Karlsruhe Institute of Technology
Institute for Neutron Physics and Reactor Technology
Hermann-von-Helmholtz-Platz 1
76344 Eggenstein-Leopoldshafen, Germany
Internet: http://www.kit.edu
E-mail (H. Liu).: haibo.liu@kit.edu

Application of the R2Smesh approach for the accurate estimation of photon radiation dose fields around activated ITER in-vessel components

Haibo LIU, Ulrich Fischer, Arkady Serikov, Pavel Pereslavtsev, Keitaro Kondo*

Karlsruhe Institute of Technology, Hermann-von-Helmholtz-Platz 1, 76344 Karlsruhe, Germany

1. Introduction

The R2Smesh ("Rigorous 2-step") approach [1] can be utilized to calculate photon radiation dose fields around activated components which are moved from the irradiation site in ITER to some external location. In this work, we applied the R2Smesh approach to dose rate analyses of ITER in-vessel components in a transfer cask.

2. Neutron flux and activation calculations for the ITER in-vessel components

➢ The blanket first wall module and the divertor cassette were analyzed.
➢ The first wall geometric model [2] and the calculated decay gamma source 2D distribution are shown below.

Fig. 1. ITER B-lite model with layered FW

Fig. 2. Layered FW

Fig. 3. FW decay gamma source distribution
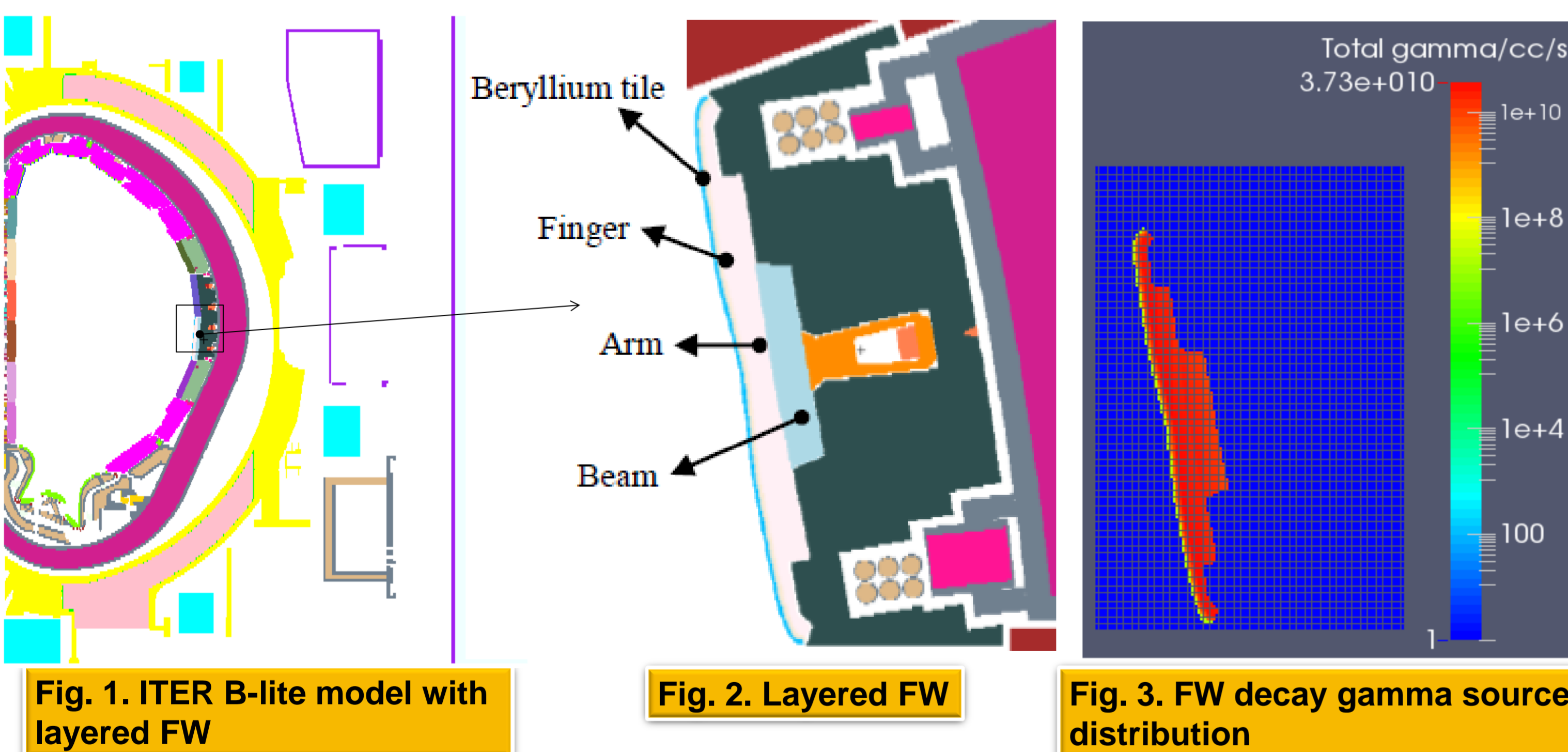
3. Dose rate calculation

➢ The ITER transfer cask is modeled as a 7 cm thick steel plate. The activated components were removed from the ITER model and integrated into this transfer cask model.
➢ The associated decay gamma source distributions were transferred to the cask and overlaid to the geometric models of the activated components using the R2Smesh approach.
➢ The photon transport geometric model and its dose rate map for the FW case and the divertor case are shown in the following figures.

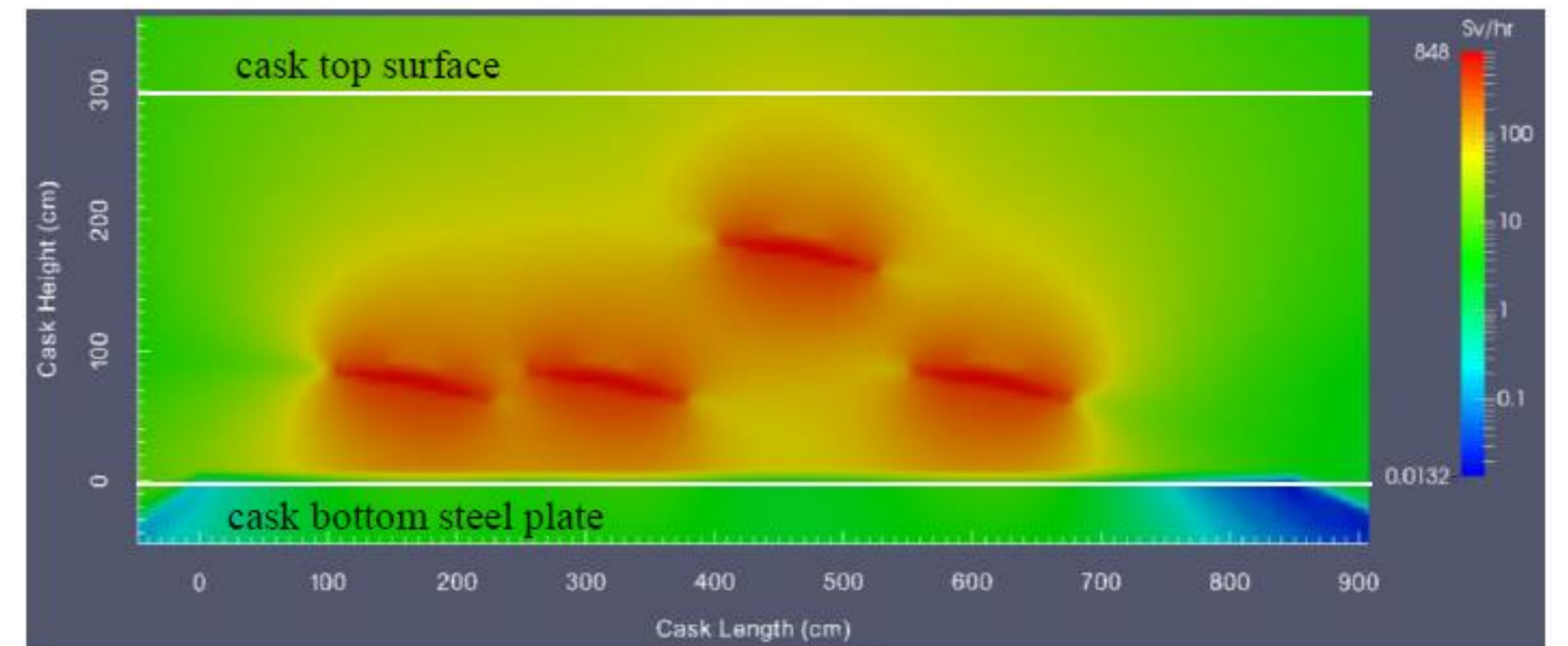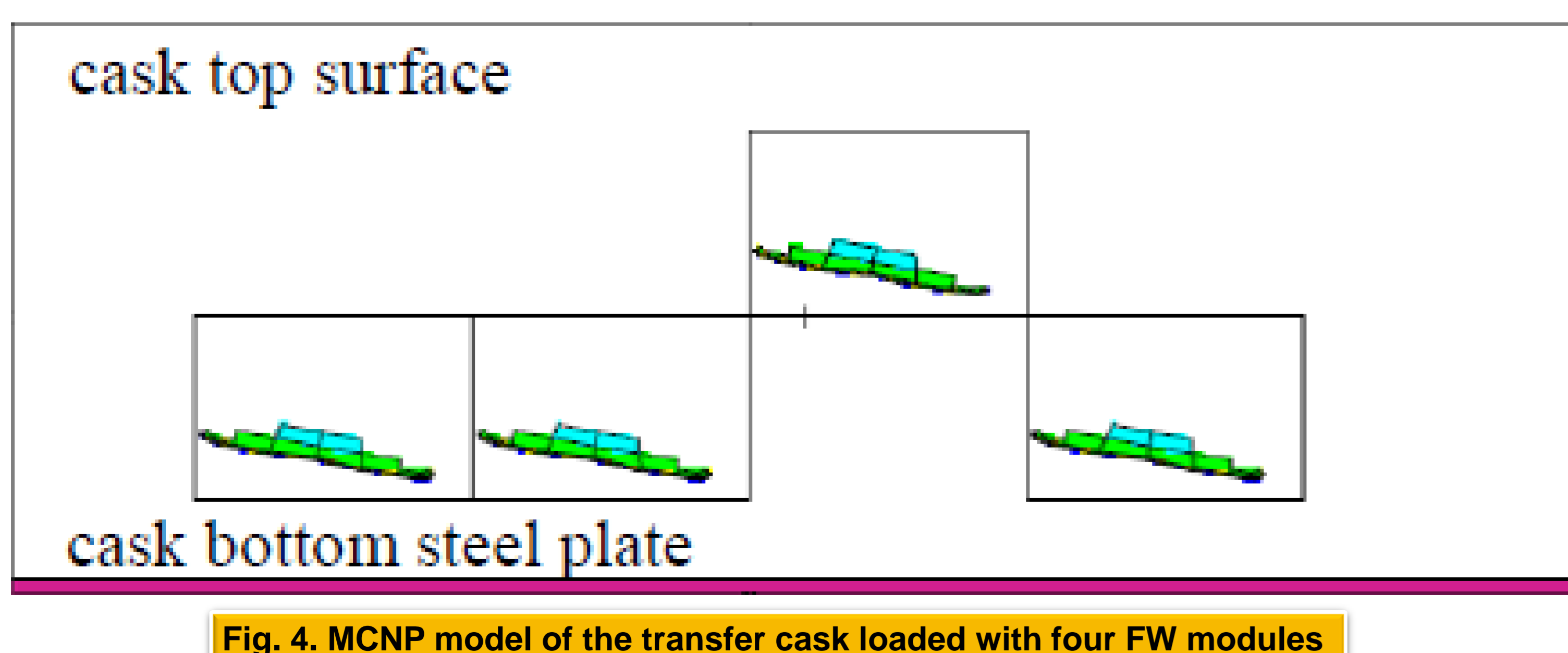Fig. 4. MCNP model of the transfer cask loaded with four FW modules

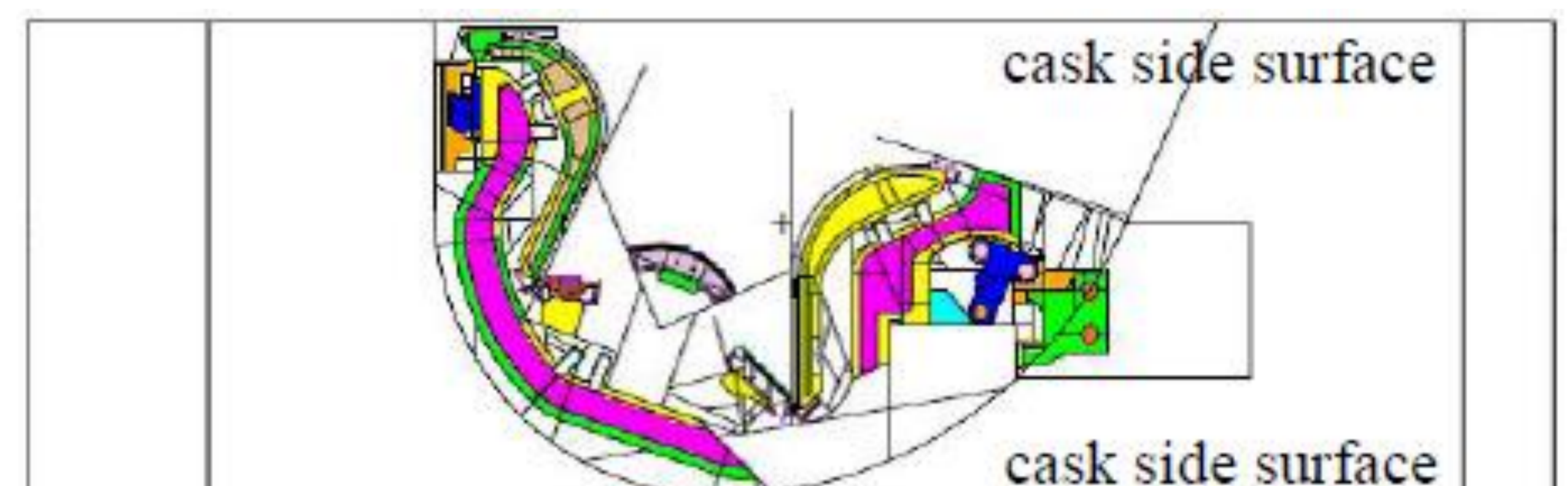Fig. 5. Dose rate map around the cask

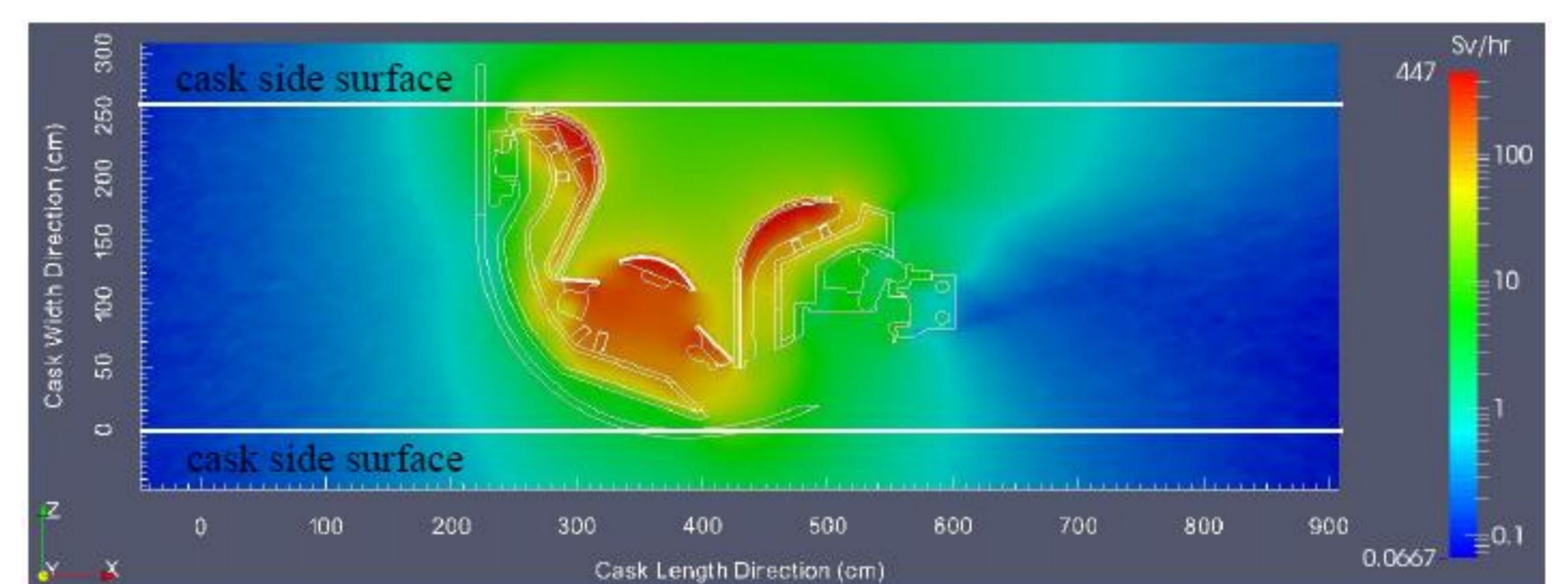Fig. 6. MCNP model of the transfer cask loaded with divertor cassette

Fig. 7. Dose rate map around the cask

➢ The dose rate level below the cask is much lower than above because of the 7 cm thick cask bottom steel plate shielding.
➢ The relative errors for the dose rates are less than about 10% for most of the cask volume.

4. Summary

The R2Smesh approach was utilized to assess the dose rate distribution around the ITER transfer cask loaded with activated in-vessel components. The results show that this approach is a versatile tool for performing such analyses.

[1] M. Majerle, et al., Fusi. Engi. & Des. 87, 443-447, 2012.
[2] M. Sawan, Private Communications, ITER IDM, 9AWXY6, 2012.
* Now working at JAEA.

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