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Detecting new forces in the gravitational wave background

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Supermassive black hole binaries generate a gravitational wave background that will soon be measured by pulsar timing arrays. While the amplitude of this background is uncertain, the shape of its spectrum is a robust prediction of general relativity. We show that the effects of new forces beyond the Standard Model can modify this prediction and introduce unique features into the spectral shape. As a benchmark scenario, we study the case in which the black holes themselves are charged under a new long-range force, which occurs naturally in many dark sector models. In this situation, we find that pulsar timing arrays can detect the effects of such a force on the spectral shape even if typical charges are small, making the shape a powerful new probe of fundamental physics.

Summary

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