Neutron Limit on the Strongly-Coupled Chameleon Field[1]

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One of the major open questions of cosmology is the physical origin of the dark energy. There are a few sets of theories which might explain this origin that could be tested experimentally. The chameleon dark energy theory postulates self-interacting scalar field that couples to matter. This coupling induces a screening mechanism chosen so that the field amplitude is nonzero in empty space but is greatly suppressed in regions of terrestrial matter density. On behalf of the INDEX collaboration, I will report the most stringent upper bound on the free neutron-chameleon coupling in the strongly-coupled limit of the chameleon theory using neutron interferometric techniques. In our experiment we measure neutron phase induced by chameleon field. We report a 95% confidence level upper bound on the neutron-chameleon coupling ranging from $\beta < 4.7 \times 10^6$ for a Ratra-Peebles index of $n = 1$ in the nonlinear scalar field potential to $\beta < 2.4 \times 10^7$ for $n = 6$, one order of magnitude more sensitive than the most recent free neutron limit for intermediate n.

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