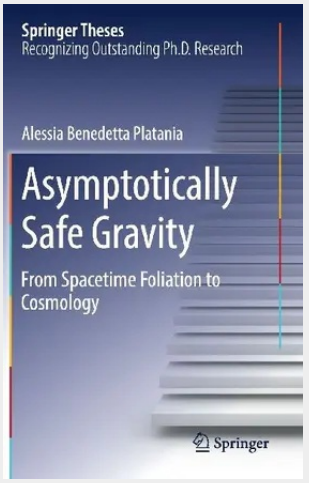
Platania

Asymptotically Safe Gravity

From Spacetime Foliation to Cosmology



This book seeks to construct a consistent fundamental quantum theory of gravity, which is often considered one of the most challenging open problems in present-day physics. It approaches this challenge using modern functional renormalization group techniques, and attempts to realize the idea of “Asymptotic Safety” originally proposed by S. Weinberg. Quite remarkably, the book makes significant progress regarding both the fundamental aspects of the program and its phenomenological consequences. The conceptual developments pioneer the construction of a well-behaved functional renormalization group equation adapted to spacetimes with a preferred time-direction. It is demonstrated that the Asymptotic Safety mechanism persists in this setting and extends to many phenomenologically interesting gravity-matter systems. These achievements constitute groundbreaking steps towards bridging the gap between quantum gravity in Euclidean and Lorentzian spacetimes.The phenomenological applications cover core topics in quantum gravity, e.g. constructing a phenomenologically viable cosmological evolution based on quantum gravity effects in the very early universe, and analyzing quantum corrections to black holes forming from a spherical collapse.As a key feature, all developments are presented in a comprehensive and accessible way. This makes the work a timely and valuable guide into the rapidly evolving field of Asymptotic Safety.

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