Precise Measurement of α_K for the 39.76-keV *E3* transition in ^{103}Rh: Further Test of Internal Conversion Theory

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We have extended our series of precision measurements of internal conversion coefficients (ICC) to include the 39.76-keV, *E3* transition in ^{103}Rh. Our goal has been to test the Dirac-Fock ICC calculations, specifically with respect to the role of the atomic vacancy created in the conversion process. We prepared a sample from pure (natural) ruthenium chloride by converting the sample to ruthenium oxide, electrochemically depositing it on an aluminum backing, and subsequently activating it with thermal neutrons at the Texas A&M TRIGA reactor for 20 hours. Decay spectra were then recorded for roughly 120 hours with a HPGe detector that has been precisely efficiency calibrated (±.15% relative precision). In the acquired spectra, all impurities were identified and corrected for accordingly. A program was written using the ROOT framework developed by CERN to extract the area of the 39.76-keV gamma-ray peak from ^{103}Rh, which partially overlapped the K_α x-ray peaks from a ^{153}Gd impurity. From the ratio of the 39.76-keV peak to the Ruthenium K x rays, we determined a preliminary value for the ICC: α_k(39.76)=134.6(19). This result agrees well with the theoretical calculation including the atomic vacancy, α_k(vacancy)=135.2, and disagrees with the calculation excluding the vacancy, α_k(no vacancy)=127.4. This is consistent with our previous measurements, indicating that the atomic vacancy must be taken into account. Precise ICC values are needed in nuclear databases that are frequently used for basic science and application purposes.