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What Happened Before the Big Bang?

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In general relativity, it is meaningless to ask what happened before the big bang because this is the moment when time itself came into existence. How the initial state arose that set up the expanding universe, or what exactly happened at that initial time are questions which cannot be answered by general relativity. In this theory, the big bang appears as a mathematical singularity: a time when the dynamical equations for a changing universe break down. Only by extending the theory by equations which do not break down can we reliably see what the earliest stages of the universe may have looked like. A commonly expected extension is to combine general relativity with quantum features. Cosmological models analyzed in this context show the emergence of repulsive forces in a small and dense universe, which prevent the formation of a singularity. Instead, the universe did have a pre-history prior to the big bang where the universe collapsed before bouncing into the expanding phase we see now. Detailed mathematical derivations combined with sensitive observations may some day allow us to obtain glimpses of our universe at and before the big bang.

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