

## Refutation of pre-measurement, decoherence, and multiverse quantum mechanics

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**Abstract:** The equation for pre-measurement is *not* tautologous, thereby refuting it and decoherence as a basis for multiverse quantum mechanics. These form a *non* tautologous fragment of the universal logic VL4.

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). The 16-valued truth table is row-major and horizontal, or repeating fragments of 128-tables, sometimes with table counts, for more variables. (See ersatz-systems.com.)

LET  $\sim$  Not,  $\neg$ ; + Or,  $\vee$ ,  $\cup$ ,  $\sqcup$ ; - Not Or; & And,  $\wedge$ ,  $\cap$ ,  $\sqcap$ ,  $\cdot$ ,  $\otimes$ ; \ Not And;  
 $>$  Imply, greater than,  $\rightarrow$ ,  $\Rightarrow$ ,  $\mapsto$ ,  $>$ ,  $\supset$ ,  $\Rightarrow$ ;  $<$  Not Imply, less than,  $\in$ ,  $<$ ,  $\subset$ ,  $\prec$ ,  $\neq$ ,  $\ll$ ,  $\leq$ ;  
 $=$  Equivalent,  $\equiv$ ,  $:=$ ,  $\Leftrightarrow$ ,  $\leftrightarrow$ ,  $\hat{=}$ ,  $\approx$ ,  $\cong$ ; @ Not Equivalent,  $\neq$ ;  
 $\%$  possibility, for one or some,  $\exists$ ,  $\diamond$ , **M**; # necessity, for every or all,  $\forall$ ,  $\square$ , **L**;  
 $(z=z)$  **T** as tautology,  $\top$ , ordinal 3;  $(z@z)$  **F** as contradiction,  $\emptyset$ , Null,  $\perp$ , zero;  
 $(\%z\>\#z)$  **N** as non-contingency,  $\Delta$ , ordinal 1;  $(\%z\<\#z)$  **C** as contingency,  $\nabla$ , ordinal 2;  
 $\sim(y < x)$  ( $x \leq y$ ), ( $x \subseteq y$ ), ( $x \sqsubseteq y$ );  $(A=B)$   $(A\sim B)$ .

Note for clarity, we usually distribute quantifiers onto each designated variable.

From: Bousso, R.; Susskind, L. (2011). The multiverse interpretation of quantum mechanics. [arxiv.org/pdf/1105.3796.pdf](https://arxiv.org/pdf/1105.3796.pdf)

**Abstract:** We argue that the many-worlds of quantum mechanics and the many worlds of the multiverse are the same thing ... Decoherence -- the modern version of wave-function collapse -- is subjective in that it depends on the choice of a set of unmonitored degrees of freedom, the "environment". ... We argue that the global multiverse is a representation of the many-worlds (all possible decoherent causal diamond histories) in a single geometry.

**Decoherence:** Decoherence.. explains why observers do not experience superpositions of macroscopically distinct quantum states, such as a superposition of an alive and a dead cat. The key insight is that macroscopic objects tend to quickly become entangled with a large number of "environmental" degrees of freedom,  $E$ , such as thermal photons. In practice these degrees of freedom cannot be monitored by the observer. ...

As an example, consider an isolated quantum system  $S$  with a two-dimensional Hilbert space, in the general state  $a|0\rangle_S + b|1\rangle_S$ . Suppose a measurement takes place in a small spacetime region, which we may idealize as an event  $M$ . By this we mean that at  $M$ , the system  $S$  interacts and becomes correlated with the pointer of an apparatus  $A$  [this process is unitary and is referred to as a pre-measurement]:

$$(a|0\rangle_S + b|1\rangle_S) \otimes |0\rangle_A \rightarrow a|0\rangle_S \otimes |0\rangle_A + b|1\rangle_S \otimes |1\rangle_A; \quad (1.1.1)$$

$$\text{LET } \begin{array}{cccc} p, & q, & r, & s \\ a|0\rangle_S, & b|1\rangle_S, & |0\rangle_A, & |1\rangle_A. \end{array}$$

$$((p+q)\&r)\>((p\&r)+(q\&s)); \quad \text{TTTT TTF} \text{T TTTT TTTT} \quad (1.1.2)$$

Eq. 1.1.2 as rendered is *not* tautologous, thereby refuting pre-measurement, decoherence, and hence the conjecture of multiverse quantum mechanics.