A Stochastic Differential Equation with a Unique (up to Indistinguishability) but not Strong Solution

Abstract:
Fix a filtered probability space and a Brownian motion $B$ on that space and consider any solution process to a stochastic differential equation SDE (1). A well-known theorem states that pathwise uniqueness implies that the solution to SDE (1) is strong, i.e., it is adapted to the $\mathbb{P}$-completed filtration generated by $B$. Pathwise uniqueness means that, on any filtered probability space carrying a Brownian motion and for any initial value, SDE (1) has at most one (weak) solution. We present an example that if we only assume that, for any initial value, there is at most one solution process on the given space, we can no longer conclude that the solution $X$ is strong.
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