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A new look at multi-gravity and dimensional deconstruction

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It has long been understood that certain theories of ghost free massive gravity and their multi-graviton extensions can be thought of as arising from a higher dimensional theory of gravity, upon discretising the extra dimension. However, this correspondence between standard multi-gravity and extra dimensional gravity holds only when one discretises the extra dimension *after* gauge fixing the lapse function associated to the various lower dimensional hypersurfaces. The lapse provides crucial structure to the extra dimensional theory: in pure general relativity (GR), it ensures full diffeomorphism invariance of the theory, and enforces its Hamiltonian constraint. Thus, upon deconstruction, important information related to the extra dimension is missing in the resulting multi-gravity theory; as a result, one could never hope to recover higher dimensional GR in its entirety upon taking the appropriate continuum limit. In this talk, I develop an improved deconstruction procedure that maintains the free lapse, and show that the correct deconstructed theory should actually be multi-gravity equipped with additional dynamical scalar fields, whose field equations encode the Hamiltonian constraint in the extra dimensional theory; I use the example of Randall-Sundrum brane cosmology to demonstrate this correspondence explicitly. This opens up a number of interesting avenues for studies of new and potentially viable theories of modified gravity, as well as providing a means by which one may begin to rephrase questions more typically asked in the context of extra dimensions in a purely 4-dimensional language.

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