Impact of standard neutrino oscillations and systematics in proton lifetime measurements

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We use atmospheric neutrino phenomenology to obtain the expected background to proton decay in large underground neutrino detectors, like DUNE. We introduced, for the first time in this kind of analysis, the experimentally confirmed neutrino oscillations of the atmospheric neutrino observations which reduce by a factor of 40% the corresponding background for nucleon decay channel $p \to \mu + \pi_0$. Furthermore, we infer the impact of four systematics on such background: the overall efficiency, the muon reconstruction energy resolution, the resonant neutral pion cross- section and the neutral pion angular resolution. Considering a 40 kton detector with efficiency 45%, our analysis leads to an error band in the lower limit for the proton lifetime sensitivity, τ/B, from 7.9×10^{33} years to 1.1×10^{34} years at 90% C.L.. These numbers can be compared with the current mode dependent experimental limits $\tau > 10^{31} - 10^{33}$ years at 90% C.L.