

Revisiting loop quantum gravity with selfdual variables

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We consider the quantization of gravity as an $SL(2, \mathbb{C})$ gauge theory in terms of Ashtekar's selfdual variables and reality conditions for the spatial metric (RCI) and its evolution (RCII).

We start from a holomorphic phase space formulation and consider holomorphic cylindrical wave functions over $SL(2, \mathbb{C})$ connections. We use an overall phase ambiguity of the complex selfdual action to obtain Poisson brackets that mirror those of the real theory. We then show that there is a representation of the corresponding canonical commutation relations the space of holomorphic cylindrical functions.

We describe a class of cylindrically consistent measures that implements RCI. We also consider a regularization of RCII and show that there are no solutions in the class of measures that we are considering.

We end with a comparison to the literature and some general observations on the consistency of reality conditions, commutation relations and use of holonomies as basic variables.

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