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White Paper and Roadmap for Quantum Gravity Phenomenology in the Multi-Messenger Era

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Abstract

The unification of quantum mechanics and general relativity has long been elusive. Only recently have empirical predictions of various possible theories of quantum gravity been put to test. The dawn of multi-messenger high-energy astrophysics has been tremendously beneficial, as it allows us to study particles with much higher energies and travelling much longer distances than possible in terrestrial experiments, but more progress is needed on several fronts. A thorough appraisal of current strategies and experimental frameworks, regarding quantum gravity phenomenology, is provided here. Our aim is twofold: a description of tentative multimessenger explorations, plus a focus on future detection experiments. As the outlook of the network of researchers that formed through the COST Action CA18108 “Quantum gravity phenomenology in the multi-messenger approach (QG-MM)”, in this work we give an overview of the desiderata that future theoretical frameworks, observational facilities, and data-sharing policies should satisfy in order to advance the cause of quantum gravity phenomenology.

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