Development of a Neutron Capture Therapy Compact Spectrometer

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Abstract

In recent years, the introduction of accelerator-based BNCT facilities has led to a significant increase in interest from the medical and scientific communities.
Monitoring and characterization of neutron beams and intercomparison of different facilities are becoming mandatory [1].
This stimulates the development of dedicated dosimetry and spectrometry techniques. This work aims to present a novel compact spectrometer with an isotropic response called Neutron Capture Therapy-Activation Compact Spectrometer (NCT-ACS), funded by INFN, highly sensitive in the energy interval ranging from thermal to 100 keV and suitable for in-phantom irradiation.
The detector geometry is composed of a spherical moderator shell containing different material foils exhibiting neutron radiative capture resonances covering the wide energy domain for BNCT. This contribution will first focus on the extensive simulations work that have been performed to optimize the geometry of the detector, its materials composition, and its response; following by the main experimental results that have been obtained.
Irradiation and activation measurements on a first prototype have been performed at the electron Linac facility installed at the university of Turin, where a well-known epithermal neutron field can be produced. The materials activation was measured using a HPGe and a LaBr(Ce) detectors, opportunely calibrated for the spectrometer geometry. A careful analysis of the activation gamma spectra has been performed to correctly estimate the statistic and systematic uncertainties.
The Turin epithermal neutron spectrum was then obtained using an unfolding code and a comparison with a standard Bonner Sphere Spectrometer (BSS) was performed. The agreement between the two measurement is within the 10%, providing a proof of the NCT-ACS working capability. More details will be provided in the presentation.

A compact multi-material spectrometer for in-phantom measurement will be a novelty for the BNCT applications, with the aim to contribute to the beam quality assurance.

References

[1] IAEA. “Advances in Boron Neutron Capture Therapy”. Ref. No: F1-TM-1905174 EVT 1905174 (2020).

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