Calibrating silicon detectors for proton-energy measurements

R. D. Page[1]
[1] *Department of Physics, Oliver Lodge Laboratory, University of Liverpool, Liverpool L69 ZE, United Kingdom*

Precisely measuring the energies of protons emitted in the radioactive decay of nuclei is of paramount importance, given the sensitivity of half-lives for proton emission to the decay energy. Analysis of the pulse heights recorded from the decays of nuclei implanted in silicon detectors demonstrates that corrections often applied to account for the contribution to the energy signal from recoiling daughter nuclei fail to reproduce the data. Correcting for the non-linear response of silicon detectors to low-Z ions improves the agreement, but discrepancies persist. Proton energies have mostly been measured using the proton decays of ^{147}Tm and/or ^{151}Lu as part of the calibration, but the accuracy of these values and the reliability of the deduced reduced proton-decay widths associated with these data are called into question by these findings. Although the impact is expected to be most marked for high-energy proton emitters, the decay energies of all direct proton emitters ought to be re-evaluated using a procedure that accounts for all of the different effects that contribute to the measured pulse heights.