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Gravity is Different –Counterexamples to the Wilsonian Paradigm of Low Energy Effective Theory

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The physical world is hierarchical. Kenneth Wilson mathematically formulated this idea in the language of effective theory. For each energy scale, there is a set of laws called an effective theory that describes physical phenomena at that scale, and we can be ignorant of more fundamental laws at higher energies. For example, the pion theory is an effective theory of QCD; we do not need to know details of QCD to discuss pion physics at energies far below the QCD scale. The basic assumption is that, as long as an effective theory satisfies consistency conditions that are evident at the applicable scale, it can be derived from a more fundamental and mathematically consistent theory at higher scales. In this talk, I will show that this assumption is false with gravity by presenting several counterexamples. These are conditions that any gravitational effective theory must satisfy, but which are not obvious from low-energy considerations alone.

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