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Nuclear decay anomalies as a signature of axion dark matter

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A number of nuclear decay anomalies have been reported in the literature, which purport to show periodic variations in the decay rates of certain radioisotopes. If these reports reflect reality, they would necessitate a seismic shift in our understanding of fundamental physics. We provide the first mechanism to explain these findings, via the misalignment mechanism of QCD axion dark matter, wherein oscillations of the effective θ angle induce periodic variation in nuclear binding energies and hence decay rates. As we expect this effect to be most pronounced in low-Q systems, we analyse 12 years of tritium decay data ($Q \simeq 18.6$ keV) taken at the European Commission's Joint Research Centre. Finding no statistically significant excess, we exclude axion decay constants below $9.4 \times 10^{12} - 1.8 \times 10^{10}$ GeV (95 \% confidence level) for masses in the $1.7 \times 10^{-23} - 8.7 \times 10^{-21}$ eV range.

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