

# Refutation of CHSH and a dual reality conjecture

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**Abstract:** The equation for the Clauser-Horne-Shimony-Holt [CHSH] inequality is refuted. Hence a dual reality conjecture for experimental (confirmation or) rejection of observer-independence in the quantum world becomes moot. Therefore the CHSH inequality is a *non* tautologous fragment of the universal logic  $\forall\mathcal{L}4$ .

We assume the method and apparatus of Meth8/ $\forall\mathcal{L}4$  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,  $\vee, \cup$ ; - Not Or; & And,  $\wedge, \cap, \cdot$ ; \ Not And;  
 $>$  Imply, greater than,  $\rightarrow, \Rightarrow, \mapsto, \succ, \supset, \rightsquigarrow$ ;  
 $<$  Not Imply, less than,  $\in, \prec, \subset, \not\subset, \neq, \leftarrow, \preceq$ ;  
 $=$  Equivalent,  $\equiv, :=, \Leftrightarrow, \leftrightarrow, \triangleq, \approx, \simeq$ ; @ Not Equivalent,  $\neq, \sqsubset$ ;  
 $\%$  possibility, for one or some,  $\exists, \diamond, \mathbb{M}$ ; # necessity, for every or all,  $\forall, \square, \mathbb{L}$ ;  
 $(z=z)$  **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;  
 $\sim(y < x)$  ( $x \leq y$ ), ( $x \leq y$ );  $(A=B)$  ( $A\sim B$ );  $(B>A)$  ( $A\sim B$ );  $(B>A)$  ( $A=B$ ).  
 Note for clarity, we usually distribute quantifiers onto each designated variable.

From: Proietti, M.; et al. (2019).  
 Experimental rejection of observer-independence in the quantum world.  
[arxiv.org/pdf/1902.05080.pdf](https://arxiv.org/pdf/1902.05080.pdf) martin.ringbauer@uibk.ac.at

[W]hen the variables  $A_x, B_y$  take values  $a, b \in \{-1, +1\}$ , then the average values  $\langle A_x B_y \rangle \dots$  must obey the Clauser-Horne-Shimony-Holt [CHSH] inequality ... :  $S =$

$$\langle A_1 B_1 \rangle + \langle A_1 B_0 \rangle + \langle A_0 B_1 \rangle - \langle A_0 B_0 \rangle \leq 2 \tag{2.1}$$

$$\begin{aligned} & \sim(\%p>\#p)\langle(((p\&q)\&(r\&s))\langle(\%p>\#p)\rangle)\rangle \\ & \sim((\%p<\#p)\langle(((p\&q)+(p\&s))+((r\&q)-(r\&s))))\rangle); \end{aligned} \tag{2.2}$$

TTTT TTNT TTTT NTNT

Eq. 2.2 as rendered is *not* tautologous. This is the shortest known refutation of the CHSH inequality. What follows is that experimental rejection (or confirmation) of a dual reality conjecture for observer-independence in the quantum world becomes moot.