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Fakeons, microcausality and quantum gravity: the FLRW metric

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Under certain assumptions, it is possible to make sense of higher derivative theories by quantizing the unwanted degrees of freedom as fakeons, which are later projected away. Then the true classical limit is obtained by classicizing the quantum theory. Since quantum field theory is formulated perturbatively, the classicization is also perturbative. After deriving a number of properties in a general setting, we consider the theory of quantum gravity that emerges from the fakeon idea and study its classicization, focusing on the FLRW metric. We point out cases where the fakeon projection can be handled exactly, which include radiation, the vacuum energy density and the combination of the two, and cases where it cannot, which include dust. Generically, the classical limit shares many features with the quantum theory it comes from, including the impossibility to write down complete, “exact” field equations, to the extent that asymptotic series and nonperturbative effects come into play.

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