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New Developments in infinite dimensional Lie algebras, vertex operator algebras and the Monster

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Vertex operator algebras and Borcherds algebras are rich mathematical structures that play a role in many areas of mathematics. They also appear as symmetries of physical models. For example, the Monster Lie algebra was constructed by Borcherds as a quotient of the physical space of the tensor product $V^\natural \otimes V_{1,1}$ of the Moonshine module vertex operator algebra $V^\natural$ and the vertex algebra $V_{1,1}$ for the even unimodular 2-dimensional Lorentzian lattice $\mathrm{II}_{1,1}$. These algebraic structures were central players in the solution of the Conway-Norton Monstrous Moonshine conjecture. Since then, the study of vertex operator algebras, Borcherds algebras, and related structures have remained a source of discovery in both mathematics and physics. Vertex operators algebras and their representations encode the symmetries of two dimensional conformal field theories. Generalized Moonshine has uncovered many connections between number theory and physics. The Monster Lie algebra has recently been shown to be an algebra of gauge symmetries of a compactification of the Heterotic string. Borcherds superalgebras have been linked to the symmetries of supergravity theories. Furthermore, groups associated to Kac–Moody algebras are conjectured to encode symmetries of supergravity theories and there have been recent constructions of Lie group analogs for Borcherds algebras. In this special session, we explore the mathematical developments and possibilities for physical applications raised by these recent discoveries. The list of speakers comprises both mathematicians and physicists, each who have interest in the collaboration between these disciplines.

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