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## Higgs branches, vertex operator algebras and modular differential equations

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Any four-dimensional  $N=2$  superconformal field theory (SCFT) admits a subsector of operators and observables isomorphic to a vertex operator algebra. After reviewing this correspondence (first identified in arXiv:1312.5344), I will aim to characterize the relationship between the Higgs branch of the SCFT (as an algebraic geometric object) and the associated vertex operator algebra. Our proposal is simple, but its correctness requires the presence of a number of null vectors in the vacuum Verma module of the algebra. One null vector in particular leads to the prediction that the Schur index of any  $N=2$  SCFT should obey a modular differential equation and transform as an element of a vector valued modular form. We illustrate these ideas in a number of examples including a series of rank one theories associated with “Deligne’s exceptional series” of simple Lie algebras, as well as a number of Argyres-Douglas theories.

References: Based on work with C. Beem (to appear soon), building on the construction of arXiv:1312.5344 and arXiv:1408.6522. For general background on  $N=2$  superconformal field theories in  $d=4$ , see e.g. Tachikawa’s review arXiv:1312.2684. For background on Zhu’s theory and the modular differential equations satisfied by VOAs, the original paper is Zhi, J. Amer. Math Soc. 9 (1996), no. 1 237-302, see e.g. Gaberdiel and Keller, arXiv:0804.0489 (and references therein) for a review in the physics literature.

### Summary

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