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From Pauli's Principle to Fermionic Entanglement

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The Pauli exclusion principle is a constraint on the natural occupation numbers of fermionic states. It has been suspected for decades, and only proved very recently, that there is a multitude of further constraints on these numbers, generalizing the Pauli principle. Surprisingly, these constraints are linear: they cut out a geometric object known as a polytope. This is a beautiful mathematical result, but are there systems whose physics is governed by these constraints? In order to address this question, we studied a system of a few fermions connected by springs. As we varied the spring constant, the occupation numbers moved within the polytope. The path they traced hugs very close to the boundary of the polytope, suggesting that the generalized constraints affect the system. I will mention the implications of these findings for the structure of few-fermion ground states and then discuss the relation between the geometry of the polytope and different types of fermionic entanglement.

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