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The Compact Neutron Generator (CNG) and the LINC-ER project for the treatment of stage I and II solid cancers

A new technological frontier in radiotherapy has been established.

An innovative device for the treatment of solid tumours in Intraoperative Radiotherapy (IORT), has been realized thank to a new idea conceived by the Italian Company "Theranosti Centre", led by the Physicist Maurizio Martellini (Professor at University of Insubria, Italy).

The purpose of the conventional IORT is to use radiation beams (electrons and X-rays) to deliver an intensive radiation dose directly on the tumour bed of early-stage solid cancers sparing normal surrounding tissues during surgery, after having removed the neoplastic tissues. In other words, the IORT is a technique able to improve the local control of solid tumours and even to reduce the cancer recurrencies by killing the potential quiescent cancer cells filling the tumour bed and shielding nearby organs from the irradiation.

But nowadays the radiological machines used to perform the conventional IORT have reached a steady-state development.

The new patented idea by "Theranosti Centre" consists in using a new type of "Compact Neutron Generator" (CNG) to create neutron fields as a more effective radiation beams in treating solid tumours of not early stages, then defining a new type of IORT, the so called nIORT (neutron Intra-Operative Radiotherapy).

Furthermore, the same technology for producing neutron beams, but with much higher energy and appropriate size, can be used for a new approach to producing the radioisotopes that are the basis of new radiopharmaceuticals, with the chance to be allocated directly to large hospitals and cancer clinics.

Based on the "Theranosti Centre" guidelines, the first prototype of the device has been manufactured by the company Berkion Ltd. (CA).

The CNG is a mobile, light, self-shielded, cylindrical geometry device (about 35 cm length x 18 cm diameter) with a beam shaping collimator (separate element) and it has been conceived with a specific design not being an adaptation of other neutron generators dedicated to other purposes.

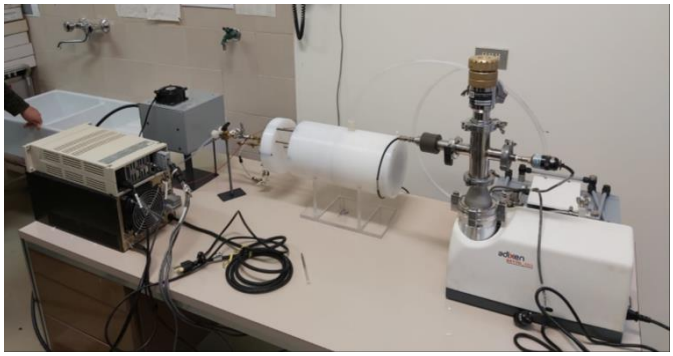

Figure 1: the CNG currently installed at ENEA Research Centre, Brasimone, Italy.

The CNG can generate a high flux of neutrons (of 2.45 MeV) with higher Relative Biological Effectiveness (RBE) than the all others form of radiation therapies, based on a Deuterium-Deuterium nuclear fusion reaction with the aim to precisely deliver (thanks to the collimator) radiation doses to the neoplastic targets during surgery.

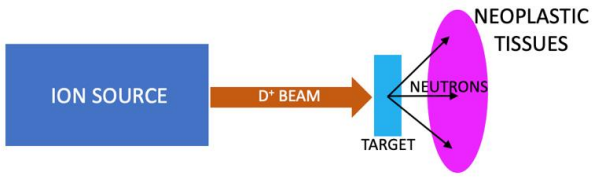

Figure 2: conceptual diagram of the use of the Compact Neutron Generator

The prototype is currently installed at the ENEA Brasimone Research Centre (ITALY) and managed by ENEA Reserchers in the frame of an agreement (2019) between “Theranosti Centre” and ENEA.

Figure 3: the ENEA Research Centre in Brasimone, Italy

The generator will be located in a dedicated bunker, and it will be tested by ENEA thanks to the regional funding: LINC-ER project. The aim is to obtain the certification of this apparatus in the first two-three months of 2023 by the ministry in charge.

The LINC-ER project (Scientific Supervisor A. Rizzo, ENEA) is a regional project funded by the Emilia Romagna Region. It belongs to the High Technologies Network of Emilia Romagna, specifically to the ENEA Technopole and it is funding the construction of a multifunctional infrastructure (a bunker) for the experimental characterization of compact fast neutron generators.

Theranosti Centre

Berkion Technology LLC

ENEA
Italian National Agency for New Technologies, Energy and Sustainable Economic Development