Quantum clouds

http://tph.tuwien.ac.at/~svozil/publ/2019-Svozil-Chile-pres.pdf
https://arxiv.org/abs/1808.00813

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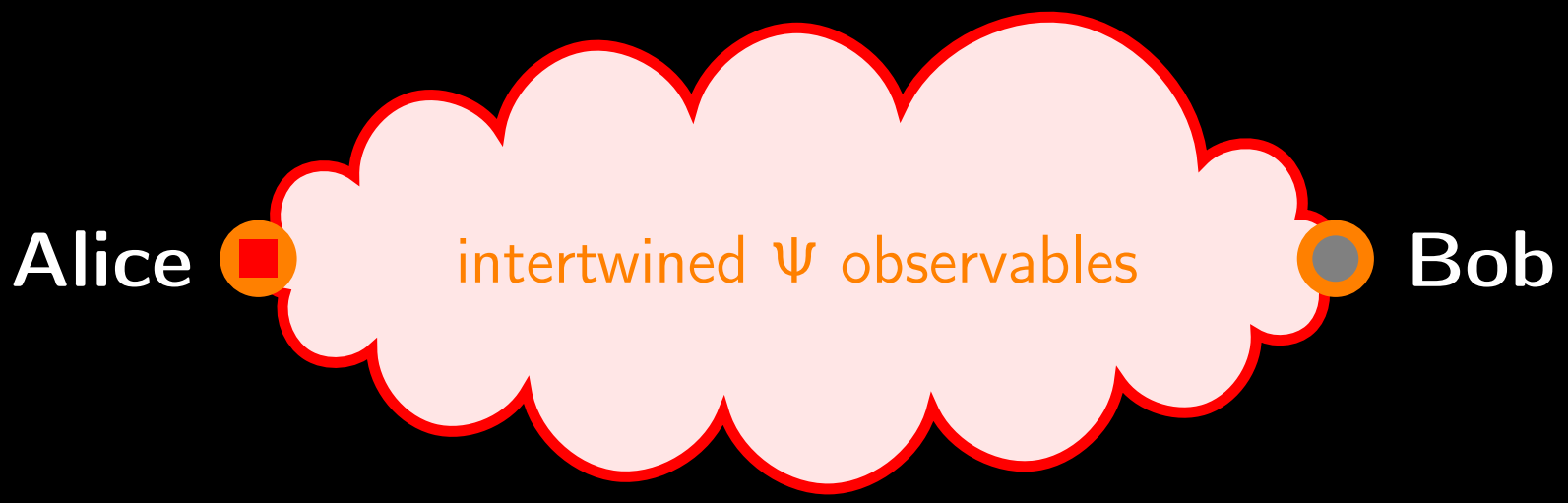
"Soft" obstacles associated with quantum progress

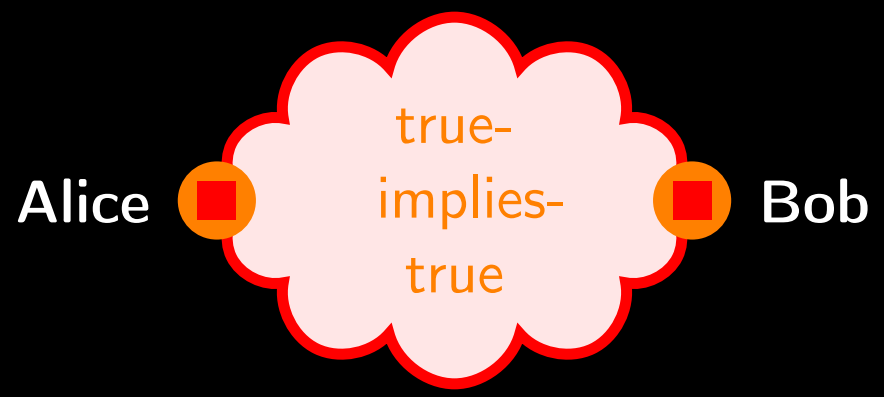
- Who listens to whom? “Pecking order,” “attention economy,” Matthew effect in science (funding) [aka compound interest]” (DOI: 10.1126/science.159.3810.56 & 10.1073/pnas.1719557115)
- Reconstruction of (physical) meaning from detector clicks (eg controversy about “a posteriori quantum teleportation” [aka Kimble versus Zeilinger] DOI: 10.1038/29678 & 10.1038/29674) yield ambiguous or even unsustainable claims (“science marketing”)
- Counterfactuals (Specker DOI 10.1111/j.1746-8361.1960.tb00422.x arXiv:1103.4537): Do “unperformed experiments have no results”? (Peres, DOI 10.1119/1.11393), “how can you measure a proof a [Kochen-Specker] contradiction?” (Clifton, IQSA meeting, personal communication, Prague 1995)
- Mind projection fallacy (Freud 1912, Jaynes 1989)

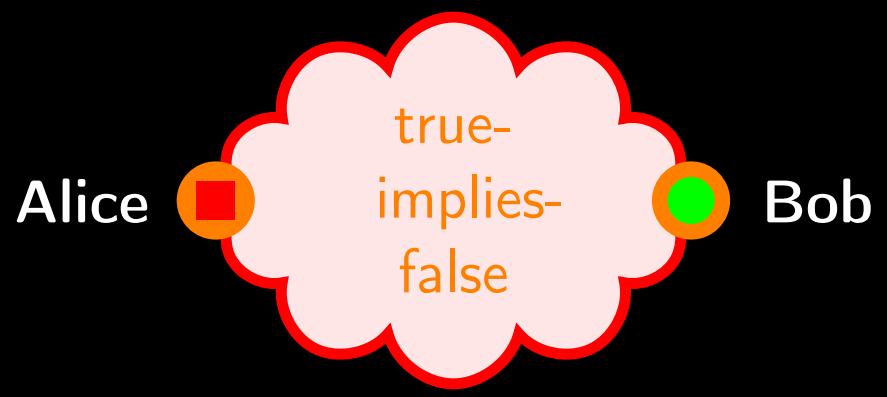
Methods & ways of exploring value (in)definiteness

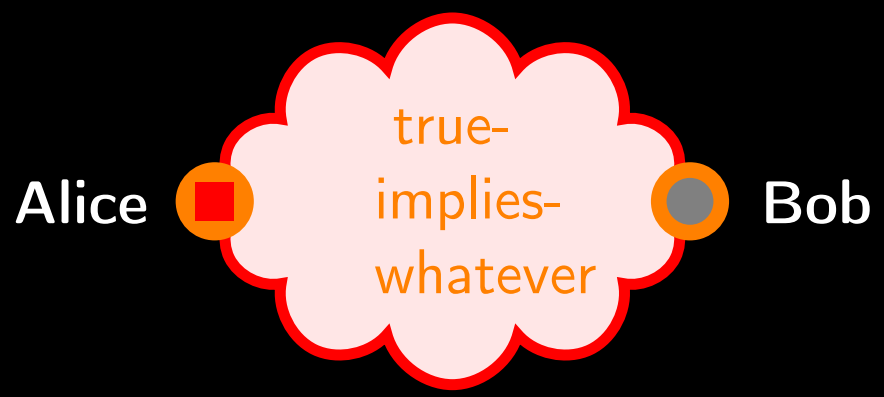
- cloud structure of intertwined contexts/cliques/maximal operators/Boolean subalgebras is quantum,
- predictions about what happens within the cloud, and, in particular, at its endpoints **Alice** & **Bob** are classical

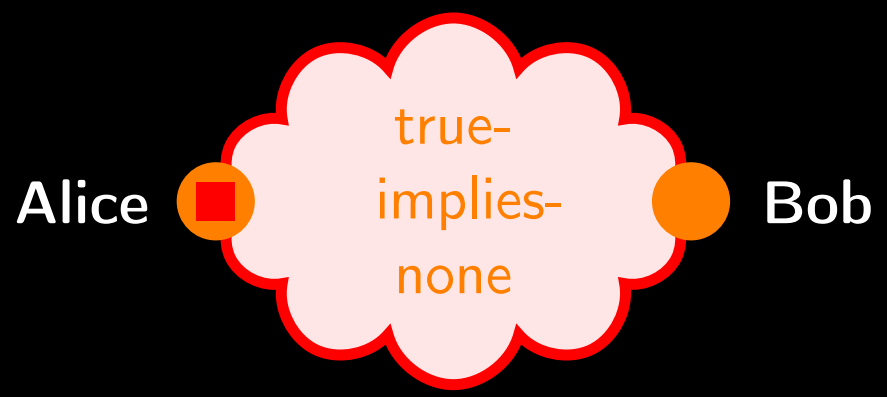


How is $|\mathbf{Bob}\rangle$ given $|\mathbf{Alice}\rangle$? True? False? Whatever? None?

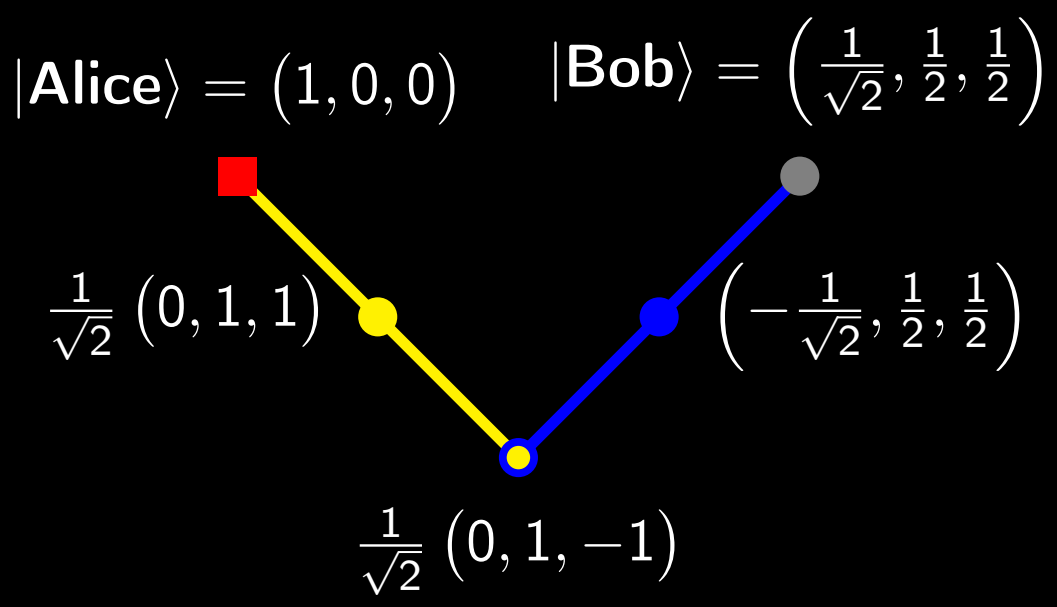






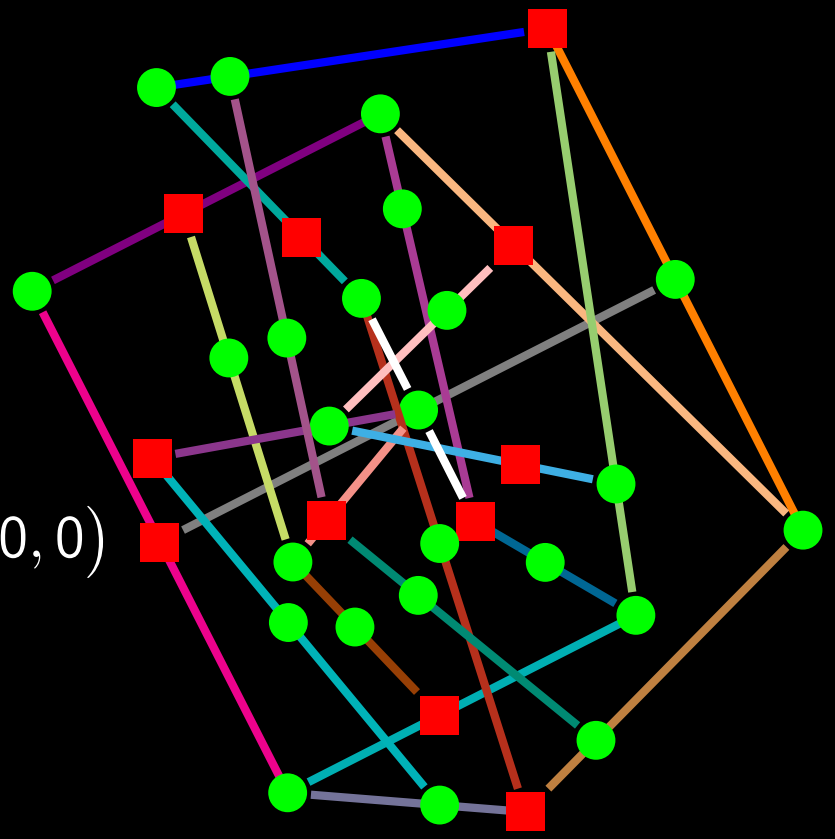


True (1) implies whatever (quantum 50:50)



True (1) implies false (0)

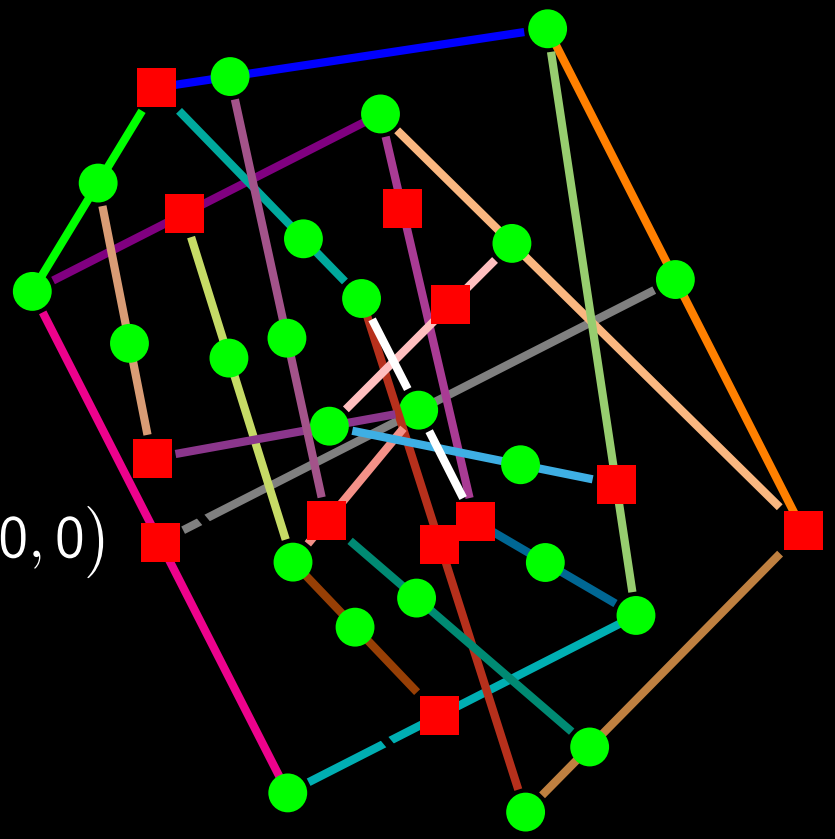
$|\textbf{Alice}\rangle = (1, 0, 0)$



$|\textbf{Bob}\rangle = \left(\frac{1}{\sqrt{2}}, \frac{1}{2}, \frac{1}{2}\right)$

True (1) implies true (1)

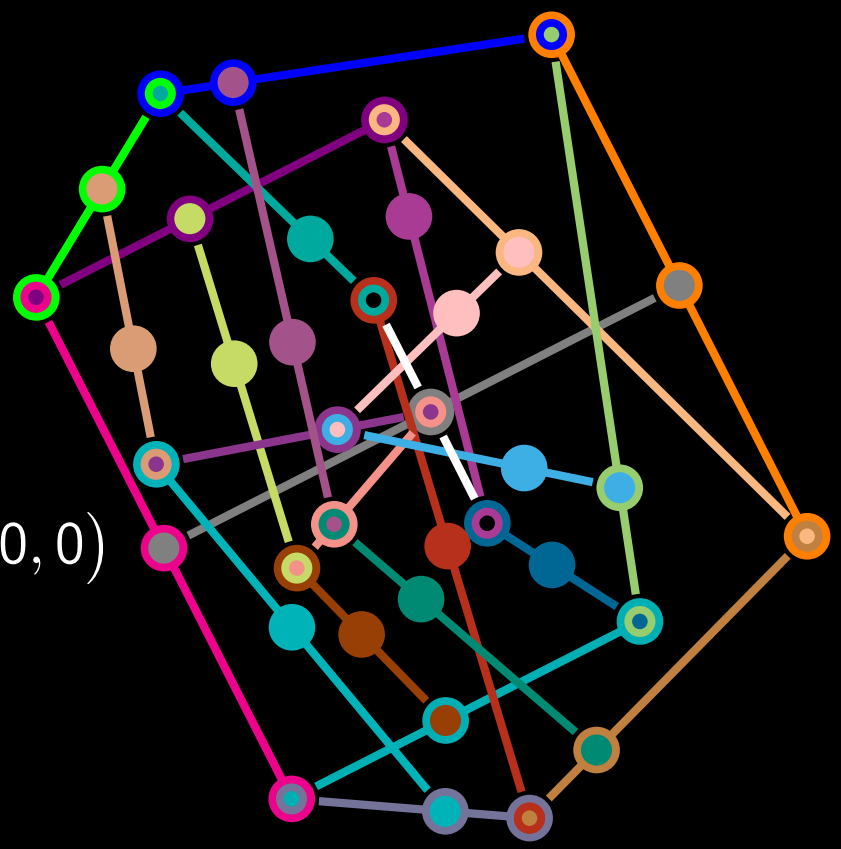
$|\textbf{Alice}\rangle = (1, 0, 0)$



$|\textbf{Bob}\rangle = \left(\frac{1}{\sqrt{2}}, \frac{1}{2}, \frac{1}{2}\right)$

True (1) implies value indefinite (Abbott, Calude, KS 2015)

$|\mathbf{Alice}\rangle = (1, 0, 0)$



$|\mathbf{Bob}\rangle = \left(\frac{1}{\sqrt{2}}, \frac{1}{2}, \frac{1}{2}\right)$

Strategies to obtain value indefiniteness/partiality

The scheme of the construction & proof of partiality of value assignments is as follows:

(i) Find a logic (collection of intertwined contexts of observables) exhibiting a true-implies-false property on the two atoms **a** and **b**.

(ii) Find another logic exhibiting a true-implies-true property on the same two atoms **a** and **b**.

(iii) Then join (paste) these logics into a larger logic, which, given **a**, neither allows **b** to be true nor false. Consequently **b** must be value indefinite.

Extensions of value indefiniteness/partiality

Partiality/value indefiniteness can be extended to any vector **b** non-collinear and non-orthogonal to **a**: Alastair A. Abbott and Cristian S. Calude and KS, "A variant of the Kochen-Specker theorem localising value indefiniteness", Journal of Mathematical Physics, **56**(10), 102201(1-17),2015; https://doi.org/10.1063/1.4931658

For a (in some respects weaker) statement relative to global truth assignments, see Itamar Pitowsky's "Infinite and finite Gleason's theorems and the logic of indeterminacy", Journal of Mathematical Physics **39**(1),218-228, 1998; https://doi.org/10.1063/1.532334

History of contextual sets & elational properties realizable by two-point quantum clouds

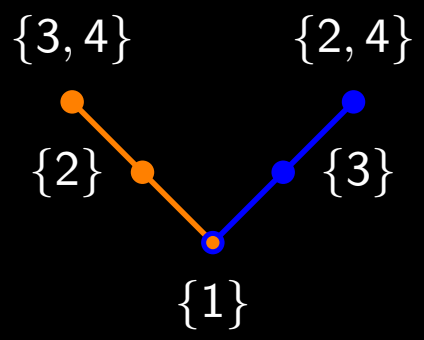
if **a** is true classical value assignments	anectodal, historic quantum realisation	reference to utility or relational properties
imply **b** is independent (arbitrary)	firefly logic L_{12} eg, Cohen, 1989[pp. 21, 22]	
imply **b** false (TIFS)	Specker bug logic KS, 1965 [Fig. 1, p. 182]	Stairs, 1983 [p. 588-589], Cabello et al, 1995 . . . 2018
imply **b** true (TITS)	extended Specker bug logic	KS, 1967 [Γ_1, p. 68], Clifton, 1993 [Sects. II,III, Fig. 1], Belinfante, 73 [Fig. C.l. p. 67], Pitowsky, 1982 [p. 394], Hardy, 1992, 1993, 1997, Cabello et al, 1995 . . . 2018
iff **b** true (nonseparability)	combo of intertwined Specker bugs	KS, 1967 [Γ_3, p. 70]
imply value indefiniteness of **b**	depending on types of value assignments	Pitowsky, 1998, Abbott et al, 2012 . . . 2015

Epistemology/ontology of clouds of intertwined contexts/cliques/maximal observables/Boolean subalgebras

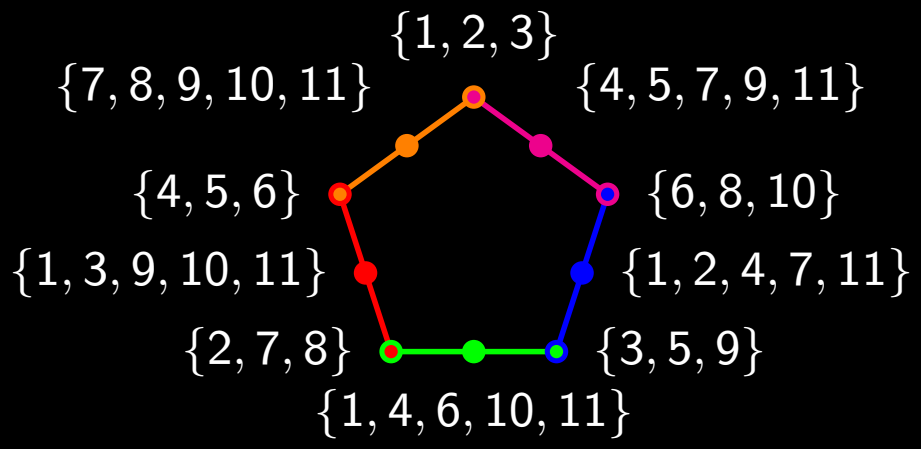
Do clouds "exist" merely in our minds? Do they represent our own subjective imaginations & constructions?

Logic/cloud does not determine the probability

As long as there is a separating set of two-valued states (Kochen-Specker, Theorem 0, DOI: 10.1512/iumj.1968.17.17004) there quasi-classical analogies: partition logics/Wright's generalized urn models/automaton logics; with classical probabilities (convex combinations of 2-valued states): KS arXiv:1810.10423.



(a)



(b)

Quantum realization in terms of the faithful orthogonal representation (Lovász, Saks and Schrijver DOI 10.1016/0024-3795(89)90475-8) and the Theta-body (Grötschel,Lovász and Schrijver DOI: 10.1016/0095-8956(86)90087-0)

Anecdotal examples of "exotic" probability measures satisfying Kolmogorovian classical probabilitie on local contexts

- Wright's (1978) dispersionless measure on the pentagon (or cyclic arrangements of odd contexts ≥ 3
- Godsil and J. Zaks (1988) Coloring the sphere (arXiv:1201.0486) stimulates Meyer's "Nullification" of the Kochen-Specker theorem (DOI: 10.1103/PhysRevLett.83.3751): use unit vectors with rational coefficients: dense but discontinuous (Havlicek, Krenn, Summhammer and KS, DOI: 10.1088/0305-4470/34/14/312)

Thank you for your attention!