Loopholes

Experimental loopholes
Metaphysical loopholes

Detection Loophole

- Photon polarization: not all photons actually arrive

- Outcomes are actually ternary: horizontal, vertical, non-detection

- If QM is true, and we would use usual optimal states and measurements, and detection is completely at random (and independent at the two measurement stations), we would need at least 82% detector efficiency before we could violate a Bell inequality

Coincidence loophole

- We don't predetermine times of *emission* of photons

- Two detections in each wing of the experiment are considered a pair, if they arrive at times less than some prechosen time interval ("the coincidence window") delta apart

Solution to coincidence loophole

- Use a pre-fixed lattice of time-slots of width delta

- Use a martingal test (ie count only those time slots when there is one detection in both wings)

Solution to detection loophole

- In photonics experiments, we now have photo-detectors with 75% efficiency

- It turns out that we can violate Bell provide we go to different states and measurements: Eberhard inequality, Peter Bierhorst proof, Vienna and NIST experiments