Singularity avoidance for collapsing quantum dust in the Lemaître–Tolman–Bondi model

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We investigate the fate of the classical singularity in a collapsing dust cloud. For this purpose, we quantize the marginally bound Lemaître–Tolman–Bondi model for spherically-symmetric dust collapse by considering each dust shell in the cloud individually, taking the outermost shell as a representative. Because the dust naturally provides a preferred notion of time, we can construct a quantum mechanically model for this shell and demand unitary evolution for wave packets. It turns out that the classical singularity can generically be avoided provided the quantization ambiguities fulfill some weak conditions. We demonstrate that the collapse to a singularity is replaced by a bounce followed by an expansion. We finally construct a quantum corrected spacetime describing bouncing dust collapse and calculate the time from collapse to expansion.