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Experimental Demonstration of Fermion Spin Correlations ROBERT CLOSE, Clark College — Bell's Theorem places limits on correlations between local measurements of particles whose properties are independent of measurement. In particular, Bell's Theorem limits the mean product of binary spin measurements at 45° (or 135°) separation to be $|P| \leq 0.5$. However, Bell's Theorem is not valid for spins sampled on a spherical distribution because the density of sampled states depends on the sampling location. We model spin-1/2 fermions as azimuthally symmetric spherical standing waves with one hemisphere of spin up and one hemisphere of spin down. We experimentally determine the spin correlation for 45° separation by randomly placing two points with fixed separation on a ball marked with lines of latitude. The normalized product of spins is +1 if the two points are on the same side of the equator, and −1 if the points are on opposite sides of the equator. The expected correlation (mean product) is $P = 1 - 45/90 = 0.5$. Correcting for the lack of azimuthal symmetry in the experimental ball increases the expected correlation in our model to approximately $P = \cos 45° \approx 0.71$, inconsistent with Bell's Theorem but consistent with experimental measurements on entangled spin-1/2 fermions.

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