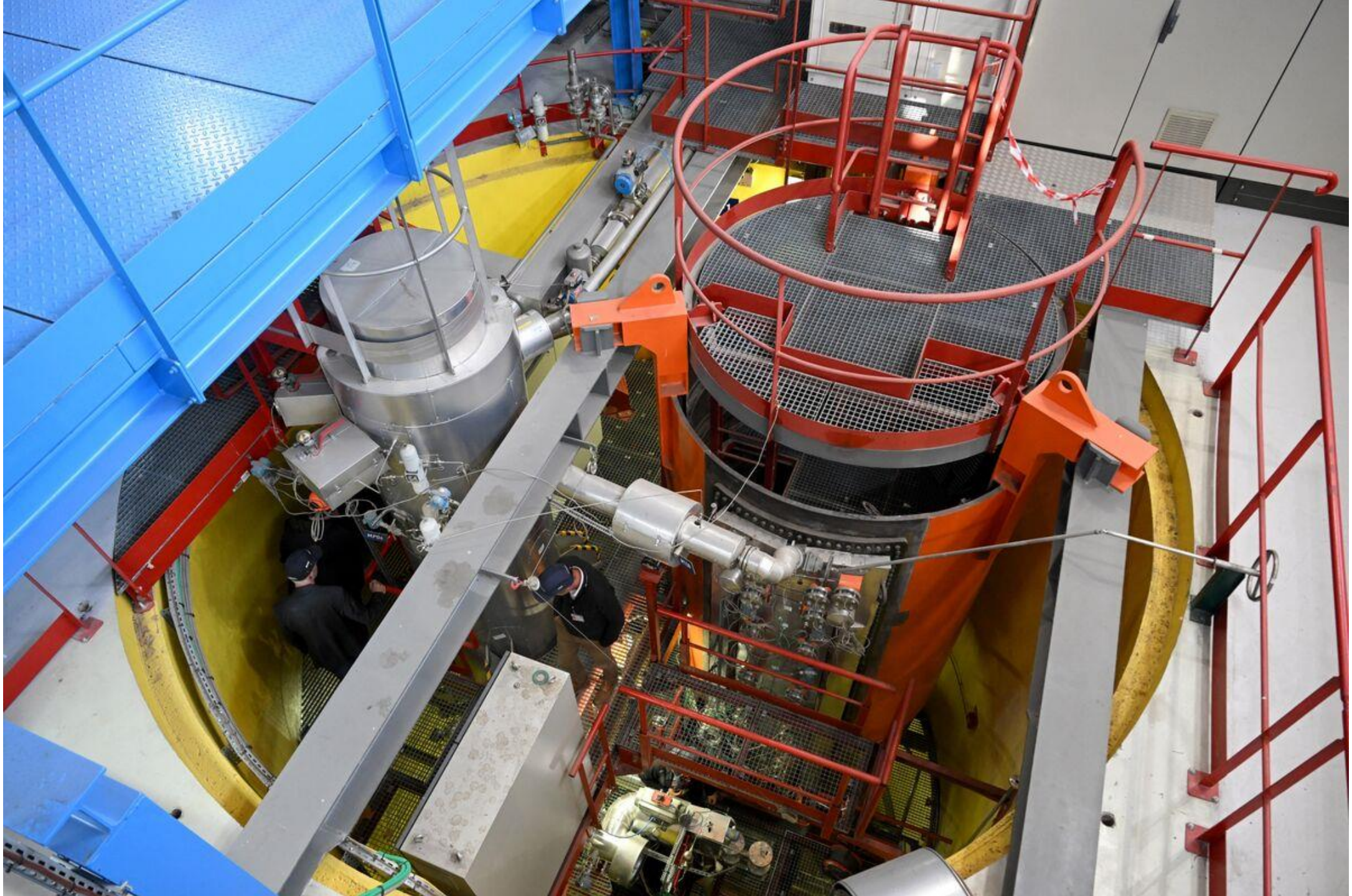
LARGE, CONVENTIONAL REACTOR
700+ MW(e)

SMALL MODULAR REACTOR
Up to 300 MW(e)



UNIVERSITY
OF OSLO

Masters Thesis Spring 2026

Neutronic Analysis of Sequential Fuel Utilization in Fluoride-Salt-Cooled High-Temperature Reactors

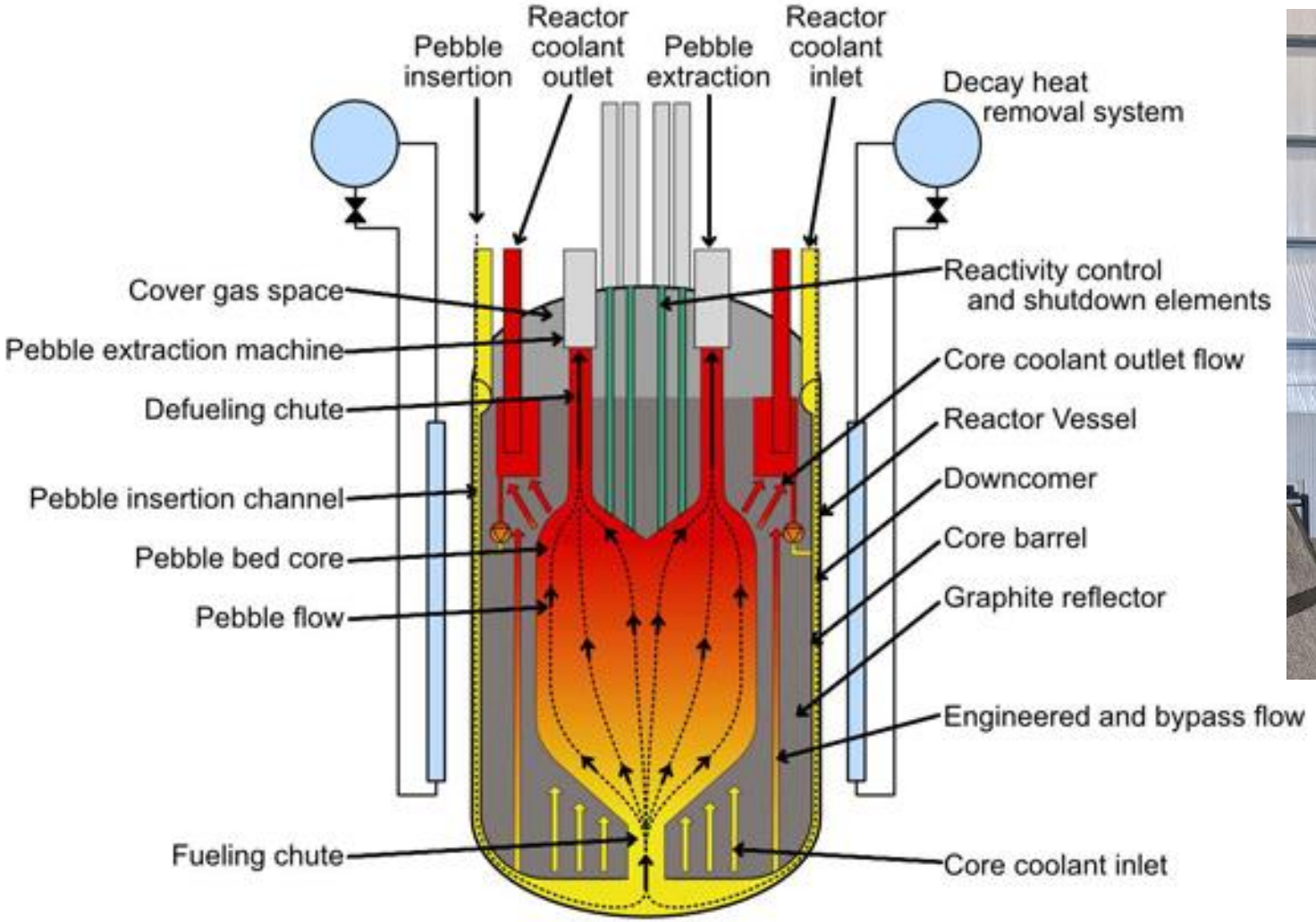
Neutronic Behavior, Burnup Optimization, and Reuse Potential of Depleted Pebbles

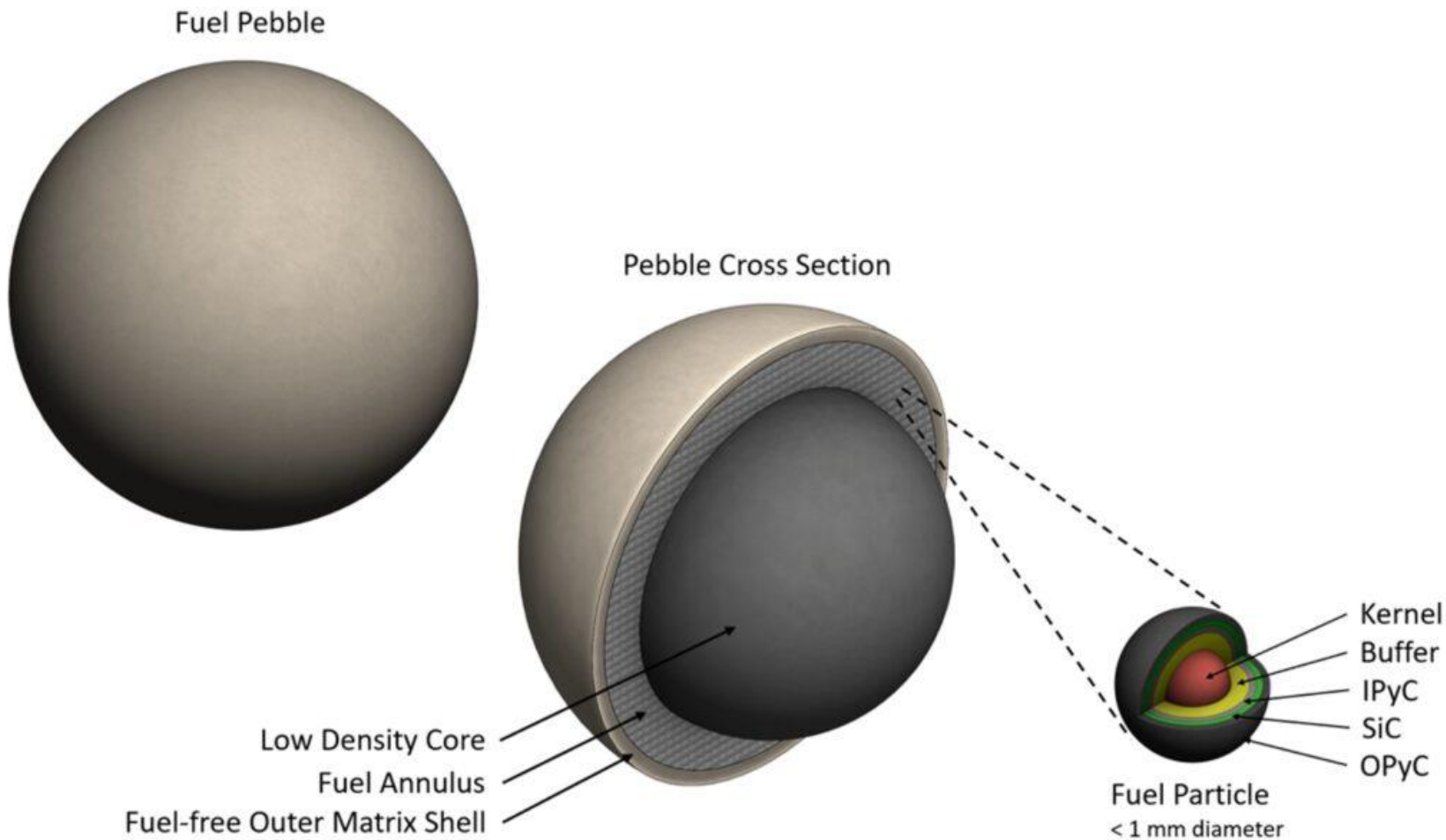
Josef A. H. Hisanawi
j.a.h.hisanawi@fys.uio.no

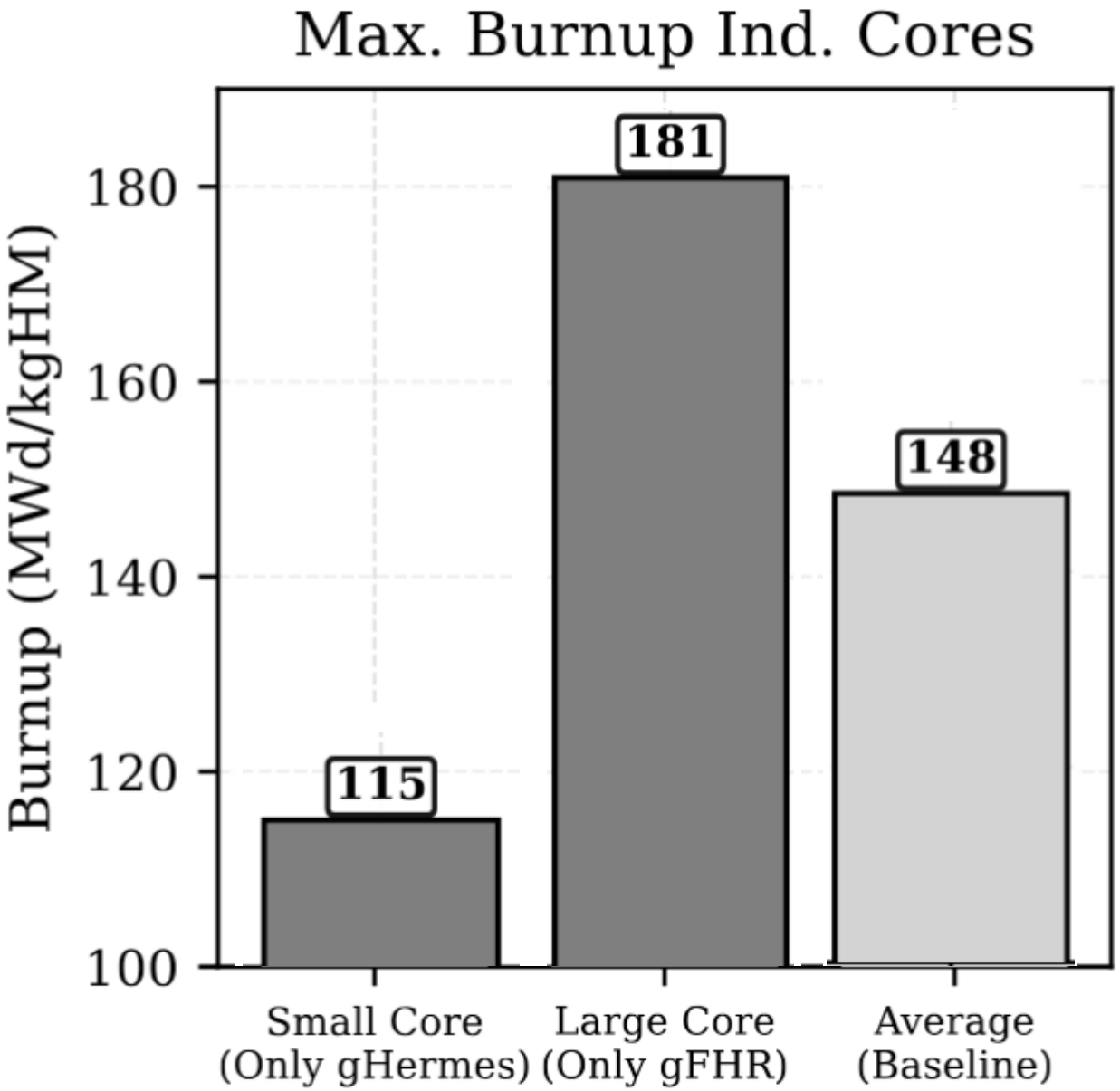
Department of Physics
Faculty of Mathematics and Natural Sciences

6th May 2026

Fluoride High-temperature Reactor (FHR)




Fuel Pebble
Pebble Cross Section
Low Density Core
Fuel Annulus
Fuel-free Outer Matrix Shell
Kernel
Buffer
IPyC
SiC
OPyC
Fuel Particle
< 1 mm diameter


Max. Burnup Ind. Cores
Burnup (MWd/kgHM)
100
120
140
160
180
115
181
148
Small Core
(Only gHermes)
Large Core
(Only gFHR)
Average
(Baseline)

Methodology

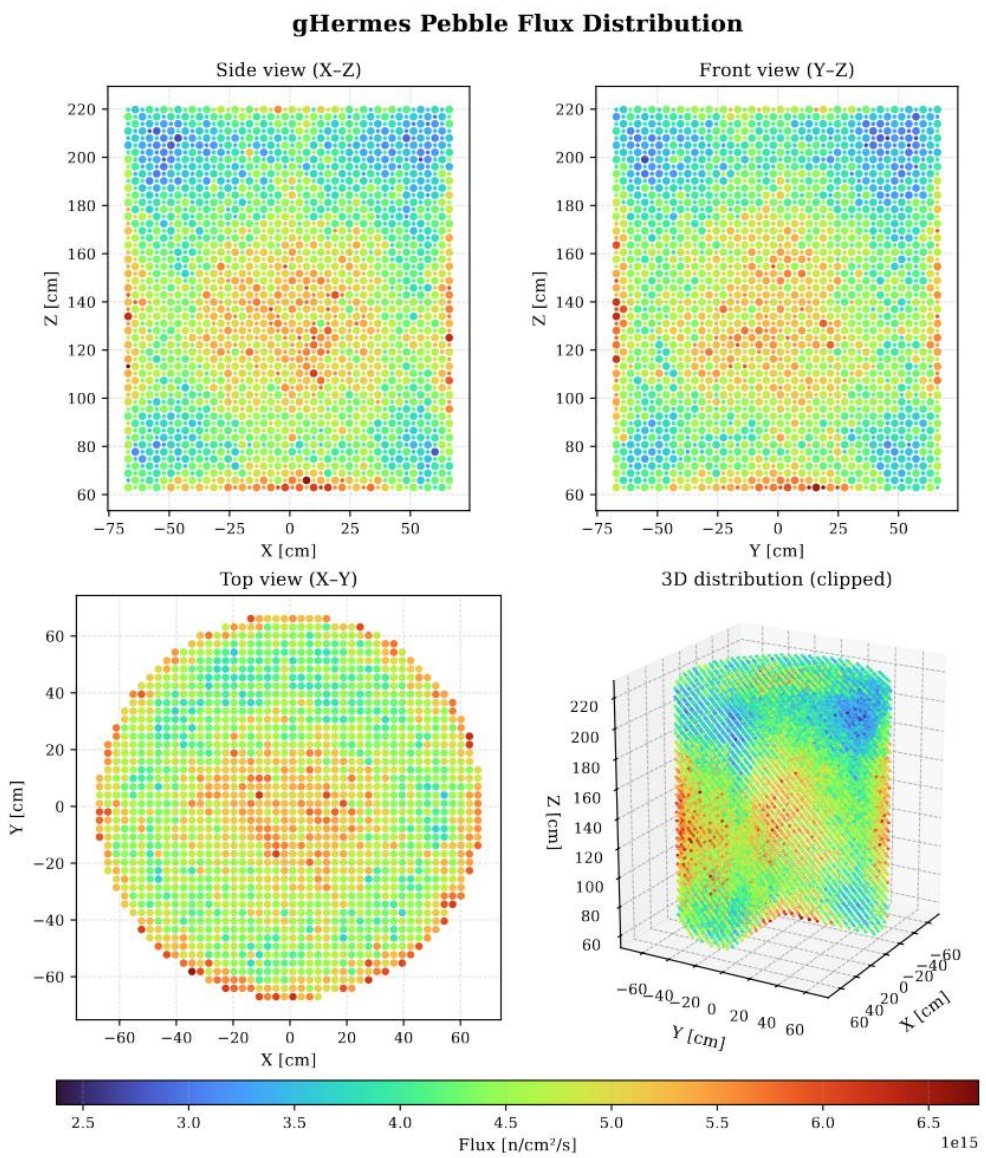


Figure 4.6: Pebble-wise neutron flux distribution in the gHermes core. The four panels show orthogonal slices through the pebble bed in the (X, Y), (X, Z), and (Y, Z) planes, together with a clipped three-dimensional visualization providing access to the interior region. Each circle represents an individual pebble at its geometrically modelled location, coloured according to its normalized neutron flux. This visualization highlights spatial gradients, symmetry properties, and localized flux.

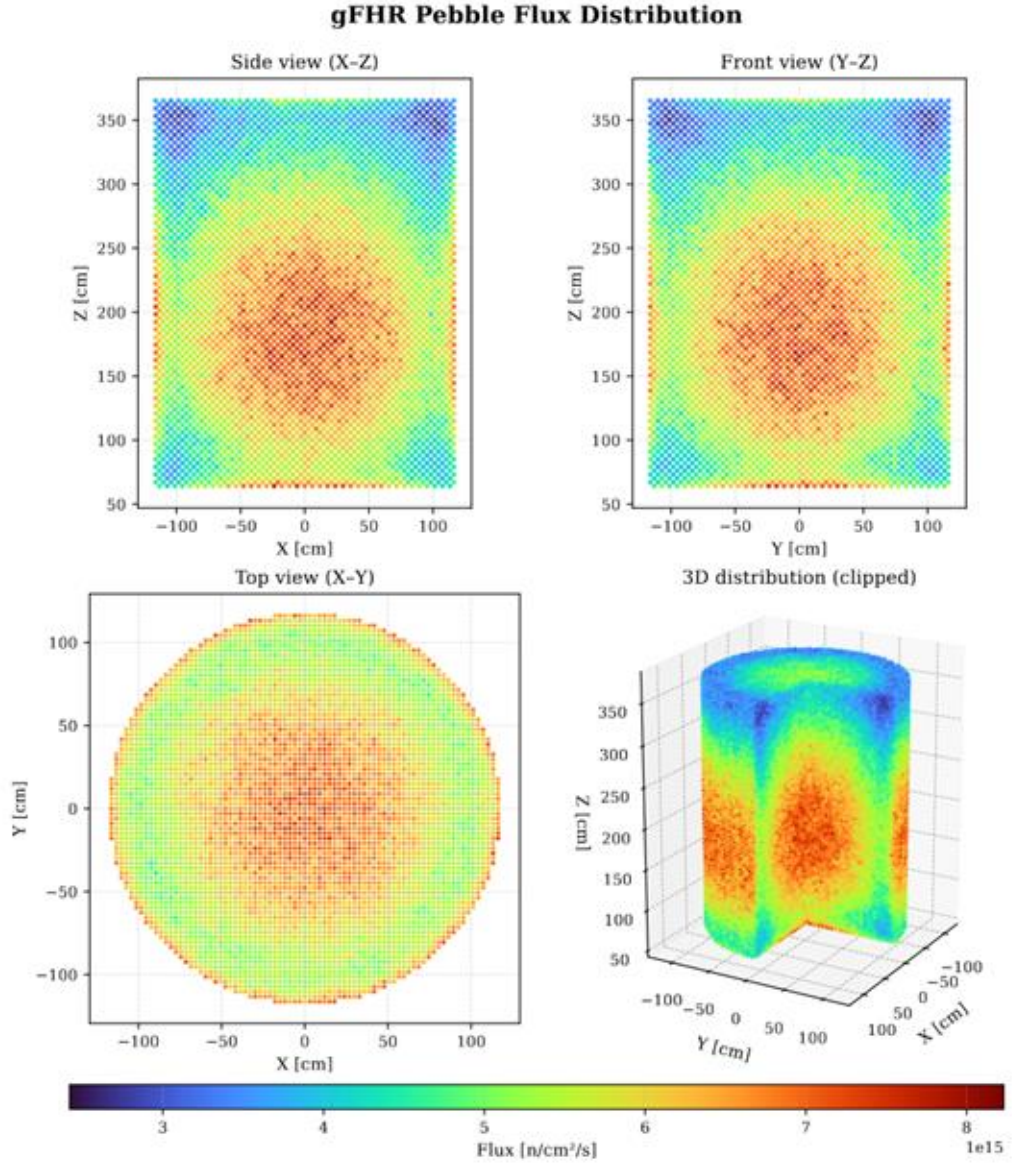
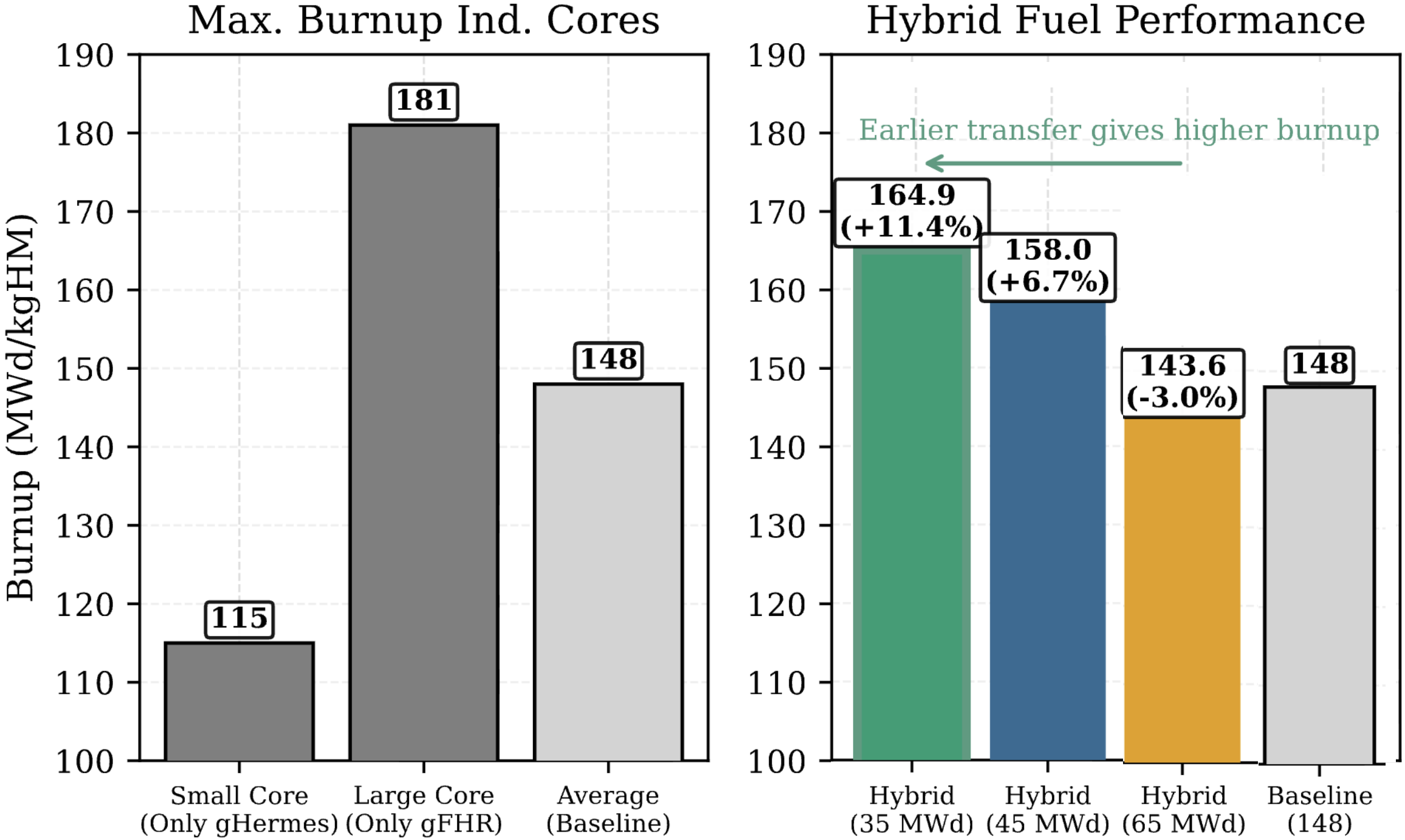


Figure 4.5: Pebble-wise neutron flux distribution in the gFHR core. The four panels show orthogonal slices through the pebble bed in the (X, Y), (X, Z), and (Y, Z) planes, together with a clipped three-dimensional visualization providing access to the interior region. Each circle represents an individual pebble at its geometrically modelled location, coloured according to its normalized neutron flux. This visualization highlights spatial gradients, symmetry properties, and localized flux


Max. Burnup Ind. Cores
Burnup (MWd/kgHM)
190
180
170
160
150
140
130
120
110
100
115
181
148
Small Core (Only gHermes)
Large Core (Only gFHR)
Average (Baseline)
Hybrid Fuel Performance
Earlier transfer gives higher burnup
164.9 (+11.4%)
158.0 (+6.7%)
143.6 (-3.0%)
148
Hybrid (35 MWd)
Hybrid (45 MWd)
Hybrid (65 MWd)
Baseline (148)

Discussion

UNIVERSITY OF OSLO

Josef Hisanawi
Master Student
University of Oslo