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Must space-time be singular?

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According to Einstein's theory of general relativity space-time singularities such as a big bang may occur. Moreover, the Penrose-Hawking theorems showed that such singularities are actually generic. It has been believed that a quantum theory for gravity might avoid such singularities. The answer will of course depend on which approach to quantum gravity one considers. It will also depend on which version of quantum theory one adopts. In this talk, we will consider the question in the context of the Bohmian version of quantum mechanics, for the special case of a homogeneous and isotropic universe. According to the Bohmian approach there is an actual space-time metric. So one immediate virtue of this approach is that the question in our title is well-posed, having the same meaning as in Einstein's theory. We show that there is a non-zero probability for the space-time to be non-singular in the case of the Wheeler-DeWitt approach to quantum gravity, while it is one in the case of loop quantum gravity. This is in contrast to the consistent histories approach to quantum theory which predicts a singularity for the Wheeler-DeWitt approach with probability one.

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