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Understanding causality in the effective field theory of gravity

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Effective field theory (EFT) is a theory-agnostic approach to understanding how high-energy phenomena would manifest in our low-energy universe. It is an expansion in higher-dimension operators built out of light fields with unknown coefficients. These coefficients can either be constrained through experiment or by demanding consistency with theoretical expectations, such as causal wave propagation. In dynamical gravitational EFTs, where there is no globally defined lightcone, defining causality is a nuanced problem. In this talk, using Gauss-Bonnet gravity as an example, I will explain why the recently introduced "infrared" causality is the correct criterion for determining consistency of low-energy EFTs. The crucial ingredient will be properly identifying the "regime of validity" of the EFT expansion, and recognising that it is only sensible to ask whether it is causal within that regime. Based on arXiv:2112.05031.

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