Identification of Isomeric States 'South' of $^{208}$Pb via Projectile Fragmentation

S.J. Steer$^1$, Zs. Podolyák$^1$, S. Pietri$^1$, P.H. Regan$^1$, D. Rudolph$^2$, E. Werner-Malento$^{3,4}$, A.B. Garnsworthy$^{1,5}$, R. Hoischen$^2$, M. Górska$^3$, J. Gerl$^3$, H.J. Wollersheim$^3$, F. Becker$^3$, P. Bednarczyk$^{3,6}$, L. Caceres$^{3,7}$, P. Doornenbal$^3$, H. Geissel$^3$, J. Grębosz$^{3,6}$, A. Kelic$^3$, I. Kojouharov$^3$, N. Kurz$^3$, F. Montes$^3$, W. Prokopowicz$^{3,6}$, T. Saito$^3$, H. Schaffner$^3$, S. Tachenov$^3$, A. Heinz$^5$, M. Pfützner$^4$, T. Kurtukian-Nieto$^8$, G. Benzoni$^9$, M. Hellström$^2$, A. Jungclaus$^7$, L.-L Andersson$^2$, L. Atanalova$^{10}$, D.L. Balabanski$^{11}$, M.A. Bentley$^{12}$, B. Blank$^{13}$, A. Blazhev$^{14}$, C. Brandau$^{1,3}$, J.R. Brown$^{12}$, A.M. Bruce$^{15}$, F. Camera$^9$, W.N. Catford$^1$, I.J. Cullen$^1$, Zs. Dombradi$^{16}$, E. Estevez$^8$, F. Fahlander$^2$, W. Gelletly$^1$, G. Ilie$^{14}$, E.K. Johansson$^2$, J. Jolie$^{14}$, G.A. Jones$^1$, M. Kmiecik$^6$, F.G. Kondev$^{17}$, S. Lalkovski$^{10}$, Z. Liu$^4$, A. Maj$^6$, S. Myalski$^6$, T. Shizuma$^{1,18}$, A.J. Simons$^1$, S. Schwertel$^{19}$, P.M. Walker$^1$, O. Wieland$^9$

$^1$Department of Physics, University of Surrey, Guildford, GU2 7XH, UK
$^2$Department of Physics, Lund University, S-22100 Lund, Sweden
$^3$GSI, Planckstrasse 1, D-64291, Darmstadt, Germany
$^4$IEP, Warsaw University, Hoża 69, PL-00-681
$^5$WNSL, Yale University, New Haven, CT, USA
$^6$The Henryk Niewodniczański Institute of Nuclear Physics, PL-31-342, Kraków, Poland
$^7$Departamento de Física Teórica, Universidad Autonoma de Madrid, E-28049, Madrid, Spain
$^8$Universidad de Santiago de Compostela, E-15706, Santiago de Compostela, Spain
$^9$INFN, and Università degli Studi di Milano, I-20133, Milano, Italy
$^{10}$Faculty of Physics, University of Sofia, Sofia, Bulgaria
$^{11}$Dipartimento di Fisica, Università di Camerino, I-62032, Italy
$^{12}$Department of Physics, University of York, Heslington, York, YO10 5DD, UK
$^{13}$CENBG, le Haut Vigneau, F-33175, Gradignan Cedex, France
$^{14}$IKP, Universität zu Köln, D-50937, Köln, Germany
$^{15}$School of Engineering, University of Brighton, Brighton, BN2 4GJ, UK
$^{16}$Institute of Nuclear Research, H-4001 Debrecen, Pf.51, Hungary
$^{17}$Nuclear Engineering Division, Argonne National Laboratory, Argonne IL-60439, USA
$^{18}$Japan Atomic Energy Agency, Kyoto, 619-0215, Japan
$^{19}$Physik Department E12, Technische Universität München, Garching, Germany

We present the results of an investigation of decays from isomeric states in exotic, neutron-rich nuclei near the doubly-magic nucleus $^{208}$Pb. This study forms part of the Rare Isotope Investigations at GSI (RISING) collaboration with a particular emphasis on isomeric decays in heavy, exotic nuclei. Previously, experimental information was available on the internal structure of $^N=126$ isotones for proton numbers less than 82 (i.e. proton holes in the magic closed shell) only down to $Z=80$; excited states have been reported in $^{207}$Tl and $^{206}$Hg [1]. The nuclei of interest were synthesised in the projectile fragmentation of a 1 GeV/u $^{208}$Pb beam on a thick Be target (2.5 g/cm$^2$). The fragments of interest produced in these reactions were separated and identified in-flight with the GSI FRagment Separator (FRS). The selected reaction products were implanted in a plastic stopper placed at the final focal plane of the FRS and viewed by the 105 germanium crystals of the high-efficiency, high granularity RISING γ-ray spectrometer. Previously unidentified isomeric decays in a number of nuclei in this region will be reported, including excited states in the $N=126$, four-proton-hole nucleus, $^{204}$Pt. The results will be compared with the results of measurements on the previously observed two-proton-hole nucleus $^{206}$Hg [1] and presented together with assignments for structure based on simple shell-model assumptions and systematics of the region.