

## Search for Dark Matter Decay of the Free Neutron from the UCNA Experiment: $n \rightarrow \chi + e^+e^-$

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The neutron lifetime is currently measured by two different types of experiments: “beam” and “bottle”. These two measurement techniques have a  $4\sigma$  discrepancy in measured lifetime. It has been proposed recently that a previously unobserved neutron decay branch to a dark matter particle ( $\chi$ ) could account for the discrepancy in the neutron lifetime observed in experiments that use two different measurement techniques. One of the possible final states discussed includes a single  $\chi$  along with an  $e^+e^-$  pair. We use data from the UCNA (Ultracold Neutron Asymmetry) experiment to set limits on this decay channel. Coincident electron-like events are detected with  $\approx 4\pi$  acceptance using a pair of detectors that observe a volume of stored Ultracold Neutrons (UCNs). The summed kinetic energy ( $E_{e^+e^-}$ ) from such events is used to set limits, as a function of the  $\chi$  mass, on the branching fraction for this decay channel. For  $\chi$  masses consistent with resolving the neutron lifetime discrepancy, we exclude this as the dominant dark matter decay channel at  $\approx 5\sigma$  level for  $100 \text{ keV} < E_{e^+e^-} < 644 \text{ keV}$ . If the  $\chi + e^+e^-$  final state is not the only one, we set limits on its branching fraction of  $< 10^{-4}$  for the above  $E_{e^+e^-}$  range at  $> 90\%$  confidence level.

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