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Relativistic Bell correlations and accelerations

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In quantum mechanics, the phenomenon described by the situation of two particles correlated in such a way that when the spin of one is measured, the other is immediately known, is called quantum entanglement. This phenomenon was first described by Einstein in an argument put forth in the now famous EPR paper to express his misgivings and what he saw as the fundamental problems with quantum mechanics. Einstein believed that one should be able to describe the correlations in the context of classical local realism. The debate was largely philosophical until John Bell, in 1964, wrote a paper that proposed a way to settle the matter experimentally. Bell, derived an inequality, now called the Bell inequality, which holds for all such correlations that can be described by classical local realism and put forward what is now called Bell's theorem. Quantum mechanics itself predicts that Bell's inequality should be violated, which it is as shown by experiment. However, Bell only calculated the theorem in the case of non-relativistic quantum mechanics. More recently, there have been some authors who have found that the Bell correlations would be modified in relativistic frames, although the maximal violation of Bell's inequality is still preserved in a different set of directions. The directions in which the maximal violation of Bell's inequality is conserved in the relativistic frames are rotated with respect to each other from the usual non-relativistic case through an angle called the Wigner angle. The Wigner angle is related two the velocity of one inertial frame with respect to the centre of momentum frame of the two particles. If such an effect on the correlation between the two particles can be observed between two inertial frames then it stands to reason that a precessional effect could be observed on Bell observables if the particles are accelerating. This precessional effect is called the Thomas Precession and we argue that we could possibly use it to detect forces between the particles.

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