

NUCL 510 Nuclear Reactor Theory I
Fall 2011

HW#1: Neutron Cross Sections

Due September 1

1. The latest ENDF/B-VII.0 library was released in 2006 and is available at the National Nuclear Data Center (<http://www.nndc.bnl.gov>). Using the ENDF/B-VII.0 library and the ENDF-6 format manual (<http://www.nndc.bnl.gov/csewg/docs/endl-manual.pdf>), answer the following questions:
 - 1) The ENDF/B library is organized into 14 sub-libraries. Describes the contents of these 14 sub-libraries and identify the number of materials included in each sub-library of ENDF/B-VII.0.
 - 2) The list of targets in ENDF/B-VII.0 library includes 393 targets or materials (381 isotopes, 9 isomers and 3 elements) for neutron reactions. Identify the 9 isomers and 3 elements.
 - 3) There are 48 targets for proton reactions, 10 targets for light ion induced reactions, 20 for thermal neutron scattering, 163 for photonuclear reactions. Identify these target materials.
 - 4) In the ENDF library, each reaction is identified by an MT number. Find the MT numbers for the following reactions.

(i) total	(ii) elastic scattering	(iii) total inelastic scattering
(iv) capture	(v) total fission	(vi) (n,n1) inelastic scattering
(vii) total $\bar{\nu}$	(viii) prompt $\bar{\nu}$	(ix) delayed $\bar{\nu}$
(x) (n,2n)	(xi) (n,3n)	(xii) (n, α)
 - 5) In the ENDF library, the list of quantities is defined by MF numbers. Describe the quantities included in MF numbers 1 through 8.
2. Using the SIGMA program available at the National Nuclear Data Center, plot the following cross sections.
 - 1) Fission cross sections of U-235, U-238, and Pu-239
 - 2) Elastic scattering cross sections of U-235, U-238, and Pu-239
 - 3) Total inelastic scattering cross sections of U-235, U-238, and Pu-239
 - 4) Elastic scattering cross sections of H-1, H-2, C-12, and Be-9
 - 5) Elastic scattering cross sections of Na-23, Fe-56, Pb-208
 - 6) Capture cross sections of B-10 and Gd-154