

## MY THOUGHTS ON QUANTUM MEASUREMENT

A “quantum measurement” means any quantum process that results in a macroscopic effect, regardless of whether humans or laboratories are involved.

All of this suggests that measurements affect superposed quantum states via entanglement of the superposed quantum with a detector.

Precisely what is superposed and what interferes in this measurement state?

The answer is surprisingly simple: Only the correlations between S(system) and M(measuring device) are superposed.

Now for some details:

The quantum system has two possible state,  $|S1\rangle$  and  $|S2\rangle$ .

When the quantum state  $|S\rangle$  is created the states  $|S1\rangle$  and  $|S2\rangle$  are in a superposition i.e.,  $|S\rangle = a|S1\rangle + b|S2\rangle$ .

When the quantum state S is measured by some macroscopic device that has two state  $|M1\rangle$  and  $|M2\rangle$ , such that if the quantum system were in state  $|S1\rangle$ , then the measuring device ends up in the state  $|M1\rangle$  after a measurement and if the quantum system were in state  $|S2\rangle$ , then the measuring device ends up in the state  $|M2\rangle$  after a measurement.

This is expressed mathematically in quantum theory by saying the measurement state is  $|SM\rangle = a|S1\rangle|M1\rangle + b|S2\rangle|M2\rangle$ .

This is called entanglement.

It is at this point that most textbooks get the interpretation wrong!

The measurement state should be read as:

The state  $|S1\rangle$  is positively correlated with the state  $|M1\rangle$ , and the state  $|S2\rangle$  is positively correlated with the state  $|M2\rangle$ .

ONLY correlations are superposed, NOT states.

When the superposition  $|S\rangle = a|S1\rangle + b|S2\rangle$  of S entangles with states of M, the superposition shifts, from a superposition of states of S to superposition of correlations between S and M, so S can be in an incoherent mixture while maintaining unitary global dynamics.

Only the correlations between S and M are superposed.

This is how nature resolves problem of definite outcomes.

A so-called collapse mechanism is NOT needed!

This analysis should not be regarded as one more interpretation of quantum physics.

It is instead a correction of the previous misunderstandings of von Neumann's entangled