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Orbital Angular Momentum in the Nucleon

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More than 20 years ago the EMC found the spin carried by quarks in the proton to be significantly less than $1/2$. Twenty years of extensive research has not discovered where the rest of the nucleon's angular momentum resides. Lattice gauge calculations have not uncovered a promising route to the solution to this dilemma. As angular momentum must be conserved the missing spin must reside somewhere. More than a decade ago DIS and Drell-Yan experiments revealed a sizable asymmetry in the sea of the nucleon. This asymmetry is not found in existing lattice gauge calculations. The size of the measured asymmetry and its x dependence convincingly demonstrate that the flavor asymmetry is due to the pionic fluctuations of the nucleon. These pionic fluctuations carry a significant amount of orbital angular momentum aligned along the proton spin, accounting for some of the missing spin not found on partons.