Attempts to Manipulate the Decay Time of Radioactive Nuclei

B. FALLIN, B. GRABOW, W. TORNOW, Duke University / TUNL — It has been known for 20 years that electron screening strongly changes nuclear reaction cross sections at sub-Coulomb charged-particle projectile energies. The screening energy can be increased considerably if the target atoms are implanted in a metallic host and cooled to low temperature (T~10 K). The large screening in metals derives from the Debye plasma model applied to the quasi-free metallic electrons. If “time reversed,” this model implies that the lifetime of radioactive nuclei placed in a metallic host can be manipulated by orders of magnitude. For α and β+ decay one expects a shorter half-life, while for β− decay and EC, a longer half-life is expected. The results of prior experiments testing this theory are controversial; about half of the published data confirm an effect, while the other half observe no effect. We will report on our experimental studies using 64Cu and 65Zn nuclei produced at TUNL via the 63Cu(d,p) and 65Cu(p,n) reactions, respectively. For 64Cu, we detected the 511 keV annihilation γ rays and for 65Zn the 1115.5 keV γ rays using HPGe detectors. In both cases we did not observe a half-life change outside experimental uncertainties between measurements at room temperature and those with the samples cooled to T=12 K.

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