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Extra-dimensional theory and phenomenology in the era of gravitational waves

Now that we find ourselves in the epoch of gravitational-wave (GW) astronomy, we can explore new avenues by which to test general relativity (GR) and search for extra dimensions. As a first step, we consider the quasinormal mode (QNM) spectrum of a 4D Schwarzschild black hole embedded in a 7D partially-compactified space-time of mixed scalar curvature. This allows us also to explore the properties of a space-time under-represented in the Beyond the Standard Model literature whose higher-dimensional part is a nilmanifold (twisted torus) characterised by negative Ricci curvature. We compute the QNM frequencies in this setup using three numerical techniques and import constraints from the LIGO-Virgo-KAGRA collaboration to place bounds on a possible observable from extra dimensions. Our next step is to study the finite temperature effective potential of a simplified 5D model to determine if a first-order phase transition is possible, as well as strong enough to generate a detectable GW signature.

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