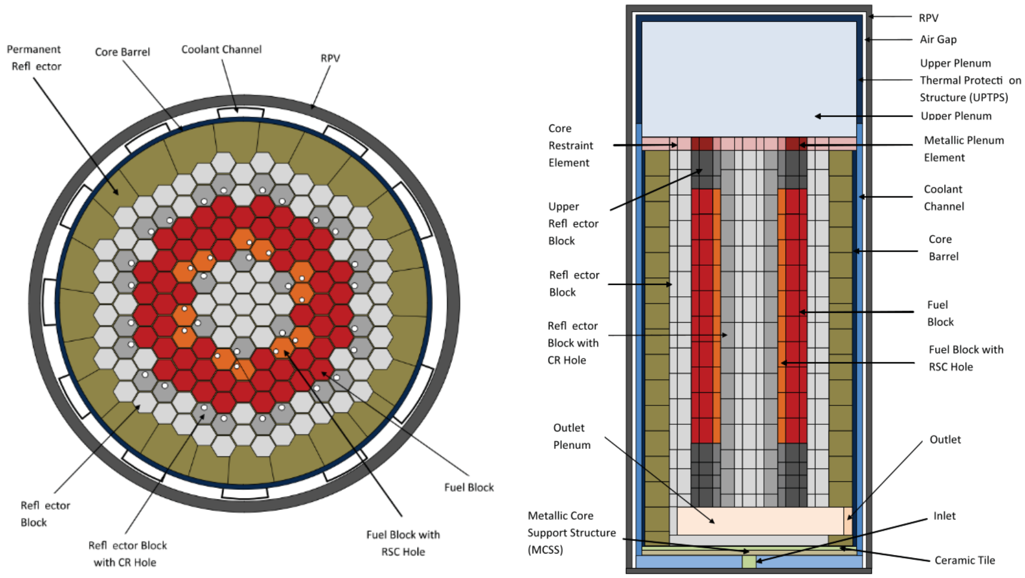
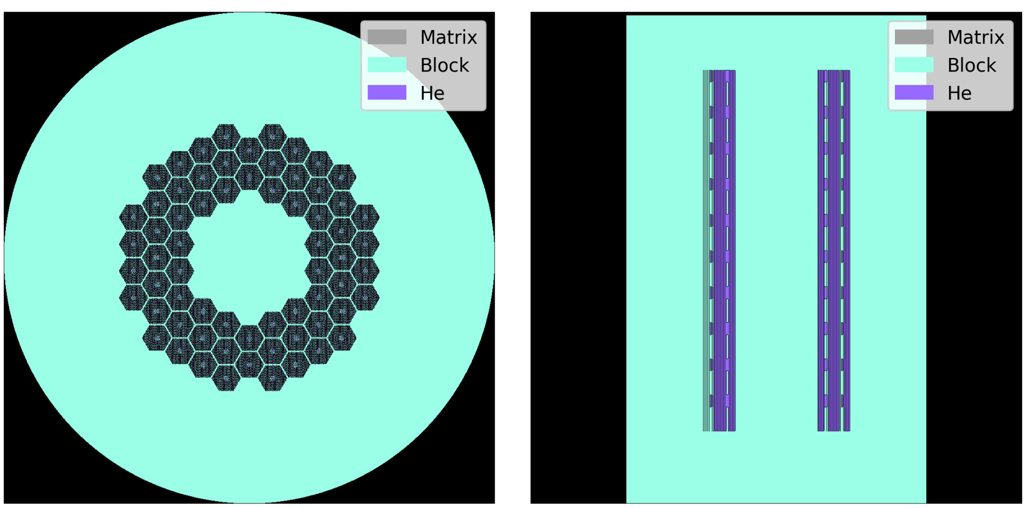
1 Serpent model



(a) XY-plane. (b) YZ-plane.

Figure 1: MHTGR reactor layout.



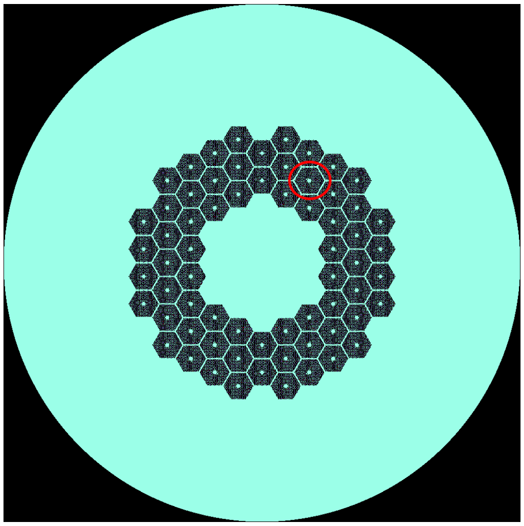
(a) XY-plane. (b) YZ-plane.

Figure 2: MHTGR full core model.

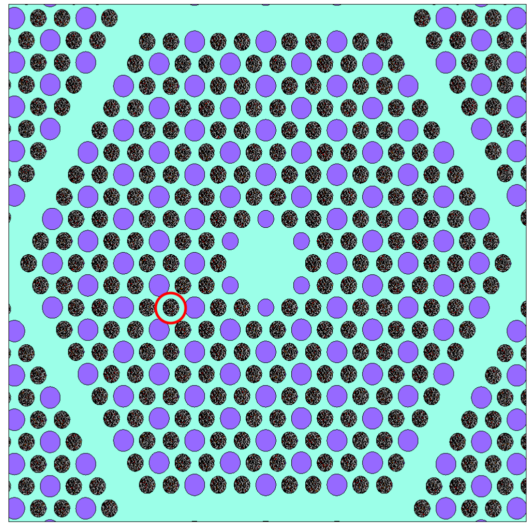
1.1 Flux detectors

Notes:

- are flux detectors properly defined?
- maybe try surface detectors?



(a) Flux detector applied in this fuel assembly.



(b) Flux detector applied in this fuel channel.

Figure 3: MHTGR full core model.

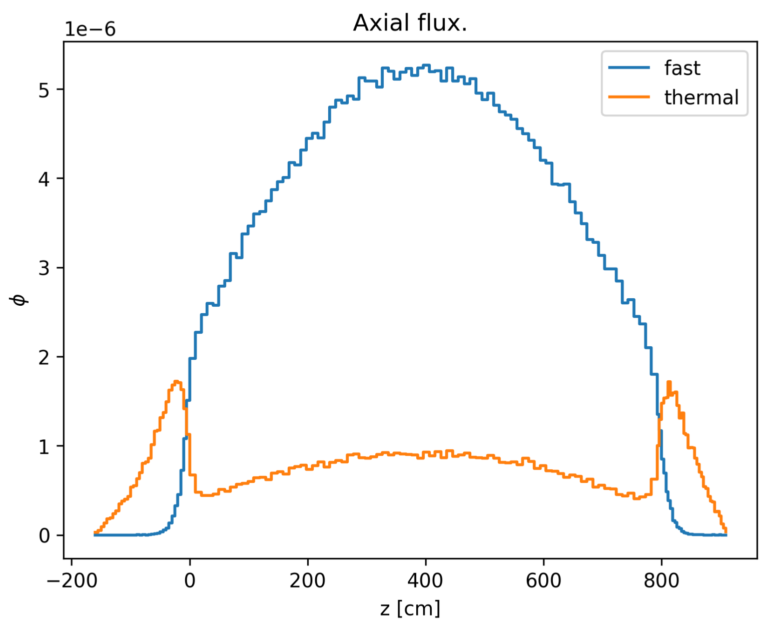


Figure 4: Neutron flux on the specified fuel channel.

2 Moltres model

Figure 5 shows the 2D unit cell of the MHTGR. Figure 6 shows the axial flux in the fuel centerline. Figure 7 shows the radial flux across the unit cell.

Figure 8 shows a different 2D unit cell of the MHTGR. In this unit cell, the coolant channel does not reach the boundary. The vacuum boundary condition is applied on the bottom and top reflectors only. Figure 9 shows the axial flux in the fuel centerline. Figure 10 shows the radial flux across the unit cell.

Figure 11 shows a 2D unit cell of the MHTGR, where the fuel, moderator, and coolant integrate one material. I homogenize their cross sections and get this new homogeneous material. The idea is to model the neutronics with this homogenized material, but leave the material definition for the thermo hydraulics heterogeneous. Figure 12 shows the axial flux in the homogenized material. This method for the 2D unit cell does not make much sense, as the flux in the r-direction will be uniform. This method makes more sense in the 2D full core model, which includes the inner and outer reflectors in the simulation.

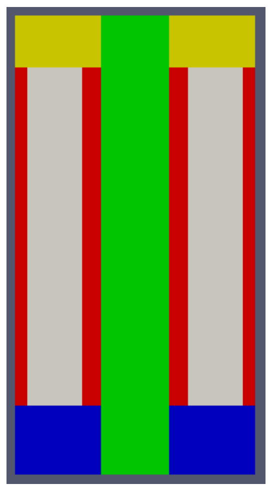
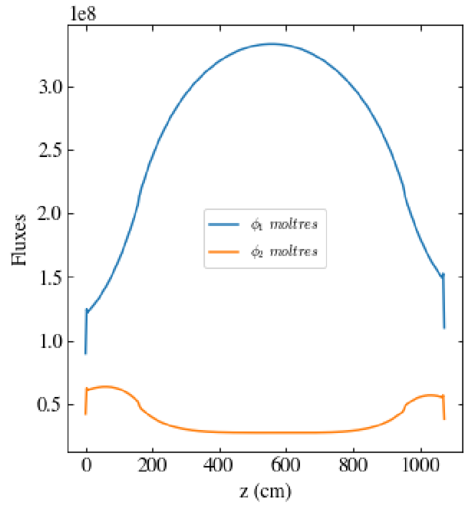


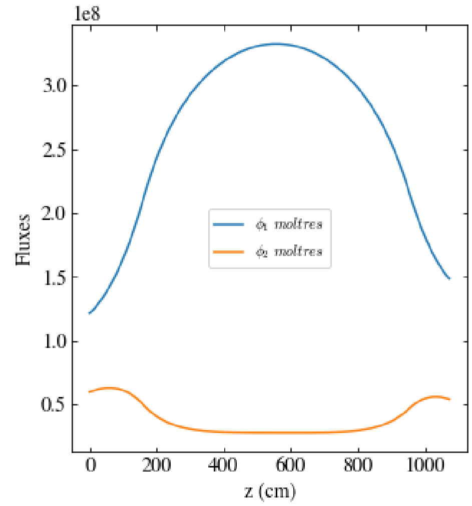
Figure 5: *2D-unitcell-refl.geo*. red: moderator, gray: fuel, green: coolant, yellow: top reflector, blue: bottom reflector.

2.1 Eigenvalue problem

The eigenvalue problem determines the steady-state flux and calculates the k_{eff} of the system. Figure 13 shows the flux in the fuel for the eigenvalue problem. Figure 14 shows the flux in the fuel, bottom, and top reflector for the eigenvalue problem. The result is wrong. It should have the same shape as the flux shown in figure 15.

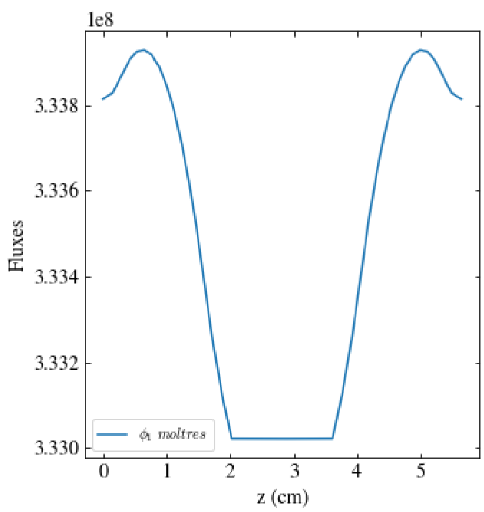


(a) Flux in the fuel centerline between points (0.94,-160,0) and (0.94,913,0).

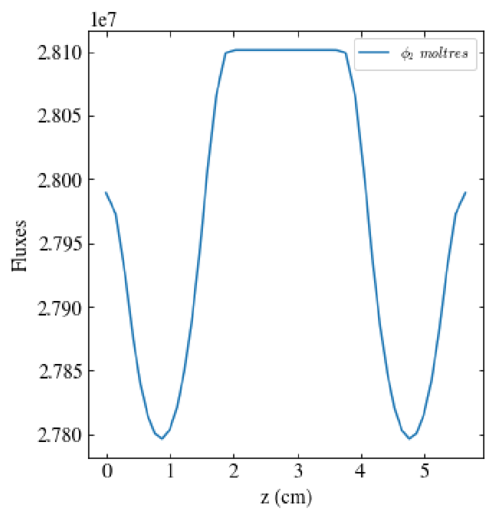


(b) Flux in the coolant centerline between points (2.82,-160,0) and (2.82,913,0).

Figure 6: Axial flux.



(a) Fast flux across the cell between points (0,400,0) and (5.64,400,0).



(b) Thermal flux across the cell between points (0,400,0) and (5.64,400,0).

Figure 7: Radial flux.

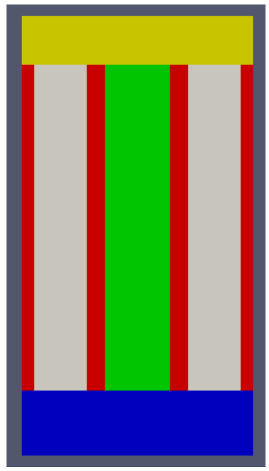
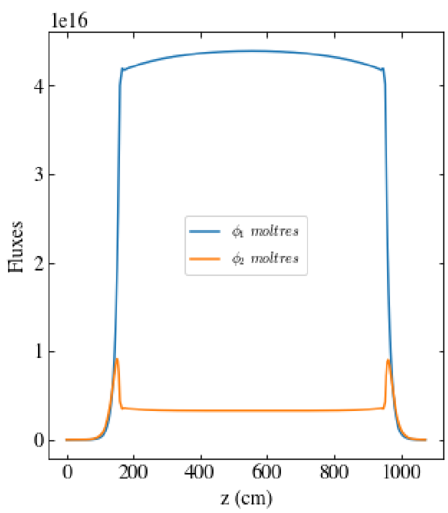
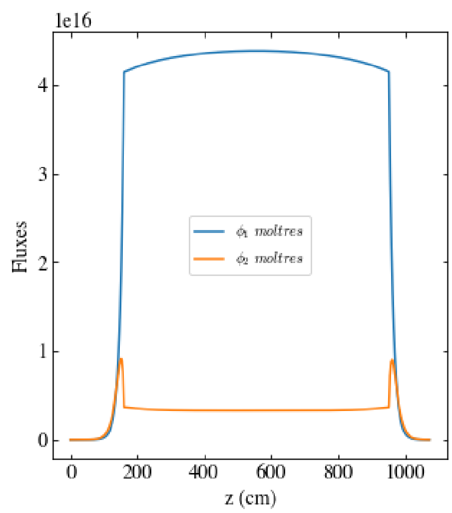


Figure 8: *2D-unitcell-refl.geo*. red: moderator, gray: fuel, green: coolant, yellow: top reflector, blue: bottom reflector.

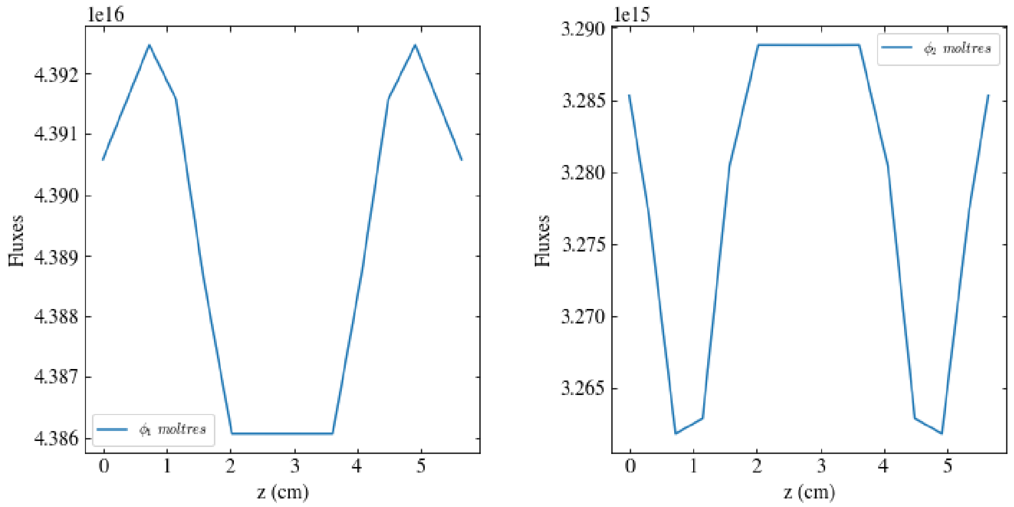


(a) Flux in the fuel centerline between points (0.94,-160,0) and (0.94,913,0).



(b) Flux in the coolant centerline between points (2.82,-160,0) and (2.82,913,0).

Figure 9: Axial flux.



(a) Fast flux across the cell between points (0,400,0) and (5.64,400,0).

(b) Thermal flux across the cell between points (0,400,0) and (5.64,400,0).

Figure 10: Radial flux.

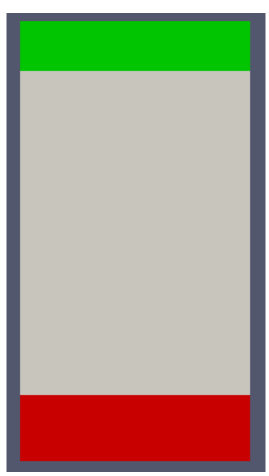
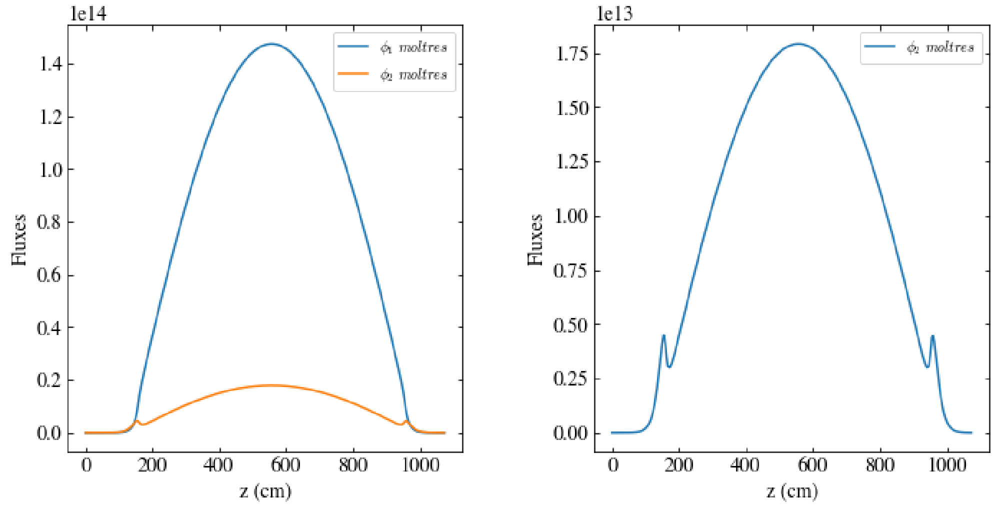


Figure 11: *2D-unitcell-refl.geo*. gray: homogeneous mixture, green: top reflector, red: bottom reflector.



(a) Flux in the fuel centerline between points (0.94,-160,0) and (0.94,913,0).

(b) Thermal flux in the fuel centerline between points (0.94,-160,0) and (0.94,913,0).

Figure 12: Axial flux.

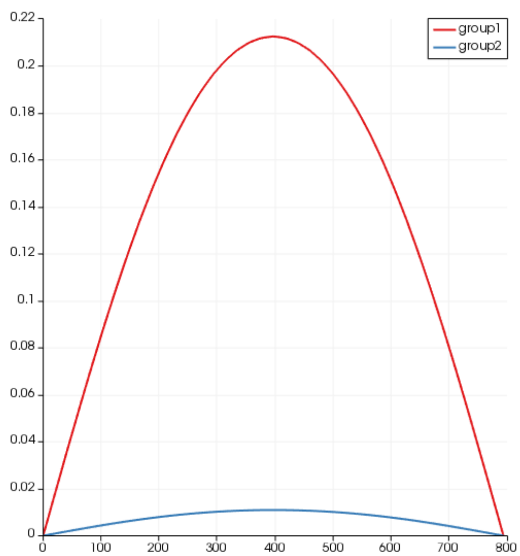
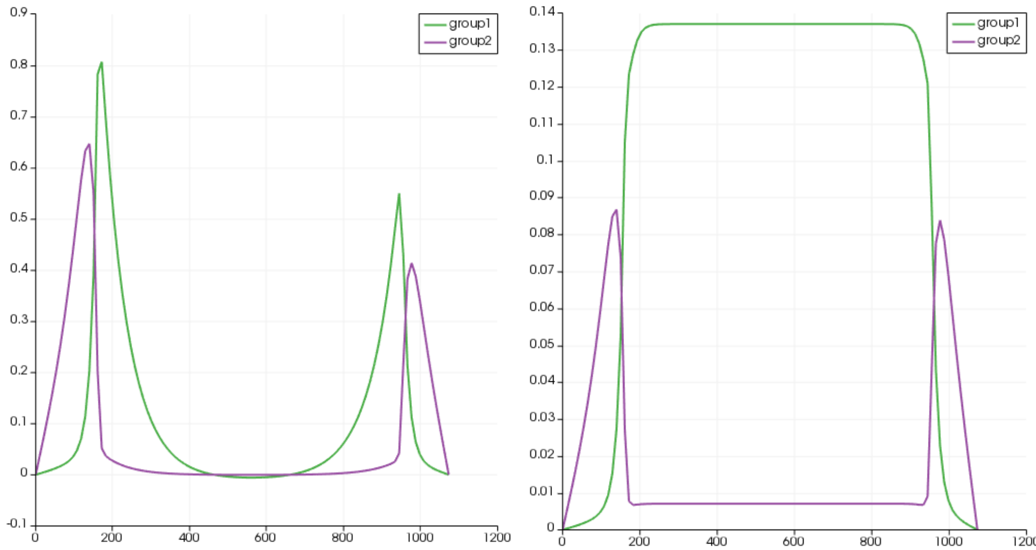


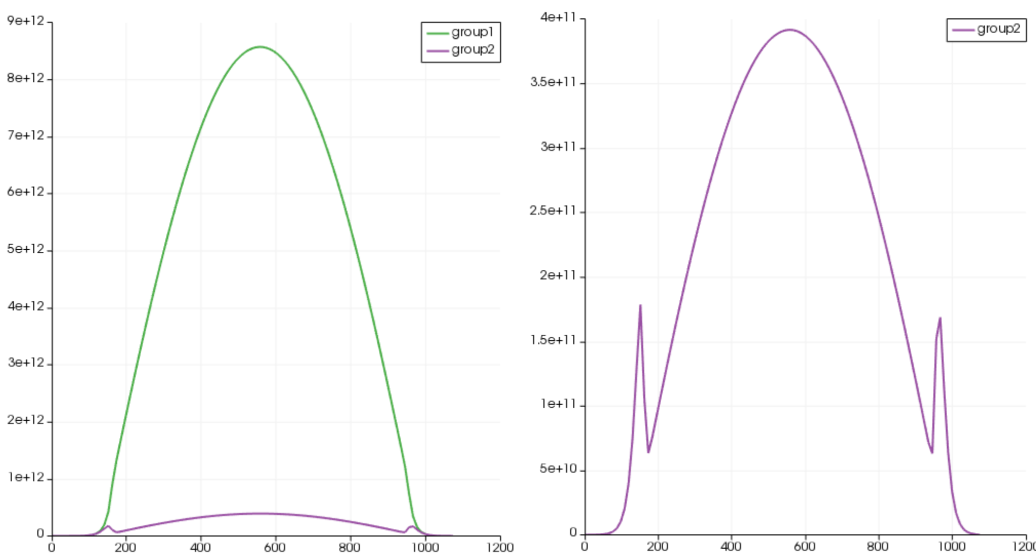
Figure 13: Eigenvalue problem.



(a) InversePowerMethod.

(b) NonlinearEigen.

Figure 14: Eigenvalue problem.



(a) Neutron flux.

(b) Thermal flux.

Figure 15: Transient problem.

References