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Research areas in Algebra

Representation Theory:

Weil Representations. These appeared as a consequence of a construction given in one of the many seminal works of André Weil during the '60s. The description of the symplectic similitude group $GSp(2n,F)$ as a general linear group $GL(2)$ with coefficients in $M_n(F)$, satisfying certain relations among them and their transposes, has suggested the notion of a generalized general linear group with coefficients in a unitary ring A with involution $*$, where the coefficients satisfy some relations that involve the involution.

Generalized classical groups G. These denoted as $GSL_*^{\varepsilon}(2,A)$ and $SL_*^{\varepsilon}(2,A)$, recover as examples the symplectic groups, orthogonal groups, and give many other and new examples when taking different unitary involutive rings. Constructing Weil representations for generalized linear groups G, irreducible representations of G, classes of involutive rings to study in a unified way groups G as above, and in general the study of the diverse categories that arise when considering generalized linear groups are main topics of work of our interest.

$\mathfrak{p}$-adic Representations and Langlands Program. We study admissible represetations of the connected reudtive group G defined over a $\mathfrak{p}$-adic field F. The local Langlands conjecture predicts the existence of a Galois representation σ to every irreducible admissible representation π of $G(F)$. The transfer carries important arithmetic information, grouped by L-packets. Whenever a local Langlands correspondence is known, e.g. for the general linear group, we study the questions of compatibility and stability of L-functions and local factors. Examples for GL(n) are symmetric square, exterior square, and Asai L-functions.

Universal Algebras:

Congruence classes of varieties of algebras. Given a variety of algebras on an arbitrary similarity type, we try to characterize the congruence class of this variety, that is the class of all (up to isomorphism) congruence lattices of algebras in the variety. In many cases a first order characterization cannot exist, however one can often decide, for a pair of varieties, whether or not they have the same congruence class. For example the congruence class of two finitely generated varieties of lattices are distinct expect in trivial cases (same variety or dual varieties). Another related question is the smallest size of a counterexample if it exists. For all known example the smallest lattice in a congruence class and not in another has $\leq \aleph_2$ compact elements, which is optimal.

Duality for finite algebras. We try to characterie dualizable finite algebras. In other words, given a finite algebra $\mathbf{A}$ with base set A we try to find a second algebra structure $\mathbb{A}$ on A (considered as a discrete topological algebra), compatible with the first structure such that we have a duality between the quasivariety generated by $\mathbf{A}$ and the topological quasivariety generated by $\mathbb{A}$. That is, for all B in the quasivariety generated by $\mathbf{A}$, the evaluation map $\mathrm{ev} : \mathbf{B} \to \mathrm{Hom}(\mathrm{Hom}(\mathbf{B},\mathbf{A}),\mathbb{A})$ is an isomorphism. For example Stone duality, or duality for vector spaces.