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Investigating the future of proton decay searches using paleo detectors

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Paleo-detectors utilize the fact that mineral lattices can retain deformations in their structure caused by charged particle interactions. We consider the search for proton decay, $p \to \overline{\nu} K^+$, in such detectors via the possible crystal damage produced by the endpoint of the charged kaon. Atmospheric neutrino induced backgrounds render this search impossible on Earth, but in a lunar environment with no atmosphere, this background is significantly suppressed. For a 100g, 10^9 year-old (100kton·yr exposure) piece of lunar olivine, we expect 0.5 kaon endpoints due to atmospheric neutrino backgrounds. If this lunar sample could be acquired and analyzed, the proton decay sensitivity would be $\tau_p \approx 10^{34}$ years, which is competitive with Super-Kamiokande's currently published limit of $\tau_p > 5.9 \times 10^{33}$ years at 90% CL, as well as the projected range of Hyper-Kamiokande and DUNE for the $p \to \overline{\nu} K^+$ channel.

Working Group

WG 5: Neutrinos Beyond PMNS

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