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Thorium Doped CsI: Implications for the Thorium Nuclear Clock Transition E. R. MEYER, E. TIMMERMANS, S. RUDIN, J. D. KRESS, L. A. COLLINS, X. ZHAO, Los Alamos National Laboratory — For the 229mTh isomer nucleus, with an anomalously low excitation energy of E*=7.8 eV, the bound internal conversion (BIC) decay process is caused by the excitation of a valence electron that is sensitive to the electronic structure of the atomic-sized neighborhood. So to obtain the minimal nuclear excitation energy E*min necessary for BIC-promoting the s-wave valence electron, we analyze a recent experiment of a Th-impurity deposited in a CsI matrix. Depending on whether the Th-impurity is imparted into the bulk, or only a few atomic layers into the (111)-surface, we find that the E*min-value, which is the gap between the Th-s-band and the conduction band minimum (in the large unit cell limit) is equal to 1.4 and 1.7 eV respectively. This number can significantly reduce the lower E*-bound of 6.8 eV, that is the first ionization potential of an isolated Th-atom, as estimated from the recent direct observation of the Th-clock transition (von der Wense et al., Nature 533, 47-51, 2016). We suggest coating the multi-channel plate with materials of different Th-impurity gaps can further narrow the E* uncertainty interval.

Joel Kress
Los Alamos National Laboratory

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