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Effect of loop quantization prescriptions on the physics of non-singular gravitational collapse

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We study some consequences of the loop quantization of the outermost shell in the Lema\^itre–Tolman–Bondi (LTB) dust spacetime using different quantization strategies motivated by loop quantum gravity. Prior work has dealt with this loop quantization by employing holonomies and the triads, following the procedure in standard loop quantum cosmology. In this work we compare this quantization with the one in which holonomies and gauge-covariant fluxes are used. While both of the quantization schemes resolve the central singularity, they lead to different mass gaps at which a trapped surface forms. This trapped surface which is matched to an exterior generalized Vaidya spacetime disappears when the density of the dust shell is in the Planck regime. We find that the quantization based on holonomies and gauge-covariant fluxes generically results in an asymmetric evolution of the dust shell in which the mass associated with the "white hole" is about 2/3 of the "black hole" for an external observer. Further, unlike the quantization using only holonomies, there can be situations in which only a black hole forms without its white hole twin. These turns out to be a distinct phenomenological signature distinguishing these two quantization prescriptions.

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