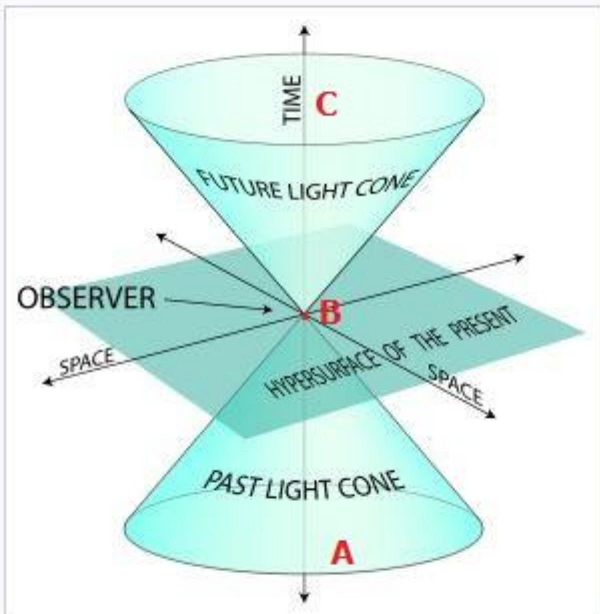
How wonderful that we have met with a paradox.
Now we have some hope of making progress.

Niels Bohr

Flipping a quantum coin



Light cone in 2D space plus a time dimension.

If Schrödinger's cat paradox is difficult to understand, look at the light cone from Wikipedia above and consider flipping a quantum coin. Saul Youssef writes in quant-ph/9509004v1:

> The situation before the observation could be described by the distribution (1/2,1/2) and after observing heads our description would be adjusted to (1,0). The problem is, what would you say to a student who then asks: "Yes, but what causes (1/2,1/2) to evolve into (1,0)? How does it happen?"

To understand 'how it happens', try to trace back your observation 'heads' (1,0) from the instant **B** 'here and now'. Before 'heads' (1,0) happened at **B**, it *should* have been a quantum coin (1/2,1/2) in you past light cone **A**, according to the axiom of causality (Wikipedia), **A** → **B** → **C** (Piotr Chrusciel).

Q: Can you trace back the quantum coin (1/2,1/2) in your past light cone **A** ?

1. If your answer is ‘yes’, please explain (**i**) the dynamics of converting the quantum coin state (1/2,1/2) at **A** into definite state ‘heads’ (1,0) at **B**, and (**ii**) the history of the other coin state ‘tails’ (0,1), which was also in your past **A**, but now is waiting patiently (where?) for the next (in any) flipping of the quantum coin, to get 50/50 chance to be observed.

2. If your answer is ‘no’, please explain why.

3. If your answer is ‘the question does not have an answer’, please explain why.

My answer to the quiz is (**3**), ‘the question does not have an answer’: the quantum coin (1/2,1/2) is <u>not</u> a fact, and therefore it does not live **anywhere** on the light cone.

But where is it? What kind of ‘time’ is implied in Schrödinger equation?

As Alfredo Macias and Hernando Quevedo explain in gr-qc/0610057v1, “time in quantum mechanics is a Newtonian time, i.e., an absolute time. In fact, the two main methods of quantization, namely, canonical quantization method due to Dirac and Feynman’s path integral method are based on classical constraints which become operators annihilating the physical states, and on the sum over all possible classical trajectories, respectively. Therefore, both quantization methods rely on the Newton global and absolute time. The absolute character of time in quantum mechanics results is crucial for its interpretation, i.e., matrix elements are evaluated at **fixed** time, and the internal product is unitary, i.e., conserved in time, and it implies conservation of the total probability. Therefore, time is part of the classical background, which is needed for the interpretation of measurements.”

Fine, but again, is the quantum coin (1/2,1/2) located **anywhere** on the light cone? Read Erwin Schrödinger from 1935:

> In general, a variable has no definite value before I measure it;
> then measuring it does *not* mean ascertaining the value that it *has*.

Therefore, the quantum coin (1/2,1/2) cannot have definite values, neither before I measure it nor *after* I measured it.

But again, is the quantum coin (1/2,1/2) **anywhere** on the light cone? If not, where *is* it ?

Plato suggested the answer twenty-four centuries ago. In modern parlance, the inevitable non-definiteness of the *uncolored* Kochen-Specker sphere (Helena Granström) is noumenal ‘monad without windows’ (Leibniz). It defies any mathematical logic. Read p. 44 in ‘Platonic Theory of Spacetime’ from 4 November 2018, available at my website below. Both the quantum coin and the Schrödinger cat exist ‘out there’ as Platonic reality, known as *Res potentia*. The Moon (David Mermin) also exists ‘out there’, but as physical reality or ‘fact’ on the past light cone **A**. *Res potentia*, on the other hand, is “attached” to the light cone only at the event **B** ‘here and now’ — once-at-a-time (Slide 7), as read with your clock. RDFM.

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