

Black Holes beyond General Relativity and the Standard Model

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According to General Relativity, astrophysical black holes are remarkably simple and their properties are determined by just two quantities, their mass and their angular momentum. Gravitational waves and other strong gravity observations promise to probe the nature of black holes more precisely than ever before. Any observed deviation from the simple description General Relativity provides can reveal the existence of new fundamental fields, which would signal a paradigm shift in theoretical physics, astrophysics, and cosmology. I will use the well-studied case of one additional new scalar field, coming from either an extension of the Standard Model or of General Relativity itself, as a case study to discuss three questions: Can new physics leave an imprint on black holes? If yes, which observations are more sensitive to this new physics? And, are all black holes the same?