



GRAVITY: CHALLENGES BEYOND GENERAL RELATIVITY

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New methods in black hole perturbation theory

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I will introduce a new method to study perturbations around black holes, using the black hole's characteristic (quasinormal, quasibound or superradiant) modes. The new method hinges on a new relativistic product, under which modes are orthogonal. Using this product, one can derive the analog of time-dependent and independent perturbation theory in quantum mechanics. I will present a first application: the calculation of the self-gravitational frequency shift in a superradiant boson cloud, in closer agreement with numerical relativity than the non-relativistic “gravitational atom” approximation. The approach has many other practical applications, in gravitational-wave astronomy and beyond general relativity.

Presenter: SBERNA, Laura