Contextuality in quantum theory and beyond

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Contextuality is the impossibility to extend local descriptions of an object to a unified global description.
Four questions

A: Is it big?
B: Is it black?
A': Is it round?
B': Is it heavy?
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\[ A'B' \]
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- B’: Is it heavy?
Liar paradox

- A: B is true.
- B: A' is true.
- A': B' is true.
- B': A is false.
Möbius strip
Quantum theory

- 1900, Planck: energy quantum
- 1905, Einstein: photons
- 1925, Heisenberg, Schrödinger: quantum mechanics
- 1927, Heisenberg: uncertainty principle
- Practice: laser, semi-conductor, GPS
- Theory: quantum cosmology, quantum geometry
- Philosophy: What does quantum theory mean?
- 1935, Einstein-Podolsky-Rosen paradox
- 1964, Bell’s theorems
Einstein-Podolsky-Rosen paradox
Double-detection task
Schröder’s stairs
Rock–Paper–Scissors
Rock–Paper–Scissors

- A: Rock
- B: Scissors
- C: Paper
Rock crushes scissors.
Scissors cut paper.
Paper wraps rock.
No global preference
Side-blotched lizards (*Uta stansburiana*)

Aerts et al. (2014):

\[
\begin{align*}
P(O > B) &= 0.72 \\
P(B > Y) &= 0.82 \\
P(Y > O) &= 0.88
\end{align*}
\]

