Subject: The future of computers (quantum computing)
Posted by Blazer on Fri, 18 Jun 2004 09:23:00 GMT
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"The state of a bit in a classical digital computer is specified by one number, 0 or 1. A word in classical computing is described by a string of n-bytes of information where the byte represents the alpha numeric bit, specifically eight bits of information. A quantum bit, called a qubit, might be represented by an atom in one of two different states, which can also be denoted as 0 or 1. Two qubits, like two classical bits, can attain four different well-defined states (0 and 0, 0 and 1, 1 and 0, or 1 and 1). However, unlike classical bits, qubits can exist simultaneously as 0 and 1, with the probability for each state given by a numerical coefficient. Describing a two-qubit quantum computer thus requires four coefficients. In general, n qubits demand 2n numbers, which rapidly becomes a sizable set for larger values of n. For example, if n equals 50, about 1015 numbers are required to describe all the probabilities for all the possible states of the quantum machine--a number that exceeds the capacity of the largest conventional computer. A quantum computer promises to be immensely powerful because it can be in multiple states at once--a phenomenon called superposition--and because it can act on all its possible states simultaneously. Thus, a quantum computer could naturally perform myriad operations in parallel, using only a single processing unit."

While at Los Alamos National Laboratory in New Mexico, Isaac Chuang, with Neil Gershenfeld of MIT, took another important step by demonstrating that quantum computing can be carried out with ordinary liquids in a beaker at room temperature. Each molecule contains atoms, and the nuclei of atoms act like tiny bar magnets. These can point in only two directions, "up" and "down", because of a property called "spin". A single nucleus can therefore act as a qubit, its spin pointing perhaps up for "off" and down for "on". A given spin lasts a relatively long time and can be manipulated with nuclear magnetic resonance, a technique used by chemists for years. Thus each molecule can act as a "little computer" and is capable of as many simultaneous calculations as there are ways of arranging its spin, according to Chuang, now with IBM Research, who has tackled some simple problems with chloroform. Does this mean the first quantum computer is about to appear on the market? His colleague, Charles Bennett, has a standard response:

"Definitely in the next millennium."