Spin in Quantum Field Theory

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I introduce spin in field theory as a characteristically quantum concept, by emphasizing the close connection between quantum field theory and quantum mechanics.

First, I show that the spin-statistics connection can be derived already in quantum mechanics, and relate this to the fiel-theoretical derivation.

Then, I discuss path integrals for spin. I show that spin can be quantized without introducing anticommuting variables, already at the nonrelativistic level, but that only for relativistic particles a nontrivial coupling of spin and momentum appears. This leads to a discussion of spinning one-particle states as Poincare irreps.

Finally, I discuss how relativistic spin leads to the quantum breaking of a classical symmetry, namely, the axial anomaly: I introduce the quantum mechanical origin of this effect, and its field-theoretical realization