

# Saving Schrödinger's cat

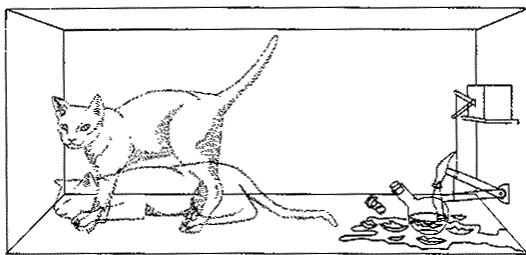
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## 1 Life and Dead of the 2 Principles of quantum mechanics Schrödinger's cat

The Schrödinger's cat is a thought-experiment created by Schrodinger to present what he thought to be a paradox of quantum mechanic.

Schrodinger imagined a cat enclosed in a box. In the box, a cyanide bulb can be broken by a device triggered by a radioactive element which has 50% chance to disintegrate in the time of the experiment. The experimenter can not observe inside the box (where the cat is). At the end of the experiment, the cat has 50% chance (or not) to be dead ... But it's not possible to determine exactly if the cat is alive or not. Generally, people say that the cat is alive **and** dead while no observation has been made, which is the paradox Schrodinger has highlighted : a cat can not be at the same time dead and alive. This thought-experiment was presented by



Schrödinger as a paradox, showing that quantum mechanic has to be supplemented ; but since, this is a classical exemple of the incredible results that quantum mechanic can give.

This widespread interpretation, in my point of view, is too much simplistic and introduce an inconsistency with the quantum mechanic theory.

It's important to remind two essential statements of quantum mechanic theory :

- Only eigen-states can be measured.
- The system state is a linear combination of eigen-states (even if the coefficients can be complex).

So, a state of a quantum system is described by a *ket*  $|\psi\rangle$  and if we have a base of N eigen-sates  $\{|\psi_i\rangle\}_{i=0..N}$  then a state of the system is described by  $|\psi\rangle = \sum_{i=0}^N a_i |\psi_i\rangle$  with the normalization condition :  $\sum_{i=0}^N |a_i|^2 = 1$ .

## 3 Is the cat dead or alive ?

We can suppose that in the case of the Schrödinger's cat there is only two eigen-states :  $|dead\rangle$  and  $|alive\rangle$ . So the Schrödinger's cat is described by a linear combination :  $\alpha|dead\rangle + \beta|alive\rangle$ , with  $|\alpha|^2 + |\beta|^2 = 1$ . In consequence, we can give the probability to find the Schrödinger's cat dead :  $|\alpha|^2$ .

The important thing to understand is that quantum mechanic does not give information on the *real state* of the system but only on the information measured. At the beginning of quantum mechanic theory, this notion of *model* was not well in minds ; this is now a better understood notion : a model describes what is measured and not the reality. According to that, quantum mechanic theory is much more phenomenologic than it is thought, because it is interested only in measurements (in a genral sense, it means in all kinds of interactions). Appart from measurements, the quantum mechanics theory does not describe anything. A quantum

system can not be describe without any kind of notion.

## 4 Positivist interpretation of quantum mechanic

The Copenhagen interpretation (which is the canonic interpretation of quantum theory) introduces the notions of states supposition, decoherence, to deal with this apparent paradox. Thus, the Schrödinger's cat would be in a supposition of the two eigen-states  $|dead\rangle$  and  $|alive\rangle$  before the observation. When we observe (directly or not) the state of the cat, the decoherence append : the system *choose* its state at this very moment (in regard of the given  $\alpha$  and  $\beta$  coefficients).

To solve the paradox of the Schrödinger's cat , many other interpretations were proposed : parallel univeses, observer choice, ... But the best for me is the one given by Bohr and Hawking and which is called *the positivist interepretation*. This interpretation states that quantum mechanics theory do not give any description of the reality but only the results of the observations.

## References

- A funny and interactive page : [http://www.phobe.com/s\\_cat/s\\_cat.html](http://www.phobe.com/s_cat/s_cat.html)
- The wikipedia related page : [http://en.wikipedia.org/wiki/Schrodingers\\_cat](http://en.wikipedia.org/wiki/Schrodingers_cat)