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## Fermion coupling in Loop Quantum gravity

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In the model of a fermion field coupled to loop quantum gravity, we consider the Gauss and the Hamiltonian constraints. According to the explicit solutions to the Gauss constraint, the fermion spins and the gravitational spin networks intertwine with each other so that the fermion spins contribute to the volume of the spin network vertices. For the Hamiltonian constraint, the regularization and quantization procedures are presented in detail. By introducing an adapted vertex Hilbert space to remove the regulator, we propose a diffeomorphism covariant graph-changing Hamiltonian constraint operator of the fermion field. This operator shows how fermions move in the loop quantum gravity spacetime and simultaneously influences the background quantum geometry. Moreover, as an innovation of our work, introducing the vertex Hilbert space also fixes issues so that a densely defined symmetric Hamiltonian constraint operator can be obtained. (Jerzy Lewandowski, Cong Zhang, arXiv:2112.08865)

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