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Spectroscopic factor and proton formation probability for the $d_{3/2}$ proton emitter ^{151m}Lu

F. Wang [a], B.H. Sun [a,*], Z. Liu [b,c,**], R.D. Page [d], C. Qi [e], C. Scholey [f], S.F. Ashley [c], L. Bianco [d], I.J. Cullen [c], I.G. Darby [g], S. Eeckhaudt [f], A.B. Garnsworthy [h], W. Gelletly [c], M.B. Gomez-Hornillos [i], T. Grahn [f], P.T. Greenlees [f], D.G. Jenkins [j], G.A. Jones [c], P. Jones [k], D.T. Joss [d], R. Julin [f], S. Juutinen [f], S. Ketelhut [f], S. Khan [l], A. Kishada [l], M. Leino [f], M. Niikura [m], M. Nyman [n], J. Pakarinen [d], S. Pietri [o], Z. Podolyak [c], P. Rahkila [f], S. Rigby [d], J. Saren [f], T. Shizuma [p], J. Sorri [f], S. Steer [c], J. Thomson [d], N.J. Thompson [c], J. Uusitalo [f], P.M. Walker [c], S. Williams [q], H.F. Zhang [r], W.Q. Zhang [b], L.H. Zhu [a]

[a] School of Physics and Nuclear Energy Engineering, Beihang University, Beijing 100191, China
[b] Institute of Modern Physics, Chinese Academy of Sciences, Lanzhou 730000, China
[c] Department of Physics, University of Surrey, Guildford, Surrey GU2 7XH, UK
[d] Department of Physics, Oliver Lodge Laboratory, University of Liverpool, Liverpool L69 7ZE, UK
[e] KTH, Alba Nova University Center, SE-10691 Stockholm, Sweden
[f] University of Jyvaskyla, Department of Physics, P.O. Box 35, FI-40014 University of Jyvaskyla, Finland
[g] Department of Nuclear Sciences and Applications, International Atomic Energy Agency, A-1400 Vienna, Austria
[h] TRIUMF, 4004 Wesbrook Mall, Vancouver, British Columbia V6T 2A3, Canada
[i] Universitat Politécnica de Catalunya (UPC), 08034 Barcelona, Spain
[j] Department York, York, YO10
[k] Foundation, Box
[l] Building, of Physics of M13
[m] CNS, of Tokyo, Tokyo 351-0100, Japan
[n] European Commission, Joint Research Centre, Institute for Reference Materials and Measurements, Retieseweg 111, B-2440 Geel, Belgium
[o] GSI Helmholtzzentrum für Schwerionenforschung, D-64291 Darmstadt, Germany
[p] Japan Atomic Energy Agency, Tokai, Ibaraki 319-1195, Japan
[q] Nikhef National Institute for Subatomic Physics, University of Amsterdam, Amsterdam, Netherlands
[r] School of Nuclear Science and Technology, Lanzhou University, Lanzhou 730000, China

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ABSTRACT

The quenching of the experimental spectroscopic factor for proton emission from the short-lived $d_{3/2}$ isomeric state in ^{151m}Lu was a long-standing problem. In the present work, proton emission from this isomer has been reinvestigated in an experiment at the Accelerator Laboratory of the University of Jyväskylä. The proton-decay energy and half-life of this isomer were measured to be 1295(5) keV and 15.4(8) μs, respectively, in agreement with another recent study. These new experimental data can resolve the discrepancy in the spectroscopic factor calculated using the spherical WKB approximation. Using the R-matrix approach it is found that the proton formation probability indicates no significant hindrance for the proton decay of ^{151m}Lu.

* Corresponding author.
** Corresponding author at: Institute of Modern Physics, Chinese Academy of Sciences, Lanzhou 730000, China.
E-mail addresses: bhsun@buaa.edu.cn (B.H. Sun), liuzhong@impcas.ac.cn (Z. Liu).

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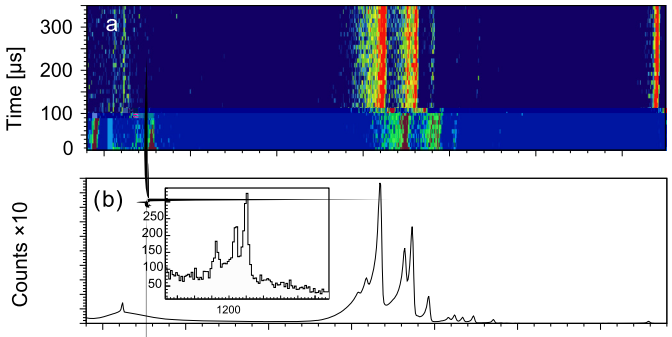
1. Introduction

Proton emission is a quantum tunneling process in which the escaping proton penetrates through a potential barrier consisting of Coulomb and centrifugal potentials. The study of proton decay provides critical spectroscopic information on the proton emitters and the ordering of quantum states of nuclei lying beyond the proton drip line [1–4]. The spectroscopic factor is conventionally employed as a measure of the purity of the single-particle configuration of the initial wave function.

The experimental spectroscopic factor ($S_p^{\exp}$) is usually defined as the ratio


a
300
200
100
0
Time [μs]
(b)
Counts ×10
250
200
150
100
50
1200


151m
151mLuisincreasedfrom0

The decay of the $d_{3/2}$ proton emitters was also discussed in terms of the proton formation probability, a more proper and microscopic quantity to describe the proton-decay process. The extracted proton formation probability for ^{151m}Lu is compared to those in neighboring nuclei, and is found to follow well the general trend of spherical proton emitters.

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