Re: Is State Vector Reduction a 'Process'?

Source: http://sci.tech−archive.net/Archive/sci.physics.research/2005−05/msg00573.html

- *From*: rof@xxxxxxxxxxxx

- *Date*: Mon, 30 May 2005 05:21:29 +0000 (UTC)

Arnold Neumaier <Arnold.Neumaier@xxxxxxxxxxxx> writes:

>rof@xxxxxxxxxxxx wrote:

>> Arnold Neumaier <Arnold.Neumaier@xxxxxxxxxxxx> writes:
>>
>>>rof@xxxxxxxxxxxx wrote:
>>

>>>You seem to be projecting _your_ anger onto me.
>>
>> Perhaps it seems that way to you; I assure you that I'm not.

>Then it must have been an artifact of the medium usenet.
>It seems to make statements to look more emotional than they
>are meant, which occasionally (and in unmoderated groups often)
>leads to an involuntary rise in aggression.

Indeed; this happens far too often. In diplomacy, people
have developed formalized rules to avoid involuntary
rises in aggression like this, and refer to it as
protocol. Usenet hasn't got anything similar yet, excapt
for the vague rule that one shold be polite.

>>>And when I say that state reduction is a
>>>physical process, I both state my belief and happen to coincide with
>>>famous physicists like von Neumann and many others, and this is good
>>>enough to make this statement honestly.
>>
>> Well, von Neumann was actually of the opinion that state reduction
>> wasn't a physical process, as far as I can determine from reading
>> his papers. In your post, you also said (more or less) that it
>> wasn't a physical process, so I presume you left out a "not"
>> above.

>No. I meant "state reduction is a physical process" since this is
>what I said and what physicists observe.

Perhaps you are using the word "physical" in a way with which I'm

not familiar. You referred, in your original post to collapse as "an artifact of the description of a quantum system by a limited number of observables". To me, that sounds very much like saying that collapse isn't a physical process.

>See
> A. Neumaier,
> Collapse challenge for interpretations of quantum mechanics
> quant−ph/0505172
> (see also http://www.mat.univie.ac.at/~neum/collapse.html).

The latter link appears to be broken. Your treatment of the Copenhagen interpretation in the article claims that the "unresolved quantum−classical interface issue (including the missing definition of which situations constitute a measurement) is a serious defect of the Copenhagen interpretation when viewed as a fundamental interpretation of quantum mechanics."

This is slightly unfair to the Copenhagen interpretation, in which the wavefunction is understood to represent knowledge about the system, rather than the system itself. A definition of measurement isn't missing because measurement is the acquisition of new knowledge. State vector reduction happens because the observer acquires new knowledge and then updates the mathematical representation of his knowledge to reflect the new knowledge that he has.

It is only if we ignore this, and suppose that the Copenhagen interpretation asserts the opposite, namely that the wavefunction doesn't represent knowledge, but represents the state of the system, that the discontinuous change in the wavefunction looks problematic, since that would mean that the system itself changes discontinuously.

>Von Neumann takes the collapse as an axiom, hence also testifies to its
>reality.

He uses it as an axiom, but that doesn't mean that he claimed that the wavefunction didn't represent knowledge.

>I'd appreciate getting a clear reference where he states
>the contrary (if he does so).

He is less clear about it than Bohr or Heisenberg, but, for example, in his 1938 paper with Birkhoff, "The Logic of Quantum Mechanics", for example, he expresses the view that the formalism of quantum mechanics is the way it is because the algebra of Hilbert−space subspaces is that of a non−distributive orthomodular lattice, which matches the structure of the collection of experimentally verifiable propositions about a system. This seems to

me to be an indication that he considered rays of Hilbert space to be associated with propositions (knowledge), rather than with the actual configuration of the system.

More concretely, in chapter 4 of his "Mathematical Foundations of Quantum Mechanics", he says:

"Let us assume that we do not know the state of a system, S, but that we have made certain measurements about the state of S and know their results. In reality, it always happens this way, because we can learn something about the state of S only from the results of measurements. More precisely, the states are only a theoretical construction, only the results of measurements are actually available, and the problem of physics is to furnish relationships between the results of past and future measurements." p. 337

In addition, he credits Bohr on page 420 with the insight that quantum mechanics can only be understood in terms of the relationship between the physical and the psychical, which seems to me to be a direct indication that he understood and agreed with the idea that the mathematical representations that quantum mechanics uses refer to knowledge about the system and not to the system itself.

He devotes chapter 6 to explaining that it doesn't matter where the boundary between the system and the observer is placed, whether at the pointer on the measuring device or at the eye of the observer. The reason that he does this is that, as he says, "the danger lies in the fact that the principle of psycho−physical parallelism is violated, so long as it is not shown that the boundary between the observed system and the observer can be displaced arbitrarily..." (p. 421).

Now, the principle of psycho−physical parallelism is understood by Von Neumann to be "that it must be possible to describe the subjective experience as if it were in reality in the physical world", and that "that [the] boundary can be pushed arbitrarily into the body of the actual observer is the content of the principle of psycho−physical parallelism" (p. 420).

What this means (as I understand it) is, firstly, that the ray of the Hilbert space in quantum mechanics represents knowledge, and the question "Knowledge about what?" can be given many answers, such as "knowledge about the position of the instrument pointer", "knowledge about the momentum of the particle", or "knowledge about the conditions

inside of my body." The principle of psycho−physical
parallelism tells us that, whatever we claim to know
about the physical world, what we actually know about
is what's going on inside our body, and Von Neumann
is observing that pushing the boundary between the
observer and the observed inside the body of the
observer works just fine with quantum mechanics.

I'd be interested to hear any conflicting interpretations
of the above quotes regarding psycho−physical parallelism
and pushing the boundary inside the body of the observer.

You might also want to read the paper by Lon Becker:
"That von Neumann Did Not Believe in a Physical Collapse",
http://bjps.oupjournals.org/cgi/content/abstract/55/1/121

>> You may very well say that this is a harsh lesson that he needs to
>> learn. I would say that it would be better if people clearly
>> distinguished between what was merely their opinion and
>> what is well−established, and then those who ask questions
>> would be able to trust the answers that physicists give them.

>Only if they have no prejudice, and if he recognizes that he speaks
>with a person without prejudice. But both requirements are very rarely
>met. So he is right to be cautious. Indeed, we learn it from the
>earliest age not to trust too early.

Well, there is a distinction to be made between the role
of a teacher and the role of a physicist debating matters
with another physicist. We expect our teachers to honestly
tell us which things they are teaching are well established
and which are their opinions. Perhaps not all teachers
meet this high standard, but I think it's important to
keep that standard in place.

I would also think that, when approached by a non−expert
who has a relatively simple question to ask, the physicist
who answers implicitly adopts the role of a teacher.

>> As another example, if somebody asks "Is the Riemann hypothesis true?",
>> most knowledgeable people would reply that it isn't known whether
>> or not it is true, although it is widely believed that it is.
>> Somebody who simply says "Yes, it's true," would be being honest
>> by your criteria,

>Only if he really thinks it is true, according to the standards
>of mathematics. For example, I think that Louis de Branges
>can say it with honesty.
>http://www.math.columbia.edu/~woit/blog/archives/000035.html

I await the results of the scrutiny of his proof with interest.

Do you, incidentally, think that mathematicians should hold
themselves to higher standards than physicists when telling
others that a particular statement is true?

>>>It is ridiculous to require a percentage of people in a field
>>>to agree with you before you utter a statement without adding
>>>a qualification like 'I believe' or 'Some physisicts believe'.
>>>There would never be an agreement on the percentage required
>>>to do so.
>>
>> I agree. I never suggested that one should require a
>> specific percentage of physicists to agree with one before
>> saying something.

>You suggested that one should require 50% in the mail which
>caused my three question marks.

I gave an example of 50% as a figure that would indicate
controversy. I would not and do not suggest that one
should ever go to the bother of checking whether it
is 49% or 51% of physicists who agree with an opinion.

R.

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- ***Follow−Ups***:
  - ♦ ***Re: Is State Vector Reduction a 'Process'?***
    - ◊ *From:* Arnold Neumaier

- ***References***:
  - ♦ ***Is State Vector Reduction a 'Process'?***
    - ◊ *From:* Souvik
  - ♦ ***Re: Is State Vector Reduction a 'Process'?***
    - ◊ *From:* Aaron Bergman
  - ♦ ***Re: Is State Vector Reduction a 'Process'?***
    - ◊ *From:* rof
  - ♦ ***Re: Is State Vector Reduction a 'Process'?***
    - ◊ *From:* Arnold Neumaier
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- Prev by Date: ***Re: please help my confusion about particles and irreps.***
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