

Title : Dark energy and its effects on black holes and other cosmic structures

Abstract : In this talk, I discuss some aspects of spacetimes endowed with dark energy. The dark energy, or the so called anti-gravity, can be thought of as an exotic matter field having negative pressure that creates repulsive effects, necessary to drive the observed accelerated cosmic expansion. The simplest and remarkably successful dark energy model is just a positive cosmological constant, Λ . After a brief review, I discuss two natural length scales of such spacetimes - the cosmological event horizon and the maximum turn around radius. The first is a causal boundary setting an upper limit of the length scale of the universe we may observe. The second is the upper limit of the radius of a cosmic structure with a given mass, determined by the point where the attraction due to the mass gets balanced with the repulsion due to Λ . Despite a positive cosmological constant's remarkable simplicity and most overwhelming phenomenological success, its observed value is far and far less than the estimation from particle physics. This so called cosmological constant problem, along with the lack of so far observational evidence of any dark matter particle candidate, have motivated people to consider alternatives of Einstein's theory and the Λ . With this background, I next briefly discuss some of the works I have done in this direction -- for both Einstein and some alternative dark energy/gravity models. I discuss aspects of field configurations outside a black hole event horizon (the no hair theorems) and the effect of the cosmological event horizon on that, as an outer boundary. For the non-black hole large scale cosmic structures like the superclusters, I present simple expressions of the aforementioned maximum turn around radius for the Brans-Dicke and the cubic galileon model and discuss some interesting consequences/phenomenological constraints. I also provide examples where, the cosmological event horizon as a faraway boundary, could affect the local physics considerably, having no analogue in spacetimes with negative or vanishing cosmological constant. I end with mentioning my ongoing works and interesting future arenas to be pursued.