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Auger and X-ray K-shell fluorescence measurements for Sc-44 isomeric decays

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Despite being a well-studied nucleus close to stability, the K-shell X-ray and Auger fluorescence yield for scandium-44 are not very well defined. However, the low-lying nuclear structure of $^{44}_{21}$Sc and its population in ^{44}Ti electron capture decay lends itself to extracting these quantities.

The first two excited states in ^{44}Sc are isomeric and lie at 68 keV and 146 keV with half-lives of 154.8(8) ns and 51.0(3) μs respectively. The 146 keV level is populated by the electron capture decay of ^{44}Ti $>$99% of the time. By carefully measuring coincident K X-rays (at 4-5 keV) and γ decays over several months using an optimised ^{44}Ti source, the half-lives of the isomeric states can be fitted. This allows extraction of the fractional X-ray intensities for the initial electron capture decay as well as the subsequent internal electron conversion that competes with γ emission to de-excite the lowest two ^{44}Sc excited states. Thus, the relative X-ray-to-Auger K-shell fluorescence can be obtained for the three decay processes.

These fluorescence values are being compared to BrIccEmiss [1,2] predictions for which Monte-Carlo simulations and fits to the Evaluated Atomic Data Library (EADL) are combined. The results of this study will be reported.

[1] B.Q. Lee, T. Kibedi, et al., Computational and Mathematical Methods in Medicine (2012).

[2] B.Q. Lee, PhD thesis, Department of Nuclear Physics, The Australian National University (2017).

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