

# Application of Serpent 2 code for shielding analyses of EU DEMO HCPB breeding blanket

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The Helium Cooled Pebble Bed (HCPB) breeding blanket is promising option for the EU DEMO driver blanket. This blanket should provide a reliable nuclear protection of the vacuum vessel from neutron and gamma irradiation. The search for the suitable shielding option is performed making use of the realistic geometry model being used for the particle transport simulations.

In this work, the Monte Carlo code Serpent 2 [1] is used to perform the 3D Monte Carlo particle transport making use of the suitable DEMO geometry representation. The plasma neutron source applied in the Serpent model is derived from a volume neutron source [2]. The results of calculations were compared with MCNP ones obtained to benchmark Serpent 2 performances in the shielding calculation of the fusion reactor. Different materials options and their geometry dimensions were analyzed to find the best solution for the HCPB shielding performance. Additionally, a parametric investigation varying the radial thickness of the neutron multiplier by partial replacement with the different shielding materials has been performed. The results demonstrate promising performances of Serpent 2 for applications in the fusion related tasks. It has been proven that the shielding performance of HCPB blanket can be largely optimized with some shielding options, keeping tritium generation at a level acceptable for the DEMO design.

*Keywords: Neutronics, Blanket, Monte Carlo, Serpent, Shielding optimization*

[1] Leppänen, J., et al. (2015) "The Serpent Monte Carlo code: Status, development and applications in 2013." *Ann. Nucl. Energy*, 82 (2015) 142-150.

[2] Sirén, P. and Leppänen, J. (2016) "Expanding the use of Serpent 2 to Fusion Applications: Development of a Plasma Neutron Source." In *proc. PHYSOR 2016, Sun Valley, ID, May 1-6, 2016*.

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