A Quantum CPU: the Pentium Q?

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A new design scheme for a quantum processor core makes potential quantum computers more technically feasible, more efficient, and in many cases faster by keeping all of the quantum bits active all the time, rather than switching them off and on as in most quantum computer designs.

Typical computers store and manipulate information as bits - that is 0's and 1's. Quantum computers are made of quantum bits, or qubits, that are encoded as a superposition of the values 0 and 1 at the same time. In addition, quantum mechanics allows qubits to become entangled, which smears information out among multiple qubits.

Previous schemes for making a quantum computer have sought to harness this process by keeping qubits under strict control - only letting them communicate with each other occasionally. But such tight constraints are hard to achieve in the lab, and experimental progress has been slow.

The new idea shows that researchers don't need to be so controlling. Instead they can assemble a processor core where qubits are active all the time, continuously and freely talking with all their neighbors. The whole core becomes entangled and the qubits record and manipulate data as a group. The key to making the new design work is a separate storage bank of qubits that swap information in and out of the quantum processor core.

Although the new design should be easier to implement than other

quantum computer layouts, the always-on processor core has yet to be realized in the lab. When researchers iron out all the difficulties, quantum computers - based either on the quantum processor core or other designs - will outperform their classical counterparts in a variety of calculations such as simulations of problems that are inherently quantum mechanical (including many nanoscopic, molecular, and biophysical problems, to name a few). They would also be good at factoring large numbers and tackling other mathematical problems that would take eons for even the most powerful classical computers imaginable to solve.

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