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Alpha decay studies near ^{100}Sn

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Nuclei around the exotic doubly-magic ^{100}Sn can provide key information to, and serve as rigorous tests of, the nuclear shell model. In particular, the energy splitting between neutron single-particle orbits in this region, the $\nu d_{5/2}$ - $\nu g_{7/2}$, can be extracted from the low-energy excited states in the odd-N Sn isotopes, ideally from ^{101}Sn. Identification and examination of these nuclei is aided by the presence of an island of alpha and proton radioactivity for nuclei with Z $>$ 50 near ^{100}Sn. The isotopes ^{109}Xe and ^{105}Te were identified at the Holifield Radioactive Ion Beam Facility using the Recoil Mass Spectrometer through the observation of the characteristic alpha decay chain ^{109}Xe $\rightarrow$ ^{105}Te $\rightarrow$ ^{101}Sn. The efficient identification of the fast ^{105}Te alpha decay was enabled through the use of digital signal processing using advanced pulse shape analysis alogrithms. The unique double alpha decay pulse provided an ideal tag to observe gamma-ray emission from the excited states of both ^{105}Te and ^{101}Sn at approximately 150 and 172 keV, respectively. Both excited states in ^{105}Te and ^{101}Sn were populated through alpha decay. The observation of the first excited state in ^{101}Sn provides the $\nu d_{5/2}$ - $\nu g_{7/2}$ energy splitting. Using the experimental value in shell model calculations suggests an ordering of single particle states in ^{101}Sn that contradicts previous expectations. The possibility of reaching the ^{108}Xe $\rightarrow$ ^{104}Te $\rightarrow$ ^{100}Sn alpha decay chain will also be discussed.