Methodological Testing of Fast Quantum Computers as Illusions

First I describe 3 different quantum computer (QC) characterizations. Then I explain Lakatos-Feyerabend-Kuhn theory of science as alternative method proliferation - needed for testing QC. Rest of paper attempts to show why I think quantum computers are illusions - Chimera as Lighthill put it. I keep trying different forms of this argument - abstract for this meeting, ArXiv paper xxxx.xxxv1 [CS:OH], this talk (will post slides on my web page www.tdl.com/<tilde>smeyer).

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Feynman's Quantum Computer Suggestion

Contrast Feynman Lectures Vol III, **1** "Quantum Behavior" and **2** "The Relation of Wave and Particle Viewpoints" with Feynman Lectures on Computation, 1986, chap. 6 "Quantum Mechanical Computers", p. 185.

- Aside from obvious limitation to size of working parts limited to atoms, no fundamental limit due to uncertainty principle.
- Aim is to exhibit the Hamiltonian [mathematical function] for a system that could serve as a computer.
- Feynman teaching QM but without feedback he received during original lectures.

DiVincenzo Spin Up/Down Spectroscopic QC

Ref. "Quantum Computation" Science, vol. 270 13 Oct. 1995, 255-261.

- 1. Bits of computers scaled down to individual atoms constructed as doped solid state semiconductor.
- 2. Interconnecting qbits most speculative and uncertain feature of QCs. Suggests using an "atomic force microscope".

DiVincenzo Spectroscopic QC continued ...

- 1. Rest of paper jumps to Shor's oracle factorization algorithm. QC has factorization algorithm compiled into apparatus as sequence of tipping pulses. Wave function of system becomes linear superposition of all possible states (the non classical exponential calculation as one step).
- 2. Read out is diffraction process with nearly every state forbidden. Classical optical diffraction grating number would need to be exponential in size of factored number of gratings.

Ladd - QCs as Quantum Wave Function Ubiquitous Computing

Ref. "Quantum Computers" *Nature*, vol. 464/4 13 Mar. 2010, 45-53.

- Engineering to exploit full complexity of many particle quantum wave function just as lasers exploit coherent light.
- Ubiquitous computing paradigm. QM will play ever more important part in many areas of emerging forms of artificial nanotechnology. Assumes human thought is limited to computer forms (see my ArXiv 1208.3739v1 [cs.OH]).

Ladd continued ...

- Entanglement is an axiom. Engineering problem becomes information isolation from the rest of the universe and decoherence from QM processes and small imperfections in non ideal machines.
- Discusses alternative technologies: photons, trapped atoms, NMR, quantum dots in solids and superconductors. Experiments show "or mathematically prove) for example QC is possible using only single photon sources and detectors - not repeatable experiments on single photon sources and detectors.

Lakatos-Feyerabend-Kuhn Method I am Using

- 1. Describe a physical theory in detail using quotations.
- 2. Skeptically criticize the view using as few assumptions as possible.
- 3. Try to promote theory proliferation by showing other equally good explanations of the relevant "experiments".

Oberheim Criticizes Feyerabend (PKF) Method in *Feyerabend's Philosophy*

- 1. Eric Oberheim's interesting criticism is that skepticism does not lead to theoretical progress. All PKF did was criticize without discovering anything.
- 2. My reply is that PKF method needed because otherwise to easy to reply that a new theory is not consistent with current dominant formalism.

Lakatos-Feyerabend-Kuhn Answer to Lack of Discovery Objection

- 1. Imre Lakatos research programme evaluation is an attempt to avoid the problems of 1 and 2 on previous slide.
- 2. Lakatos-Feyerabend-Kuhn contribution is that research programmes including quasiempirical mathematical programmes can only be tested by proliferating alternatives that can be compared to objective criteria (MSRP) and to each other.

Lakatos-Feyerabend-Kuhn continued ...

- 1. Idea for theory proliferation from David Bohm's answer to Feyerabend's review of Bohm's Causality and Chance in Modern Physics in Popper archive Box 278 no. 2.
- 2. Bohm's role was also noticed by Oberheim.
- 3. Related is that quantum physicists worked together to teach their beliefs and encourage study of methodology (see *Feynman's Tips on Physics*).

Recent Nick Maxwell Hopos Post Giving PKF's Method

I am of the view that the splitting of natural philosophy into science and philosophy was a bit of an intellectual disaster - especially for philosophy. Philosophy of science ought to be an integral part of science. This becomes clear the moment it is appreciated that, inherent in the aims of science, there are problematic assumptions concerning metaphysics, values and politics. The task of articulating and improving aims and methods something philosophy of science should surely seek to do - needs to be undertaken as an integral, influential part of the scientific enterprise. From Einstein's "Lecture on Geometry", 1921

This view of axioms, advocated by modern axiomatics, purges mathematics of all extraneous elements, and thus dispels the mystic obscurity, which formerly surrounded the basis of mathematics. But such an expurgated exposition of mathematics makes it also evident that mathematics as such cannot predicate anything about objects of our intuition or real objects.

Cryptography Different Characterization of Computing Using Enigma History

- Contrast Turing method that started with formulas and performed (then by people) logic operations and resolutions until found logic equations that described Enigma configuration (basically Hilbert's large array definition of proof).
- Tutte's guess as much as possible using human intuition, no specific representations required, then extend and check to determine Enigma configuration (basically satisfiability but maybe different from Tarski's).
- It seems to me this shows the problem with the concept of all computing is universal (Turing machine) because the wrong things are abstracted out.

X Propagation Good Model of the Nature of Computation

The X-propagation model of computation assumes that hardware is fabricated (software is slower/cheaper simulation). The hardware gates define computation, but the gate's switch behavior is defined to be as pessimistic as possible. Namely, if an unknown or wrong answer can possibly occur, it will.

An approximation in Verilog simulators can be shown by:

```
reg [127:0] rst;
...
if (rst) a=1;
else a = b&c;
```

If rst has any unknown bits result of a is that both if and else are evaluated. If any positions have x or disagree the bit in a is unknown (1'bx).

Problem with Physical Reality Defined by Axiomatics - Finsler Alternative

Following H. Breger "A restoration that failed: Paul Finsler's theory of sets" p. 249-264 in Gillies, D. *Revolutions in Mathematics.* **Finsler's papers are in** *Finsler set theory* (**D. Booth and R. Ziegler eds.**)

- 1. Finsler attacked "paper mathematics", a formal mathematics without meaning or content (p.254) [read physics]. Existence is not formal derivability.
- 2. Finsler proved Godel style incompleteness and inconsistency in a general framework before Godel. Finsler believed mathematics needed experiments in Lakatos quasiempirical sense. Bernays said Finsler's result was the same as Godel's because constructive Zermalo Frankel set theory is reality.

Finsler continued ...

- 1. Compare to entanglement as reality because it follows from Von Neuman's formalization of QC using Hilbert spaces.
- 2. Breger sees Finsler as showing "on the basis of different paradigms different theorems will be valid." (p. 260) Physics solves this problem with experiments, but QC existence depends on only one particular axiomatics.
- 3. In the geometry area, Finsler proved the continuum hypothesis (Cohen's independence is wrong) using an analog to the parallel line axiom (non Euclidean geometry).
- 4. This sort of reasoning was believed by physicists and I think what Einsten meant by general relativity not geometric (in the axiomatics not 19th century sense).

Background - Non Axiomatic Infinity

- Two kinds of infinity. Finite but unbounded (numerical calculation type) and actual conceptual infinity.
- Algorithm complexity analysis since the 1970s has used oracles. Oracles produce some perfect data not limited by algorithm speed or properties of infinity. Oracles have what ever properties one imagines.
- P=?NP difficult because oracles produce different answers in spite of problem seeming to not involve infinity.
- Dedekind cut definition of real numbers better than Cantor's because Cantor's requires an equivalence class calculation.

Shor's Factoring Algorithm Defines Wished for Oracle

My reconstruction of Shor's discovery method (follows DiVincenzo[1995]):

- Find step that speeds up algorithms using accepted complexity theory
- Discover the number theory results on factoring analyzing complexity proofs
- Find some formal system that has the needed speed up properties
- Popular QM Hilbert formalism entanglement fits the bill.
- Unconscious problem shift from physical reality to just need to build QC.

This is exactly the type of proof analysis Lakatos criticizes in *Proofs and Refutations* and is not related to physical reality. Political Motivation - 1972 UK Lighthill Report (p. 19):

Research on AI in some other countries may be funded by military agencies (ARPA in the USA) or by other mission-oriented public bodies. With this type of funding it is common for Scientists to 'close their ranks' and avoid public disagreement among themselves, in the hope that the total funds available for science may thus be enhanced to an extend that may outweigh any harmful results of a distribution of those funds determined on the basis of insufficient scientific discussion. Werner Heisenberg Description (*Physics and Philosophy*, 1958, p. 167)

[...] the scientific problems have finally become connected with political issues, and some scientists have taken recourse to political methods to carry their views through.

Ubiquitous Computing Economy Turns Physical Quantum Theory into Computing

- 1. Some Kantian thinking. Argument: computers are "good". Quantum is "good". Therefore QC is "good" and a mere engineering problem. Illusion?
- 2. Is there some fabricated or etched material than can compute exponentially fast? Yes, a child's bubble blower computes 'minimum energy surface' of the soap fluid.

Ubiquitous Computing continued ...

- 1. Bubbles are not computing. I claim QC oracle also mis-characterizes computation. Analog computing was rejected because it was problematic readout problem for one.
- 2. Opportunistic engineers remove philosophically interesting atomic quantum behavior and believe photons are simple waves (ArXiv paper discusses related engineering simplification in "hidden" momentum in special relativity "paradox" that goes back to William Shockley).

Heisenberg's Complimentarity Particle Matrix to Wave Equation Transformation

The dualism between the two complimentary pictures - wave and particles is clearly brought out in the flexibility of the mathematical scheme. The formalism is usually written out to resemble Newtonian mechanics. ... But by a simple transformation it can be written out to resemble a wave equation [Schrodinger's] for a ordinary three-dimensional matter wave (*Physics and Philosophy*, p. 50).