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Varieties of four-dimensional gauge theories

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Given a gauge Lie algebra, it is natural to seek representations for four-dimensional spacetime fermions that are anomaly-free and complex. Even for irreducible representations, where the problem reduces to studying \mathfrak{su}_n for $n \geq 3$, solutions seem to be few and far between: a trial-and-error scan by Eichten, Kang and Koh found only three for \mathfrak{su}_5 , for example. In this talk, I will explain how concepts and constructs in algebraic geometry show that there are in fact infinitely many such representations and yield them all. In particular, I will show that the problem is nearly identical to finding chiral solutions to the $U(1)$ anomaly cancellation equations for n Weyl fermions in four spacetime dimensions.

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