Contribution ID: **9**   Type: **Presentation (CLOSED)**

Tidal response of black holes

Friday 14 June 2024 13:40 (20 minutes)

Tidal Love numbers encode gravitational response to external tidal fields generated by companions. These depend on the structure of the gravitating object, such as a black hole or a neutron star, and in a binary coalescence are measurable in the last stages of the inspiral before the merger. Quite strikingly, the black hole tidal Love numbers are zero. By now, they have been calculated for Schwarzschild, Reissner-Nordstrom, and Kerr black holes. Several of these calculations are reviewed here. Special emphasis is given to the case of Kerr black holes, where the Love numbers have been a matter of debate. Zero tidal and nonzero dissipative Love numbers for Kerr black holes have been obtained. This computation, however, relies on a specific regularisation scheme, namely analytic continuation in the harmonic quantum numbers. Here, the response of the Kerr-Newman black holes to charged scalar field perturbations is described. This is used to obtain the Kerr Love numbers for scalar field perturbations in the zero-charge limit. The black hole charge serves as a regularisation parameter and, unlike the analytic continuation approach, this procedure is physically well-defined. Zero tidal and nonzero dissipative Love numbers are obtained in full agreement with the method of analytic continuation.

Field of study

Quantum Physics

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Session Classification: Presentations