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Dark energy with vector fields in the generalized SU(2) Proca theory

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The cosmological observations are consistent with a homogeneous and isotropic universe at large scales which favours the use of scalar fields as generators of the primordial and late inflationary periods. However, in the Standard Model of Particle Physics, whose action is invariant under SU(3)C × SU(2)L × U(1)Y local transformations, there exist vector fields which are the messengers of the fundamental interactions and that could serve as the driving force behind the cosmological inflationary periods. We have studied the vector-tensor variant of the Horndeski theory, when the action enjoys a global SU(2) symmetry, which is called the generalized SU(2) Proca theory. In particular, we have analyzed the Einstein-Hilbert plus the Yang-Mills Lagrangian plus the Lagrangian piece that contains products of two covariant derivatives of the vector field and that is reduced, in the Abelian case, to products of the S tensor (the symmetric version of the gauge field strength tensor). We have found an asymptotic behaviour, for an ample spectrum of initial conditions, where an eternal inflationary period is generated with an effective equation of state $\omega = -1$, which would represent the current behaviour of dark energy. Unfortunately, this mechanism fails at describing the thermal history of the universe , since the radiation- and matter-dominated periods are, essentially, inexistent.

Authors: Mr NAVARRO LEÓN, Andrés Américo (USTA & UIS (Colombia)); RODRIGUEZ GARCIA, Yeinzon (UAN & UIS (Colombia))

Presenter: Mr NAVARRO LEÓN, Andrés Américo (USTA & UIS (Colombia))

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