THE CHINESE UNIVERSITY OF HONG KONG
Department of Physics
SEMINAR

Gravitational-Wave Tests of General Relativity with METRICS

by

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ALL INTERESTED ARE WELCOME
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Abstract

Many of the gravitational-wave signals detected by the LIGO-Virgo-KAGRA detectors end with exponentially decaying waves emitted by the remnant black holes formed by the corresponding binary black-hole coalescence. The frequencies and lifetimes of these decaying waves are called quasinormal mode frequencies, and they are closely related to the dynamics of the spacetime near the horizon of the remnant black hole. In this connection, detecting black-hole quasinormal modes is a powerful probe into the nature of gravity. However, the challenge of computing quasinormal mode frequencies has meant that quasinormal-mode tests of gravity have remained largely statistical and model-independent. In this talk, I will introduce Metric pErTuRbations wIth speCtral methodS (METRICS) [1], a novel spectral code capable of accurately computing the quasinormal mode frequencies of black holes, including those with modifications beyond Einstein's theory or the presence of matter. I will demonstrate METRICS' accuracy in calculating quasinormal mode frequencies within general relativity as a validation. Then, I will show the results of the first accurate computations of the quasinormal-mode frequencies of rapidly rotating black holes in Einstein-scalar-Gauss-Bonnet gravity [2, 3] and dynamical Chern-Simons gravity. Finally, I will discuss how the METRICS frequencies can be used to test different gravity theories by analyzing gravitational waves.

[1]: Phys. Rev. D 109, 044072 (2024)
[2]: Phys. Rev. Lett. 133, 181401 (2024)
[3]: Phys. Rev. D 110, 064019 (2024)

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