

THE QUANTUM CAT MEETS THE  
QUANTUM COMPUTER



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A NEW PERSPECTIVE BY K. STRANG

## Superposition and The Cat

There were many critics of the Copenhagen interpretation and Schrödinger was principal among them. His famous cat was his attempt to demonstrate how ridiculous the interpretation was but it somehow backfired and has been used ever since as a demonstration of ‘quantum weirdness’. The existing wave equation in classical wave mechanics is linear and in mathematics it means that solutions can be added together to give a further solution and this is considered a ‘superposition of states’. It is not a peculiar feature of Quantum Mechanics. It was appropriated from the physics of vibrations:

**‘ . . . the principle of superposition, which enables us to envisage simultaneous gradual changes of any and all amplitudes without surrendering the essential discontinuity, if any, namely that of the frequencies . . . ’**

[Schrödinger *Are there Quantum Jumps* The British Journal for the Philosophy of Science, Vol 111 August 1952, No. 10 p109]

It is ridiculous to move from this to concluding it must be a feature of macro objects such as cats. Schrödinger observed that one can easily show for example, by including a cat in the system the:

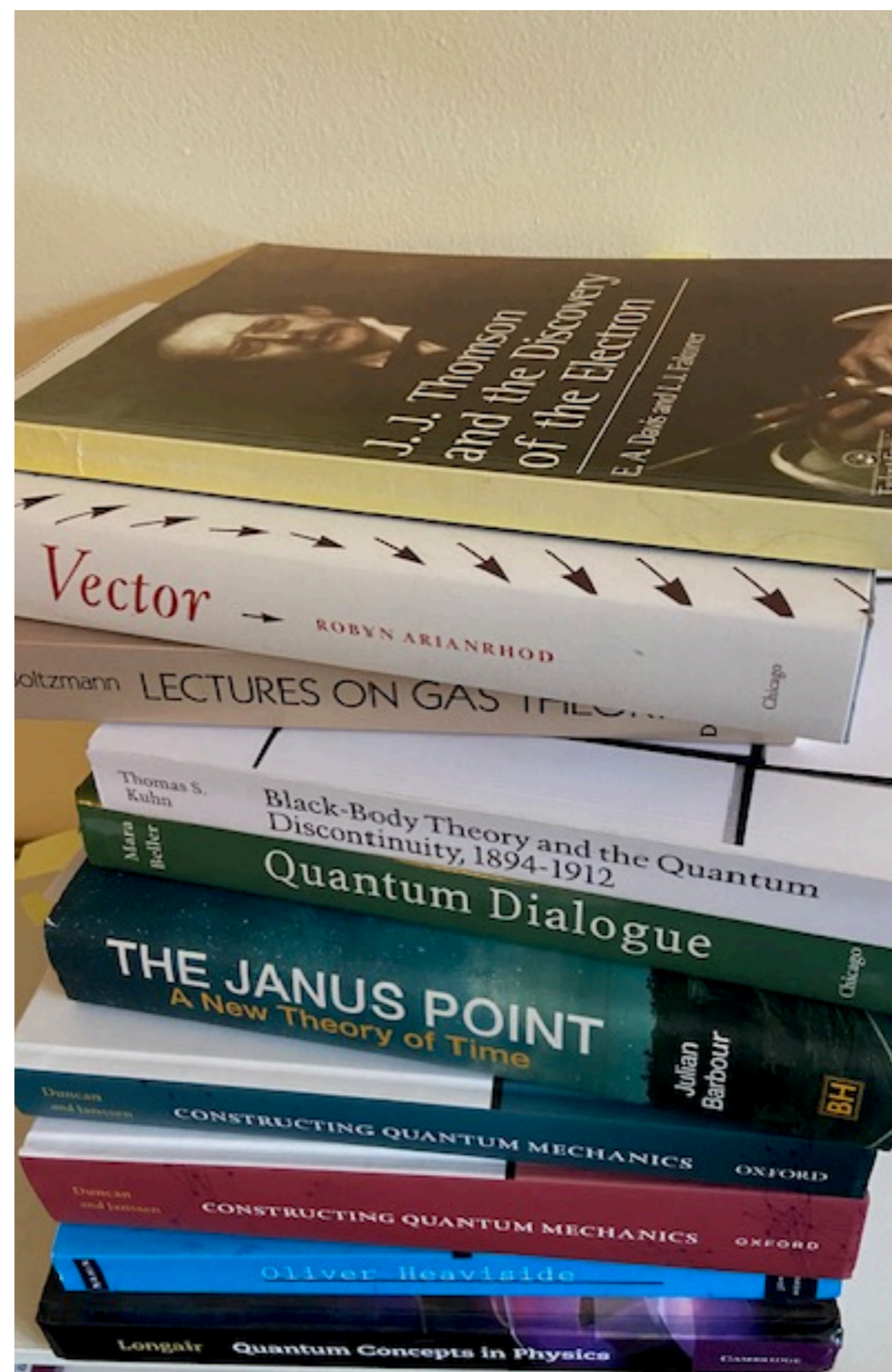
**‘ . . . quite ridiculous cases with the  $\psi$ -function of the entire system having in it the living and the dead cat (pardon the expression) mixed or smeared out in equal parts’.**

[Schrödinger Die Naturwissenschaften 1935. Volume 23, Issue 48. *The Present Status of Quantum Mechanics* ]

So Schrödinger found it difficult to regard the Copenhagen interpretation as ‘representing reality’. His conclusion is that

**‘ . . . the reigning doctrine rescues itself or us by having recourse to epistemology. We are told that no distinction is to be made between the state of a natural object and what I know about it, or perhaps better, what I can know about it if I go to some trouble. Actually—so they say—there is intrinsically only awareness, observation, measurement.’** [ibid]

This once again indicates the blurring of the boundaries between mathematics, statistics, epistemology and ontology.



The Copenhagen interpretation of Schrödinger's equation is that it describes a free 'particle' of mass  $m$  moving in one dimension, with potential energy function  $V(x)$ . Squaring the result changes the imaginary number  $i$  ( $\sqrt{-1}$ ) in the equation to a real number and using a factor to 'normalise' the solution to arrive at 1 (i.e. the probability of 100%) gives the location of the particle.

In this interpretation, the superposition of states is interpreted as the electron being *in many different positions at once*. Squaring the wave function removes the imaginary number  $i$  and provides the probability of finding it at a given location. When the electron is located and a measurement taken, the wave function 'collapses' and what I suppose can be imagined as a cloud of probability and uncertainty coalesces around a single actuality. In order to preserve the discreteness of particles, this extremely convoluted and rather suspect procedure is elevated to the status of ontological truth.

### The Real Interpretation of the Wave Equation

It is important to deconstruct the wave equation and examine what each part of it means. See the table below which provides a broad explanation of each term of the equation.

$$i\hbar^2 \partial \psi(x,t) / \partial t = - \hbar^2 / 2m \partial^2 \psi(x,t) / \partial x^2 + V(x)\psi(x,t)$$

Term	Explanation
$i\hbar^2$	this is the imaginary number $i$ which is ( $\sqrt{-1}$ ) times Plank's constant for angular momentum which taken together is a complex number
$\partial \psi(x,t) / \partial t$	this is the first partial derivative of the wave function (i.e. a sine wave) and the first derivative is a cosine wave.
$\hbar^2 / 2m$	this is a constant
$\partial^2 \psi(x,t) / \partial x^2$	this is the second partial derivative which is -sin wave (i.e. flip the sine wave around the x axis to negative side)
$V(x)\psi(x,t)$	this is the potential energy due to environment, for example a charged surface.

It is clear that the description is of wave phenomena not particles.

A more detailed explanation of the imaginary number,  $\sqrt{-1}$  is required because it tends to suggest and support the view that the mind of the observer plays a part in the collapse of the wave function. The word 'imaginary' is a misnomer as the number is a mathematical device for avoiding lots of tedious trigonometry:

**' Let  $i^2 = -1$  ( and thus  $i = \sqrt{-1}$ ). Geometrically we already know that multiplying by  $i^2$  is equivalent to a 180° rotation, and since  $i = i \cdot i$ , i.e., two successive applications of  $i$ , and since each  $i$  must have equal impact then each  $i$  must have a 90° rotation. Thus is born the idea of drawing a vertical line, 90° from the horizontal axis, and creating the pair of axes that define the co-ordinates of the complex plane.**

**The vertical axis is often called the imaginary axis, but in fact there is nothing imaginary about it all (it has been drawn in Fig. 9.1). Although this idea seems to have been around since the late 1600s it wasn't until 1799 that the Norwegian Casper Wessel specifically called the vertical axis the "axis of imaginaries." The word imaginary is a holdover from olden times when mathematicians first stumbled upon the square root of minus one in solutions to certain algebraic equations. Not yet having a geometric interpretation for such solutions, they called them imaginary and then swept them under the rug.'** [Oliver Heaviside by Paul J. Nahin, The John Hopkin University Press, pp 204-205]

Nahin goes on at some length to explain the trigonometric underpinning of  $i$  and I have included a copy of this on my website.

From this explanation and from the table above I hope it becomes clear that the wave equation is describing a real physical process: one involving (one dimension) of a three dimensional standing wave that is revolving or pivoting around a centre while pulsing at two different frequencies indicated by the alterations of the sine and cosine parts of the equation. As an actual wave can be superimposed on another actual wave with no real limit to the number of times this can be done, one can begin to see a picture of how an atom may be constructed: a superposition of standing waves of different frequencies. One could also get rid of the rather primitive notion of 'charge' and replace it with resonance phenomena. I plan to give a more detailed account of this in a later series of essays and podcasts. For present purposes, I simply wished to present the two interpretations of the wave equation and leave it to the reader to decide which is more persuasive.

## Superposition and the Quantum Computer

Returning to the Copenhagen interpretation, the idea that a particle can be in many different positions at once formed the basis of the search for a quantum computer. This search began decades ago and is now a multi-billion dollar industry with nothing very much to show for itself. Supercomputers based on classical technology which obviously use electrons but in a classical framework of electronics, outperform them. It was AlphaFold, a standard AI system developed by Google's Deep Mind research institution that solved the structure of proteins – typically it can take a PhD student three years to work out just one. To get an idea of scale, there are around 10,000 proteins in the human body alone. Contrast this with recent claims by Google on the supremacy of their quantum computer which were discredited by their arch rival IBM. The history of the subject shows that while there are numerous theories on the development of a quantum computer, no fully functional practical example exists.

**‘The concept of the Quantum Turing Machine (QTM) was first introduced by David Deutsch in his 1985 paper “Quantum theory, the Church-Turing Principle and the universal quantum computer”. In this work, Deutsch proposed a theoretical model for a quantum computer that could simulate any physical system, including itself. The QTM is based on the idea of a Turing machine, which is a mathematical model for computation developed by Alan Turing in the 1930s.**

**The QTM consists of a read/write head that moves along an infinite tape divided into cells, each of which can hold a qubit (quantum bit) of information. The QTM's operation is governed by a set of quantum gates, which are the quantum equivalent of logic gates in classical computing. These gates perform superposition, entanglement, and measurement on the qubits stored in the cells. Deutsch showed that a QTM could simulate any physical system with sufficient resources.**

**One of the key features of the QTM is its ability to exist in a state of superposition, meaning that it can process multiple possibilities simultaneously. This property allows the QTM to solve specific problems much faster than classical computers. For example, Deutsch showed that a QTM could factor large numbers exponentially faster than any known classical algorithm.’**

Sounds good until one reads the caveats.

The conclusion drawn is: *‘However, it is still essentially a theoretical construct, and significant technical challenges must be overcome before a practical implementation can be achieved.’*

A further problem is noted in this article:

*‘. . . it has been shown that any attempt to build a QTM would require a vast amount of energy, far beyond what is currently technologically possible.’*

[my italics] [*History of Quantum Computing*, Quantum Zeitgeist 19 February 2025 <https://quantumzeitgeist.com/history-of-quantum-computing/>]

I do not find this at all surprising as the concept of a quantum computer is based on a false premise, namely that the electron (as a discrete particle) can be in many different places at once.

**‘One of the biggest barriers for today's quantum computers is that the underlying hardware is highly error-prone. Due to the quirks of quantum mechanics, fixing those errors is tricky and it has long been known that it will take many physical qubits to create so-called “logical qubits” that are immune from errors and able to carry out operations reliably.’** [*History of Quantum Computing*, Live Science, 30 September 2024, <https://www.livescience.com/technology/computing/history-of-quantum-computing-key-moments-that-shaped-the-future-of-computing>]

In attempting to fit continuous wave phenomena which *can* be in a superposition of states into the binary and digital framework of a computer, one could easily end up with the flaws identified in the current examples.

### What is the quantum?

It strikes me that if the physical process characterising quantum behaviour is wave mechanics which can be described mathematically by adapting and applying the wave mechanics of light, water and sound to quantum phenomena, then the computer hardware would have to be re-imagined, not as a binary, digitised processor but with more complex circuits that accommodate the characteristics of waves. The irony is that we already have billions of quantum computers, called ‘brains’.