Contribution ID: **967** Type: **Verbal**

Updating the nuclear databases: re-measurement of the half-life of Sm-146, Gd-148, and Dy-154

Tuesday, 17 May 2022 10:30 (20 minutes)

During the last years, an increased effort was put into the measurement of decay data with high precision, with the ultimate goal of confirming the existent nuclear values and/or lowering their uncertainties. Precise nuclear data is extremely important in the description of galactic events, in the nuclear dating of samples, as well in the evaluation of the toxicity of nuclear waste. Surprisingly, the re-evaluated half-life data of a considerable number of radionuclides (e.g., Fe-60 [1], Se-79 [2, 3], Sm-146 [4]) showed a substantial disagreement with previous values. The repercussions are significant: For example, the shorter measured half-life for Sm-146 implies a higher abundance of this radionuclide in the early Solar System, and thus, planetary events dated with the Sm-146/Nd-142 chronometer converge now to a shorter time span than previously estimated. Similarly to Sm-146, the currently available half-life data of other radio-lanthanides, such as Gd-148 and Dy-154, are inconsistent or affected by uncertainties even up to 50% [5-7]. Through their pure alpha-decay chain, Gd-148 and Dy-154 directly influence both the abundance of Sm-146, as well as the natural isotopic composition of stable Nd, contributing thus to the Sm-146/Nd-142 chronometer. Therefore, an exact knowledge on the half-life of both Gd-148 and Dy-154 is urgently required.

It has to be mentioned, that reasons for these imprecise nuclear data lie in the difficulty of obtaining samples of the isotopes of interest in sufficient amounts and purity, together with inherent problematics in performing such demanding measurements. In this work, that belongs to the initiative "ERAWAST - Exotic Radionuclides from Accelerator Waste for Science and Technology"[8], we obtained sufficient amounts of Sm-146, Gd-148, and Dy-154 by reprocessing irradiated Ta materials available at the PSI accelerator-facilities. The re-determination of the half-lives of the above-mentioned radio-lanthanides proceeded by successively applying the "direct"method, which consists in the determination of the number of radioactive atoms in a specific sample, combined with the measurement of its radioactivity.

Here, preliminary results on the measured half-lives of Gd-148 and Dy-154, together with the first steps towards determining the decay constant of Sm-146, will be presented.

Acknowledgement
This project is funded by the Swiss National Science Foundation (SNF grant no 200021-159738).

[1] Rugel G., et al. 2009. Physical review letters, 103, p. 072502. [2] Jörg G., et al. 2010. Applied Radiation and Isotopes, 68, pp. 2339-2351. [3] Bienvenu P., et al. 2007. Applied Radiation and Isotopes, 65, pp. 355-364. [4] Kinoshita N., et al. 2012. Science, 335, pp. 1614-1617. [5] Khazov Yu, et al. 2016. Nuclear Data Sheets, 136, pp. 163-452. [6] Nica N., et al. 2014. Nuclear Data Sheets, 117, pp. 1-229. [7] Reich C. W. 2009. Nuclear Data Sheets, 110, pp. 2257-2532. [8] Schumann D., et al. 2007. Journal of Physics G: Nuclear and Particle Physics, 35, p. 014046.

Primary author: CHIERA, Nadine Mariel (Paul Scherrer Institute)

Co-authors: Dr DRESSLER, Rugard (Paul Scherrer Institute); Dr TALIP, Zeynep (Paul Scherrer Institute); Dr SPRUNG, Peter (Paul Scherrer Institute); SCHUMANN, Dorothea

Presenter: CHIERA, Nadine Mariel (Paul Scherrer Institute)

Session Classification: Radionuclides Production & Application

Track Classification: Production and Application of Radionuclides