Title: Modified gravity theories and future observations in astrophysics and cosmology

Authors: Hugo Roussille (APC), Karim Noui (Institut Denis Poisson), David Langlois (APC)

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Abstract: General relativity is the most successful theory of gravity yet proposed. It has been tested at several scales in many systems, from the corrections to planet movements in the solar system to the emission and propagation of gravitational waves by a binary black hole. Yet in order to propose an explanation to the accelerated expansion of the universe, one can simply add a "cosmological constant" Λ to the theory. This parameter corresponds to a mysterious "dark energy" that would drive the expansion. However, the measured value for Λ has never been explained by a theoretical model: all predicted values for this constant are many orders of magnitude higher than what is found in the experiments. Therefore, new theories of gravity have emerged, in order to have the same predictions as general relativity while explaining the expansion by another mechanism. We study a subset of these theories, called "DHOST theories", in which gravity is coupled to a scalar field that represents a new degree of freedom. This scalar field appears in the action with higher derivatives, which allow mechanisms mimicking the accelerated expansion of the universe. More precisely, we study black hole solutions in these theories and how the gravitational waves emitted by binary black holes would differ from the profile predicted by general relativity. Such differences could be detected by the next generation of gravitational waves detectors, for example LISA.