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Dynamical dimensional reduction in multi-valued Hamiltonians

Several physical systems of interest in cosmology, such as the Lovelock extension of general relativity in higher dimensions, k-essence fields, Horndeski theories, and nonlinear electrodynamics, have apparent ill-defined symplectic structures, due to the fact that their Hamiltonians are multivalued functions of the momenta. In this talk, based on the paper [PRD 105, 084064 (2022)], the dynamical evolution generated by such Hamiltonians is described as a degenerate dynamical system, whose symplectic form does not have a constant rank, allowing novel features and interpretations not present in previous investigations, which could lead to remarkable consequences on the evolution of dark matter models and modified gravity theories. In particular, it is shown how the multivaluedness is associated with a dynamical mechanism of dimensional reduction, as some degrees of freedom turn into gauge symmetries when the system degenerates.

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