

# Solving big problems with new quantum algorithm

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(PhysOrg.com) -- In a recently published paper, Aram Harrow at the University of Bristol and colleagues from MIT in the United States have discovered a quantum algorithm that solves large problems much faster than conventional computers can.

One of the most basic problems in maths is solving very large linear equations. There's nothing mysterious about them, they simply take time and the more variables there are, the longer it takes. Even a supercomputer would struggle to solve a system of equations that has a trillion variables.

However, in a new paper recently published in [Physical Review Letters](#), Aram Harrow at the University of Bristol and colleagues from MIT in the United States have discovered a quantum algorithm that solves the

problem much faster than conventional computers can. And the larger the problem, the greater the speedup.

To understand how the quantum algorithm works, think of a digital equaliser in a stereo CD player. The equaliser needs to amplify some components of the signal and attenuate others. Ordinary equalisers employ classical computer algorithms that treat each component of the sound one at a time.

By contrast, a quantum equaliser could employ a quantum algorithm that treats all components together at once (a trick called 'quantum parallelism'). The result is a huge reduction in the difficulty of signal processing.

“Large-scale linear systems of equations exist in many fields, such as weather prediction, engineering, and computer vision”, says Harrow. “Quantum computers could supply serious improvements for these and many other problems. For example, a trillion-variable problem would take a classical computer at least a hundred trillion steps to solve, but using the new algorithm, a quantum computer could solve the problem in just a few hundred steps”.

The solution could also be applied to other complex processes such as image and video processing, genetic analyses and even Internet traffic control.

More information: Quantum Algorithm for Linear Systems of Equations, Phys. Rev. Lett. 103, 150502 (2009), [DOI:10.1103/PhysRevLett.103.150502](https://doi.org/10.1103/PhysRevLett.103.150502)

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