The existence of an island of alpha emission above the neutron-deficient Sn isotopes provided the initial evidence that the Z=50 and N=50 shell closures hold in this exotic region. For nuclei above \(^{108}\)Sn and close to the N=Z line, protons and neutrons are expected to occupy identical orbitals, the \(2d_{5/2}\) and \(1g_{7/2}\). It was expected to enhance the preformation of alpha particles with respect to the \(^{208}\)Pb region and give rise to the so-called “superallowed” alpha decay [1] with a large decay width. The decay rates around \(^{100}\)Sn are also important for the analysis of nucleosynthesis in hot stars, since this region has been cited as the end of the rapid proton capture process due to the Sn-Sb-Te cycle [2].

The new \(\alpha\)-emitting isotope \(^{109}\)Xe was produced using the \(^{58}\)Ni(\(^{54}\)Fe,3n) fusion-evaporation reaction with a beam energy of 222 MeV at the Holifield Radioactive Ion Beam Facility at Oak Ridge National Laboratory [3]. The recoiling products were separated by means of the Recoil Mass Spectrometer [4] and implanted into a Double-sided Silicon Strip Detector (DSSD). Recoil and decay signals were analyzed using a digital data acquisition system based on the XIA-DGF modules [5]. The large recoil implantation pulses had their amplitudes extracted by the real time on-board algorithm. For decay pulses below 9 MeV, 25 \(\mu\)s-long images of the DSSD preamplifier signals were recorded with the 25 nanosecond time resolution. These decay signal traces were transferred to the main acquisition, where the pulse shapes were analyzed with floating point algorithms. The novel data acquisition technique allowed for the resolution of the two overlapping alpha particle signals into two separate energies despite the sub-microsecond half-life of \(^{105}\)Te.

The lightest mass \(\alpha\)-radioactivity identified to date, \(^{105}\)Te, was detected through the \(^{109}\)Xe→\(^{105}\)Te→\(^{101}\)Sn alpha decay chain. This marks the closest experimental approach to the N=Z line above \(^{108}\)Sn achieved 25 years after the first observation of the \(^{110}\)Xe→\(^{106}\)Te→\(^{102}\)Sn decay chain [6]. The enhanced decay width of observed alpha transitions and the deduced decay schemes will be presented. The results include the determination of energy difference between the \(\nu d_{5/2}\) ground state and the \(\nu g_{7/2}\) first excited state in \(^{105}\)Te.

The prospects for the identification of \(^{108}\)Xe→\(^{104}\)Te→\(^{100}\)Sn superallowed \(\alpha\)-decay chain will be discussed.