Direct measurement of energy spectrum of the electron beam produced by the mobile accelerator Novac7 for IORT and comparison with the simulated spectrum by Monte Carlo method

F. Baffigi[1*], G. Bussolino[1], F. Di Martino[2], L. Labate[1,3], D.Palla[1], S.Righi[4], P. Tomassini[1], C.Traino[2], L.A. Gizzi[1,3]

1) *CNR-INO, Area della Ricerca di Pisa, Via G. Moruzzi 1, Pisa, Italy*
2) U.O. Fisica Sanitaria, Azienda Ospedaliera-Universitaria Pisana, Pisa, Italy
3) INFN Sezione di Pisa, Largo Pontecorvo 3, 56127 Pisa, Italy
4)U.O. Fisica Sanitaria, Ospedali Galliera, Genova, Italy

** Corresponding author: federica.baffigi@ino.it*

Novac7 is a linear accelerator dedicated to intraoperative radiation therapy (IORT) which produces high energy electron beams. The characteristics of its head and, consequently, of the electron beams produced, are differences to that of a conventional radiotherapy linac. The knowledge of the specific Novac7 electron beams energy spectrum is important for the radioprotection and to improve the accuracy of the clinical dosimetry. The radioprotection is very important in a IORT contest, because the treatment is executed in a surgery room and not in a bunker, as for conventional radiotherapy. In particular, the presence of high energy component in the energy spectrum and, of consequence, the possibility of neutron production by activation need to be evaluated. Previous papers based on Monte Carlo simulation, have described the Novac7 electron beams characteristics in terms of energy spectrum, mean energy profiles, photon contamination and angular distributions at the end of the beam collimation. No direct measurements of the energy spectrum has been made until now.
This paper reports the first experimental measurements of the electron energy spectrum at the end of the beam collimation in the IORT therapy machine Novac7, based on the used of two magnetic spectrometers. The two magnetic spectrometers used for the measurements are specifically designed for this purpose, exploiting the techniques of the particle acceleration mechanism driven by laser. In fact, the characteristics of the electron beams accelerated by laser are very similar in terms of energy spread and angular divergence to the beams accelerated for the IORT treatment by a radiofrequency-based accelerator.
The measurements were carried out on 7 and 9 MeV electron beams on the central axis of the beam and at the edges of the collimator. The results obtained were compared with those obtained with the simulations.