

Refutation of gedanken experiment for quantum theory as not descriptive of itself, or not

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Abstract: The gedanken experiment for quantum theory as not descriptive of itself is not tautologous and not contradictory. This means quantum theory can neither describe itself nor not describe itself. This result foils the attempt to resuscitate quantum theory.

We assume the method and apparatus of Meth8/VL4 with Tautology as the designated *proof* value, **F** as contradiction, **N** as truthity (non-contingency), and **C** as falsity (contingency). Results are a 16-valued truth table in row-major and horizontal, or repeating fragments of 128-tables for more variables.

LET $p, q, r, s: C, Q, \text{Theorem}_1, S; \sim$ Not; $+$ Or; $-$ Not Or; $\&$ And; $>$ Imply;
 $\%$ possibility, for one or some, \exists $\#$ necessity, for every or all, \forall .
 $(p=p) \top$ tautology; $(p@p) \mathbf{F}$ contradiction; $(\%p\>\#p) \mathbf{N}$ truthity; $(\%p\<\#p) \mathbf{C}$ falsity;

From: Frauchiger, D.; Renner, R. (2018). "Quantum theory cannot consistently describe the use of itself". Nature Communications. Vol 9. Article 3711.

Table 4 Interpretations of quantum theory

The proposed Gedanken experiment can be employed to study the various interpretations of quantum theory [QT]. Theorem 1 implies that each of them must violate at least one of the assumptions (Q), (S), and (C) [as indicated by an \times].

No.	Type of QT	(Q)	(S)	(C)
1.1	Copenhagen	✓	✓	×
2.1	HV theory applied to subsystems	✓	✓	×
3.1	HV theory applied to entire universe	×	✓	✓
4.1	Many worlds	?	×	?
5.1	Collapse theories	×	✓	✓
6.1	Consistent histories	✓	✓	×
7.1	QBism	✓	✓	×
8.1	Relational quantum mechanics	✓	✓	×
9.1	CSM approach	×	✓	✓
10.1	ETH approach	×	✓	✓

Remark: The meaning of the assumptions Q, S, C is irrelevant to this demonstration.

The value for unknown for "?" reads:

p as not (truthity or falsity), i.e. p as neither truthity nor falsity (0.1.1)

$p = ((\%p\>\#p) - (\%p\<\#p));$ TFTF TFTF TFTF TFTF (0.1.2)

q as not (truthity or falsity), i.e. q as neither truthity nor falsity (0.2.1)

$$q=((\%p>\#p)-(\%p<\#p)) ; \quad \text{TTF} \text{TTF} \text{TTF} \text{TTF} \quad (0.2.2)$$

s as not (truthity or falsity), i.e. s as neither truthity nor falsity. (0.3.1)

$$s=((\%p>\#p)-(\%p<\#p)) ; \quad \text{TTTT} \text{TTTT} \text{FFFF} \text{FFFF} \quad (0.3.2)$$

From the Table 4 above:

Q&S&~C: (1.1, 2.1, 6.1, 7.1, or 8.1)

$$(((q=(\%p>\#p))\&(s=(\%p>\#p)))\&\sim(p=(\%p>\#p)))=(p=p) ; \\ \text{FCFF} \text{FCFF} \text{FNFF} \text{FNFF} \quad (1.2, 2.2, 6.2, 7.2, \text{ or } 8.2)$$

~Q&S&C: (3.1, 5.1, 9.1, or 10.1)

$$((\sim(q=(\%p>\#p))\&(s=(\%p>\#p)))\&(p=(\%p>\#p)))=(p=p) ; \\ \text{FFCF} \text{FFCF} \text{FNFF} \text{FNFF} \quad (3.2, 5.2, 9.2, \text{ or } 10.2)$$

?Q&S&?C:

$$(((q=(\%p>\#p)-(\%p<\#p))\&(s=(\%p>\#p)))\&(p=((\%p>\#p)-(\%p<\#p))))=(p=p) ; \\ \text{CFFF} \text{CFFF} \text{NFFF} \text{NFFF} \quad (4.2)$$

We evaluate this story: Eqs. (1.1, 2.1, 6.1, 7.1, or 8.1) or (3.1, 5.1, 9.1, or 10.1) or (4.1) (11.1)

$$((((q=(\%p>\#p))\&(s=(\%p>\#p)))\&\sim(p=(\%p>\#p)))+ \\ ((\sim(q=(\%p>\#p))\&(s=(\%p>\#p)))\&(p=(\%p>\#p))))+ \\ (((q=(\%p>\#p)-(\%p<\#p))\&(s=(\%p>\#p)))\&(p=((\%p>\#p)-(\%p<\#p))))=(p=p) ; \\ \text{CCCF} \text{CCCF} \text{NNNF} \text{NNNF} \quad (11.2)$$

We then evaluate this sentence:

Theorem_1 implies Eqs. (1.1, 2.1, 6.1, 7.1, or 8.1) or (3.1, 5.1, 9.1, or 10.1) or (4.1) (12.1)

$$r > (((((q=(\%p>\#p))\&(s=(\%p>\#p)))\&\sim(p=(\%p>\#p)))+ \\ ((\sim(q=(\%p>\#p))\&(s=(\%p>\#p)))\&(p=(\%p>\#p))))+ \\ (((q=(\%p>\#p)-(\%p<\#p))\&(s=(\%p>\#p)))\&(p=((\%p>\#p)-(\%p<\#p)))))) ; \\ \text{TTTT} \text{CCCF} \text{TTTT} \text{NNNF} \quad (12.2)$$

Eq. 12.2 as rendered is *not* tautologous, meaning the gedanken conjecture that QT cannot describe itself is refuted. This is not to mean that QT can describe itself because Eq. 12.2 is not a contradiction. Hence QT cannot be resuscitated.