A team of researchers affiliated with several institutions in China has developed a form of the board game Go using entangled photons. They have posted a paper to the arXiv preprint server describing their game and explaining why they believe their setup could be used as a baseline for creating other quantum-based games.

Go is a board game somewhat resembling checkers—it is played on a square board filled with a grid of boxes, though it involves black and white stones instead of red and black discs. Two players take turns placing stones on the vertices of the squares, rather than within them. The goal for each player is to enclose more of the board than their opponent—rival pieces can be captured by encircling them on all orthogonally adjacent points. At first glance, the game appears simple, but a closer look shows that high levels of play can arise due to complexity. In this new effort, the researchers sought to increase the complexity of Go by adding a quantum element. Instead of using stones, they used entangled photons and instead of each player laying down a single stone, players laid down a pair of entangled photons. In the quantum version of the game, both of the entangled photons remain in play on the virtual board until contact occurs with another photon. At that point, only one of the entangled photons remains in play. Adding entangled photons increases the complexity of the game because adding pairs doubles the number of possible configurations. And that, of course, makes it more difficult for both players to work out their next move. In quantum Go, players can still capture an opponent's stone (photon) by encircling it—with one exception—the stone must not be in an entangled state. Making things even more interesting, the player will not know beforehand if the stone is entangled—if it turns out to be, the encircling is nullified and the stone remains on the board.

The researchers created a version of quantum Go using entangled photons and found that in continuously generating entangled photons as play progressed, they were able to introduce a random element to the game, which, they note, is required...
to build ever more powerful AI systems able to play sophisticated games with an element of randomness, such as poker.

arxiv.org/abs/2007.12186

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