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Testing noncommutative spacetimes and violations of the Pauli Exclusion Principle through underground experiments

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Abstract: We propose to deploy limits that arise from different tests of the Pauli Exclusion Principle in order: i) to provide theories of quantum gravity with an experimental guidance; ii) to distinguish among the plethora of possible models the ones that are already ruled out by current data; iii) to direct future attempts to be in accordance with experimental constraints. We firstly review experimental bounds on nuclear processes forbidden by the Pauli Exclusion Principle, which have been derived by several experimental collaborations making use of different detector materials. Distinct features of the experimental devices entail sensitivities on the constraints hitherto achieved that may differ one another by several orders of magnitude. We show that with choices of these limits, renown examples of flat noncommutative space-time instantiations of quantum gravity can be heavily constrained, and eventually ruled out. We devote particular attention to the analysis of theκ-Minkowski and θ-Minkowski noncommutative spacetimes. These are deeply connected to some scenarios in string theory, loop quantum gravity and noncommutative geometry. We emphasize that the severe constraints on these quantum spacetimes, although cannot rule out theories of top-down quantum gravity to whom are connected in various way, provide a powerful limitations of those models that it will make sense to focus on in the future.

Keywords: Quantum gravity phenomenology, Tests of Pauli Principle, Underground experiments

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