Then L is classical or of generalized Cartan type.

Theorem: Suppose that all one-sections $L(\alpha)$ with respect to an optimal torus are solvable. Then $L(\alpha)$ is nilpotent and $L(\alpha)^{(1)}$ acts nilpotently on L.

Theorem: Suppose that all one-sections $L(\alpha)$ with respect to an optimal torus are solvable or have core sl(2). Assume that there is a nonsolvable one-section. Then L is classical.

Thedy, A.:
Jordan radicals of U-algebras

We show that noncommutative Jordan algebras over an arbitrary ring of scalars satisfying $(x,x,y^2) = (x,x,y) \circ y$ for $x,y \in R$ (and some proper condition in case of characteristic 2) are characterized as those noncommutative Jordan algebras that strictly satisfy the identity $U_{xy}(x) = U_{xy,y}(x^2) - U_y(x^3)$. Hence, they are U-algebras, algebras such that $U_{xy}(z)$ lies in the Jordan ideal generated by x. For any U-algebra we relate the radical theories of R and R^+. Our main result is that any radical property P of quadratic Jordan algebras induces a radical property P- of U-algebras such that P'- rad(R) $\subset$ P- rad(R^+). If P is nondegenerate then P' is nondegenerate and P'- rad(R) = P- rad(R^+). This applies in particular to the McCrimmon, locally nilpotent, nil, Jacobson and Brown-McCoy radicals of Jordan algebras.

Timoney, R. M.:
The centriod of a JB*- triple system

This talk will report on joint work with S. Dineen.
The centroid of a JB^*- triple system is defined as the class of bounded linear operators T having the commutativity property

$$T\{x,y,z\} = \{Tx,y,z\}.$$

The centroid is shown to coincide with the entirely geometric concept of centraliser which is defined for any Banach space using extreme points of the dual ball. In the case of unital JB^*- algebras or C^*- algebras the centroid may be identified with the center.

Upmeier, H.:
Jordan algebras and quantization of symmetric spaces

Let Z be a finite dimension positive definite Jordan triple system. The open unit ball Ω of Z is a Kähler manifold and hence a symplectic manifold. Given a function f on Ω, define a formal operator $W_\lambda(f)$ by $W_\lambda(f) = \int_\Omega f(\zeta)\, W_\lambda(s_\zeta)\, d\mu(\zeta)$ on the Hilbert space H_λ spanned by the functions $N_{\underline{w}}^{\lambda}(\underline{z}) := N(\underline{z}, \underline{w})^{-\lambda}$ $(\underline{z}, \underline{w} \in \Omega)$, where N is the generic norm of Z, λ parametrizes the holomorphic discrete series and s_ζ is the symmetry at $\zeta \in \Omega$. Using invariant differential operators, we give a sufficient condition on f such that $W_\lambda(f)$ is a bounded operator on H_λ.

Walcher, S.:
Algebras that need many generators I

Algebras that need many generators (i.e. finite dimensional algebras A whose smallest sets of generators are large compared to their dimension) are of some interest in connection with the existence of a "large" derivation algebra and also in connection with certain differential equations. Together with H. Röhrl I was able to characterize one class of these algebras explicitly:

Theorem 1: Let A be n-dimensional and commutative over a field K, char K $\neq 2,3$. Then any smallest set of generators of A has $n-1$ elements.

$\Longleftrightarrow$ There is a linear form λ, a symmetric bilinear form $\varphi \neq 0$ and a $b \in A\setminus\{0\}$ such that $xy = \lambda(x)y + \lambda(y)x + \varphi(x,y)b$ for all x, y over a base field extension $L \supset K$ ($L = K$ for $\dim A > 2$).

The most important intermediate result in the proof (and of some interest for itself) is:

Theorem 2: Every cyclic subalgebra of A has dimension ≤ 2.

$\Longleftrightarrow$ There are polynomials γ_1, γ_2 such that $x^3 = \gamma_1(x)x^2 + \gamma_2(x)x$ for all x.

We outline the proofs and discuss some examples.

Willhöft, O.:
Classification of central-simple normal Jordan superalgebras

Let F be a field of characteristic $\neq 2,3$. A normal Jordan superalgebra is a superalgebra with certain additional properties.

The classification of central-simple Jordan superalgebras shows that - with exception of some types of small dimension - every finite-dimensional central-simple Jordan superalgebra is of type $\mathfrak{H}(\mathfrak{B},\psi,J) = \{a \in \mathfrak{B} \mid Ja = a\}$, where $(\mathfrak{B},\psi,J)$ is a central-simple associative superalgebra with superinvolution J.

Zel'manov, E. I.:
Jordan superalgebras

A list of simple finite-dimensional Jordan superalgebras over algebraically closed field of zero characteristics consists of those superalgebras listed in V. G. Kač ("Communs. in alg.", 1977) and the series of Hamiltonian superalgebras discovered by I. L. Kantor. We show that any simple finite-dimensional Jordan superalgebra over algebraically closed field of char $= p \neq 2$ is superalgebra of Poisson-Jordan brackets on polynomials in odd Grassman variables ξ_i and truncated even variables x_j ($x_j^p = 0$).

Given a variety of algebras $\mathfrak{M}$ the important question which concerns infinite-dimensional algebras from $\mathfrak{M}$ is: what is the structure of finite-dimensional $\mathfrak{M}$-superalgebras? In this way we construct new examples of prime degenerate Jordan algebras (Pchelintsevmonsters) and show that the radical of the free Jordan algebra is not solvable (Y. A. Medvedev), as well as prove some positive results.

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