Efficient distributed quantum computing

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(Phys.org)—A quantum computer doesn't need to be a single large device but could be built from a network of small parts, new research from the University of Bristol has demonstrated. As a result, building such a computer would be easier to achieve.

Many groups of research scientists around the world are trying to build a quantum computer to run algorithms that take advantage of the strange effects of quantum mechanics such as entanglement and superposition. A quantum computer could solve problems in chemistry by simulating many body quantum systems, or break modern cryptographic schemes by quickly factorising large numbers.

Previous research shows that if a quantum algorithm is to offer an exponential speed-up over classical computing, there must be a large entangled state at some point in the computation and it was widely believed that this translates into requiring a single large device.

In a paper published today in *Proceedings of the Royal Society A*, Dr Steve Brierley of Bristol's School of Mathematics and colleagues show that, in fact, this is not the case. A network of small quantum computers can implement any quantum algorithm with a small overhead.

The key breakthrough was learning how to efficiently move quantum data between the many sites without causing a collision or destroying the delicate superposition needed in the computation. This allows the different sites to communicate with each other during the computation in much the same way a parallel classical computer would do.

Dr Brierley said: "Building a computer whose operation is based on the laws of quantum mechanics is a daunting challenge. At least now we know that we can build one as a network of small modules."

More information: Beals, R. et al. Efficient Distributed Quantum Computing, *Proceedings of the Royal Society A*: rspa.royalsocietypublishing.or … 53/20120686.abstract

Arxiv: arxiv.org/abs/1207.2307

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