



Preparatory work for the evaluation of ^{52}Cr high energy neutron data for EFF

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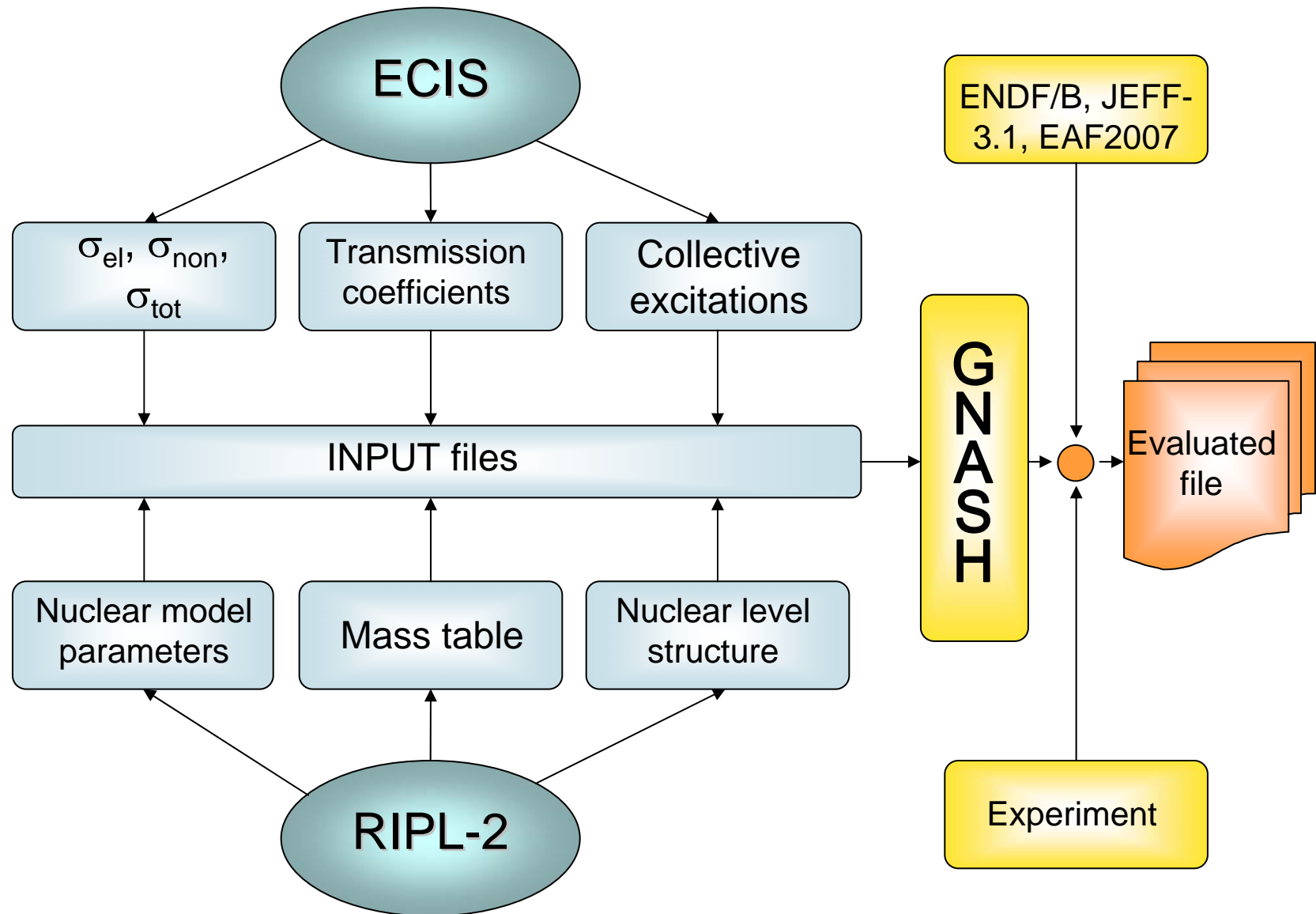
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New evaluated data file for ^{52}Cr

- Chromium is an important constituent of the low activation EUROFER steel.
 - Chromium nuclear reaction data have priority in the European Fusion Technology Programme.
 - General purpose neutron cross section data files should cover energy range from 0 to 150 MeV.
 - Data have to include charged particle, photons and secondary recoil emission spectra to enable nuclear heating and radiation damage calculations.
 - Data files must be ENDF-6 formatted for processing with the standard NJOY99 code.
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Flowchart of the evaluation procedure





Nuclear model calculations

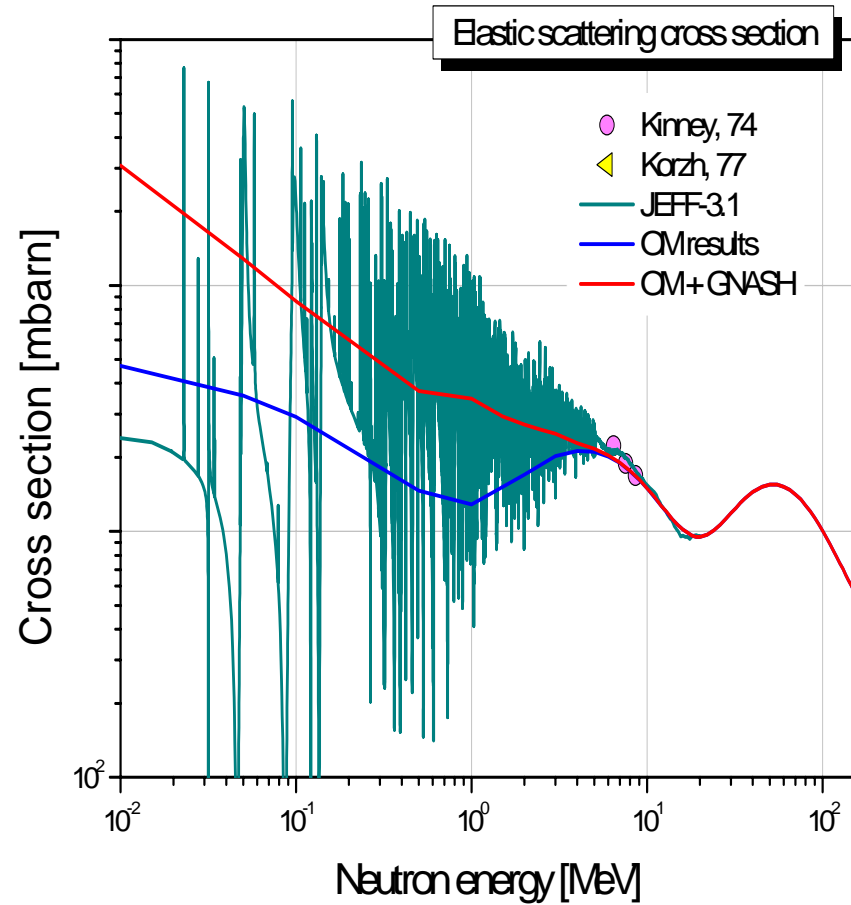
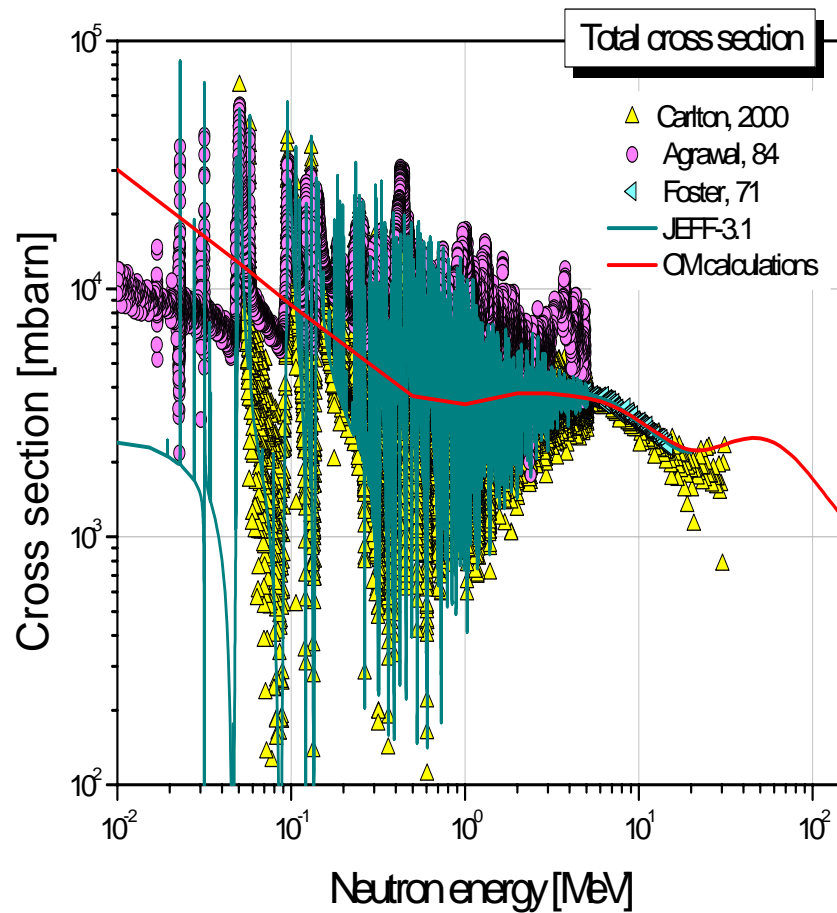
Optical model potential used:

- *Neutrons* – local OMP by Koning & Delaroche
- *Protons* – local OMP by Koning & Delaroche
- *Deuterons* – **new** global OMP (China, based on OMP by Bojowald)
- *Alphas* – global OMP by Avrigeanu
- *Tritons* – **new** global OMP
- *Helions* – **new** global OMP (**new** local OMP as an option)

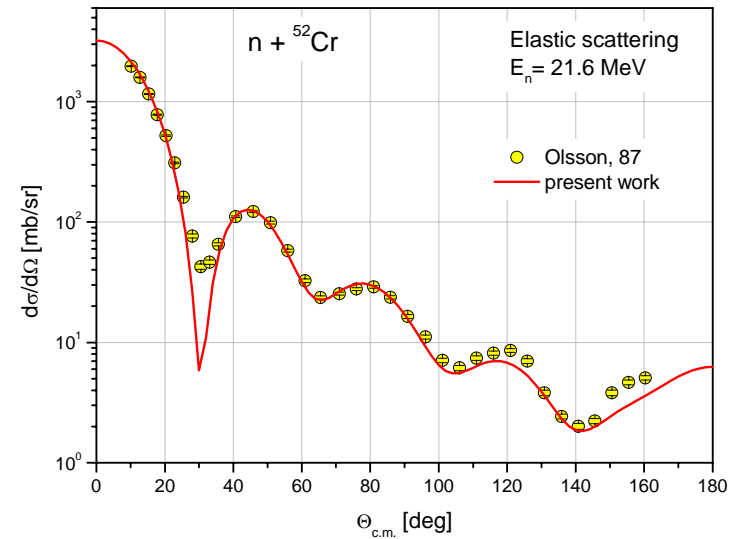
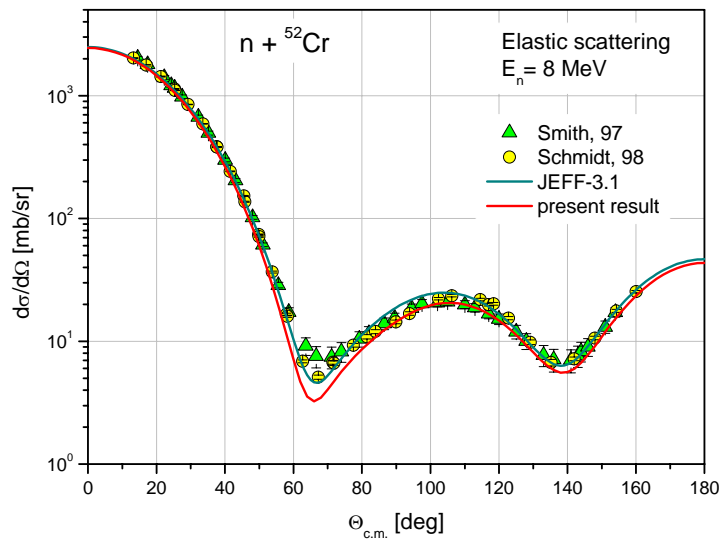
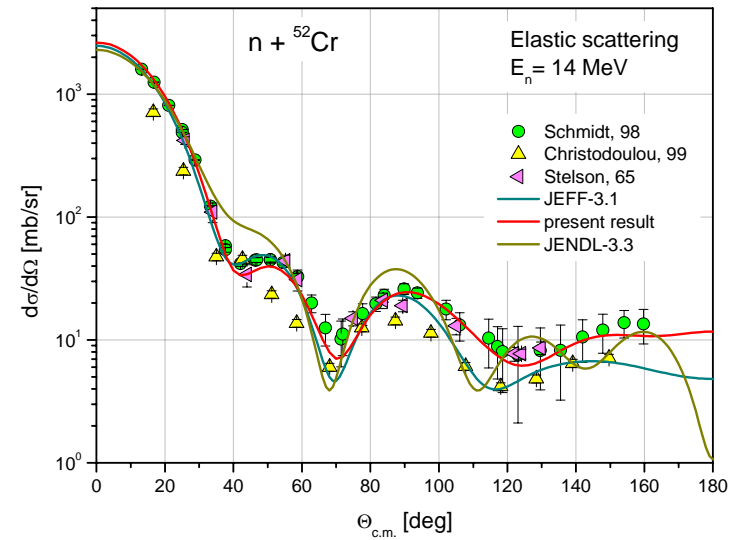
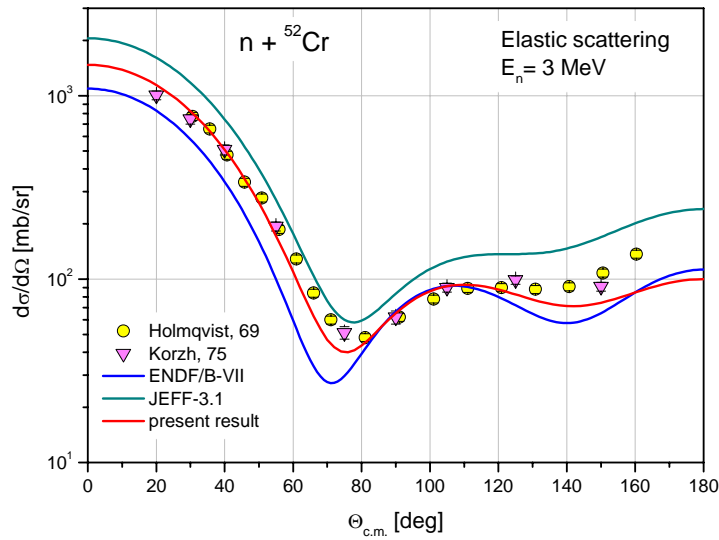
Nuclear reaction cross sections calculations using **GNASH**:

- Hauser-Feshbach for compound nucleus;
 - Ignatyuk form of the Fermi-gas level-density model
 - gamma-ray strength functions by Kopecky-Uhl;
 - exciton model for pre-equilibrium decay by Kalbach;
 - multiple pre-equilibrium emission;
 - collective excitations based on Kalbach model;
 - Kalbach systematics for particle angular distributions;
 - RIPL-2 data.
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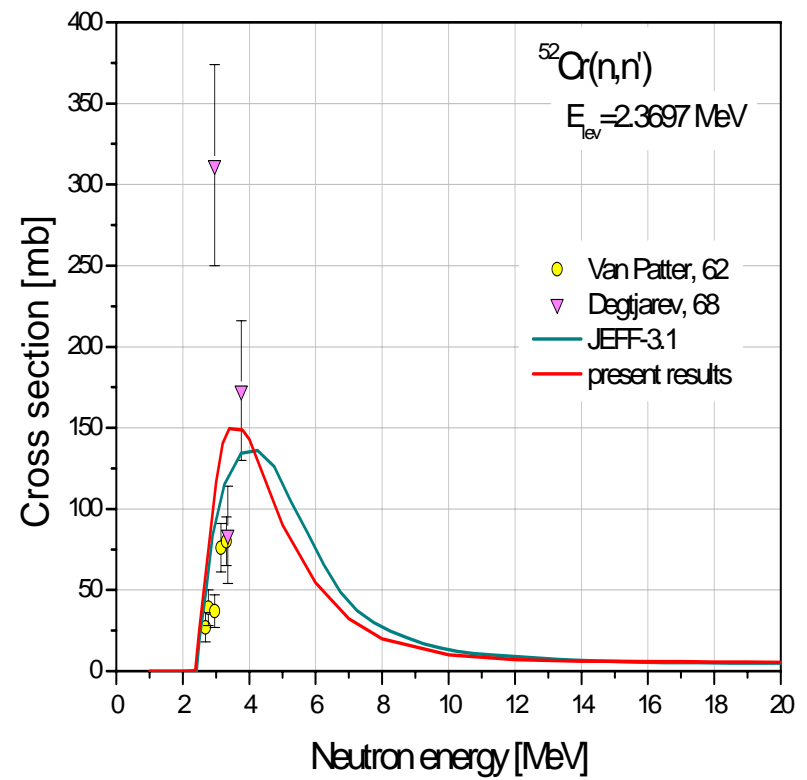
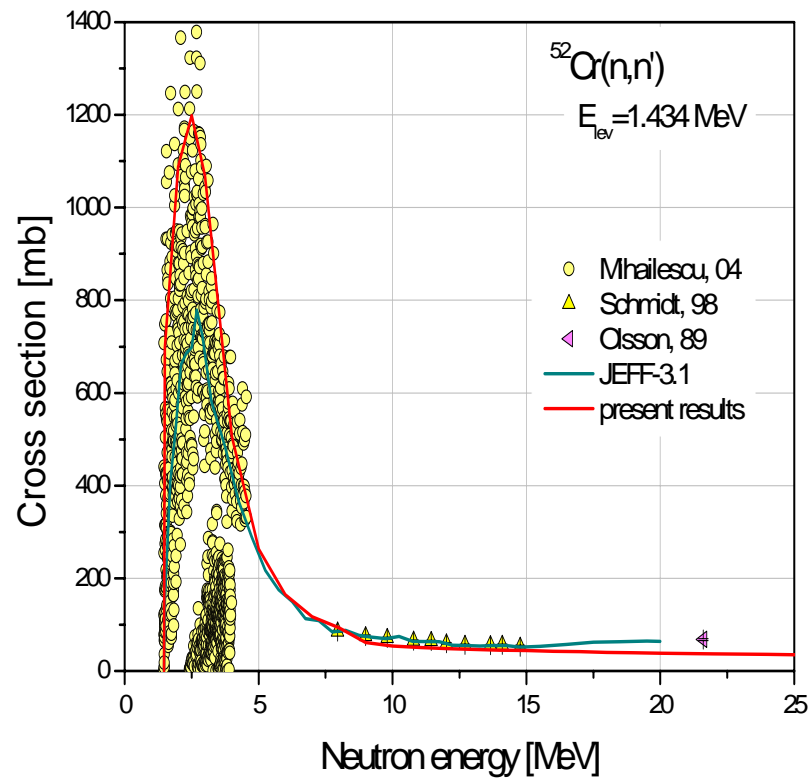
Total and elastic scattering cross sections



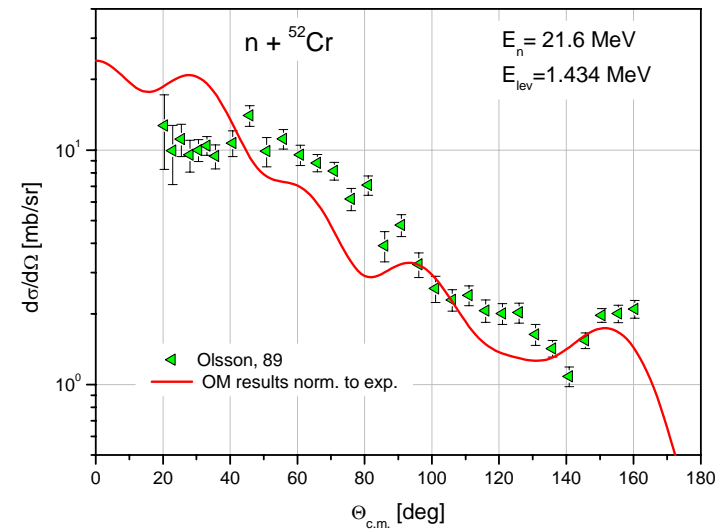
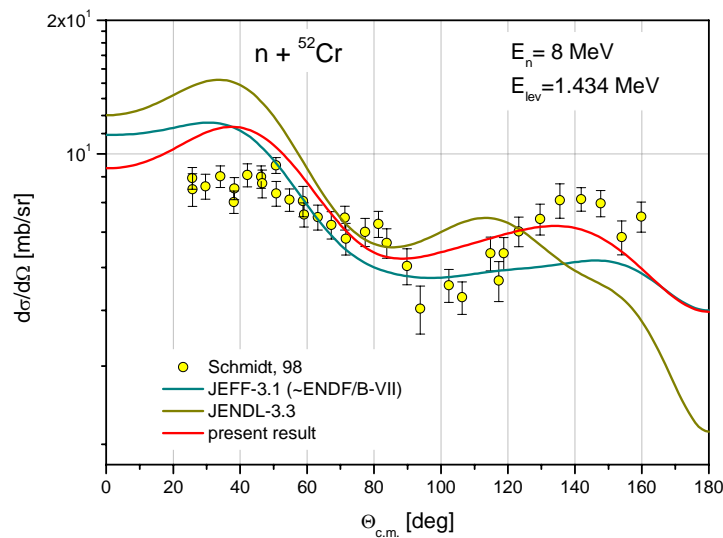
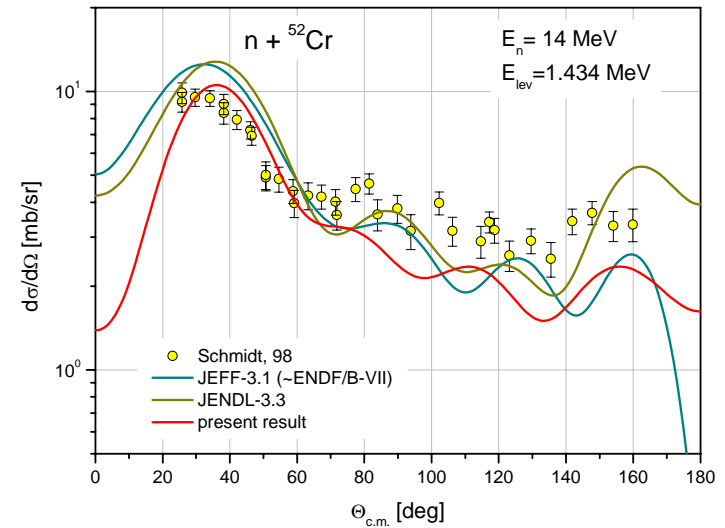
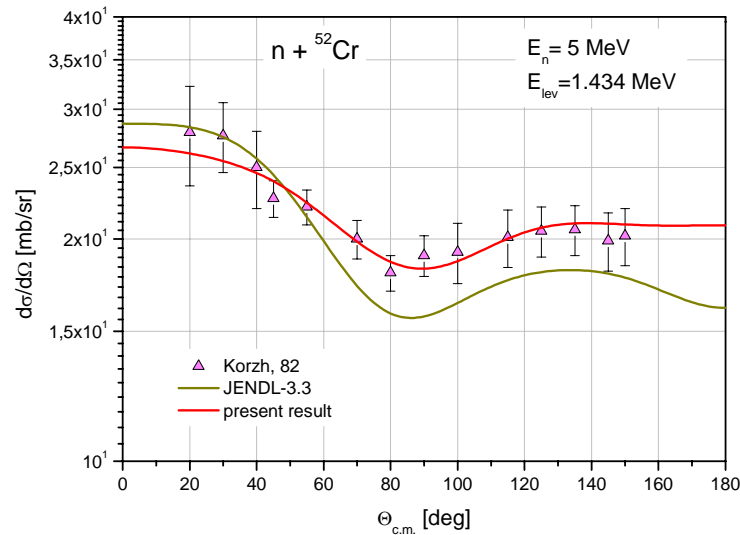
Elastic scattering angular distributions



Inelastic scattering cross sections



Inelastic scattering angular distributions

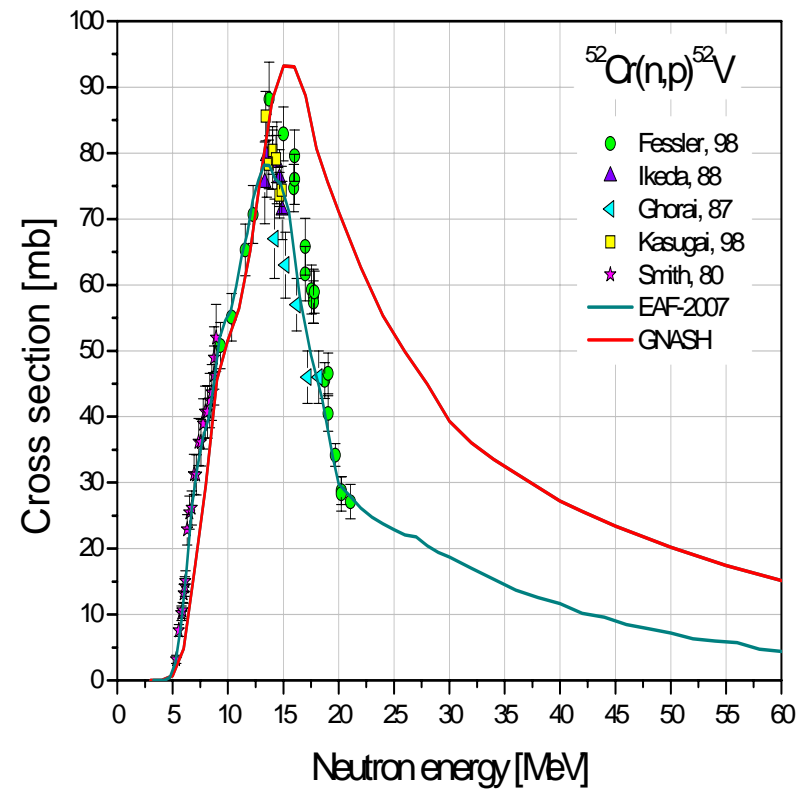
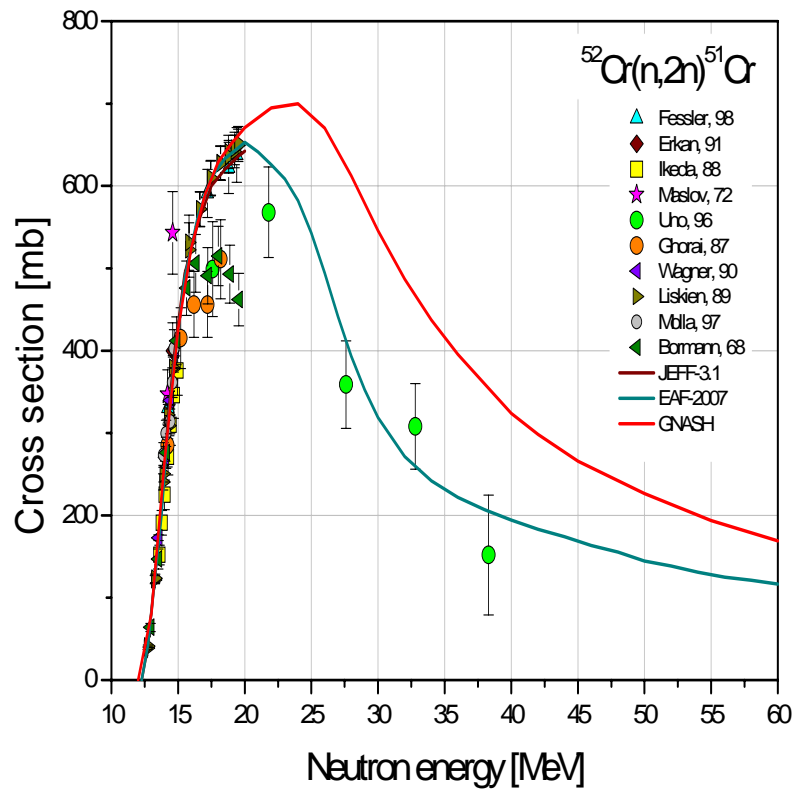




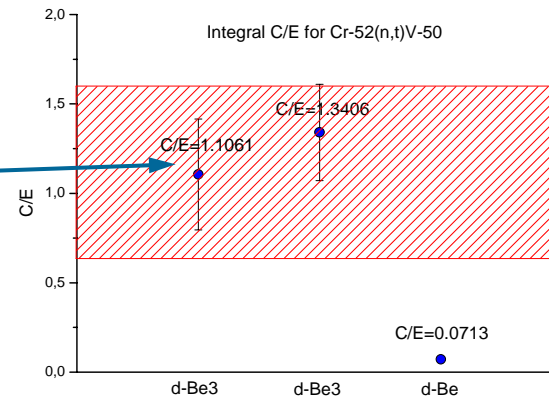
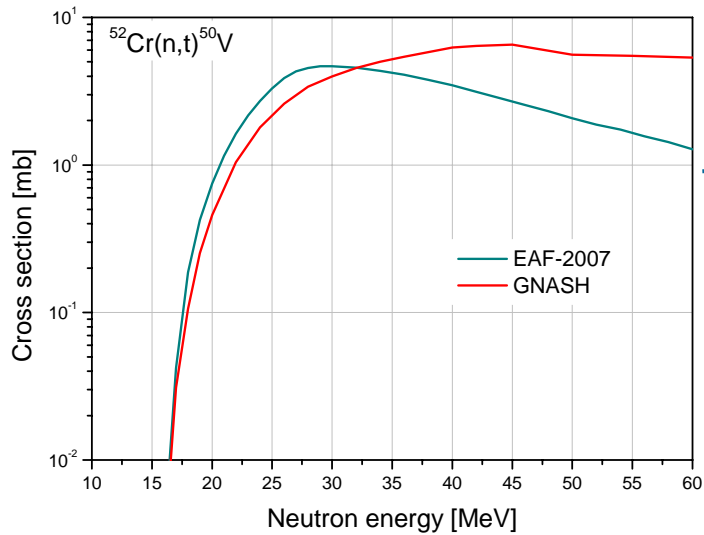
Optical model calculations (comments)

- ➡ JEFF-3.1 evaluation reproduces much better experimental data than ENDF/B-VII and JENDL-3.1;
 - ➡ Total and elastic scattering cross sections are fitted very well with optical model results in whole energy range;
 - ➡ Inelastic scattering cross sections at low energies require careful evaluation (for example, the first excited level);
 - ➡ Above 20 MeV optical model results fit very well high energy experimental data
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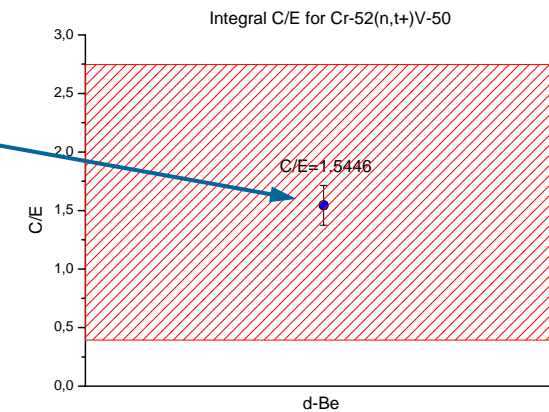
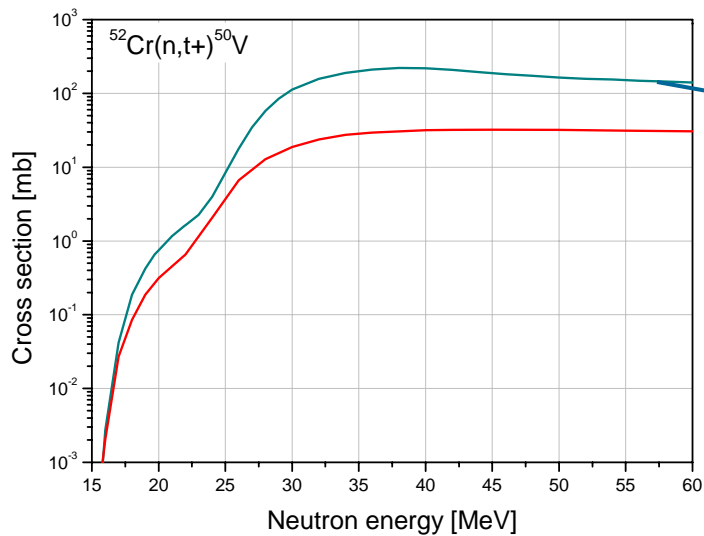
Exclusive cross sections MT=16 and MT=103



(n,t) and (n,t+) cross sections



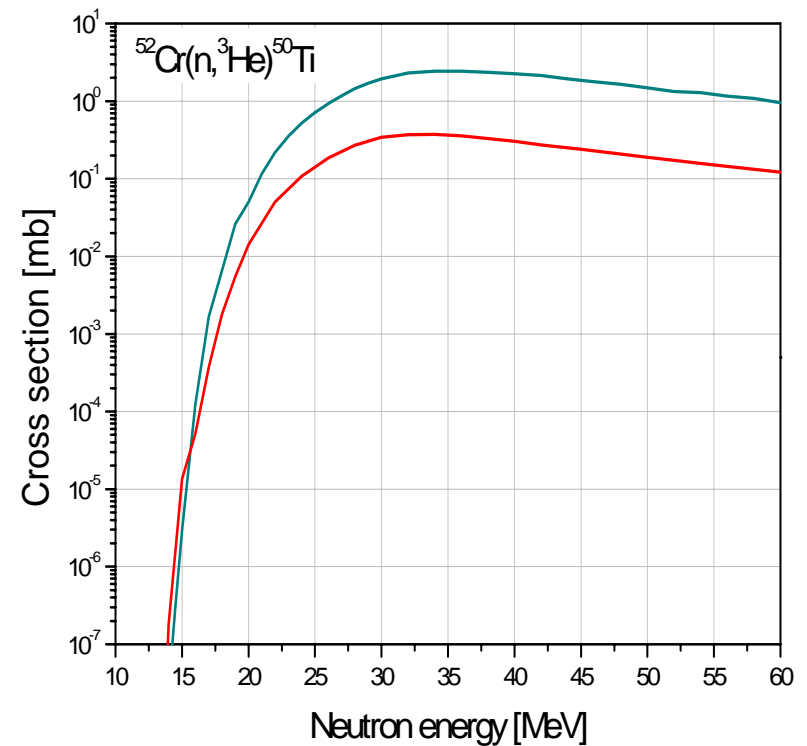
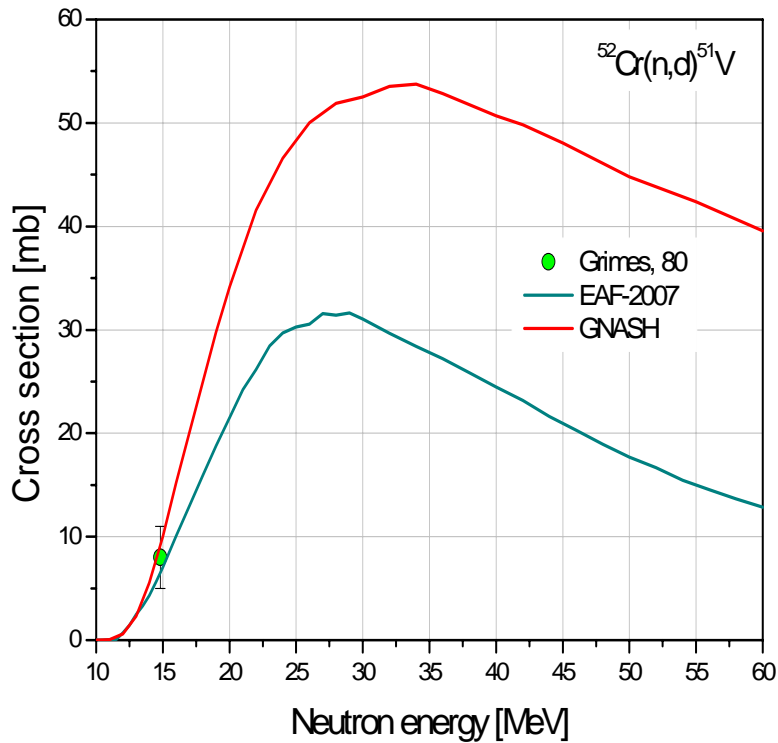
Slight overestimation at low energies ?



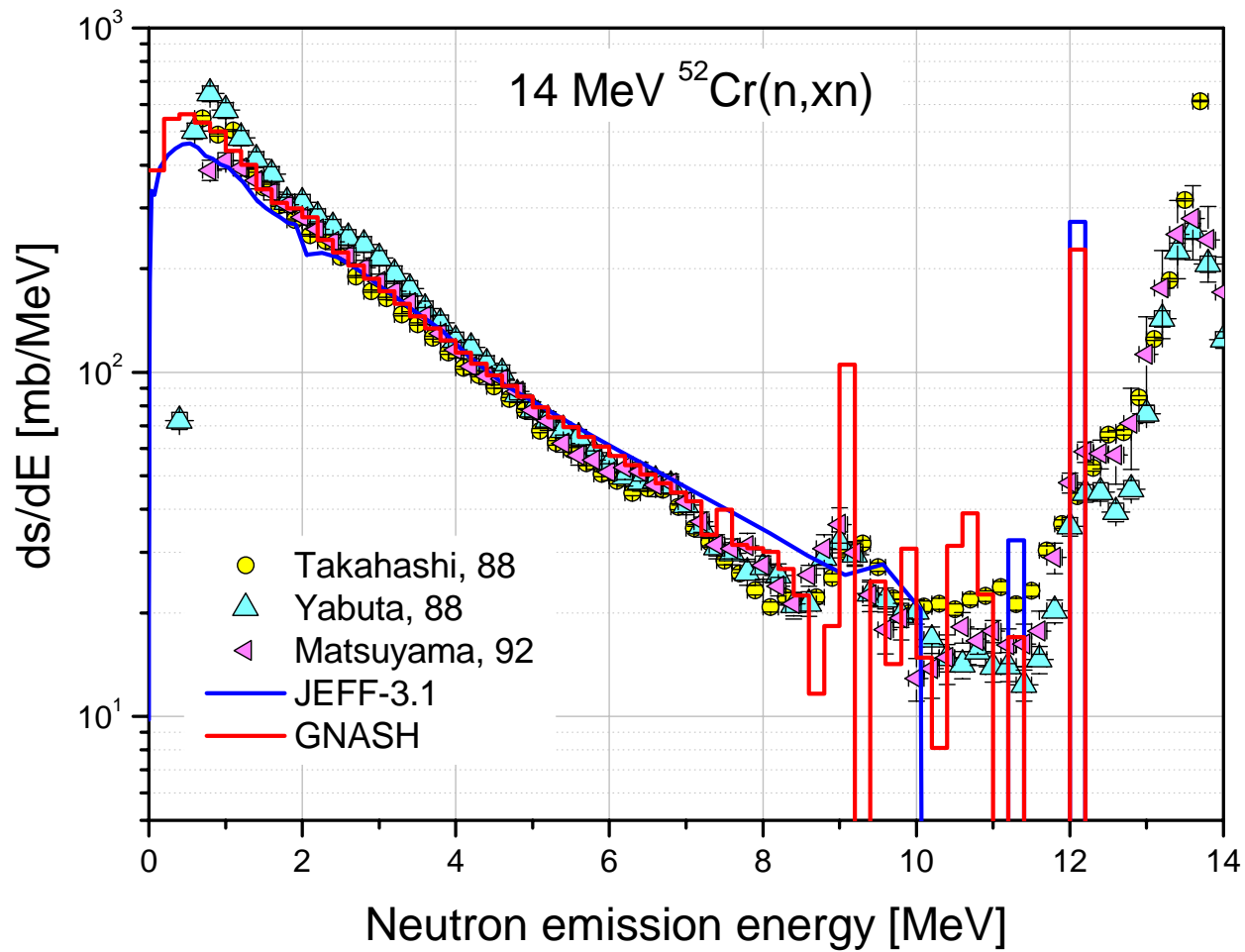
Overestimation at high energies ?



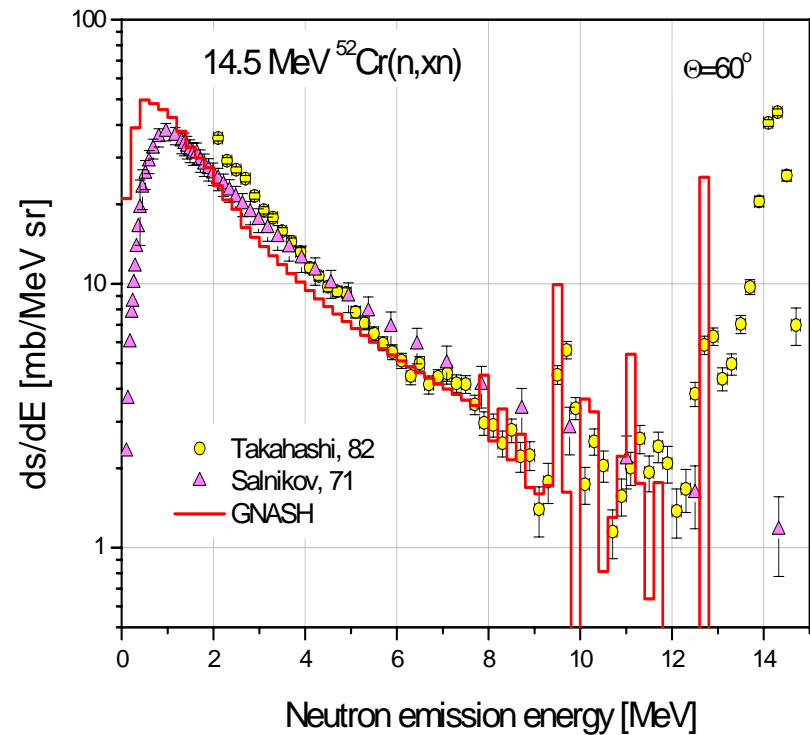
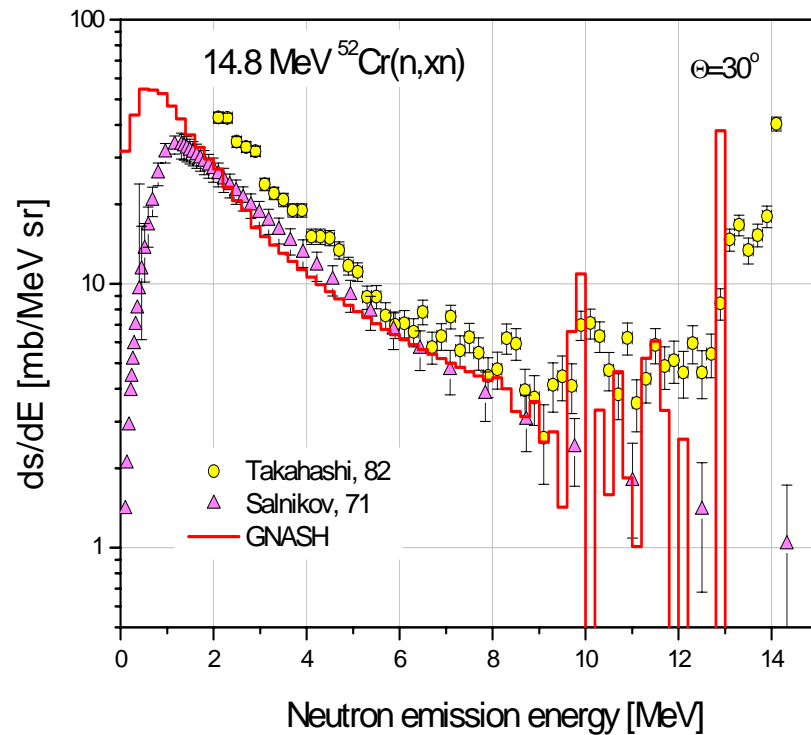
(n,d) and (n,³He) cross sections



Neutron emission spectrum



Double-differential neutron emission spectra





Conclusions

- ➡ Preparatory work was performed for ^{52}Cr in neutron energy range from 0.001 to 150 MeV
 - ➡ The results are based on ECIS+GNASH codes
 - ➡ Good description of experimental data was achieved, but evaluation work is still required
 - ➡ Neutron induced data for ^{52}Cr have a complex resonance region at low energies (below 5 MeV)
 - ➡ Future evaluation work requires careful evaluation of nuclear data below 5 MeV
 - ➡ The results for photon emissions must be checked against experimental data
 - ➡ JEFF-3.1 evaluation is much better compared to ENDF/B-VII and JENDL-3.3 libraries
 - ➡ JEFF-3.1 data below 5 MeV could be used for future high energy neutron induced data evaluation
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