Modification of the thermal column of the TRIGA Mainz for the treatment of liver metastases

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In 2001 the BNCT method was successfully applied for the extracorporeal treatment of liver metastases at the University of Pavia [1]. Due to this promising result the BNCT project shall be established at the University of Mainz in a close collaboration with the University of Pavia.

The requirements for the therapy in Mainz are ideal: Like the TRIGA reactors in Finland (Espoo) and Italy (Pavia), the TRIGA Mainz is well suited for BNCT. Its irradiation facility is easily accessible, there is sufficient flexibility concerning irradiation times and it is located close to the University Hospital. Nevertheless, medical and technical requirements as well as the legal regulations must be considered.In order to determine the optimal parameters for the planned therapy and for the design of the thermal column calculations were carried out using the MCNP-code as well as the transport code ATTILA [2]. On the basis of the calculations, the reconstruction of the thermal column will be undertaken.

The irradiation facility must provide a homogenous thermal neutron field over the organ and a negligible gamma field at the irradiation position. To guarantee constant irradiation conditions in the thermal column during the treatment, online monitoring of the gamma and neutron component is desirable. The irradiation, handling and transport time for the explanted liver must be as short as possible. To maintain the organ in adequate extracorporeal conditions during the irradiation time, a special confinement which allows the placement of the organ in the thermal column and ensures storage of about 4 °C during the irradiation must be designed.

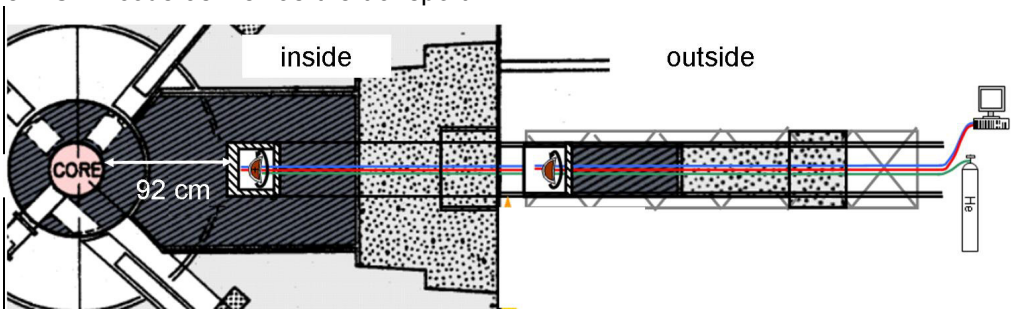

Fig.2: Planned modification of the irradiation channel of the thermal column. The image shows the transportation system for the organ, the gamma shielding is not included in the picture

At present, the accessible irradiation channel inside the thermal column has the size of 10 x 10 x 120 cm³, which is too small for the irradiation of a human liver. The channel is to be enlarged on a space of 30 x 30 cm². Furthermore, the optimum neutron flux for the liver can only be achieved in case the irradiation channel is lengthened, too. So far, two possible configurations have been discussed for the irradiation of the liver, one of which is displayed in fig. 2. The organ will be transported into the channel with a remotely controlled sleigh. The configurations differ in the irradiation position of the organ: Either 60 cm or 92 cm in distance to the core. Whereas a distance 60 cm would be ideal, a distance of 92 cm is easier to construct. In this case, the neutron field is very favourable as well.

References:

[1] Pinelli et al. *"TAOrMINA: From the First Idea to the Application to the Human Liver"*. Proceedings of the 10th International Congress on Neutron Capture Therapy, Monduzzi editore, Bologna, 2002, 1065-1072

[2] B. Wortmann “Auslegung und Optimierung einer Bestrahlungseinrichtung für die Bor-Neutroneneingangtherapie an autotransplantierten Organen”, Dissertation, Technische Universität Dresden, Juni 2007