Positive Signs in Modified Gravity

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Effective Field Theories (EFTs) exploit a decoupling between high and low energy scales, allowing us to make useful predictions of large scale cosmological observables without appealing to the underlying UV physics. However, the low energy EFT is not completely blind to the UV—certain physical properties like causality, locality and unitarity at high energies manifest themselves as *constraints* on the low energy EFT. These constraints are particularly important for cosmology and gravity, as they are able to rule out large regions of parameter space on purely theoretical grounds (i.e. only certain regions could ever make physical sense at high energies), complementing and strengthening our ever-improving experimental tests.

In this talk, I will review recent progess in using these connections between the IR and the UV to constrain our IR model-building [1, 2]. In particular, a recent application of positivity constraints as theoretical priors on a Monte Carlo Markov Chain analysis has improved the experimental constraints on Horndeski scalar-tensor models by a factor of 100 [3]. And this is just using our current CMB, BAO, matter power spectrum and RSD data (Planck/SDSS/BOSS/6dF)—as our future cosmological measurements increase in precision, the role of positivity in determining good theoretical priors will play a crucial part in strengthening our data analysis, improving our observational constraints, and guiding our theories of modified gravity.

References

[1] C. de Rham, **S. Melville**, A. J. Tolley and S.-Y. Zhou, *Positivity bounds for scalar field theories*, *Phys. Rev.* **D96** (2017) 081702,

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[3] **S. Melville** and J. Noller, *Positivity in the sky*, in prep. (2019)