

## Exact formulation of the quantum scalar constraint in LQG

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Several new applications for LQG will be presented. The first one is a new quantum representation of the gravitational scalar constraint. In this representation, for the first time in the literature, the quantum  $C(N)$  itself preserves the Hilbert space for every lapse function  $N$ . Owing to that property, solutions to the quantum constraints of vacuum GR can be well defined by the spectral decomposition and set a physical Hilbert space. Our representation admits also a new proposal of the quantum physical Hamiltonian of the Rovelli-Smolín model of gravity coupled to the massless Klein-Gordon time field. The third application we propose, is a new operator for the quantum Hamiltonian of the Klein-Gordon Scalar field coupled to LQG. Our new framework captures the degrees of freedom of the scalar field lost in the framework in which time is deparametrized by the scalar field.

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