The measurement of p-nuclei alpha decay

Heinrich Wilsenach,[1] Yordan Georgiev,[2] Réne Heller,[3] Ulli Koester,[4]
Volker Neu,[5] Philipp Scholz,[6] Tommy Schönherr,[2] and Kai Zuber[1]

[1]*IKTP TU-Dresden, Dresden, Germany*

[2]*Transport Phenomena in Nanostructures, Dresden-Rossendorf, Germany*

[3]*Institute of Ion Beam Physics and Materials Research, Dresden-Rossendorf, Germany*

[4]*Institut Laue-Langevin, Grenoble, Isere, France*

[5]*Institute for Metallic Materials, Dresden, Germany*

[6]*Institute for Nuclear Physics, University of Cologne, Köln, North Rhine-Westphalia, Germany*

For heavy proton rich nuclei created in the p-process often only the alpha decay channel is energetically allowed. These nuclei are long living with half-lives up to billions of years. Due to the wide range of half-lives these p-nuclei play a vital role in Geo- and Cosmo-chronometry. One of the crucial requirements of this technique is a high precision of the half-lives. Measuring this quantity is challenging as the material usually has a very low natural abundance. This means that the isotopes of interest will have to be made accurately in a quantity to enable a sufficiently detectable signal.

Alpha decay also plays a role in activation experiments where the product decays through the emission of an alpha particle. One such experiment is the investigation on the ^{144}Sm(α,γ)^{148}Gd cross-section, which can be measured due to the alpha decay of ^{148}Gd. This cross-section is important for p-process nucleosynthesis.

To overcome this challenge an ultra-low background alpha chamber was designed and constructed at IKTP TU-Dresden. The gas filled ionisation chamber was chosen for this task as it has a remarkably high efficiency $(98.6 \pm 2.2)\%$. The chamber was specially designed and built to measure low signal rates and has a background in the region of interest (1 MeV to 4 MeV) of around 0.27 counts per day per MeV.

The presentation will discuss samples made at the ISOLDE facility at CERN, as well as the alpha counting method used to determine the ^{144}Sm(α,γ)^{148}Gd cross-section.