ID contributo: **172** Tipo: **Poster**

Complete one-loop renormalization-group equations in the seesaw effective field theories

martedì 18 giugno 2024 17:30 (2 ore)

We derive the complete set of one-loop renormalization-group equations (RGEs) for the operators up to dimension-six (dim-6) in the seesaw effective field theories (SEFTs). Two kinds of contributions to those RGEs are identified, one from double insertions of the dimension-five (dim-5) Weinberg operator and the other from single insertions of the tree-level dim-6 operators in the SEFTs. A number of new results are presented. First, as the dim-5 Weinberg operator is unique in the standard model effective field theory (SMEFT), its contributions to the RGEs for the SEFTs are equally applicable to the SMEFT. We find the full contributions from the Weinberg operator to one-loop RGEs in the SMEFT, correcting the results existing in previous works, and confirm that those from dim-6 operators are consistent with the results in the literature. Second, in the type-I SEFT, we give the explicit expressions of the RGEs of all the physical parameters involved in the charged- and neutralcurrent interactions of leptons. Third, the RGEs are numerically solved to illustrate the running behaviors of the non-unitary parameters, mixing angles and CP-violating phases in the non-unitary leptonic flavor mixing matrix. Together with the one-loop matching results of the dim-5 and dim-6 operators and their Wilson coefficients, the present work has established a self-consistent framework up to dim-6 to investigate low-energy phenomena of three types of seesaw models at the one-loop level.

Poster prize

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Classifica Sessioni: Poster session and reception 1

Classificazione della track: Theory of neutrino masses and mixing, Leptogenesis