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Quantum affine algebras have a rich theory of finite-dimensional representations, with important applications to integrable systems in statistical mechanics and quantum field theory. In 2008, it was discovered that the Grothendieck rings of certain monoidal categories of representations have the natural structure of a cluster algebra, such that all cluster monomials are classes of irreducible representations.

Since then the theory has developed a lot. It now covers all untwisted quantum affine algebras and larger classes of representations. One recent application is a geometric formula for the  $q$ -character of a product of Kirillov-Reshetikhin modules, in terms of Euler characteristics of certain new types of quiver varieties.

I will give a survey of the main results and conjectures, and if time allows, I will mention some recent extension of the theory to some infinite-dimensional representations of Borel subalgebras of quantum affine algebras.

*Joint work with David Hernandez (Université Paris 7, France).*