Nonlinear gravitational waves as dark energy in warped spacetimes

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On a warped five-dimensional Friedmann-Lemaître-Robertson-Walker(FLRW) spacetime, dark energy can be induced by a U(1) scalar-gauge field on the brane. We consider a zero effective cosmological constant, i.e., the Randall-Sundrum(RS) fine-tuning and no bulk matter fields. The standard model fields interact via the bulk Weyl tensor and cause brane fluctuations. Due to the warp factor, disturbances don't fade away during the expansion of the universe. The late-time behavior could be significant deviate from the standard evolution of the universe. The effect is triggered by the time-dependent part of the warp factor with two branches and the modified brane equations. The self-gravitating cosmic string builds up a huge mass per unit length in the bulk and can induce massive KK-modes felt on the brane. From a non-linear perturbation analysis, i.e., the so called multiple-scale method, it is found that the effective Einstein equations contain a "back-reaction" term on the righthand side caused by the projected 5D Weyl tensor and can act as a dark energy term. The propagation equation to first order for the (φ,φ) metric component is triggered by the disturbances coming from the bulk disturbances and is amplified by the warp factor.

Keywords: Dark energy; Brane world models; U(1) scalar-gauge field; Self-acceleration; Multiple-scale analysis

References

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