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Search for a neutron dark decay in ${}^6\text{He}$

Neutron dark decays have been suggested as a solution to the discrepancy between bottle and beam experiments, providing a dark matter candidate that can be searched for in halo nuclei. The free neutron in the final state following the decay of ${}^6\text{He}$ into ${}^4\text{He} + n + \chi$ provides an exceptionally clean detection signature when combined with a high efficiency neutron detector. We will report on the results of an experiment performed at GANIL using the unique neutron detector TETRA and the high-intensity ${}^6\text{He}+$ beam. A search for a coincident neutron signal resulted in an upper limit on a dark decay branching ratio of $\text{Br}\chi \leq 4.0 \times 10^{-10}$ (95% C.L.). Using the dark neutron decay model proposed originally by Fornal and Grinstein [1], we translate this into an upper bound on a dark neutron branching ratio of $\mathcal{O}(10^{-5})$, improving over global constraints by one to several orders of magnitude depending on $m\chi$ [2].

References

- [1] B. Fornal and B. Grinstein, Phys. Rev. Lett. 120 (2018) 191801.
- [2] L. Lejoubioux et al., Phys. Rev. Lett. 132 (2024) 132501.

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