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New quantum toroidal algebras from a correspondence with 5D $N = 1$ instantons on deformed ALE spaces

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Quantum toroidal algebras are obtained from quantum groups by a further affinization, and, like quantum groups, can be used to construct quantum integrable systems. These algebras also describe the symmetries of instanton partition functions for 5D $N = 1$ supersymmetric gauge theories. When the gauge theory spacetime is a, ALE space obtained as a $\mathbb{Z}/p\mathbb{Z}$ orbifold of the omega-deformed Euclidean spacetime, the relevant algebra is the quantum toroidal $\mathfrak{gl}(p)$ algebra. In this talk, we consider a more general action of $\mathbb{Z}/p\mathbb{Z}$ on the spacetime, thereby introducing a deformation of the quantum toroidal $\mathfrak{gl}(p)$ algebras. These new quantum toroidal algebras are characterized by a non-symmetrizable Cartan matrix. A coproduct can also be defined, providing a Hopf algebra structure. We provide two types representations: a 'vertex representation' and a lowest weight representation with states parameterized by colored Young diagrams. Finally, we construct the vertex operator intertwining between these two types of representations. This object is identified with the refined topological vertex pertaining to this specific spactime orbifold. The vertex operator is used to reconstruct the partition function and the qq-characters of the gauge theory.

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