

Re: Why physicists should pay attention to the mind

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- *From:* Hendrik van Hees <hees@xxxxxxxxxxxxxx>
 - *Date:* Thu, 2 Jun 2005 05:39:08 +0000 (UTC)
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rof@xxxxxxxxxxxxxx wrote:

- > Perhaps you are saying that there's a silent majority of physicists
- > who would not disagree with the statement "The wavefunction describes
- > the actual state of the system, rather than the experimenter's
- > knowledge about it."
- >
- > Maybe; we would need to do a poll to find that out. Perhaps it's
- > been done already?

In the German physics news group (de.sci.physik), we have a quite similar debate. From the discussion there, I get the impression that there are as many "interpretations" of the meaning of "state" as there are physicists using quantum mechanics.

I myself became convinced of the so-called "Statistical Interpretation" which is due to Ballentine, because it is a minimal interpretation. It assumes only what is really needed to apply quantum theory to experimenter's every-day experience with quantum systems in the lab (especially in the realm of quantum optics, where many of the former "gedanken experiments" can be realized as true experiments).

This interpretation, which is on my opinion very well summarized in

L. E. Ballentine, The Statistical Interpretation of Quantum Mechanics, Rev. Mod. Phys. *42* (1970) 358

or in the book by the same author

L. E. Ballentine, Quantum Mechanics, (Publisher?)

It takes the Born interpretation *really* serious and identifies the state (i.e., the ray in a Hilbertspace in the formal language of quantum theory) only with its inherent statistical meaning about real systems. This means the quantum state is not describing any kind of physical entity of a single system but only the statistics of similarly prepared ensembles of such single systems.

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With this minimal interpretation, all the problems with "spooky actions at a distance", inherent in the orthodox Copenhagen interpretation, where the state is attached as a physical entity to a single system and criticized by Einstein, Poldolsky and Rosen in their famous paper. In fact, one can read this paper as a criticism of the Copenhagen interpretation and not so much of quantum theory itself.

As an example take a maximally entangled photon pair in the Bell state

$$|\Psi\rangle = \frac{1}{\sqrt{2}} [|H_x, V_y\rangle + |V_x, H_y\rangle],$$

where $|H_x\rangle$ stands for a horizontally polarized photon (one might think of a wave packet) localized in a small region around x .