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Bootstrapping large graviton non-Gaussianities

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Gravitational interferometers and cosmological observations of the cosmic microwave background offer us the prospect to probe the laws of gravity in the primordial universe. To study and interpret these datasets we need to know the possible graviton non-Gaussianities. To this end, we derive the most general tree-level three-point functions (bispectra) for a massless graviton to all orders in derivatives, assuming scale invariance. Instead of working with explicit Lagrangians, we take a bootstrap approach and obtain our results using the recently derived constraints from unitarity, locality and the choice of vacuum. Since we make no assumptions about de Sitter boosts, our results capture the phenomenology of large classes of models such as the effective field theory of inflation and solid inflation. We present formulae for the infinite number of parity-even bispectra. Remarkably, for parity-odd bispectra, we show that unitarity allows for only a handful of possible shapes: three for graviton-graviton-graviton, three for scalar-graviton-graviton and one for scalar-scalar-graviton, which we bootstrap explicitly. These parity-odd non-Gaussianities can be large, for example in solid inflation, and therefore constitute a concrete and well-motivated target for future observations.

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