What is being detected in Bell-test experiments

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Abstract:

In Bell-test experiments the projection of spinvectors of entangled electrons is detected.
To get the right results the perspective of the electrons has to be taken into account. It must also be assumed that electrons of entangled pairs have fixed opposite spin. Based on these assumptions the QM correlation in Bell-test experiments is perfectly explicable.

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In Bell-test experiments the projection of spinvectors (onto detector planes) is being detected, not the spinvectors themselves. Spinvectors of electrons of entangled pairs point in exact opposite directions in space. Is one detector (A) detecting the projection of spin of one elektron of an entangled pair then the other detector (B) detects the projection of spin of the other electron of that pair.

A detector is a plane with a direction (the detecting direction), a centre and a central perpendicular plane perpendicular to the detecting direction. The detecting direction of a detector is adjusted by rotating the plane (in itself) around its centre. Of course the central perpendicular plane rotates along.

Detectors are placed in a parallel position. If the detection direction of B is adjusted at φ° with respect to A then the angle between their central perpendicular planes is also φ°. The spaces between the central perpendicular planes are vectorspaces. Spinvectors of an entangled pair are both situated in those vectorspaces or they are both not situated in those spaces. In the case that the vectors are both in the spaces, the spinvector of the electron detected by A can find itself above the cetral perpendicular plane of A and then the spinvector of the electron detected by B finds itself above the perpendicular plane of B or the spinvector of the electron detected by A can find itself beneath the central perpendicular plane of A and then the spinvector of the electron detected by B finds itself beneath the central perpendicular plane of B. In this situation the detectors are not yet placed perpendicular to the direction of movement of the electrons (line of motion). There is also no detection taking place yet. Until now only the position of the detectors is established. Now the detectors have to be placed perpendicularly on the line of motion (or the line of motion perpendicularly to the detectors) in such a way that the centres of both detectors are on the line of motion. This can be achieved by choosing a random line in the plane of a detector through the centre. This is going to be the line of motion. Perpendicularly to that line, also in the plane of that detector and through the centre, a second line is chosen. This second line is the axis around which the first line rotates 90° to get perpendicularly to the detectors. The line of motion is now perpendicularly to the detectors. But now the perspective of the electrons has been rotated 90° and to make the vectorspaces correspond to the perspective of the electrons, they also have to rotate 90° around the same axis. Of course we could have started from the line of motion and have the detectors rotated 90°. Then the vectorspaces would have stayed in their position but also in that case the new spaces between the perpendicular planes of the detectors (after perpendicular positioning) would find themselves perpendicularly to the original vectorspaces (before perpendicular positioning).

In whatever way the detectors are being put perpendicular on the line of motion, the positions of the detectors with respect to the line of motion define in only one way vectorspaces (before perpendicular positioning) in which pairs of spinvectors are situated who, projected onto the detectorplanes (after perpendicular positioning), will give results of equal spin. The spinvectors who are situated in the original vectorspaces (before perpendicular positioning) above the central perpendicular plane of a detector, will give a result of positive (+) spin and the spinvectors who are situated in the original vectorspaces beneath the central perpendicular plane of a detector, will give a result of negative (–) spin. Vectors don't need to 'know' in which space they are situated, or to 'remember' from which space they came. We just have to take into account the perpendicular positioning in the explanation for the detection of spin: from the perspective of the electrons the spaces between the central perpendicular planes of the detectors are the original spaces between the central perpendicular planes before the detectors have been put perpendicularly to the line of motion. Those are not the spaces between the central perpendicular planes after the detectors have been put perpendicularly to the line of motion (the detecting position).

The projection of the vectors onto the detectorplanes is caused by the movement of the electrons. They project their spinvectors in the direction of their movement perpendicularly onto the detectorplanes. Therefor the placing of the detectors perpendicularly to the line of motion is an essential action in the experiment.

The electronpairs whose opposite spinvectors are situated in the original vectorspaces between the central perpendicular planes, will show to A as well as to B an equal spin and thus cause a combination of results of equal spin. It can be demonstrated mathematically that the chance for a spinvector from the original vectorspace to arrive, after projection, on the part of the detectorplane which is defined by the projection of that vectorspace on the detectorplane, is given by

$$(1 - \cos^2(\varphi / 2)).$$

This is the chance of equal spin results by both detectors. So, although spin of a certain electronpair is opposite, there is yet a chance for a combination of results of A and B to be equal.

The chance of a combination of results of opposite spin, then, is the chance for a spinvector from the remaining vectorspace to arrive, after projection, on the remaining part of the detectorplane. This chance is: $1 - (1 - \cos^2(\varphi / 2))$. This is $\cos^2(\varphi / 2)$.

Correlation is defined as chance of equal spin result minus chance of opposite spin result. This is $1 - 2\cos^2(\varphi / 2) = - \cos \varphi$.This result accords with the predictions of Quantum Mechanics and that is to be expected because Quantum Mechanics describes the electrons and so gives the results of the experiment from the perspective of the electrons.

So the result of the detection of a spinvector by a detector is + or – . The result is + if the concerning spinvector was situated above the central perpendicular plane of the detector (before perpendicur positioning) and the result – if the concerning spinvector was situated beneath the central perpendicular plane of the detector (before perpendicular positioning). The combination of results of A and B is equal if the opposite spinvectors were situated in the vectorspaces between the central perpendicular planes of the detectors (before perpendicular positioning). This goes for A as well as for B.

Detectors detect the projection of spinvectors onto the detectorplanes and with that they give as result the chance of a combination of equal spin result and the chance of a combination of opposite spin result for each entangled pair of electrons. These chances are exclusively depending on the adjustment of the detectors as is to be seen in the formula for the correlation: $C = - \cos \varphi$. There are no numbers of electronpairs with equal spin and numbers of electronpairs with opposite spin detected. Indeed there are no electronpairs with equal spin. Entangled electronpairs only have opposite spin as experiments clearly show.

This model is beautifully demonstrated in the You Tube video: Correlation in Bell-test Experiments explained.

The realization of what is happening in Bell-test experiments gives a clear view on the way Quantum Mechanics is to be interpreted. The dispute between Einstein and Bohr, concerning the properties of quanta, is settled in favour of Einstein.