Study of the superallowed $0^+ \rightarrow 0^+$ $\beta$ decay of $^{70}$Br$^\dagger$

A. I. Morales,$^{*1}$ A. Algora,$^{*1,2}$ B. Rubio,$^{*1}$ K. Kaneko,$^{*3}$ J. Agramunt,$^{*4}$ V. Guadilla,$^{*1}$ A. Montaner-Pizà,$^{*1}$ S. E. A. Orrigo,$^{*5}$ G. de Angelis,$^{*4}$ D. Napoli,$^{*4}$ F. Recchia,$^{*5}$ S. Lenzi,$^{*5}$ A. Bosi,$^{*5}$ S. Nishimura,$^{*6}$ G. Kiss,$^{*6}$ V. H. Phong,$^{*6}$ J. Wu,$^{*6}$ P.-A. Söderström,$^{*6}$ T. Sumikama,$^{*6}$ H. Suzuki,$^{*6}$ H. Takeda,$^{*6}$ D. S. Ahn,$^{*6}$ H. Baba,$^{*6}$ P. Doornebal,$^{*6}$ N. Fukuda,$^{*6}$ N. Inabe,$^{*6}$ T. Isobe,$^{*6}$ T. Kubo,$^{*6}$ S. Kubono,$^{*6}$ H. Sakurai,$^{*6}$ Y. Shimizu,$^{*6}$ C. Sidong,$^{*6}$ B. Blank,$^{*7}$ P. Ascher,$^{*7}$ M. Gerbaux,$^{*7}$ T. Goigoux,$^{*7}$ J. Giovannazzo,$^{*7}$ S. Grévy,$^{*7}$ T. Kurtukian Nieto,$^{*7}$ C. Magron,$^{*7}$ W. Gelletly,$^{*1,8}$ Za. Dombreddi,$^{*7}$ Y. Fujita,$^{*9}$ M. Tanaka,$^{*9}$ P. Aguiler,$^{*10}$ F. Molina,$^{*10}$ J. Eberth,$^{*11}$ F. Diel,$^{*11}$ D. Lubo,$^{*12}$ C. Borcea,$^{*13}$ E. Ganioglu,$^{*14}$ D. Nishimura,$^{*15}$ H. Oikawa,$^{*15}$ Y. Takei,$^{*15}$ S. Yagi,$^{*15}$ W. Korten,$^{*16}$ G. de France,$^{*17}$ P. Davies,$^{*18}$ J. Liu,$^{*19}$ J. Lee,$^{*19}$ T. Lokotho,$^{*19}$ I. Kojouharov,$^{*20}$ N. Kurz,$^{*20}$ and H. Shafin$^{*20}$

One of the core concepts of the Electroweak Standard Model (ESM) is the unitarity of the Cabibbo-Kobayashi-Maskawa (CKM) matrix which describes the mixing between the three families of quarks. Increasingly high-precision measurements of the CKM matrix elements are required to test the limits on any possible physics beyond the ESM. The largest matrix element, the up-down term $V_{ud}$, can be extracted from high-precision measurements of half-lives, masses, and branching ratios of superallowed $\beta$ transitions between $J^P = 0^+$, $T = 1$ analog states starting in $N = Z$ nuclei.\(^1\) In this report we provide the most precise half-life measurement for the $T = 1$ ($J^P = 0^+$) ground state of the heavy self-conjugate nucleus $^{70}$Br and the first estimate of the total branching fraction decaying through the first $2^+$ state in the daughter nucleus, $^{70}$Se.

The $^{70}$Br nuclei were produced in the fragmentation of a $^{78}$Kr primary beam at 345 MeV/nucleon and 38 pnA colliding with a 5-mm thick Be target. After separation and selection in the BigRIPS separator, the nuclei were implanted in the WAS3ABi active stopper, surrounded by the EURICA $\gamma$-ray spectrometer.\(^2\)

Standard delayed-coincidence techniques were applied to study the $\beta$ decay of $^{70}$Br, including an exhaustive evaluation of the factors that could influence the half-life measurement.\(^3\) As an example, Fig. 1 shows the half-life of the $T = 1$ ($J^P = 0^+$) ground state as a function of the fitting range (a) and the $\beta$ threshold (b).

References


---

$^1$ Condensed from the article in Phys. Rev. C 95, 064327 (2017)

$^2$ MTA ATOMKI

$^3$ Department of Physics, Kyushu Sangyo University

$^4$ INFN-Legnaro

$^5$ INFN-Padova

$^6$ RIKEN Nishina Center

$^7$ CEN Bordeaux-Gradignan

$^8$ Department of Physics, Surrey University

$^9$ Osaka University

$^{*10}$ CCHEN

$^{*11}$ Institute of Nucl. Physics, Universität zu Köln

$^{*12}$ Physik Department, Technische Universität München

$^{*13}$ IFIN-HH, Bucarest

$^{*14}$ Department of Physics, University of Istanbul

$^{*15}$ Tokyo Univ. Sci.

$^{*16}$ CEA-Saclay

$^{*17}$ GANIL-Caen

$^{*18}$ Department of Physics, York University

$^{*19}$ Department of Physics, University of Hong Kong

$^{*20}$ GSI, Germany