



# Validation analysis of FZK evaluated data files for W isotopes

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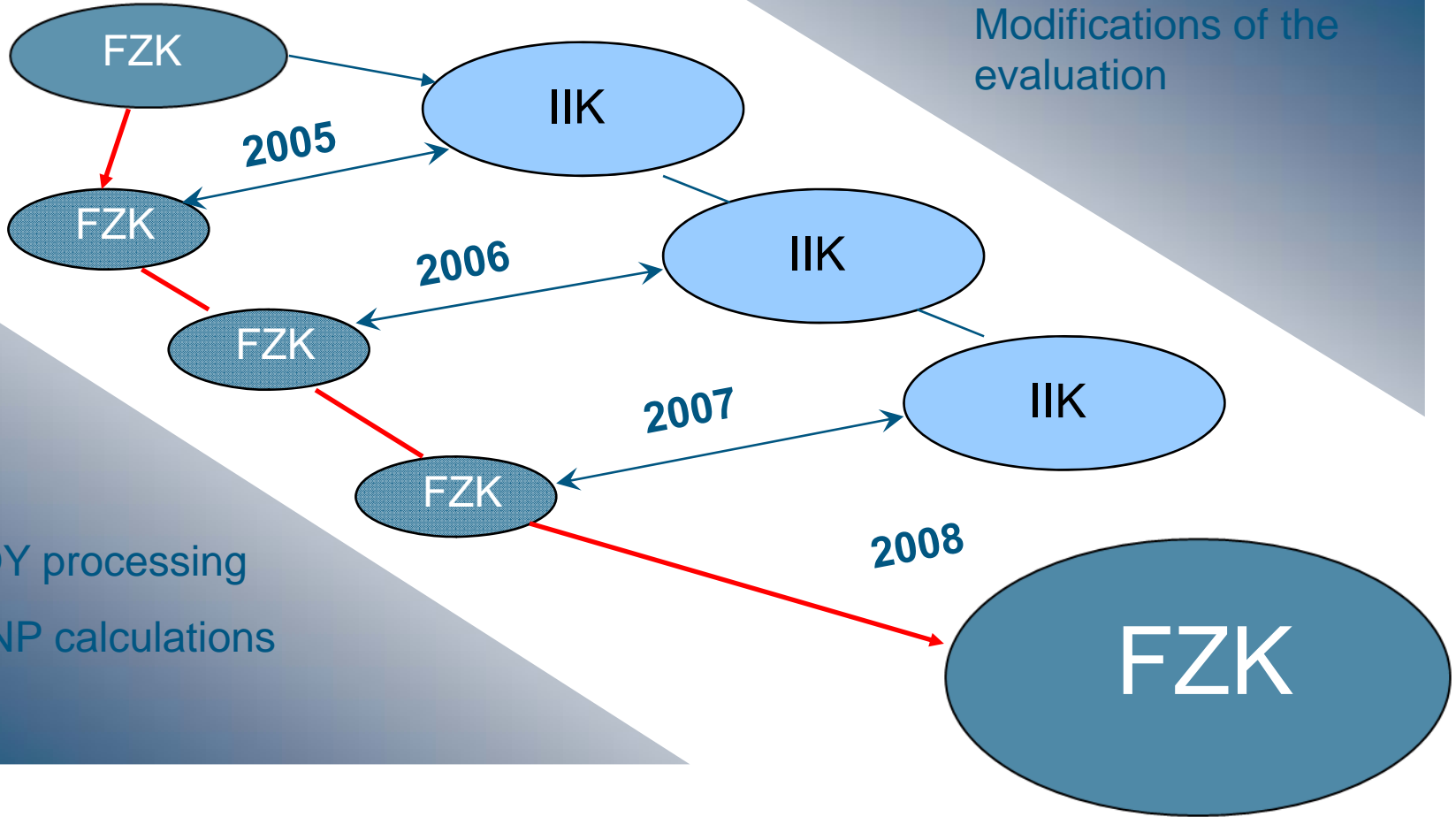


# Outline

- FZK nuclear data evaluation work
    - Tungsten evaluation in collaboration with IIK
    - FZK nuclear data evaluation activity
  - TUD measurements on W at FNG
    - Measurement of neutron & photon flux spectra in W assembly (*K. Seidel et al., EFF-DOC-857*)
    - Spectra measured in four positions in W assembly
  - FNG experiment on W
    - Measurement of reaction rates in W assembly
    - Reaction rates were measured in four positions in W assembly
  - Monte Carlo Transport Analysis
    - MCNP5 calculations for 3D model of W assembly (Frascati MCNP model)
    - W data: IAEA (2007) and FZK (2008)
    - Comparison of flux spectra & C/E-data
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# Background of the new FZK evaluation for W

2004

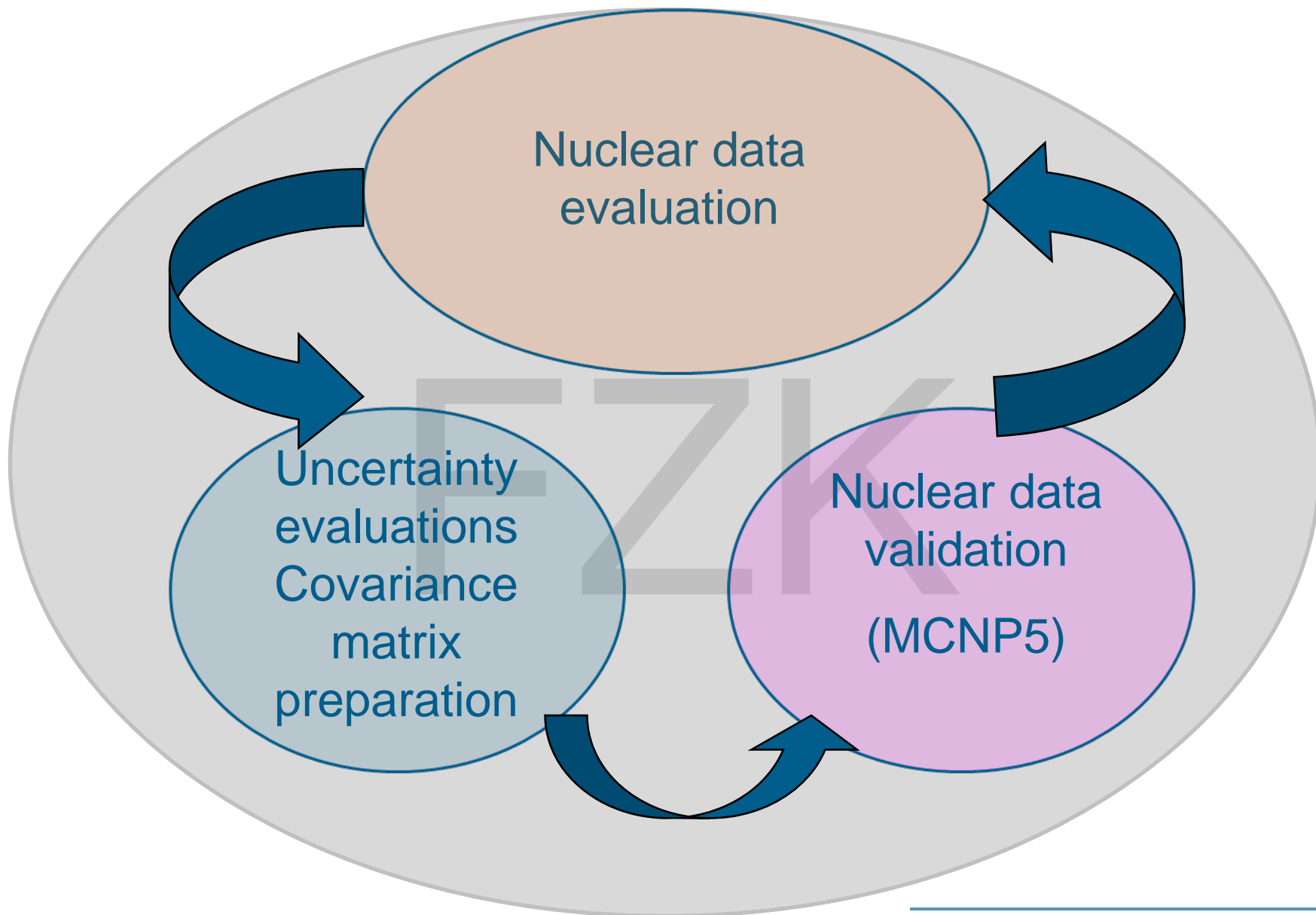


Modifications of the evaluation

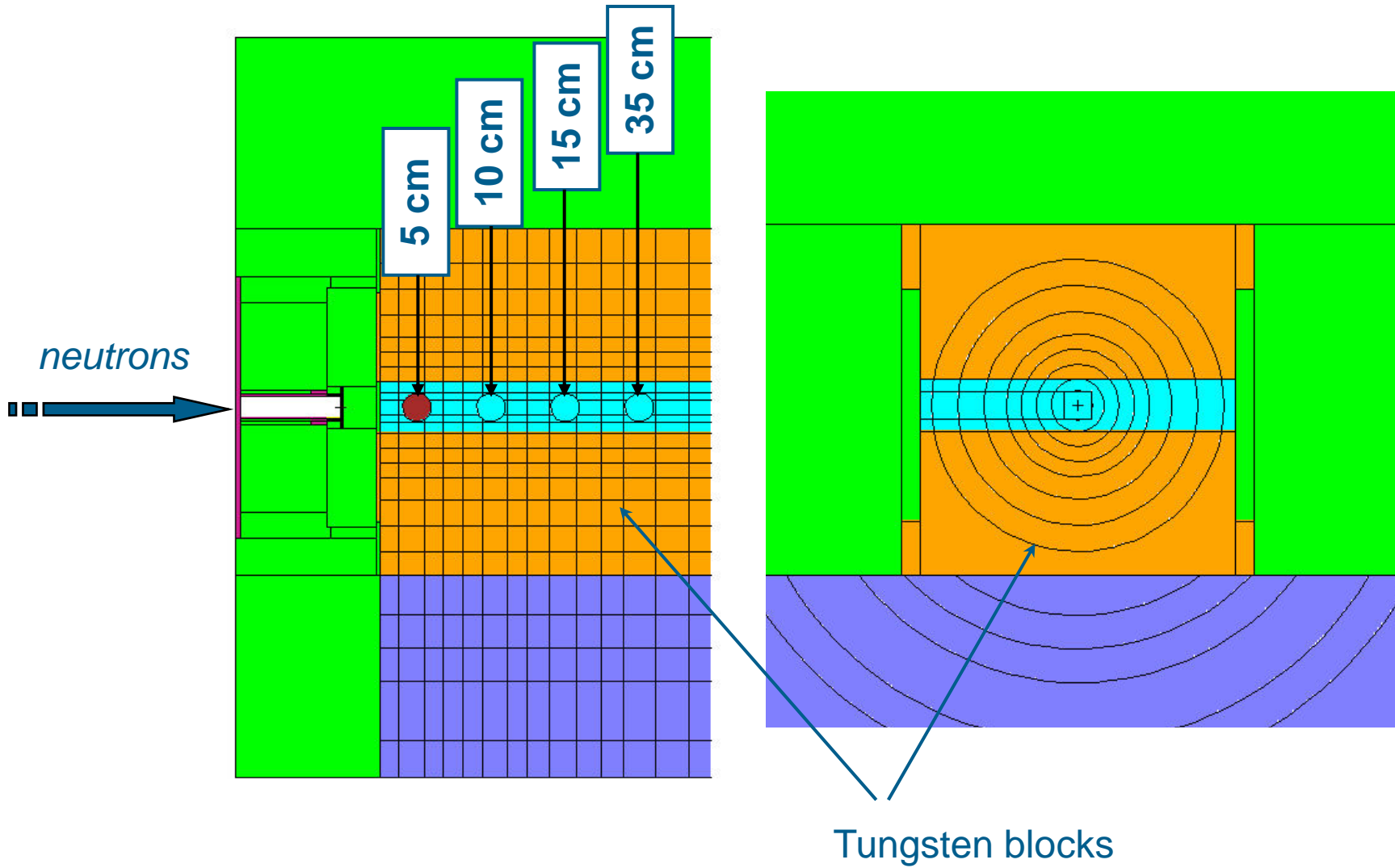
NJOY processing  
MCNP calculations

FZK

# Nuclear data evaluation in FZK



# FNG tungsten experiment (MCNP model)

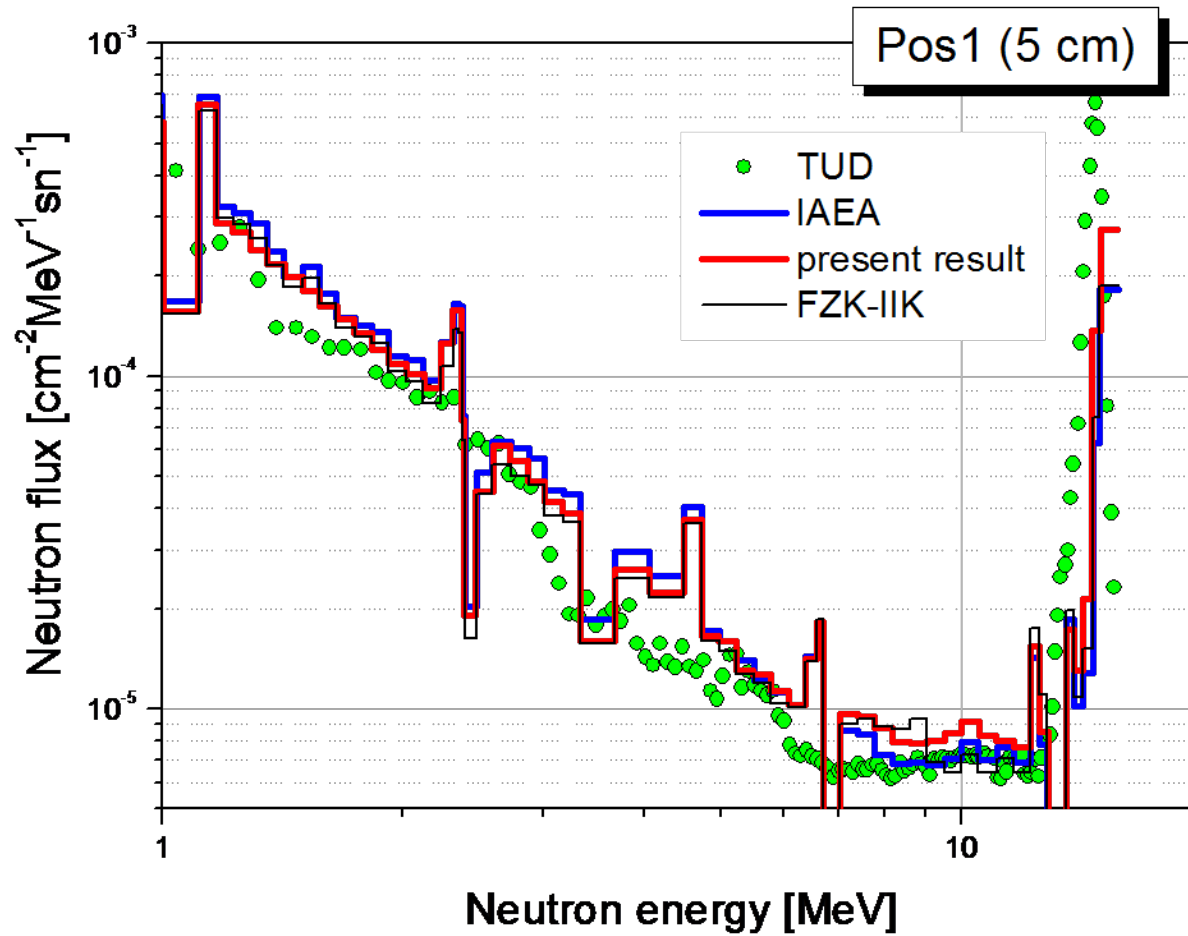




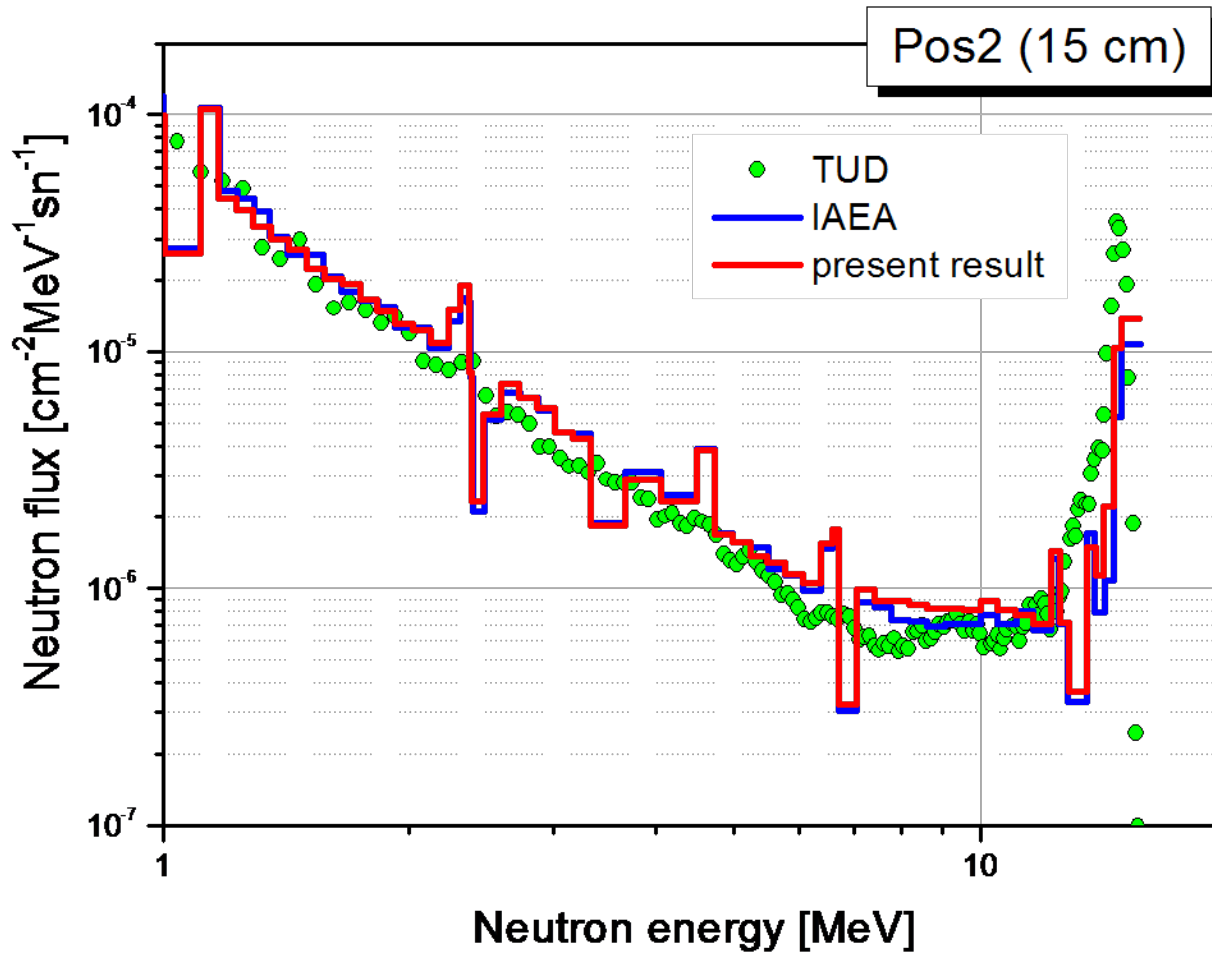
# Present work

- Modified FZK data (EFFDOC-1032) were taken for the analysis
    - *The evaluated data are consistent*
    - *The changes (if required) can be made very quickly, no need to disassemble the file*
  - All modifications/validations can be made very quickly within one department
  - New ACE file were produced with NJOY99.245
  - Accurate MCNP transport calculation were performed to validate evaluated data
    - *Original FNG source subroutine was modified for parallel computing*
    - *MCNP5 run takes ~6 days with 1 processor (100 millions histories) and ~ 4 hours with parallel computing*
  - The MCNP results were compared with experimental data
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# Neutron spectrum, Pos. 1

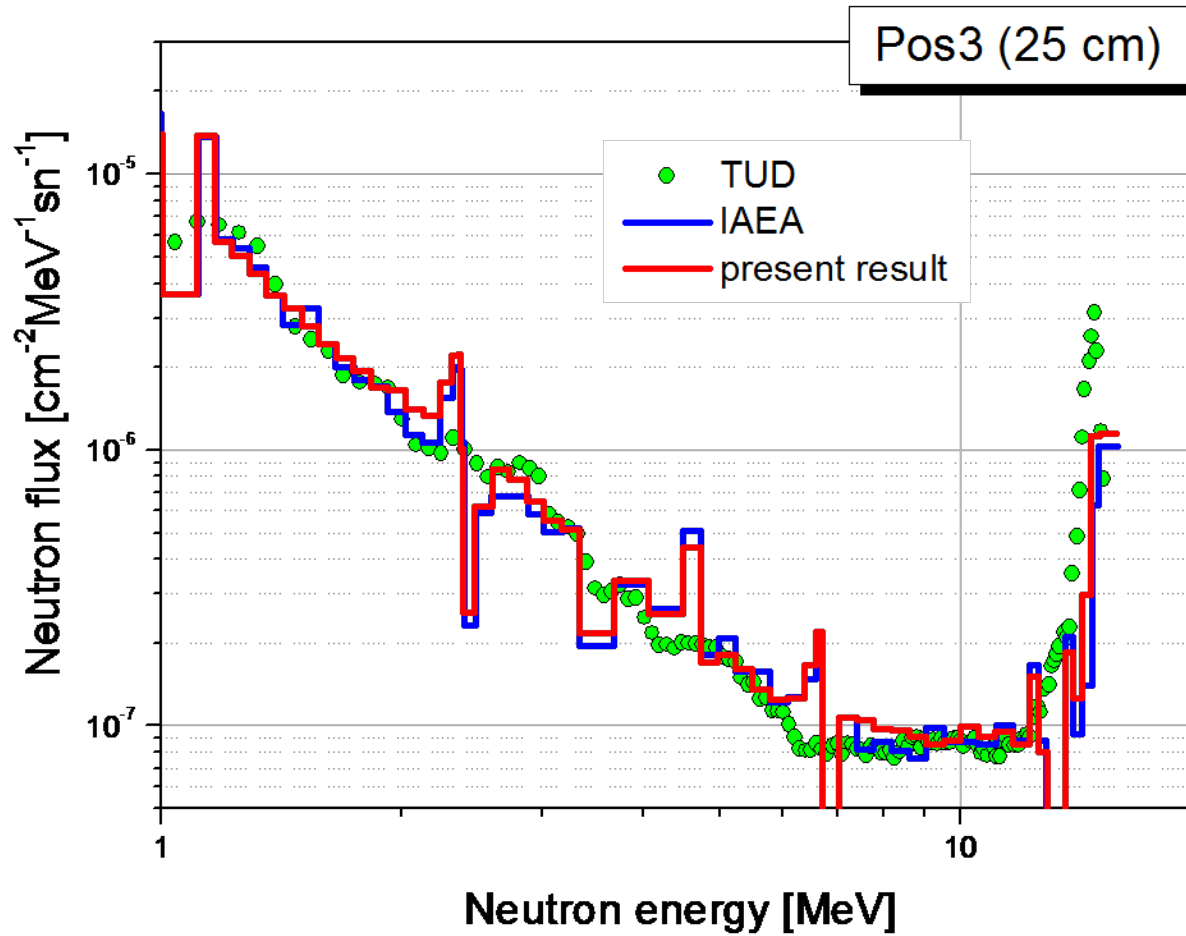


# Neutron spectrum, Pos. 2

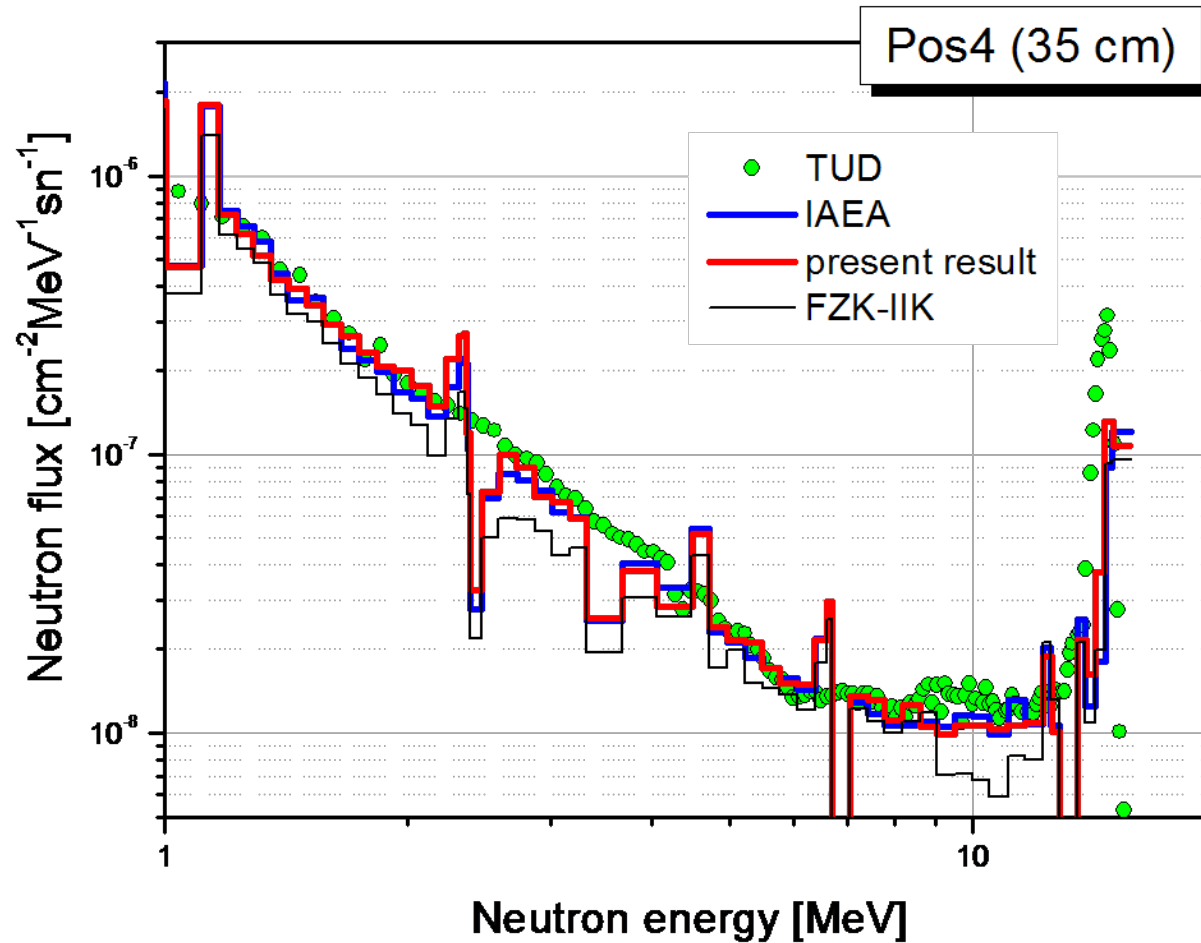




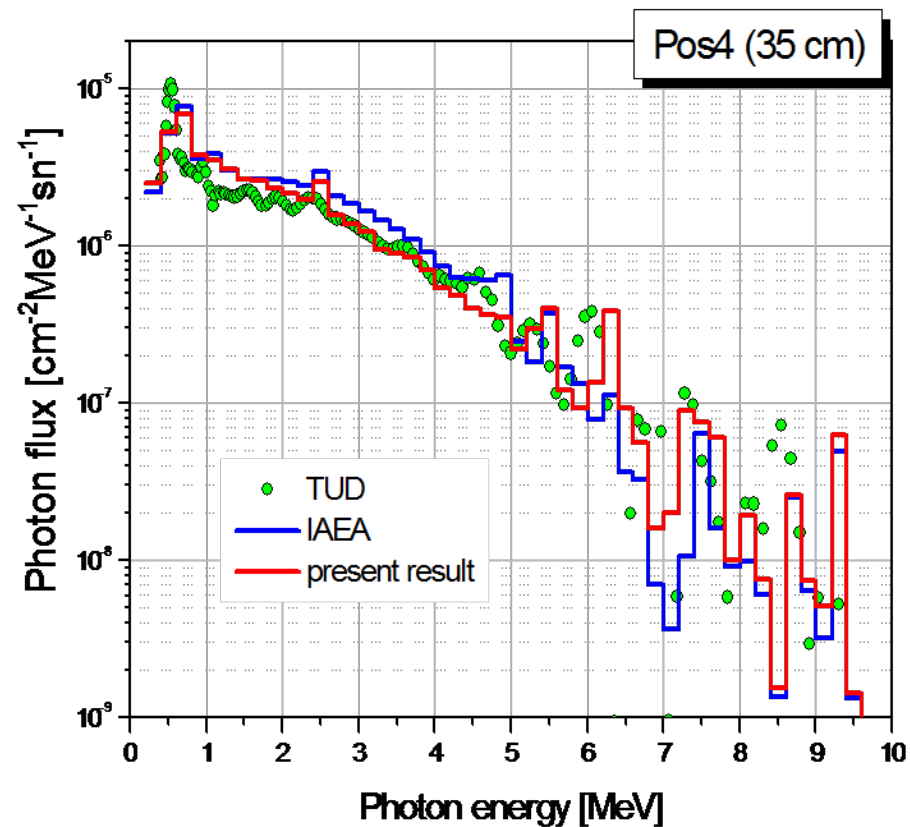
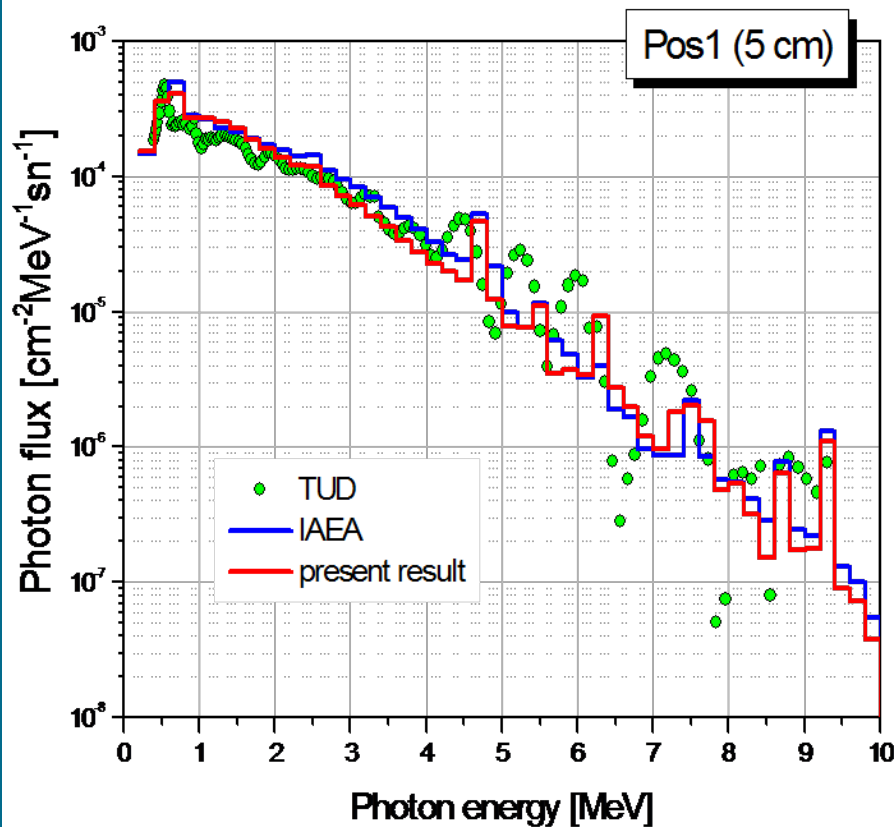
# Neutron spectrum, Pos. 3



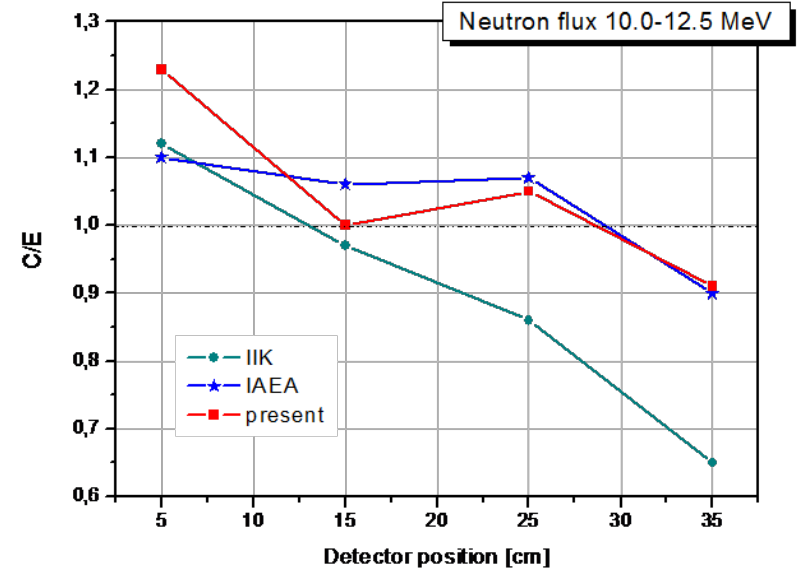
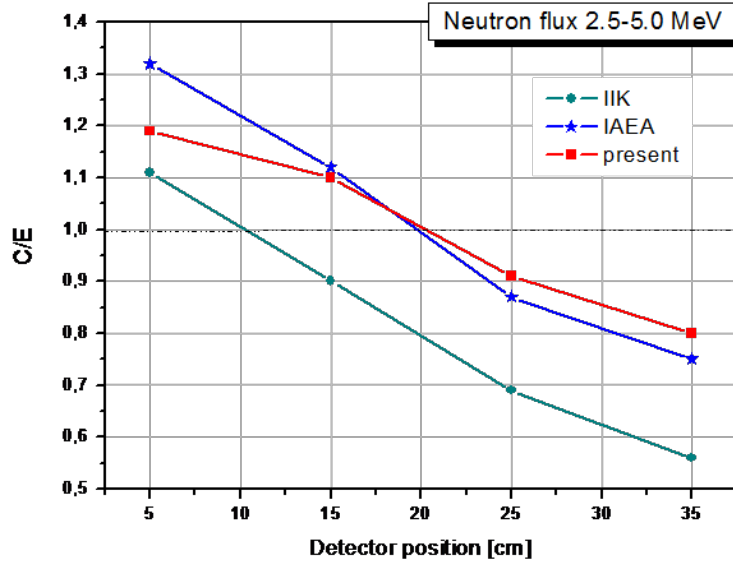
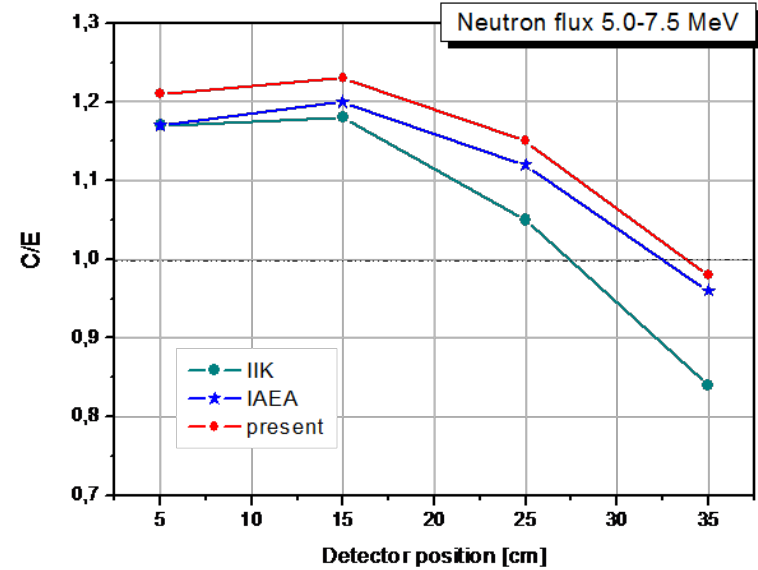
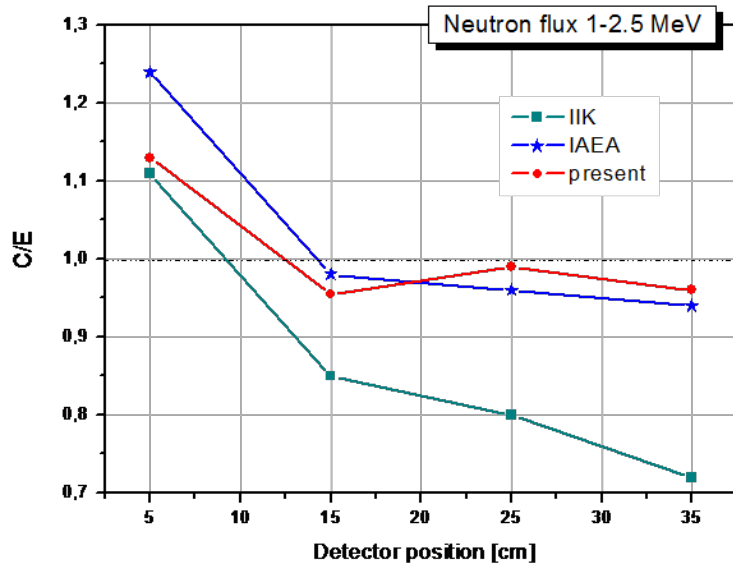
# Neutron spectrum, Pos. 4



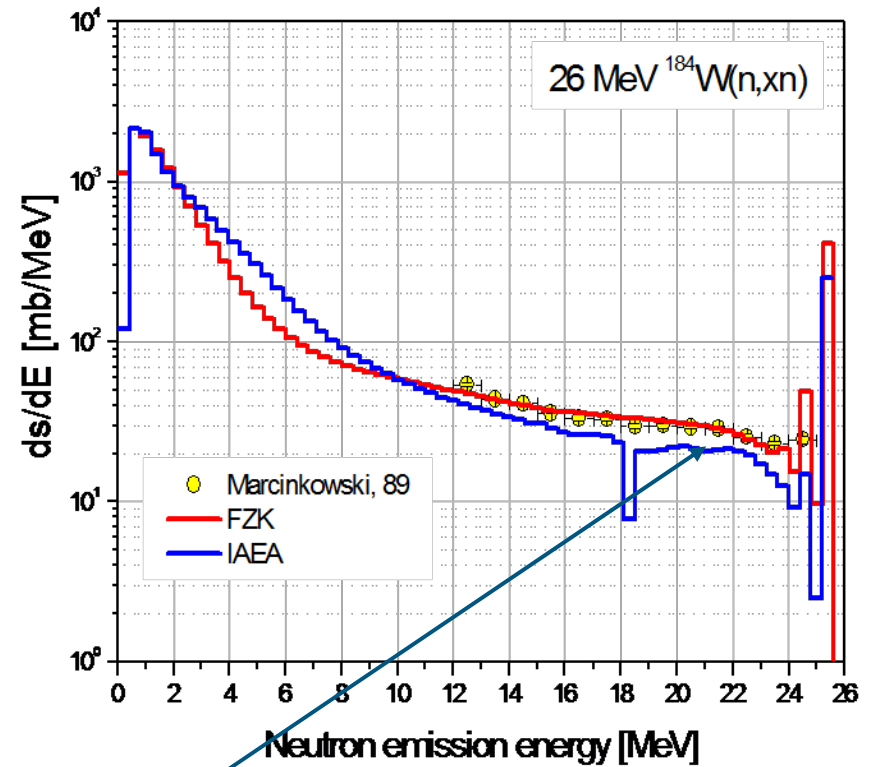
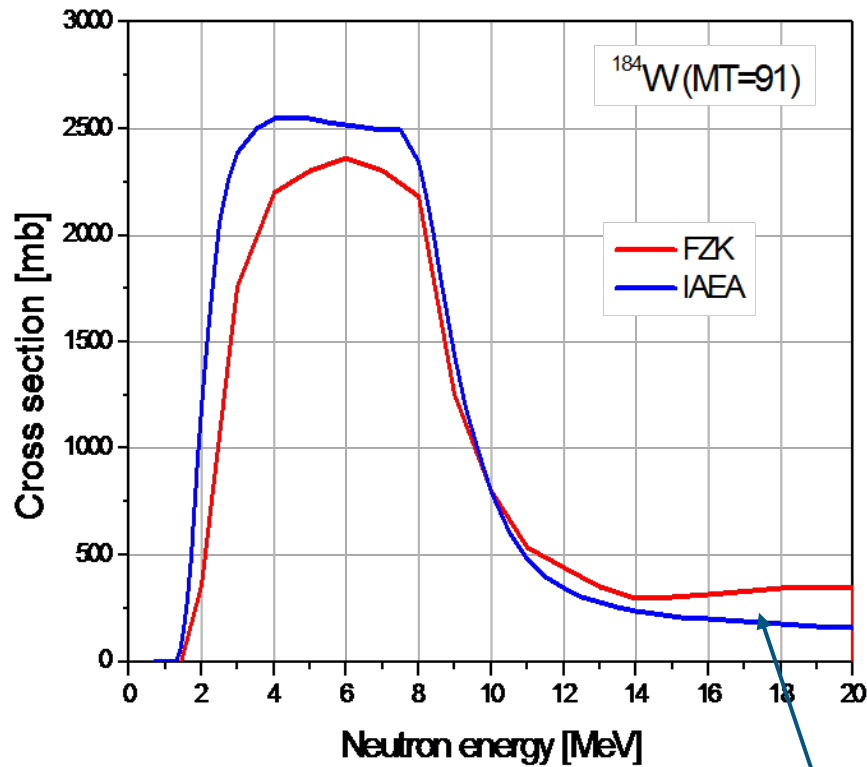
# Photon spectra



# C/E neutron flux integrals



# MT=91 cross sections



Differences in MT=91 cross sections

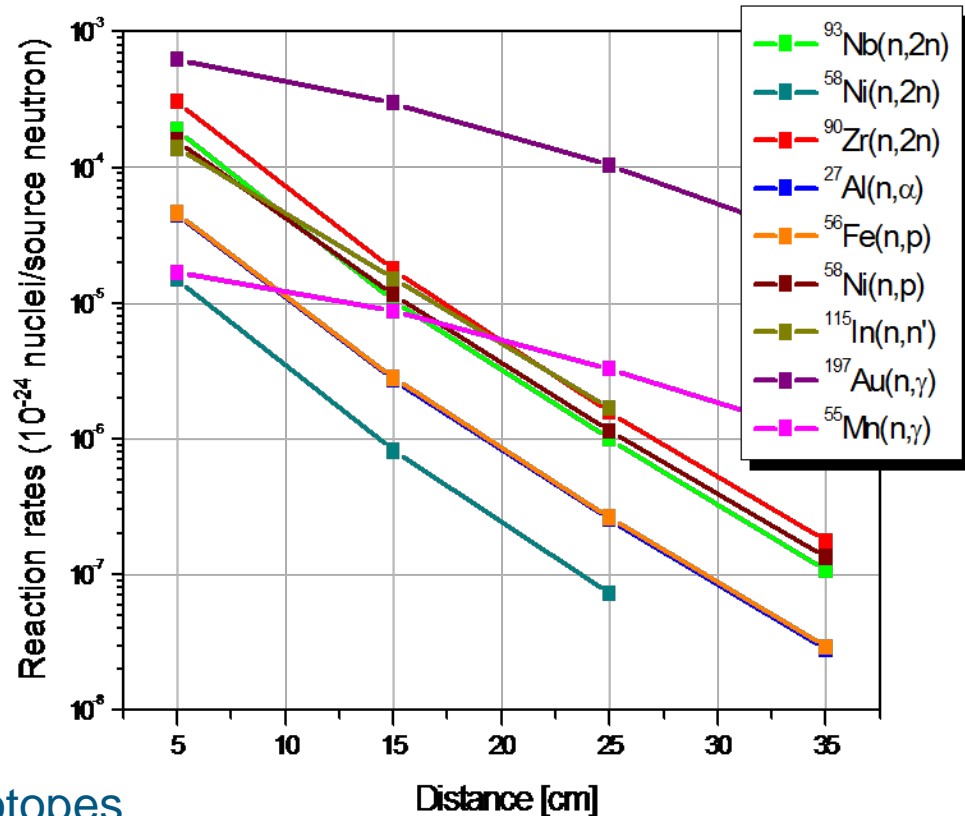
# FNG reaction rates measurements for W

## Measured reaction rates:

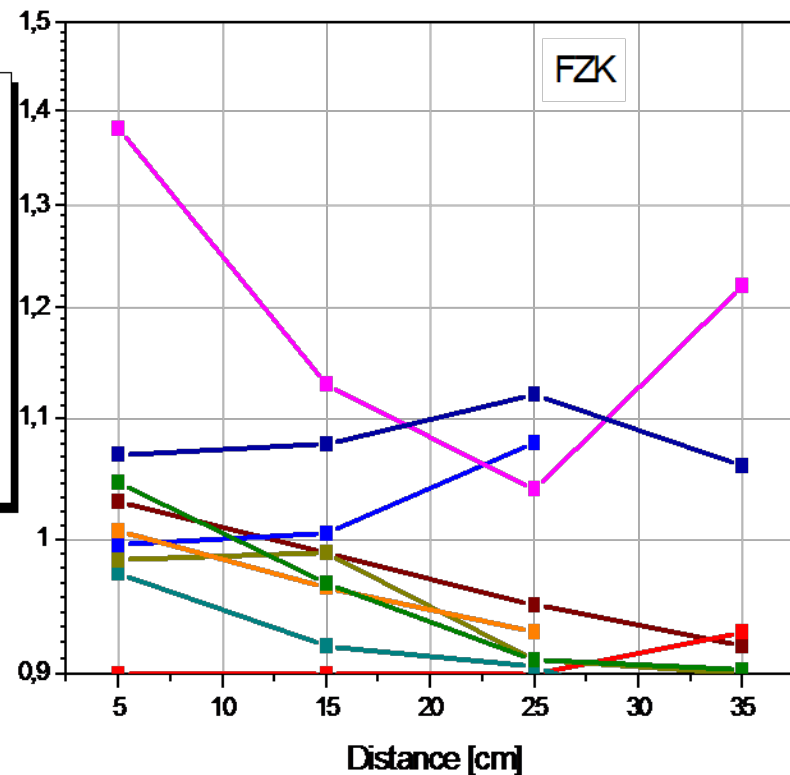
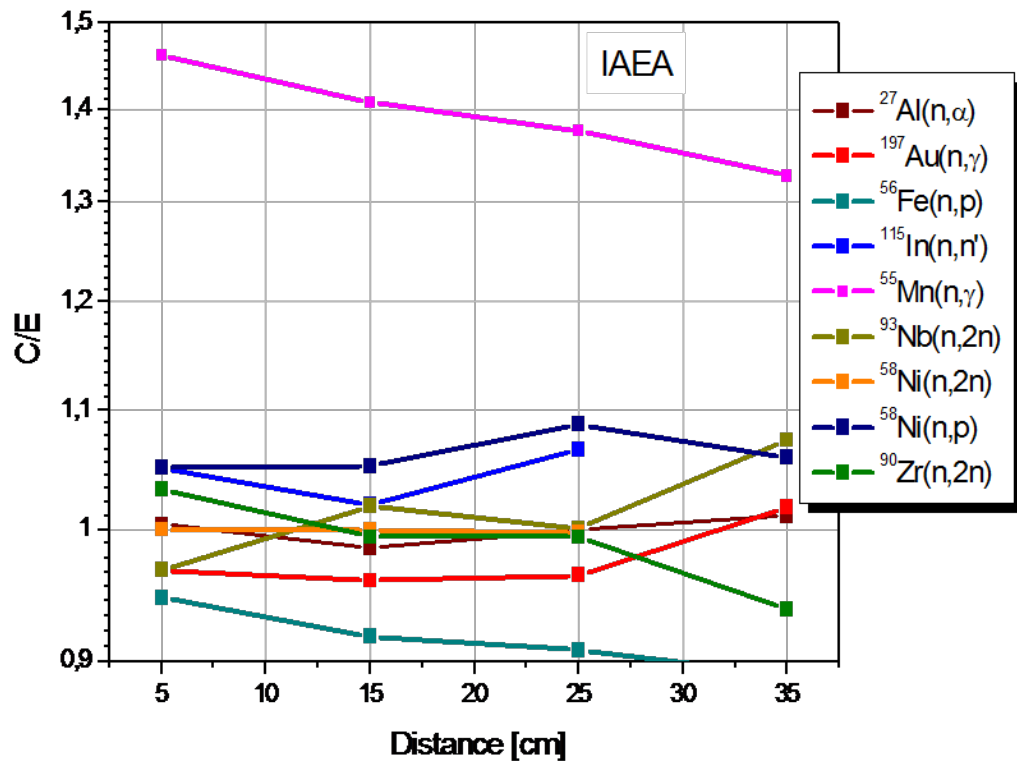
- $^{93}\text{Nb}(n,2n)^{92}\text{Nb}$
- $^{58}\text{Ni}(n,2n)^{57}\text{Ni}$
- $^{90}\text{Zr}(n,2n)^{89}\text{Zr}$
- $^{27}\text{Al}(n,\alpha)^{24}\text{Na}$
- $^{56}\text{Fe}(n,p)^{56}\text{Mn}$
- $^{58}\text{Ni}(n,p)^{58}\text{Co}$
- $^{115}\text{In}(n,n')^{115\text{m}}\text{In}$
- $^{197}\text{Au}(n,\gamma)^{198}\text{Au}$
- $^{55}\text{Mn}(n,\gamma)^{56}\text{Mn}$

## MCNP5 calculations:

- FZK and IAEA data for W
- FENDL-2 data for other isotopes
- IRDF-2002 cross sections for reaction rates calculations



# Results of MCNP benchmark calculations





# Conclusions

- The updated FZK general purpose neutron data files for  $^{182,183,184,186}\text{W}$  are already available
  - FZK general purpose neutron data files for  $^{182,183,184,186}\text{W}$  have been checked against FNG integral experimental data.
  - Significant improvements have been achieved compared to the previous FZK-IK evaluation
  - Covariance data will be included in the files very soon
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