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Positivity Bounds for Effective Field Theories with Spontaneously Broken Lorentz Invariance

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Positivity Bounds are a very powerful tool to impose constraints on the parameters of low energy effective field theories (EFTs). Starting from the assumption that an EFT admits a UV completion which satisfies Lorentz Invariance, Locality and Unitarity, one can derive a set of inequalities that must be satisfied by the Wilson coefficients of the low energy theory. In the Lorentz Invariant scenario, the S-matrix, with its analytic structure, is the object that provides the link between IR and UV physics. In particular, Cauchy's theorem allows to relate quantities evaluated within the EFT regime of validity, to an integral whose sign is fixed by Unitarity.
The last decade saw an increasing effort towards the extension of the positivity program in the cosmological scenario. The implementation of the positivity arguments to the cosmological context would imply the formulation of a set of theoretical priors which would affect cosmological parameter constraints and explicitly illustrate the impact on a specific EFT for Dark Energy. However, such an extension is highly non-trivial and complicated, due to the spontaneous breaking of Lorentz Invariance that characterizes the cosmological setup. This leads to serious conceptual and technical difficulties which make it extremely challenging to adopt the original approach to the Lorentz Breaking scenario.
Recently, Creminelli, Jannsen and Senatore (DOI: https://doi.org/10.1007/JHEP09(2022)201) proposed the first promising approach towards a successful implementation of these bounds on EFTs with spontaneously broken Lorentz invariance.
In this talk, I will review the state of the art of the positivity arguments. I will comment the key ideas of the seminal paper by Addams et al. (DOI: 10.1088/1126-6708/2006/10/014) and discuss the difficulties that arise whenever one wants to extend the positivity logic to the study of effective field theories with spontaneously broken Lorentz invariance, which is the focus of my current PhD research.

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