

# Positronium Lifetime Measurements using $^{82}\text{Rb}$ in a Long-Axial FOV PET/CT Scanner

W. M. Steinberger<sup>1</sup>, H. Sari<sup>3</sup>, L. Mercolli<sup>2</sup>, S. Parzych<sup>4</sup>, S. Niedźwiecki<sup>4</sup>, G. Lapkiewicz<sup>4</sup>, P. Moskal<sup>4</sup>, E. Stępień<sup>4</sup>, A. Rominger<sup>2</sup>, K. Shi<sup>2</sup>, M. Conti<sup>1</sup>

<sup>1</sup> Siemens Medical Solutions USA, Inc., Department of Physics, Knoxville, Tennessee, United States of America

<sup>2</sup> Inselspital, Bern University Hospital, University of Bern, Department of Nuclear Medicine, Bern, Switzerland

<sup>3</sup> Siemens Medical Solutions USA, Inc., Siemens Healthcare AG, Bern, Switzerland

<sup>4</sup> Jagiellonian University, Center for Theranostics, Institute of Physics, Krakow, Poland

## Abstract

This work details results from two positronium (Ps) lifetime measurements performed in a long-axial FOV PET/CT scanner using  $^{82}\text{Rb}$ . Ps lifetime measurements are of interest for PET because they can yield additional diagnostic information. The first measurement placed drops of a  $^{82}\text{Rb}$  solution in between aluminum disks, quartz disks, and into a gelatin mixture. The extracted ortho-Ps (o-Ps) lifetime for the quartz sample was measured to be  $1.53 \pm 0.04$  ns, which agrees well with the previously published value of  $1.56 \pm 0.08$  ns. The lifetime of the aluminum is also compared with previous results, however, the lifetime exhibits a longer o-Ps lifetime due to positrons leaking into the surrounding plastic holder. The second measurement performed assessed the uniformity of the extracted lifetimes across a uniform cylinder ( $20\phi \times 30$  cm<sup>3</sup>) filled with water and an activity of approximately 73.3 MBq. The resulting histo-image was sliced into 1.25 cm thick cross sections, which resulted in lifetime distributions containing on average  $1.98 \times 10^5 \pm 1.06 \times 10^4$  counts. These lifetime distributions were integral normalized and compared to an averaged lifetime across the uniform cylinder. Overall average deviation in the lifetime measured across the cylinder was determined to be  $-0.015 \pm 1.53$  %.

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