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Stability of the IMS Radionuclide Detector Network and Lessons Learnt for Exotic Physics Searches

The diverse range of locations, continuous operation, and system uniformity of the IMS radionuclide network permits an unprecedented opportunity to evaluate long-term systematic effects on HPGe detector stability. An understanding of these effects is often crucial to physics experiments designed to evaluate exotic or anomalous nuclear decays over many years. In a unique effort to investigate reports of anomalous nuclear decay, we evaluate the 152Eu branching ratio for evidence of periodicities over many years using the daily "check source" measurements of multiple IMS Radionuclide Automated Sampler / Analyzer (RASA) detectors. After studying systematic effects across many RASA detectors, we document a number of statistically significant and unexplained periodicities occurring among the measured check source photo-peaks. The implications of these unexplained periodicities are examined in the context of searches for new physical phenomena and related to results of other recent experiments reporting anomalous decays. In addition, we also seek to highlight the applicability of techniques in High Energy Physics and Bayesian analytic methods in the review of IMS detector diagnostics and time-series interpretation of radionuclide data.

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