

2015-2016 Hilledale Lecture in the Physical Sciences



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Free and Open to the Public

May 5, 2016

Grainger Hall, 975 University Avenue

Reception 4:45 PM – 6:00 PM, 1305 East Atrium

Lecture 6:00 PM – 7:30 PM, 1310 Plenary Room

Sums of Squares & Golden Gates

A classical question in number theory asks which positive integers can be represented as sums of two, three, or four squares. This was studied and solved in the 17th and 18th centuries by Fermat, Gauss, and Lagrange. It is an elementary question, but exploring it leads to many beautiful mathematical structures. In 1900, Hilbert challenged the mathematical community to extend these results to a general quadratic equation. While much progress has been made on this problem, it has not yet been completely resolved.

Remarkably, these classical questions are related to the very modern problem of constructing a quantum computer. More precisely, is there a small set of quantum gates that is "universal", in the sense that we can efficiently build any other gate we need by combining them into a circuit? I will describe how the mathematical tools that let us understand sums of squares can also be used to construct such a set of universal quantum gates in the best way possible.

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