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Adrià Delhom · Alejandro Jiménez Cano · Francisco José Maldonado Torralba

Instabilities in Field Theory

A Primer with Applications in Modified Gravity

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Preface

Modified theories of gravity usually present new degrees of freedom, as well as higher order derivatives, wrong signs in certain terms and complicated couplings, either in the original Lagrangian or originated by the field redefinitions needed to reach an Einstein frame. As a consequence, they are very prone to present dynamical instabilities that could spoil any attempt to construct viable models within these frameworks. In this book, we introduce the most common types of instabilities that appear in field theory as well as some techniques to detect them, and supplement these contents with several examples. The goal is to understand the implications of having such behaviors and the application of these notions to modified theories of gravity.

This text is an extended and polished version of the lectures prepared for the course "Selected Topics in the Theories of Gravity", given at the Institute of Physics (University of Tartu, Estonia) in spring 2022.

The last chapter contains part of the results presented in recent peer-reviewed publications by the authors.

In order to follow the lectures smoothly, the reader is expected to have previous knowledge on differentials equations and classical field theory. For the last chapter, it is useful to have already some background in General Relativity theory.

For a better understanding, we included a list of exercises related to the topics introduced, and their solutions are provided at the end of the book.

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