

Something from Nothing: the γ -ray Spectroscopy of ^{231}U

**D.G. Roux¹, R.A. Bark², E.A. Lawrie^{2,3}, J.J. Lawrie², S.S. Ntshangase⁴,
T.S. Dinoko², J.L. Easton², P. Jones², B.V. Kheswa³, N.A. Khumalo³,
S.N.T. Majola^{2,5}, L.P. Masiteng^{2,5}, D. Negi^{2,6}, S.P. Noncolela^{2,3,7},
J.F. Sharpey-Schafer, O. Shirinda², P.C. Uwitonze^{1,8}**

¹Department of Physics and Electronics, Rhodes University,
6140 Grahamstown, South Africa

²iThemba LABS, National Research Foundation,
P.O. Box 722, Somerset West 7129, South Africa

³University of the Western Cape, Department of Physics,
Private Bag X17, Bellville 7535, South Africa

⁴University of Zululand, Department of Physics,
Private Bag X1001, KwaDlangezwa 3886, South Africa

⁵Department of Physics, University of Johannesburg,
P.O. Box 524, Auckland Park 2006, South Africa

⁶Department of Physics, Manipal Institute of Technology,
Manipal Academy of Higher Education, Manipal, Karnataka-576104, India

⁷University of Stellenbosch, Department of Physics, Stellenbosch, South Africa

⁸University of Rwanda, Department of Mathematics, Sciences and Physical Education,
50 Rwamagana, Rwanda

The γ -ray spectroscopy of uranium nuclei far from stability is compromised by large fission cross sections and competition from electron conversion. However, by using a recoil detector to discriminate against the fission background, together with the AFRODITE γ -ray spectrometer array, we have observed the first rotational bands in ^{231}U , to date the lightest odd uranium nucleus shown to exhibit collective structure. Excited states were populated in the $^{232}\text{Th}(\alpha,5n)$ reaction at a beam energy of 52 MeV. The data analysis revealed three rotational bands, interpreted as the ground-state band $\nu[633]5/2^+$, yrast band $\nu[752]5/2^-$, and an excited band $\nu[631]3/2^+$. These configuration assignments are supported by Cranked Shell Model calculations and the electromagnetic properties of the bands. The excitation energy of the $\nu[752]5/2^-$ band head is suggested to be 113.0 keV.