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How the world look like for a quantum particle?

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The covariance of physical laws in quantum reference frames

In our laboratories, we perform experiments with single quantum particles which can be in a superposition of different states or entangled with other particles, showing features which are strikingly different to the classical world. What would be the description of the world, if we could "sit" on a particle that is in a superposition state with respect to the laboratory frame of reference? The relational approach to physics suggests that the description from such a "quantum reference frame" is exactly the opposite: while for itself, the particle appears classical, it is the laboratory that is in a quantum superposition of states. In the talk, I will introduce a quantum theory framework for an observer that is "attached" to a quantum particle. I will show that that although the features of observed systems - such as entanglement and superposition - are observer-dependent, the physical laws themselves remain the same for all observers (i.e. are invariant under the transformation between quantum reference frames). Finally, I will conclude with the insights the new framework provides for understanding Wigner's friend thought experiment.

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