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Sweeping vacuum gravitational waves under the rug

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Stellingen

behorende bij het proefschrift

Sweeping Vacuum Gravitational Waves Under The Rug

1. We do not have separately access to *classical quantities* and *quantum corrections*: all physical observations are necessarily fully quantum corrected quantities.
Chapter 1
2. Finite inflation can cure infrared divergences, but it does not eliminate the need to renormalize divergences arising in the coincidence limit.
Chapter 3
3. Bounds on the effective number of relativistic species at the time of Big Bang nucleosynthesis cannot constrain vacuum gravitational waves.
Chapter 4
4. The analytical treatment of quantum tensor perturbations, also called vacuum gravitational waves, should be different from that of gravitational waves originating from astrophysical sources.
Chapters 4 and 6
5. “How are we to make physical sense out of a divergent result?” Renormalization techniques must be used in order to extract meaningful results from infinite quantities.
N. D. Birrell and P. C. W. Davies, *Quantum Fields in Curved Space*, (1984).
6. The renormalized effective stress energy tensor for the linearized gravitational field is necessary to study back-reaction effects due to graviton production around a black hole. Furthermore, it can be used to study gravitons in the early universe.
B. Allen, A. Folacci and A. C. Ottewill, *Phys. Rev. D*, 38, 1069 (1988)
7. The quantum field theory formulation of general relativity has a really bad reputation, however, even if there are remaining problems, quantum general relativity can be successful if treated as an effective field theory.
J. F. Donoghue, M. M. Ivanov and A. Shkerin, arXiv:1702.00319[hep-th]
8. Detecting any gravitational wave background in the future will offer insights on the fundamental high-energy theory describing the early universe, as it is a probe of energy scales that extend beyond the sensitivity of particle accelerators.
C. Caprini and D. G. Figueroa, *Class. Quant. Grav.*, 16, 35 (2018)
9. It is not a trivial task to identify problems that are both relevant and solvable at a given moment in history. In the words of Weinberg: “forgive yourself for wasting time”.
S. Weinberg, *Nature*, 426, 389 (2003)

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