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Quantum Linear Groups and Representations of Gln (Fq) (Memoirs of the American Mathematical Society)

Jonathan Brundan, Richard Dipper, A. S. Kleshchev

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We give a self-contained account of the results originating in the work of James and the second author in the 1980s relating the representation theory of $GL_n(mathbb{F}_q)$ over fields of characteristic coprime to q to the representation theory of 'quantum GL_n' at roots of unity. The new treatment allows us to extend the theory in several directions. First, we prove a precise functorial connection between the operations of tensor product in quantum GL_n and Harish-Chandra induction in finite GL_n. This allows us to obtain a version of the recent Morita theorem of Cline, Parshall and Scott valid in addition for p-singular classes.From that we obtain simplified treatments of various basic known facts, such as the computation of decomposition numbers and blocks of $GL_n(mathbb{F}_q)$ from knowledge of the same for the quantum group, and the non-defining analogue of Steinberg's tensor product theorem. We also easily obtain a new double centralizer property between $GL_n(mathbb{F}_q)$ and quantum GL_n, generalizing a result of Takeuchi. Finally, we apply the theory to study the affine general linear group, following ideas of Zelevinsky in characteristic zero. We prove results that can be regarded as the modular analogues of Zelevinsky's and Thoma's branching rules. Using these, we obtain a new dimension formula for the irreducible cross-characteristic representations of $GL_n(mathbb{F}_q)$, expressing their dimensions in terms of the characters of irreducible modules over the quantum group.

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