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Evidence for the history of cosmic expansion

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The cosmic expansion function, quantifying how the relative cosmic expansion rate developed in cosmic history, is one of two central and (almost) directly observable properties of our Universe. From a theoretical point of view, the expansion function is determined by the time evolution of all forms of matter and energy density in the Universe. Empirically, it enters into all distance measures and into the growth function describing the evolution of cosmic structures. I will first summarize the empirical information available on the expansion function and then show that the expansion function is tightly contrained without the need to specify any cosmological model. Adopting a metric theory of gravity and the usual symmetries of spatial isotropy and homogeneity suffice to determine the expansion function quite precisely. With little further assumptions, also the growth function is empirically tightly constrained. Such empirical limits on these two functions which are independent of any particular cosmological model, are to a large degree also valid for alternative theories of gravity.

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