Indirect Radiation Therapy of Cancer by Neutron Capture at dense Gadolinium Targets (Gd-NCT)

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"Neutron Capture Therapy NCT is an indirect radiation therapy of cancer, which inactivates tumors by secondary products evolving from an incorporated target upon specific absorption of external radiation. Early trials with Boron (B-NCT) were limited by the low physiological target concentration (1 mM) and the moderate cross section of 3843 barn. The change to ^{157}Gd with 254,000 barn cross section and highly concentrated biocompatible Gd-targets improves the method by 3 orders (fig.1a). The Lanthanide-complex is applied in a key-formulation, which breaks the blood-brain barrier BBB reversibly, as in our synchrotron X-ray therapy project with Lu-Gd complexes at ESRF-ID17. The local deposition of the gamma photons arising after neutron capture is achived by a second Lanthanide (Er/Lu), which works as an internal radiation enhancer (gamma - Auger electron conversion, fig.1b). The study is done with cold and thermal neutrons at the ILL- D22 and Neutrograph instruments. The biological tests are done in tight collaboration between ILL, ESRF with BioMedical Facility BMF.

References: (1) T. Nawroth, M. Rusp, R.P. May; Physica B 350(2004), e635-638; (2) T. Nawroth, G. Le Duc, St. Corde, R.P. May, P. Boesecke, A. Bravin; ESRF User meeting proceedings (2006, 3 contributions); (3) WEB-site: www.mpsd.de/irt"

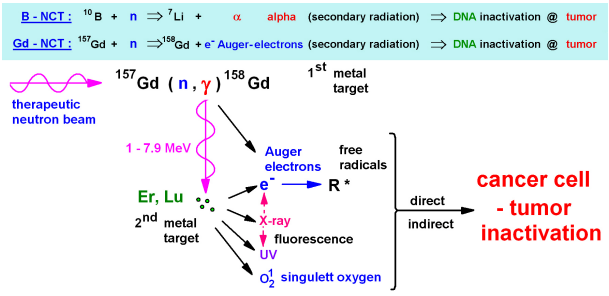

Fig. 1: a) Neutron Capture Therapy NCT inactivates cancer cells by secondary radiation products after specific absorption of neutrons at a tumor-local target. The change from Boron (B-NCT) to Gadolinium (Gd-NCT) improves the method by 3 orders. b) A concentrated dual-Lanthanide target enhances the therapy effect by heteronuclear self-absorption of the gamma radiation (1-8 MeV).