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Polychronic Tunneling

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The quantum tunneling in quantum field theory has attracted theoretical and phenomenological interests for a long time. Although it has been nearly established in the absence of gravity, there are subtleties in the presence of gravity. We re-formulated quantum tunneling with the Wheeler-deWitt equation and found that there is a possibility that a system may experience both Euclidean and Lorentzian evolution simultaneously. It allows us to consider a new class of tunneling processes having Euclidean evolution in one region and Lorentzian evolution in the others. We found that such a process can have a much higher tunneling rate than that of the well-known process with the Coleman-De Luccia bounce. We also found that the processes exist even in the decoupling limit of gravity and remain important at a low energy scale.

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