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Statistical significances for proton decay experiments

Thursday 15 December 2022 14:00 (1 hour)

We study the statistical significances for exclusion and discovery of proton decay at current and future neutrino detectors. Various counterintuitive flaws associated with frequentist and modified frequentist statistical measures of significance for multi-channel counting experiments are discussed in a general context and illustrated with examples. We argue in favor of conservative Bayesian-motivated statistical measures, and as an application we employ these measures to obtain the current lower limits on proton partial lifetime at various confidence levels, based on Super-Kamiokande's data, generalizing the 90% CL published limits. Finally, we present projections for exclusion and discovery reaches for proton partial lifetimes in $p \to \overline{\nu} K^+$ and $p \to e^+ \pi^0$ decay channels at Hyper-Kamiokande, DUNE, JUNO, and THEIA.

Session

Beyond the Standard Model

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