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3D modularity revisited - enumerative invariants from 3D topology

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A particular type of BPS q-series has been proposed recently as a topological invariant which provides a non-perturbative completion of complex Chern-Simons theory on closed 3-dimensional manifolds. This invariant has been defined mathematically from 3D topology, quantum groups and resurgence, and has key properties the integrality of the q-series and their behaviour under surgery. The q-series invariants have displayed relations to vertex operator algebras, and structurally, they have intriguing modular properties. Their mathematical formulation is nevertheless quite constrained, relying heavily on certain negative-definite conditions for the 3-manifolds, and much effort has been devoted to extending this definition. This operation is called "going to the other side", with different interpretations from the physics, vertex algebra, and 3D topology perspectives. I will discuss different approaches to this challenge, in particular through modularity and resurgence, with implications for the related vertex operator algebras.

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