Re: entanglement question

Source: http://sci.tech−archive.net/Archive/sci.physics/2004−09/5727.html

---

From: John Denker (*jsd_at_av8n.com*)
Date: 09/13/04

```
Date: 13 Sep 2004 17:34:33 GMT
```

Paul Kelly wrote:
> from a humble chemist; as I understand it, if you have two entangled
> particles (a) and (b) and measure a property of particle (a) this
> instantaneously, and "spookily", determines the property of particle (b), no
> matter how far away it is. Measurement of (b)'s property would confirm
> this.
> But what if the two measurements − of particle (a) and particle(b) − were
> done instantaneously? (a) and (b) would both try to exert a spooky action at
> once...

A refinement: If you want to keep the nitpickers at bay, you shouldn't say "instantaneous". Instead say "at a spacelike separation" ... which means sufficiently quickly and sufficiently far apart that no signal from one measurement−site can arrive in time to influence the other measurement, because of the limitations of relativistic causality, i.e. no signals can travel faster than the speed of light.

Subject to that emendation, the question is an excellent one. A lot of very sharp physicists have asked the question, and some even did the experiment to check whether the theory gave the right answer. (Spoiler: it does.)

What you find is that the theory does not predict that any "action" is "exerted". Instead the theory predicts a slightly spooky _correlation_. The correlation is enforced even across spacelike separations.

Here's the classical analogy. (The quantum refinement will follow). Roll a die. The number on top is random. The number on the bottom is also random. They are however correlated. (They always add up to 7, in case you hadn't noticed.) The top−number is just as random as the bottom number. Classically, you can see how the correlation is enforced: the top of the die is locked to the bottom of the die, and if grab one side of the die and try to flip it to a new number, the other side will find out about it at the speed of sound if not faster.

You can also set up partial correlations. For instance the number on the north side of the die is partially correlated with the number on the top of the die.

For the corresponding QM experiment, the "top" number is entirely random, and the "bottom" number is also entirely random ... but they are correlated. Under ideal conditions you can have 100% correlation, or you can arrange partial correlation if you want (like the top/north correlation exhibited by the die).

O