Quantum computing: view from the enemy camp

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Quantum computing is heavily advertised nowadays, to the extent that people feel obliged to justify whatever research they are doing by claiming that it has some relevance to quantum computing. This talk is an attempt to dispel the general enthusiasm and put the subject into a proper perspective. The so-called quantum cryptography is beyond the scope of this presentation.

In comparing "quantum" computing with normal digital computing, labelled in this context as "classical" computing, and stressing the enormous efficiency of the former, an important point is always omitted. Namely, that the "quantum" computer is an analog machine employing a physical system with continuous degrees of freedom. The relation is illustrated below.

Digital computer >>> employing a binary yes/no code	Analog computer >>> employing a system with continuous degrees of freedom, described by classical physics	Analog computer employing a system with continuous degrees of freedom, described by quantum physics

Thus, quantum computing should be compared with analog classical computing. And, as I will argue, the advantages are similar ... as well as the shortcomings.

The cornerstone of a quantum computer, the qubit, is a two-level quantum system. It is well known, that the dynamics of such a system in an external field is equivalent to that of a classical spin, as described by classical Bloch equations. An assembly of many qubits is very similar to a system of many classical spins (clabits?) which can interact with external fields and with each other. A huge amount of information can (in principle!) be stored and processed in such a system. The crucial problem is to physically manipulate our system and detect its state (classical or quantum, never mind) with sufficient precision and speed. If some day a viable solution is found, which I strongly doubt, analog computers (not necessarily governed by quantum physics and involving the annoying probabilistic nature of measurement) will replace digital ones.

In summary, the "quantum" computer is an analog machine and it is of secondary importance that this analog machine obeys quantum, rather than classical laws.