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Decomposition of the proton spin from lattice QCD

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The origin of the proton spin has attracted a lot of attention since the first surprising result from the European Muon Collaboration about 30 years ago. We present a significant step towards solving the proton spin puzzle. The calculation is done using $N_f = 2 + 1 + 1$ twisted mass fermions directly at the physical point. Both gluon and quark contributions to the proton spin are evaluated, where the latter are computed in high precision for both valence and sea quarks. The renormalization is performed non-perturbatively taking into account the mixing between the gluon and quark operators. We will present results for the up, down, strange and charm quark momentum fractions, intrinsic spin, angular momentum, and orbital angular momentum as well as the gluon contributions.

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