

Discussion Materials for Renninger's negative-result Quantum Mechanics thought experiment.

Well, I managed to generate homework for myself...

It all started last month, October. Near the end of our meeting Bill Daniel asked how we thought Rovelli might address the Renninger thought experiment. At the time I thought I recognized the reference and this last month spent some time researching it. I haven't figured out why I thought it familiar yet but I certainly think it worth becoming familiar with. Below I list several papers that are quite readable if in some cases challenging. Then, some extra credit papers some somewhat more challenging. And then one humorous paper (thanks to my daughter). And a couple extra credit papers that veer off a bit. I include some thoughts in most cases - mostly directing why I think them important and directing your reading, I hope, in a pedagogically useful direction.

It's taken a few days to put all this together hampered by my duties for another club...

I start on a contrarian note: The authors argue that a good scientific theory need do no more than connect the dots in experiments. Anything more - description of 'reality' - is an extra. It is not to be considered essential. But is it? Without a mental picture of what is going on, how does one imagine what new things to predict and test for? The authors make quite clear that in their opinion the wave function has no physical reality. Not so in some other readings below.

Christopher Fuchs and Asher Peres opinion piece "Quantum Theory Needs No 'Interpretation'":
<http://sackett.net/QuantumTheoryNeedsNoInterpretation.pdf>

The following references get to the meat of the matter brought up by Bill Daniel.

The original Renninger paper as translated by De Baere, 'On Wave-Particle Duality':
arxiv.org/pdf/physics/0504043.pdf

De Baere's followup paper in which he comments on and expands on the Renninger paper, 'Renninger's Thought Experiment: Implications for Quantum Ontology and for Quantum Mechanics' Interpretation':
arxiv.org/pdf/quant-ph/0504031.pdf

(If you are not familiar with the details of the operation of a 'Mach-Zehnder interferometer' I recommend you read the Wikipedia page on it, 'Mach-Zehnder interferometer':
en.wikipedia.org/wiki/Mach%E2%80%93Zehnder_interferometer)

Wikipedia article on Renninger thought experiment. Probably worth reading before the original paper to help get a feel for the lay of the land, 'Renninger negative-result experiment':
en.wikipedia.org/wiki/Renninger_negative-result_experiment

The Stanford Encyclopedia of Philosophy provides an article by Rovelli which I would characterize as short but much more advanced description of Relational QM to the one presented in our book. There are NO mathematical equations in the article but it is heavy reading. (Note that there is an older version out there. Don't confuse them.) 'Relational Quantum Mechanics':
plato.stanford.edu/entries/qm-relational/

The above is what I propose be the heart of our discussion. Rovelli vs. Renninger. The traditional Copenhagen interpretation made more sensible (everything is an observer in any interaction) vs a very

strict form of realism, respectively. Who wins the argument?

Extra credit:

De Baere, the translator of the Renninger paper, writes extensively himself. This paper argues for strict locality. Reading this paper is like jumping into the middle of a long running conversation. It would take me a long time to catch up on what they're talking about. That is, a LOT of reading. But you can glean a bit of good stuff if you don't allow yourself to get bogged down in the minutia of the arguments. But, in doing so, I think I miss quite a bit also... Note that it is a good idea to write down his textual shortcuts the first time you run across them (e.g. locality = LOC). There are a several of them to keep track of. I suggest no more than skim to section II. If you attempt this, note that he seems as if ignorant of the the experiments of Aspect, et al. I don't get it. Perhaps some brave soul can educate me/us. 'On the Consequences of Retaining the General Validity of Locality in Physical Theory'. arxiv.org/pdf/quant-ph/0504030.pdf

(You might find the above paper as confusing as I: CFD = counterfactual definiteness. It means to be able to say something is definitely so without directly interacting with it. As in the various EPR experiment variants. But philosophers generalize the concept. Wikipedia: en.wikipedia.org/wiki/Counterfactual_definiteness)

Extra, extra credit:

Rovelli, a goodly number of times in the book, refers to the philosopher of science Mauro Dorato. So it seems appropriate to consider one of his works as cited by Rovelli. Philosophy in general and of science, and especially of QM, is all about trying to answer the question, "What do you really mean?" This is tough reading for me. Reminder: this is in the Extra, extra Credit section! 'Properties and Dispositions: Some Metaphysical Remarks on Quantum Ontology'. philsci-archive.pitt.edu/2932/1/ghirardi2f.pdf

Lastly, a bit of humor and not necessarily extra credit: 'Blueberry Earth' wherein the author considers the physics and the time evolution of spontaneously converting the earth volume as the standard earth to closely packed blueberries. A humorous pedagogical exercise. arxiv.org/pdf/1807.10553.pdf

All right - one more for curiosity and humor. It is not identified as such but this could be the paper in which Wigner introduces his friend - not declared as such. (The Wigner's friend paradox derived from the Schrodinger's cat paradox.) It's not the topic of the paper. But it's in there. 'Remarks on the Mind-Body Question': www.informationphilosopher.com/solutions/scientists/wigner/Wigner_Remarks.pdf

Cheers, Peter

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