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The MEDAPP instrument as test site for fast neutron radiation damage

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At the FRM II medical application instrument MEDAPP, fast neutrons are available for radiation therapy and radiation hardness testing of electronic components and materials. In a unique set-up, thermal neutrons from the reactor core are converted to fast neutrons by fission of uranium-235 and transported through the beam tube with direct sight on the fission source.

With optional filtering, three neutron spectra are available at MEDAPP. The fast fission spectrum for medical applications is filtered with a thermal filter and has a mean energy of 1.9 MeV and a total flux of 3.2e8 n/(cm^2 sec) at reference position in the irradiation room. The maximum neutron energy of the fast spectrum is at around 10 MeV. When the thermal filter is removed a mixed thermal and fast fission spectrum with a significant intermediate component is available. In addition, the converter can be removed entirely for irradiation with thermal neutrons from the reactor core. While information on the filtered fast fission spectrum is available from both measurements and simulations, the last two are only available from simulations.

The medical beam is well characterized in terms of flux and the separation of the neutron and gamma component and a well-established dosimetry method is available for reference measurements at the irradiation position.

Furthermore, the large available field size of around 30 cm x 20 cm can be limited with a multi leaf collimator to adjust the irradiated region of the sample.

With the broad range of energies and especially the fast neutron beam, MEDAPP can serve as test side for radiation hardness testing and characterization of radiation damage due to fast neutrons. With neutrons from fusion having higher energies that are not available at MEDAPP, the applicability will depend on the location of the investigated material in the fusion reactor. Thus, MEDAPP holds great potential for the investigation of radiation damage due to fast neutrons and can substitute higher energy neutron sources respecting the limitation due to the available neutron energy.

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