



Produced by University Communications

Neutronics Activities at the University of Wisconsin

Mohamed Sawan

P. Wilson, T. Tautges(ANL), L. El-Guebaly, D. Henderson,
T. Bohm, Ed Marriott,
B. Kiedrowski, A. Ibrahim, B. Smith, R. Slaybaugh

IEA Workshop on Fusion Neutronics

Heidelberg, Germany

October 1, 2007

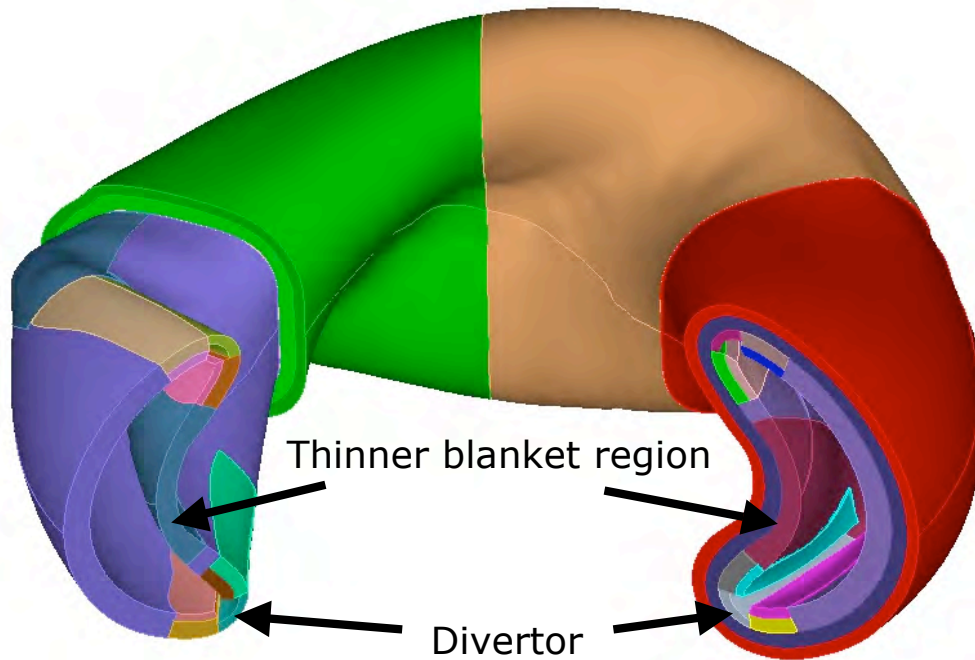


THE UNIVERSITY
of
WISCONSIN
MADISON

Outline

- DAG-MCNP applications
 - ARIES-CS
 - HAPL
 - ITER FWS
- Impact of ENDF/B-VII.0 release on FENDL-2.1

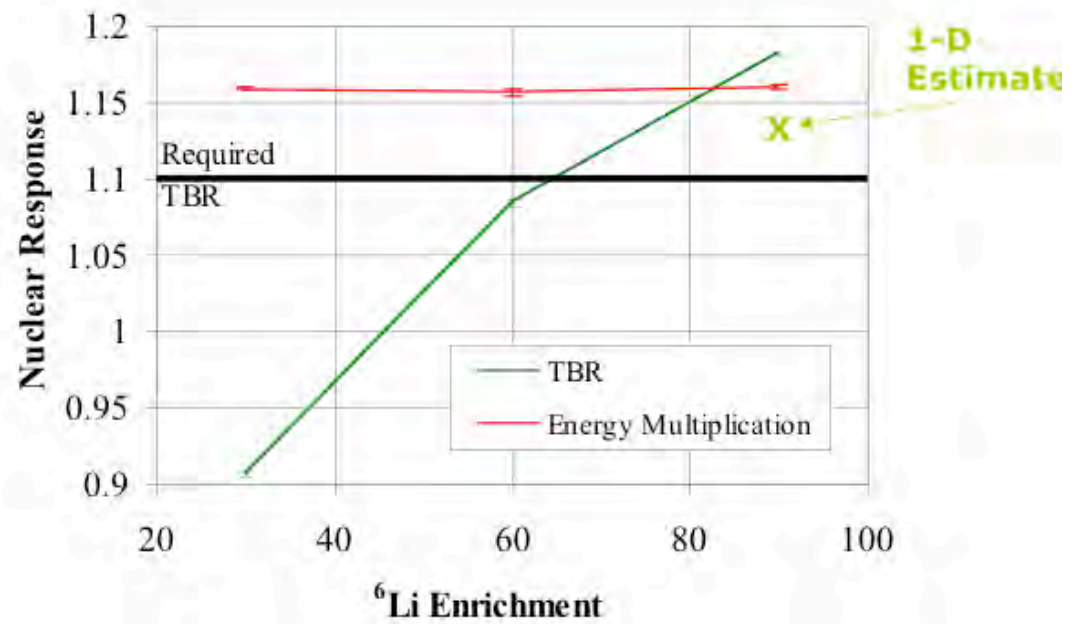
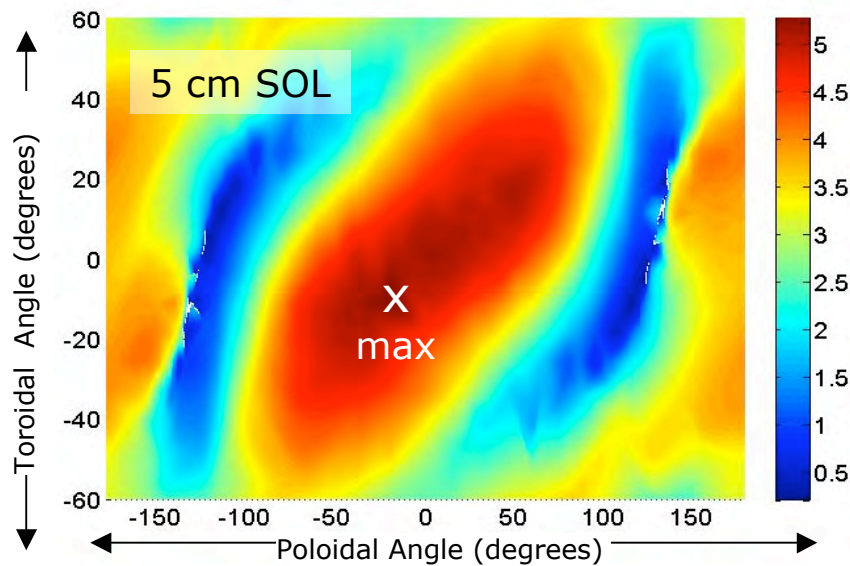
Application to ARIES-CS Compact Stellarator



- Geometry complex
- FW shape and plasma profile vary toroidally within each field period
- Cannot be modeled by standard MCNP

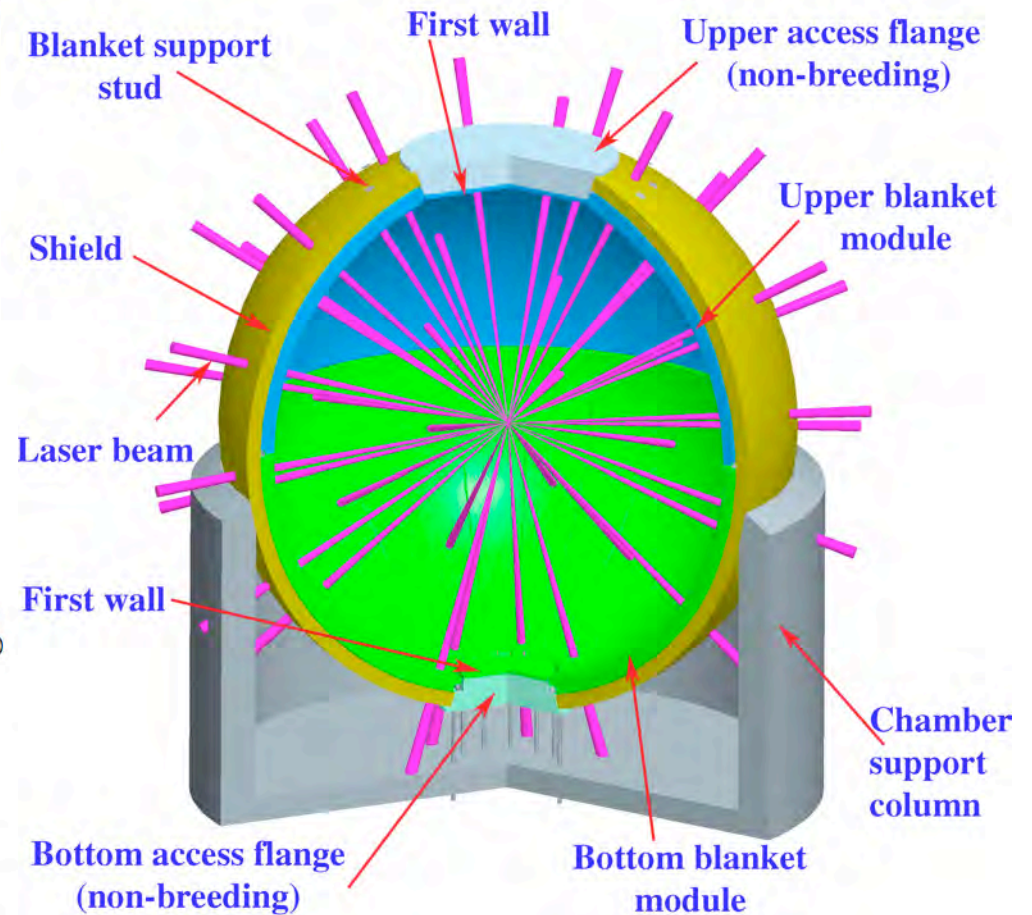
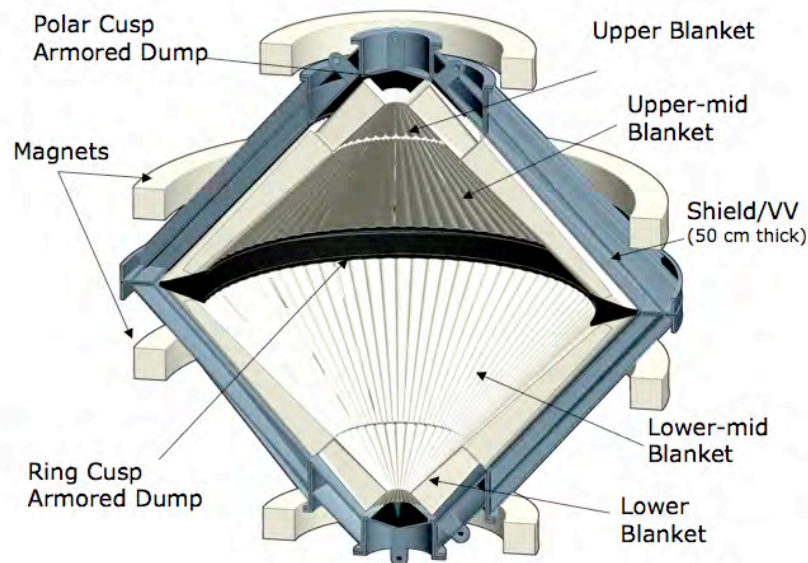
Examined effect of helical geometry and non-uniform blanket and divertor on NWL distribution and total TBR and nuclear heating

NWL Maps and Overall TBR and Energy Multiplication



High Average Power Laser (HAPL) Conceptual Design

Direct drive targets
Dry wall chamber
40 KrF laser beams
367.1 MJ target yield
5 Hz Rep Rate

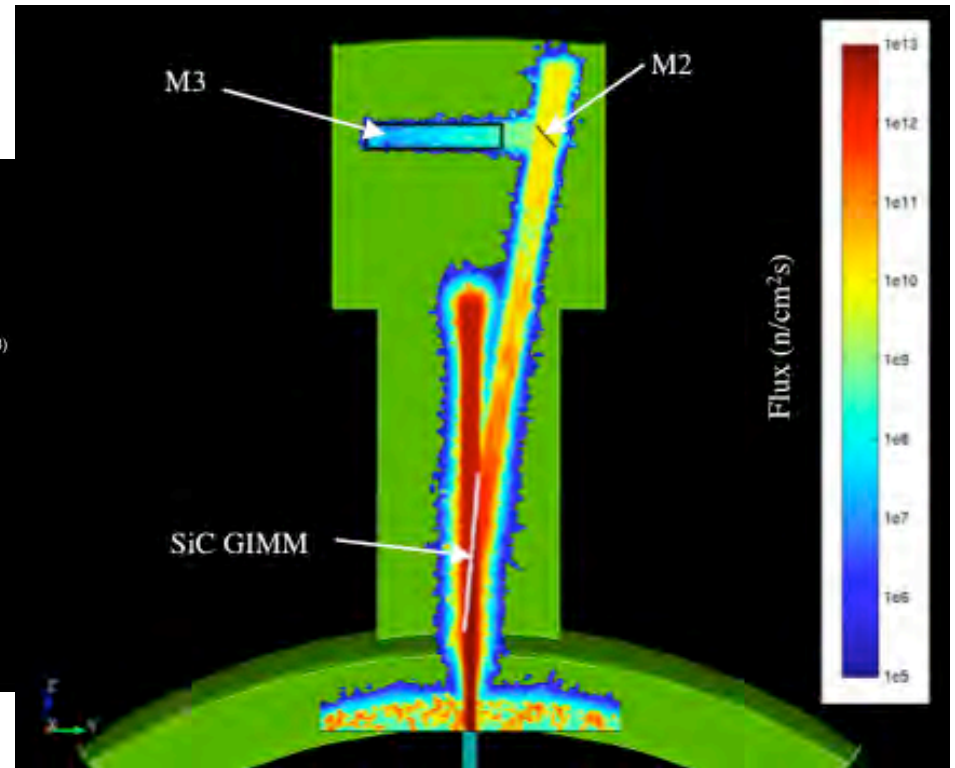
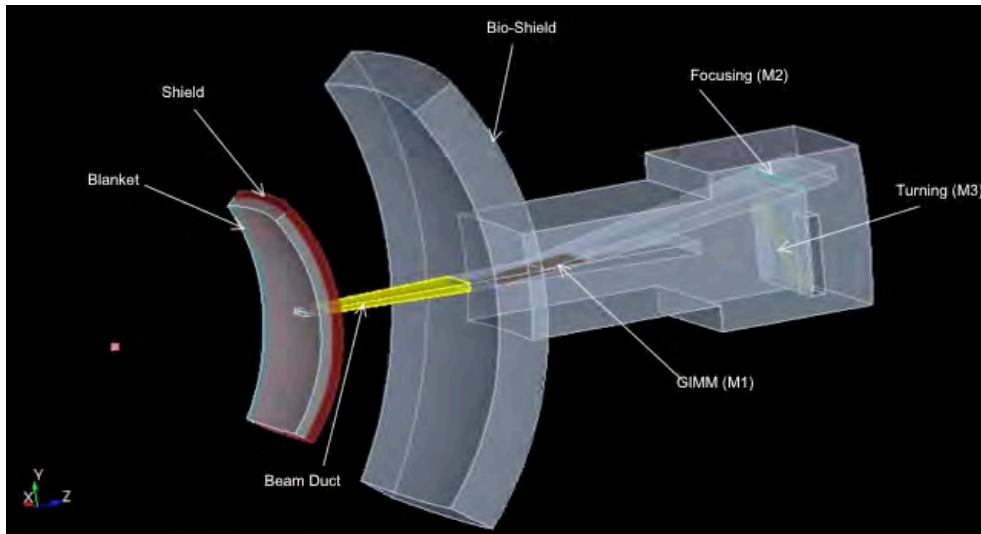


Design with Magnetic Intervention

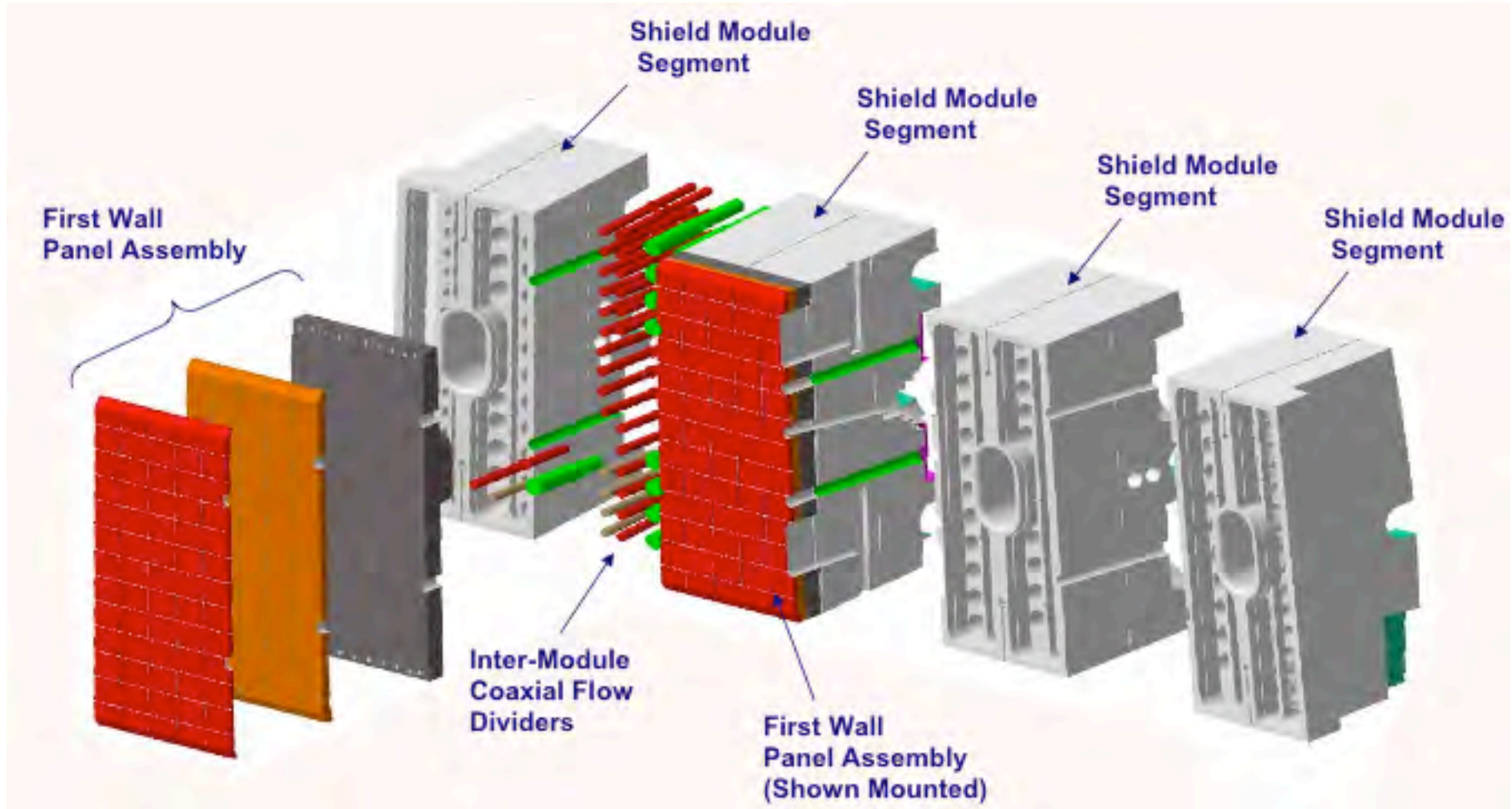
Large Chamber Design

October 2007

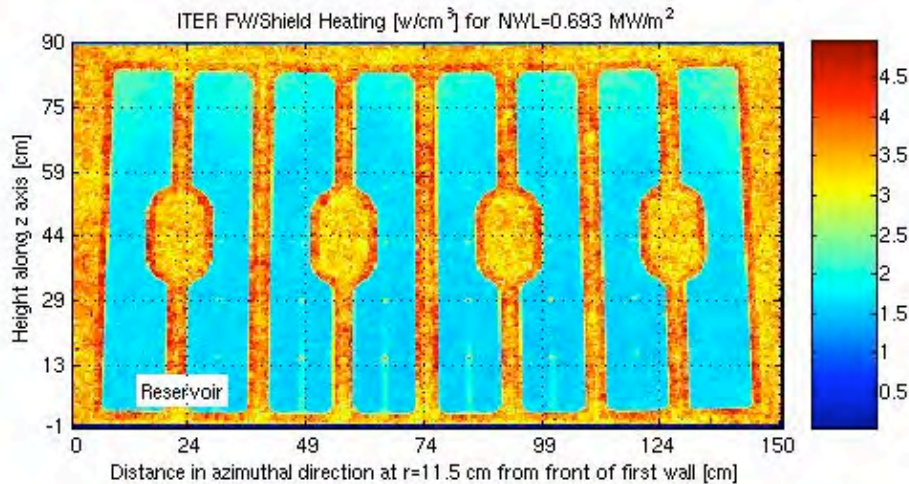
HAPL Final Laser Optics



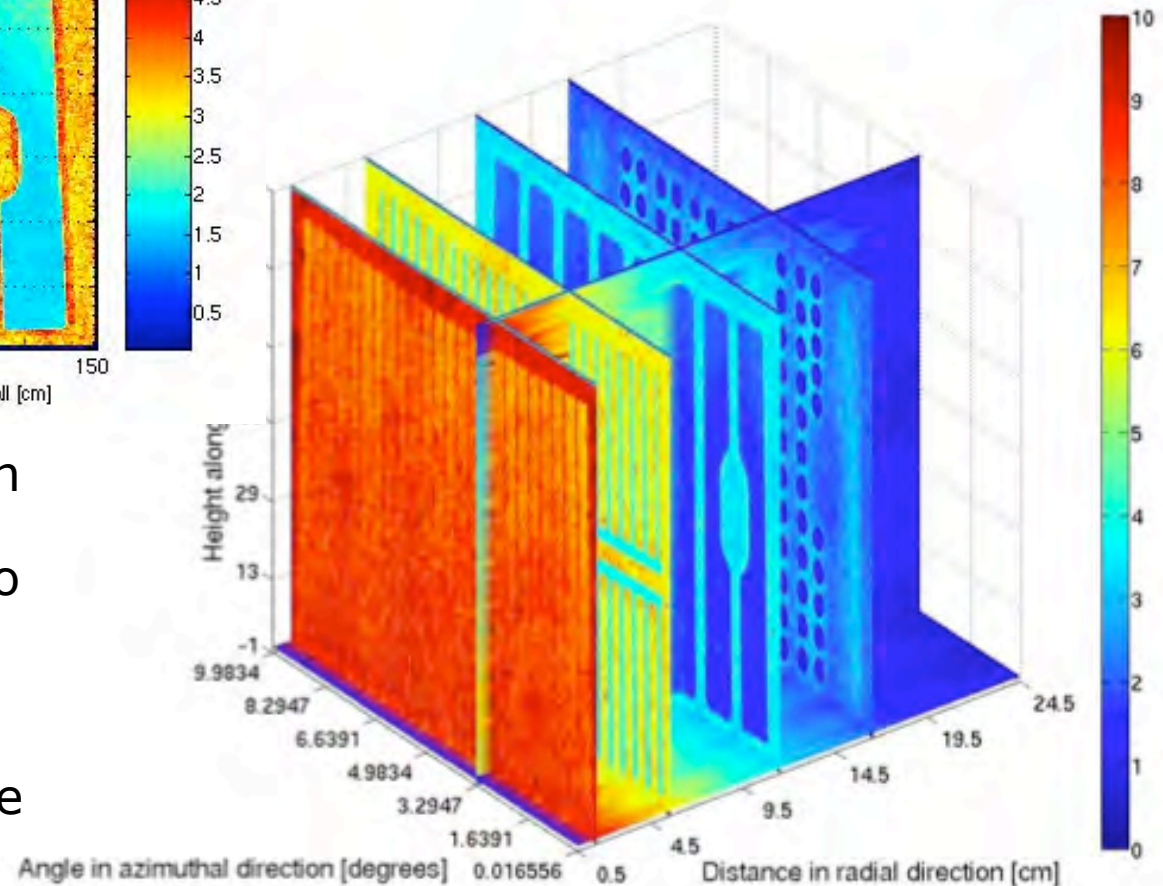
ITER FWS Module Elements



Nuclear Heating

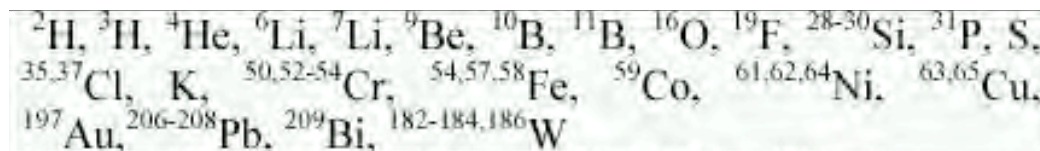


- High-fidelity high resolution results obtained showing significant variations due to heterogeneity
- While nuclear heating is higher in steel than in water, the steel nearest the water sees the highest nuclear heating



ENDF/B-VII.0 Release and Impact on FENDL-2.1

- The ENDF/B-VII.0 library was **officially released on December 15, 2006**
- An extensive **paper on ENDF/B-VII.0 library** appeared in a special issue of **Nuclear Data Sheets, NDS 107(2006) pp. 2931-3060**
- FENDL-2.1 compiled in November 2003, INDC(NDS)-451 is the new reference data library for ITER neutronics calculations
- It has 71 elements/isotopes with 40 of them taken from ENDF/B-VI.8

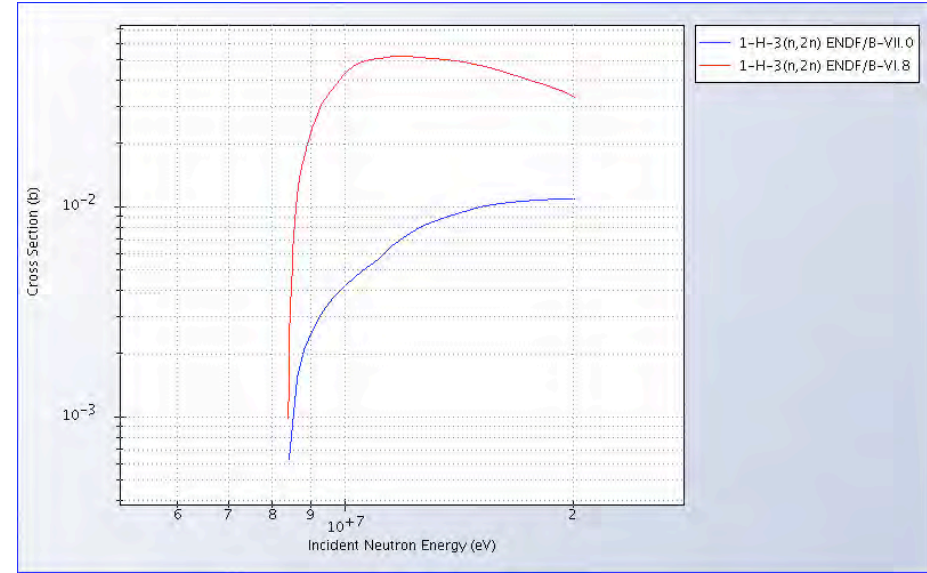
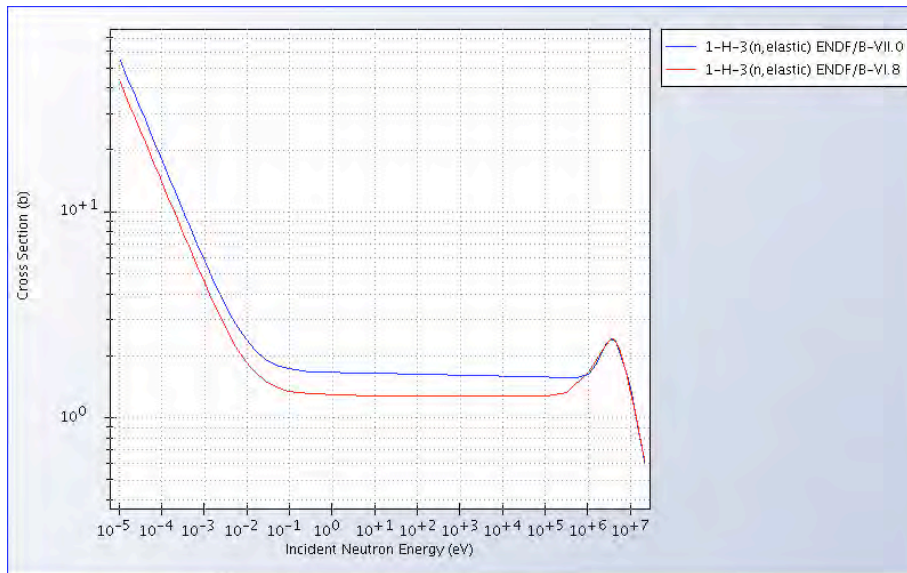


- **Compared data for these 40 elements/isotopes**

Assessment of changes made in data for the 40 isotopes/elements taken from ENDF/B-VI.8

H-3

Changes in (n,total), (n,elastic) and (n,2n) cross sections



Large changes in (n,2n) and elastic scattering cross sections

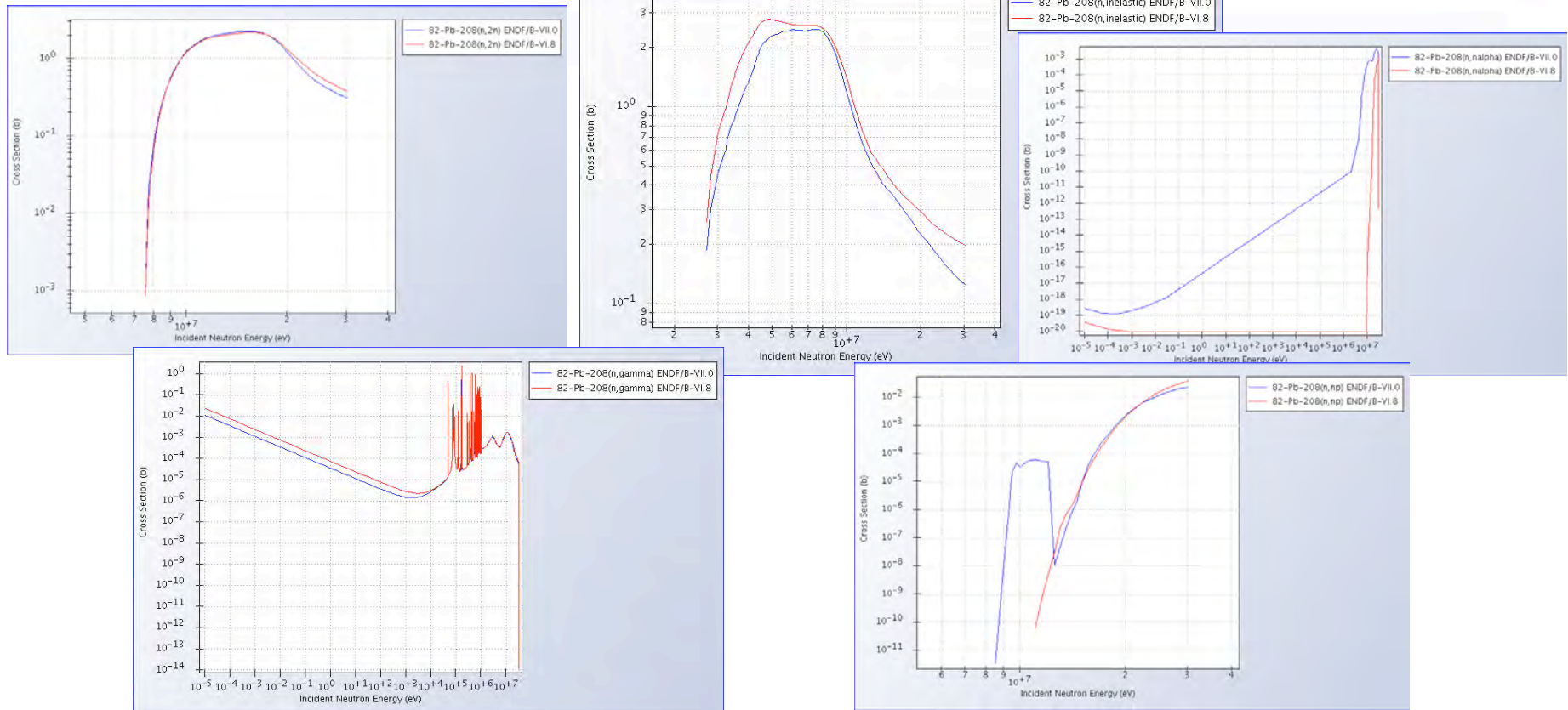
Only possible impact on ICF target neutronics

Does not impact ITER

Assessment of changes made in data for the 40 isotopes/elements taken from ENDF/B-VI.8

Pb-208

Many cross sections changed



Large changes in several cross sections
Possible impact on ITER-TBM

October 2007

Findings

- Minor impact on ITER nuclear analysis is expected except for ITER-TBM nuclear analysis due to changes in data for Li-6, Pb-208, and F-19
- Effects of changes could be large in other fusion systems
 - Power plants with breeding blankets
 - Inertial fusion systems (e.g., H-3 and Au-197 data are important for ICF target neutronics)
- Calculation benchmarks will be used to assess possible impact on relevant nuclear parameters
 - M. Sawan, "FENDL Neutronics Benchmark: Specifications for the Computational Neutronics and Shielding Benchmark," IAEA Nuclear Data Section Report INDC(NDS)-316 (December 1994).
- Impact of changes introduced in JENDL-3.3, JEFF-3.1, BROND-2.2 should also be assessed
- FENDL-2.1 needs a new update (FENDL-2.2 or 3.0?) for fusion neutronics but this update is not urgently needed for ITER analysis