Contribution ID: **57** Type: **not specified**

Production of innovative radionuclides for therapy or diagnostic: nuclear data measurements and comparisons with the TALYS code

Wednesday 13 June 2018 12:10 (20 minutes)

Nuclear medicine is a specialty that uses radioactive nuclei for therapy or diagnostic of diseases such as different types of cancer. These radionuclides are most of the time coupled with carrier molecules to target cells of interest. Currently, only few radionuclides are deployed in clinical practice. However, many others may be of medical interest due to their emitted radiation, their half-life and/or their chemical properties that can be adapted to the transit time of carrier molecule and to the pathology.
Since nuclear data measurements are essential for the optimization of the radionuclide production, the PRISMA group of the SUBATECH laboratory carried-out experiments in collaboration with the GIP ARRONAX (Nantes, France), which possesses a multi-particle high-energy cyclotron (70 MeV for protons, 68 MeV for alpha particles and 35 MeV for deuterons). The cross section associated to a given nuclear reaction is the fundamental physical parameter needed to infer the production rate of a radionuclide. Using the stacked foils technique and the gamma-spectroscopy, we measured experimental data for a selection of radionuclides of medical interest: photon emitters (Hg-197m, Ru-97) and positron emitter (Sc-44g) for diagnostic as well as electron emitters (Re-186, Tb-155, Sn-117m) and α emitters (Th-226, Ra-233, Bi-213) for therapeutic applications.
The aim of this presentation is to give the status of nuclear data collected for medical isotopes production and to present the large set of experimental data collected by our group using the protons, deuterons and alpha particles delivered by the ARRONAX cyclotron from few MeV up to 70 MeV and covering a wide range of target masses. Using these data, we will also show that constrains can be put on simulation tools such as the TALYS code and compare with TENDL-2015, the TALYS-based evaluated nuclear data library.
The TALYS code, developed by NRG Petten (Netherlands) and CEA Bruyères-le-Châtel (France), provides a complete description of all reaction channels and observables based on many state-of-the-art nuclear models. It includes a combination of models, defined by the authors of the code and put as default, that best describe the whole set of data available for all projectiles. The last release of the code, TALYS-1.9, has been first used with these default models. Then, three main phenomena have been found to have a great influence on the calculated production cross section values in the energy range of the experiments: the optical model, the pre-equilibrium model and the level density model. Finally, a better overall agreement with our experimental data could be obtained with a different combination of models already included in the code.

Primary author: GUERTIN, Arnaud (Laboratoire SUBATECH, CNRS/IN2P3, IMT Atlantique, Université de Nantes)

Co-authors: NIGRON, Etienne (Laboratoire SUBATECH, CNRS/IN2P3, IMT Atlantique, Université de Nantes); SITARZ, Mateusz (GIP ARRONAX and University of Warsaw); DUCHEMIN, Charlotte (Laboratoire SUBATECH, CNRS/IN2P3, IMT Atlantique, now at CERN, HSE-RP group); Prof. HADDAD, Ferid (Laboratoire SUBATECH, CNRS/IN2P3, IMT Atlantique, Université de Nantes and GIP ARRONAX); Prof. MÉTIVIER, Vincent (Laboratoire SUBATECH, CNRS/IN2P3, IMT Atlantique, Université de Nantes)

Presenter: GUERTIN, Arnaud (Laboratoire SUBATECH, CNRS/IN2P3, IMT Atlantique, Université de Nantes)

Session Classification: Medical radioisotopes

Track Classification: Medical radioisotopes