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Non-exotic modified gravity wormholes and closed timelike curves

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The flaring-out condition at a wormhole's throat is a fundamental aspect of wormhole physics, which, in the context of classical general relativity, leads to a violation of the null energy condition. In this work, we explore the broadest possible conditions under modified gravity, where the matter threading the wormhole throat satisfies the energy conditions. In fact, it is the higher-order curvature effects, interpreted as a gravitational fluid, that sustain these non-standard wormhole geometries. Our analysis demonstrates that wormholes can theoretically exist without requiring exotic matter, but rather within the framework of modified gravity. Interestingly, these non-trivial geometries have the potential to generate closed timelike curves, thus posing challenges to the concept of causality. Given that causality is central to the formulation of physical theories, the prospect of time travel and the resulting paradoxes demands careful scrutiny. This presentation will address these critical issues in detail.

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