Benchmark Analyses of the recent W data evaluations

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Background

- TUD Experiment on W at Frascati Neutron Generator (FNG)
  - Measurement of neutron & photon flux spectra in W assembly using a NE 213 liquid-scintillation spectrometer *(K. Seidel et al., EFF-DOC-857)*
  - Spectra measured in four positions in W assembly
- Previous analyses *(U. Fischer et al, EFF-DOC-860, EFF-DOC-897, EFF-DOC-931*)
  - MCNP4C calculations for 3D model of W assembly & rack, spectrometer, neutron generator and experimental hall (FNG)
  - W data: EFF-2.4 (=JENDL-3.0), FENDL-1(=ENDF/B-VI.0), FENDL-2(=JENDL-FF), JENDL-3.3, FENDL-2.1 (=ENDF/B-VI.8)

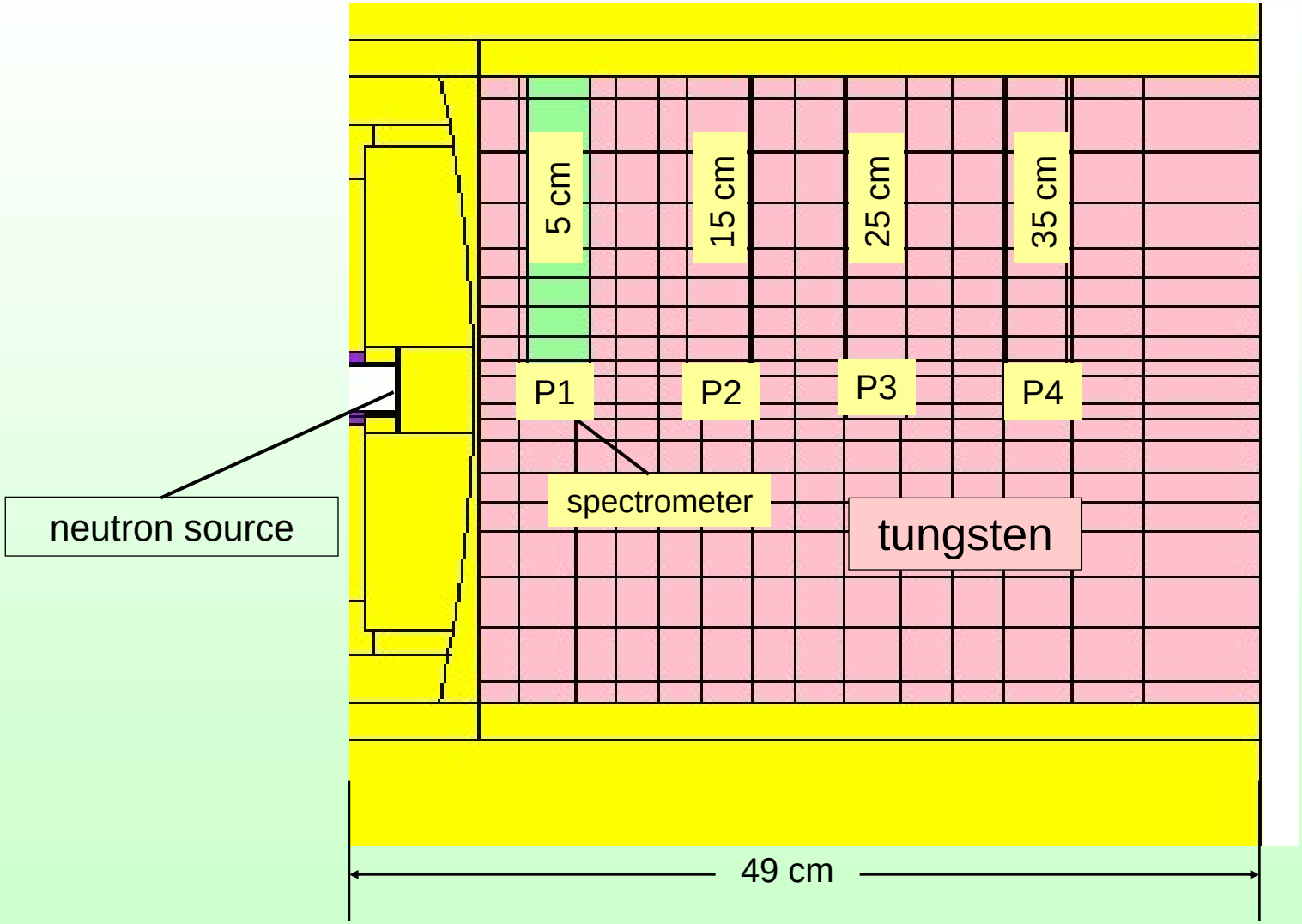
Outline

- New W nuclear data evaluations:
  - JEFF3.2T (P. Pereslavtsev, S. Tagesen, H. Vonach)
  - IAEA 2007 (A. Trkov et al.)
- MCNP4C calculations of neutron and gamma spectra
- C over E comparisons
- Conclusions

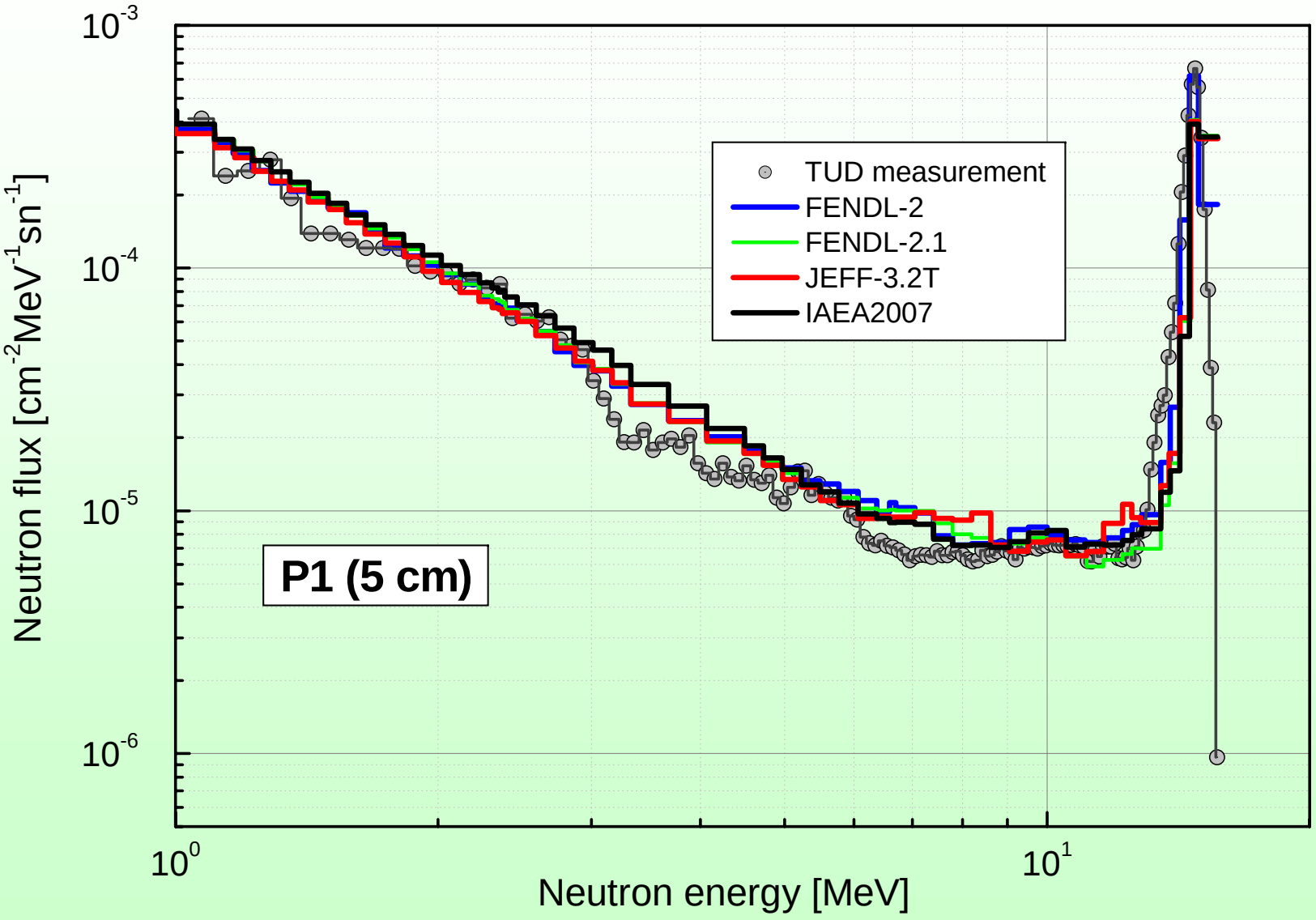
Tungsten nuclear data evaluations

- JEFF3.2T
  - ECIS96, GNASH
  - ENDF-B/VI.8 below 5 MeV
  - Resonance parameters from JENDL3.2
  - Angular distributions from Kalbach systematics
  - ENDF Structure of ENDF/B-VI.8 retained
  - MF6 MT5 energy-angle distributions (except neutrons)
- IAEA 2007
  - EMPIRE-2.19
  - Resonance parameters: IRDF-2002, ENDF/B-VII
  - Angular distributions from EMPIRE
  - MF6 MT5 energy-angle distributions (except neutrons)

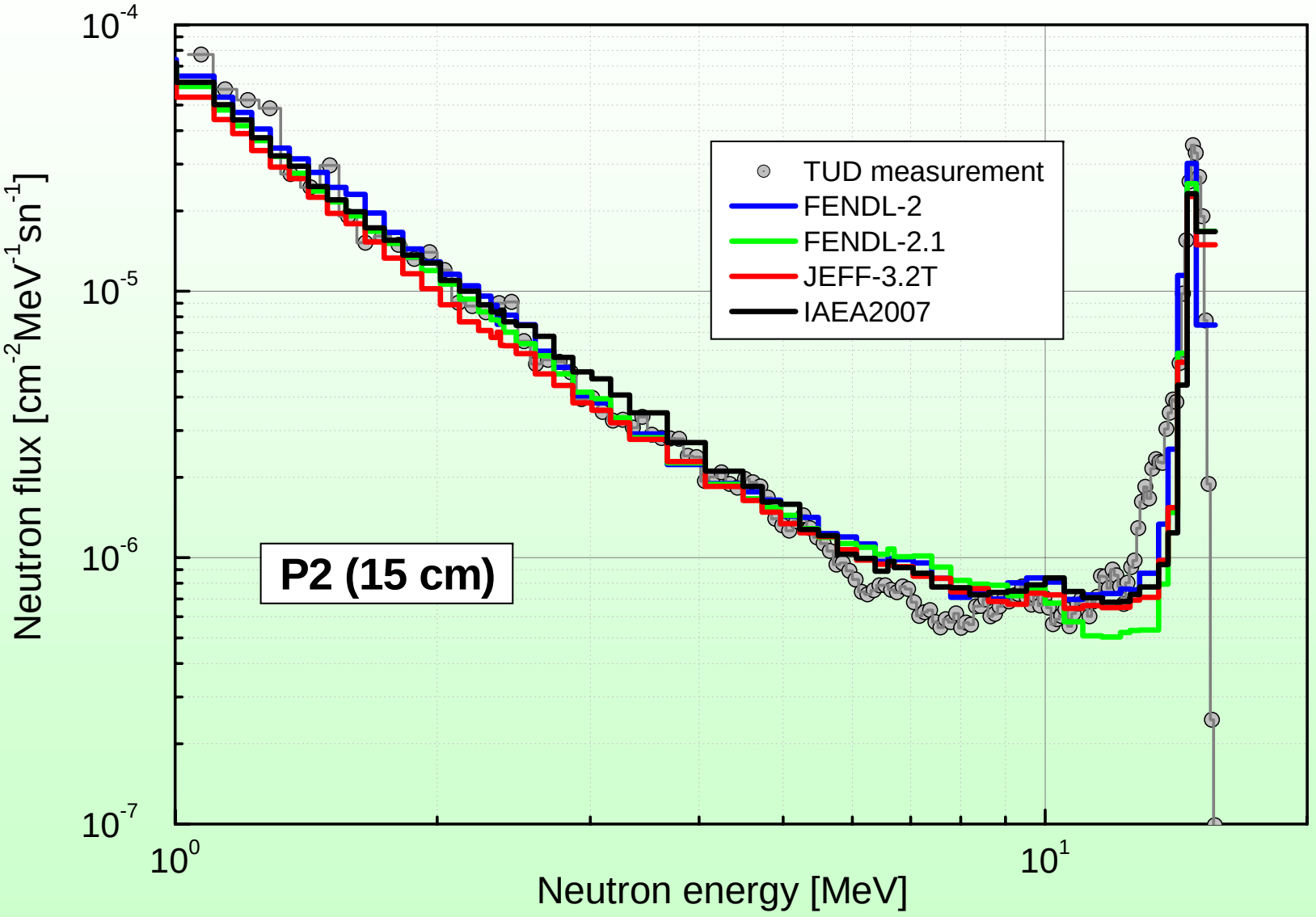
FNG Tungsten Assembly Model



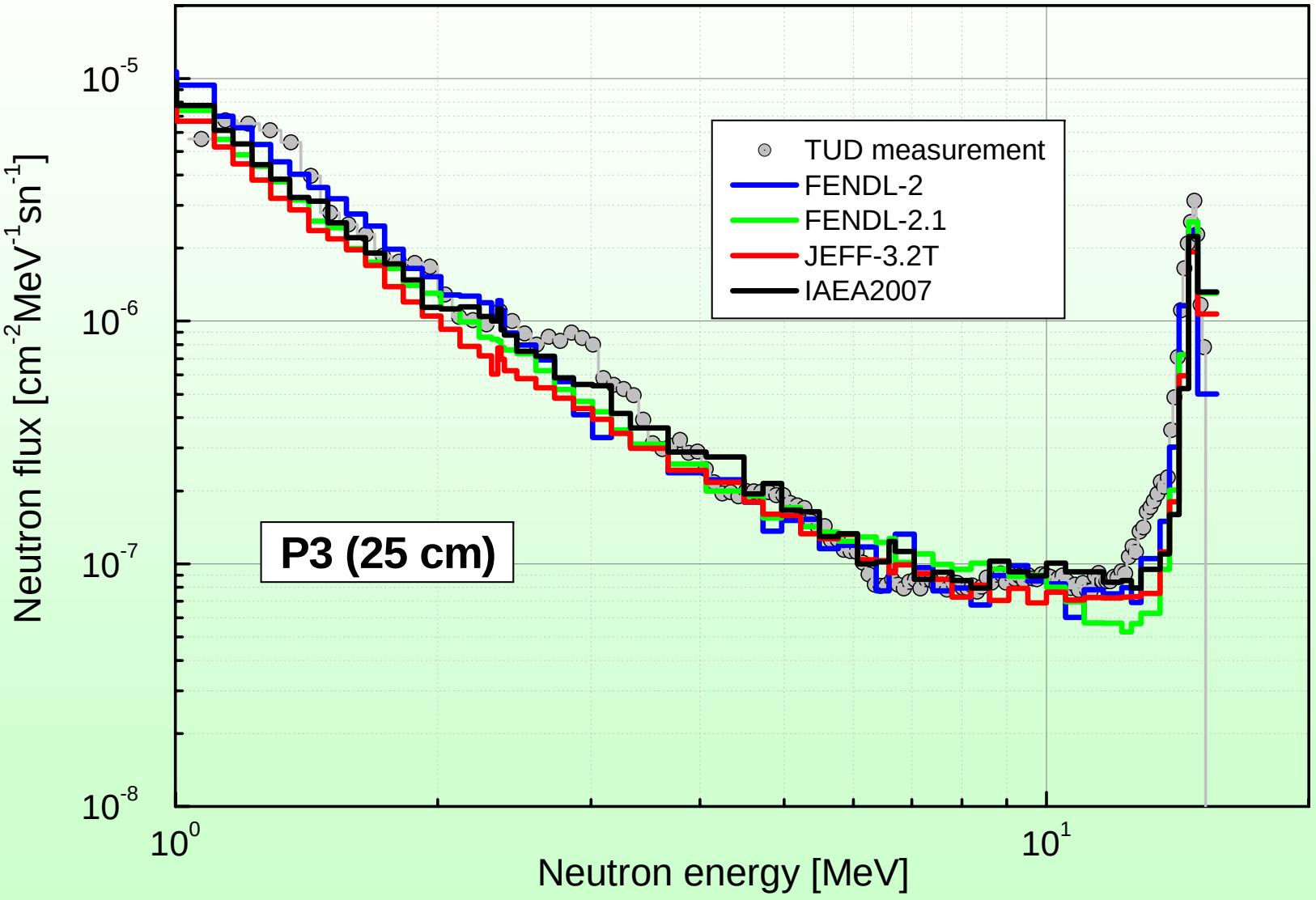
Neutron flux spectra in W assembly at P1



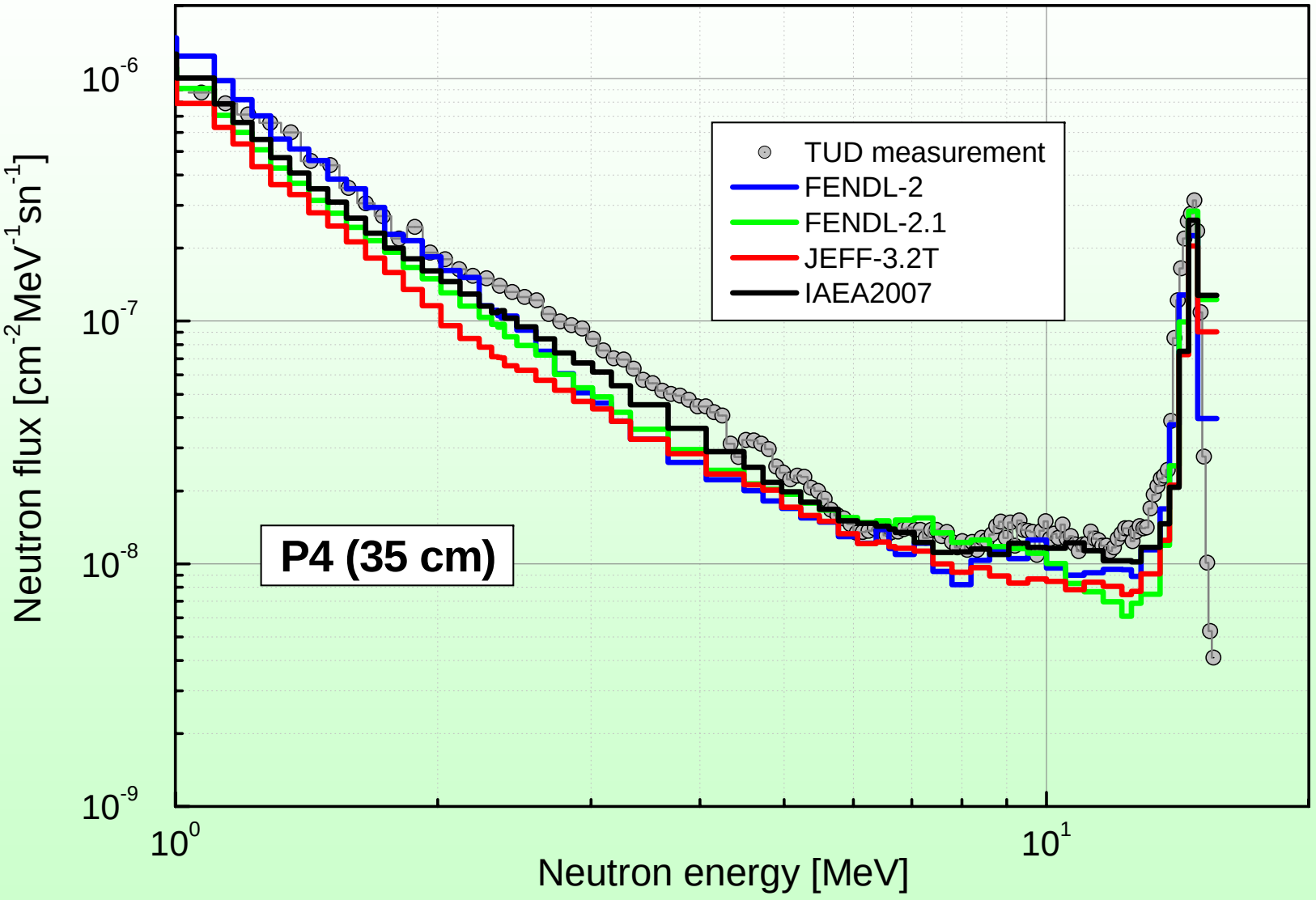
Neutron flux spectra in W assembly at P2



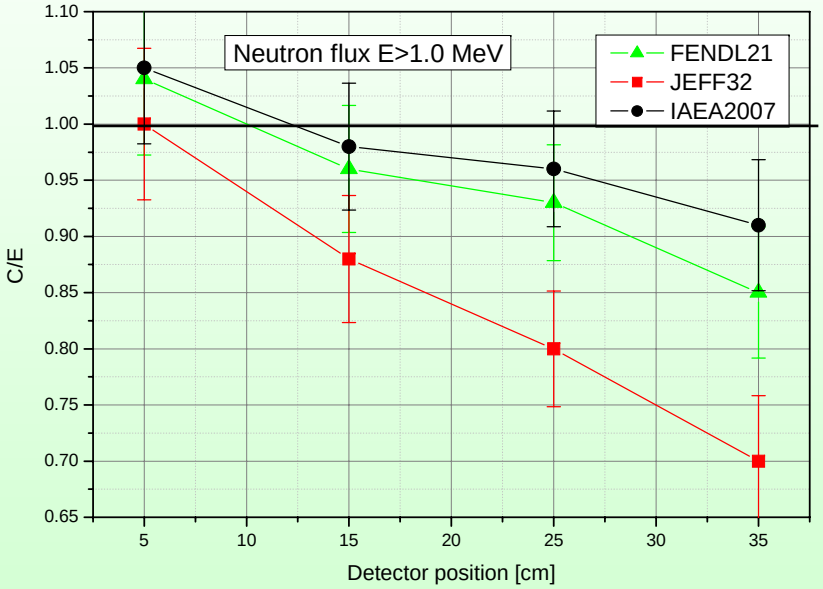
Neutron flux spectra in W assembly at P3

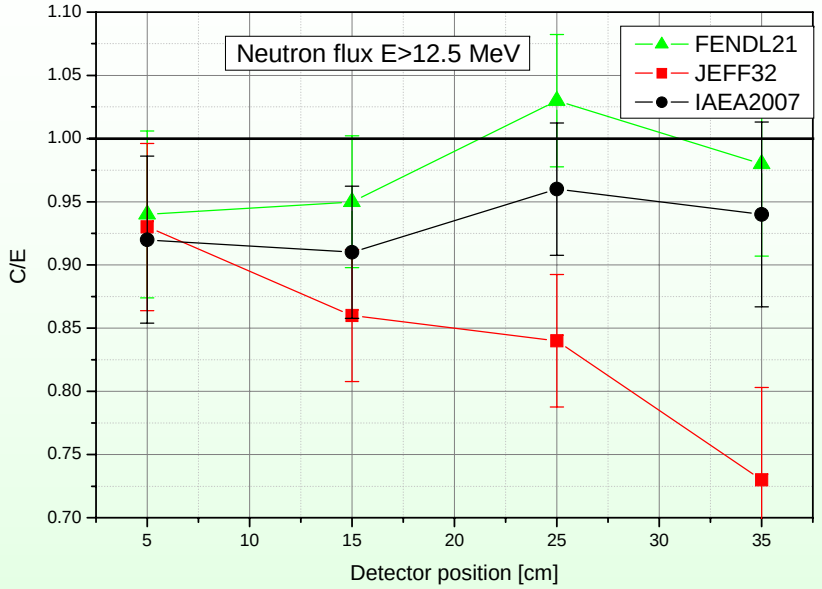


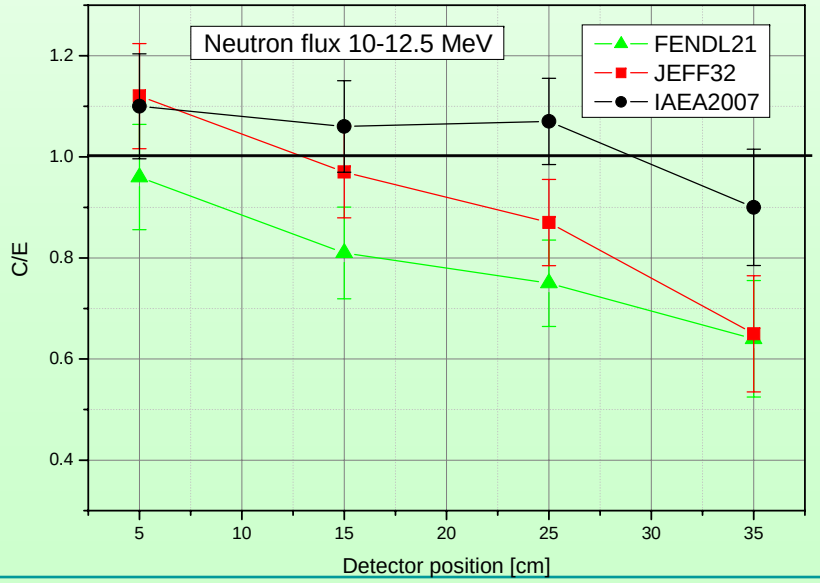
Neutron flux spectra in W assembly at P4



C over E neutron flux integrals







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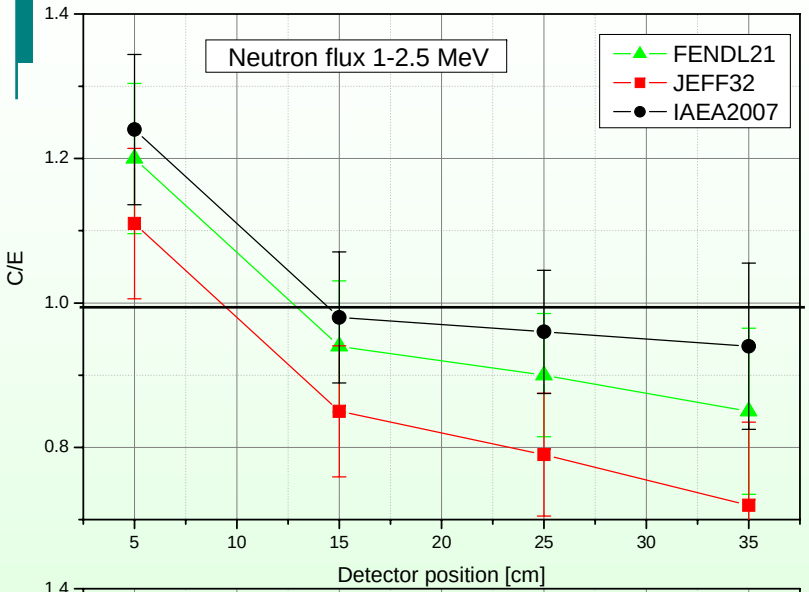
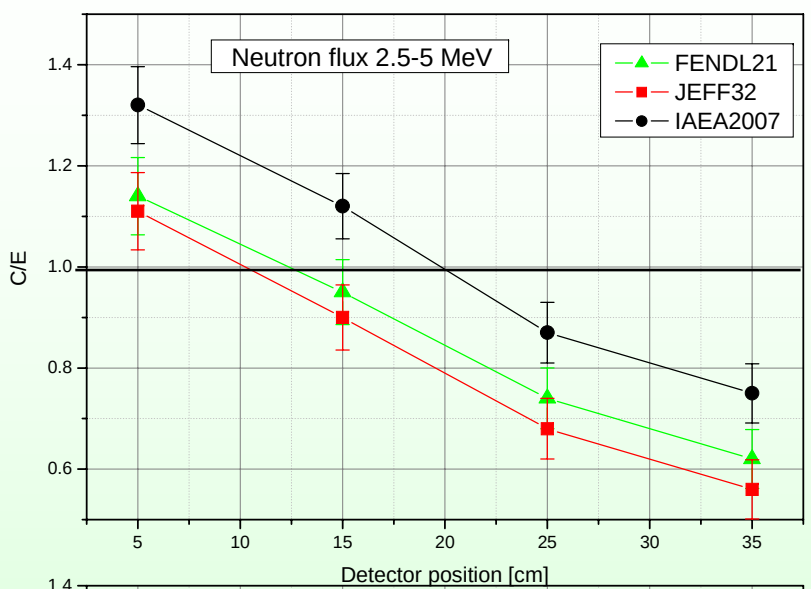
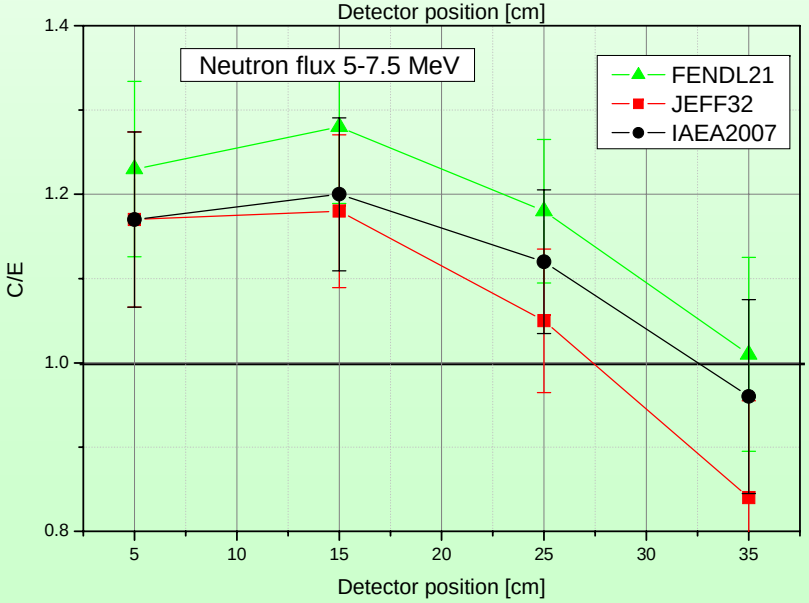
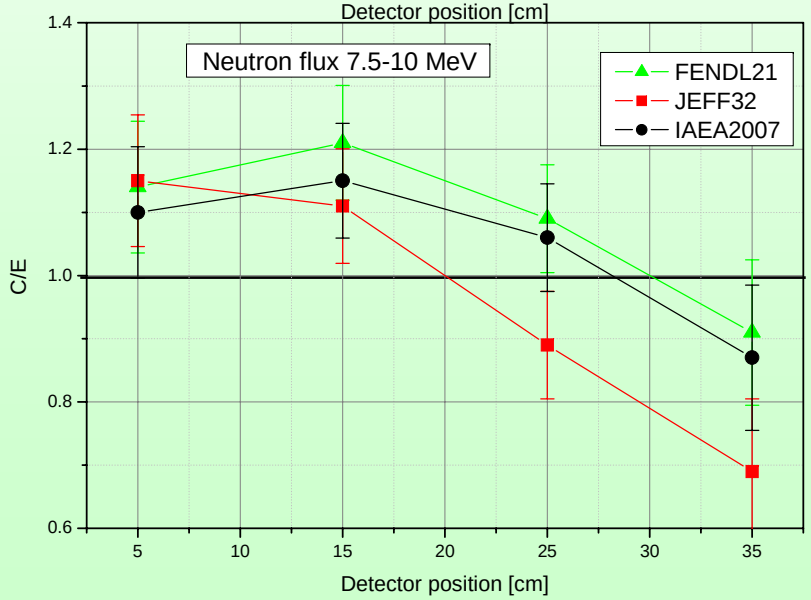
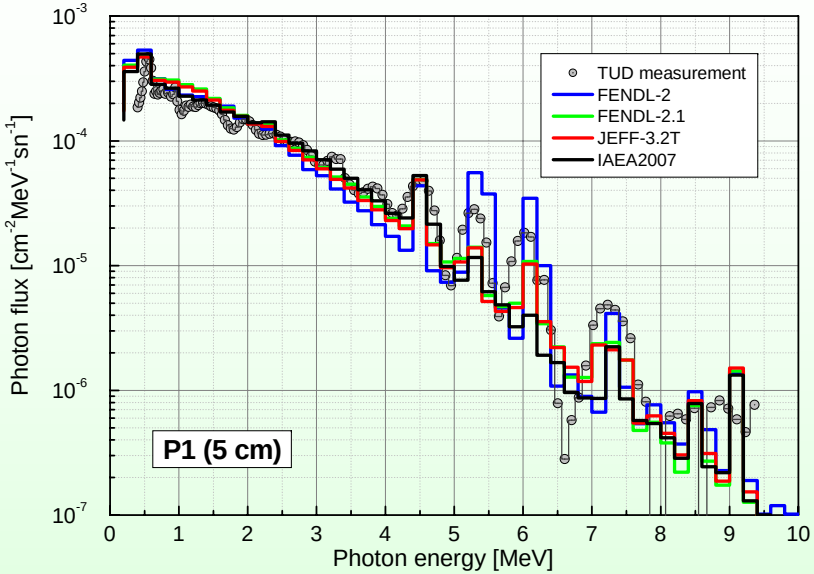


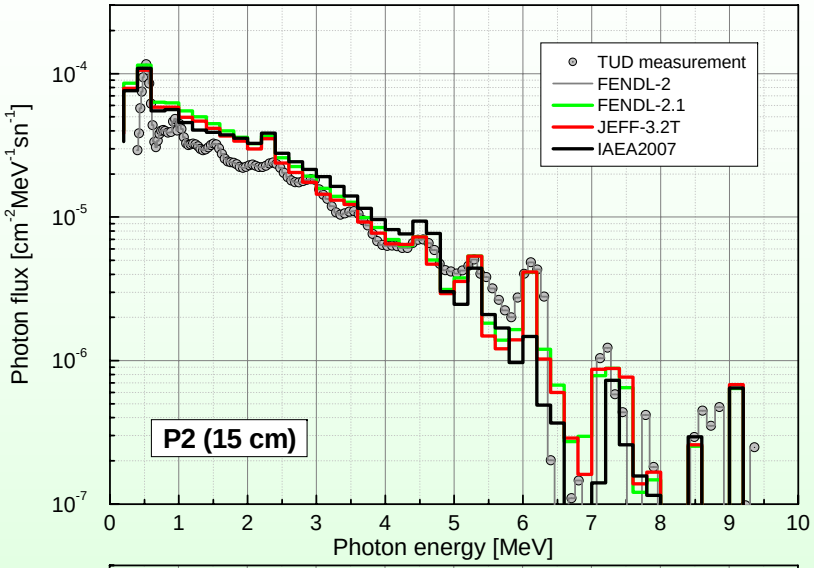


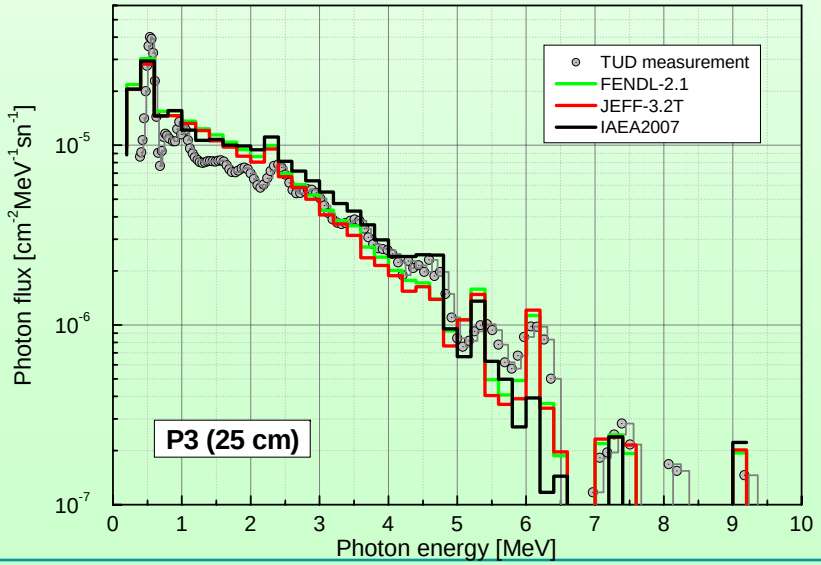


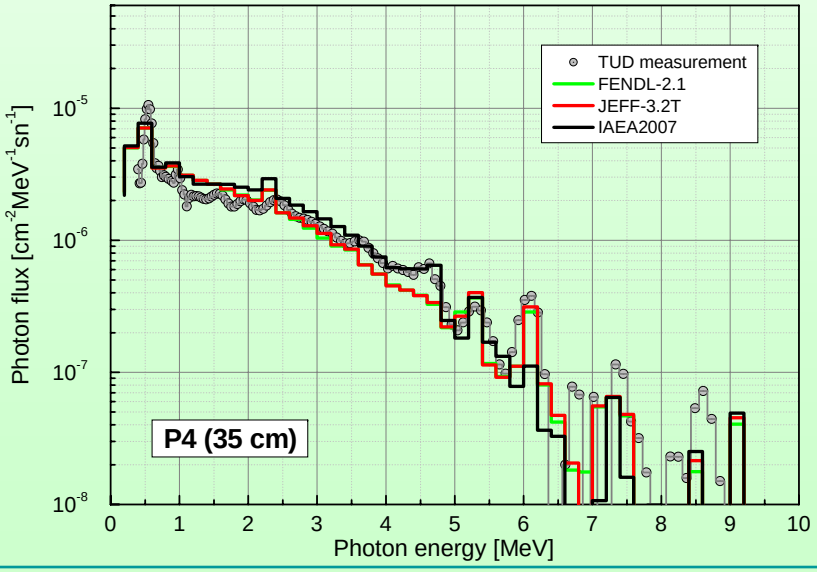


Photon flux spectra in W assembly

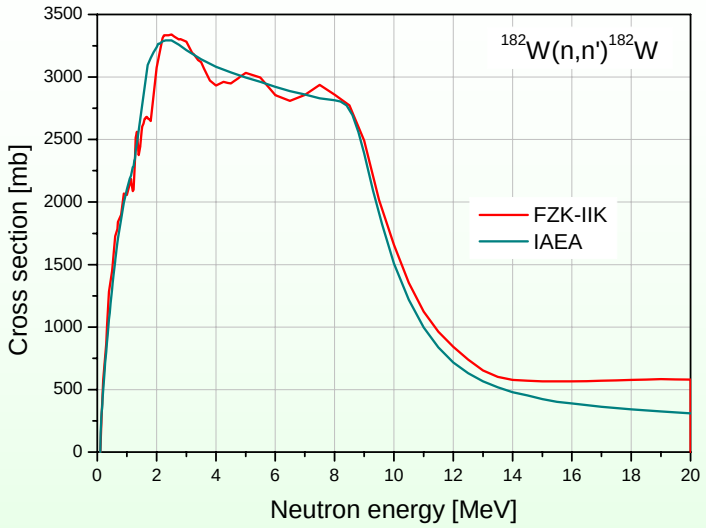


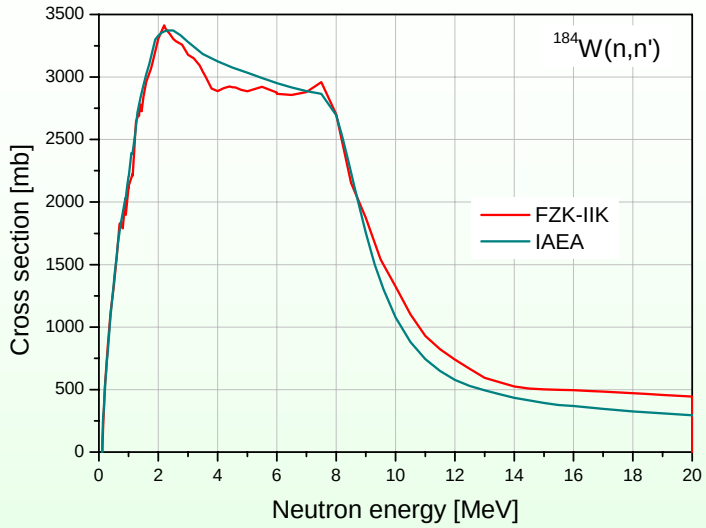


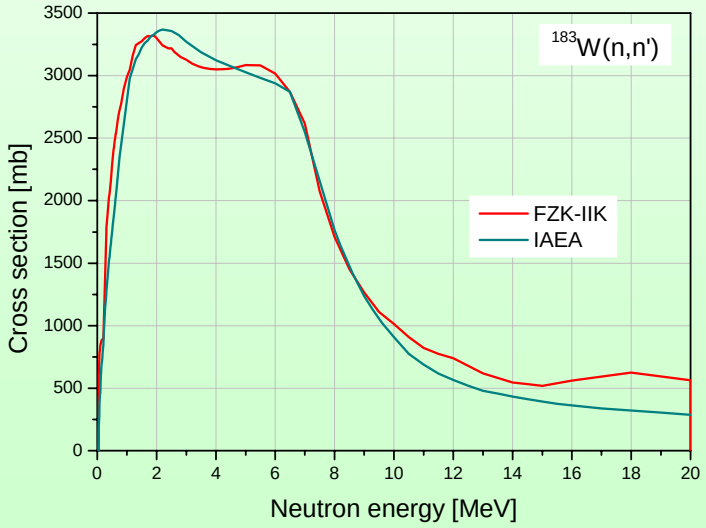


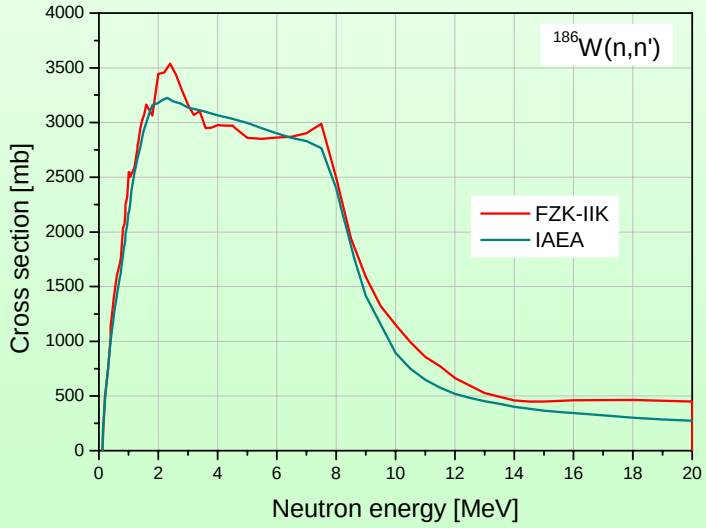


^{182,183,184,186}W inelastic cross-sections

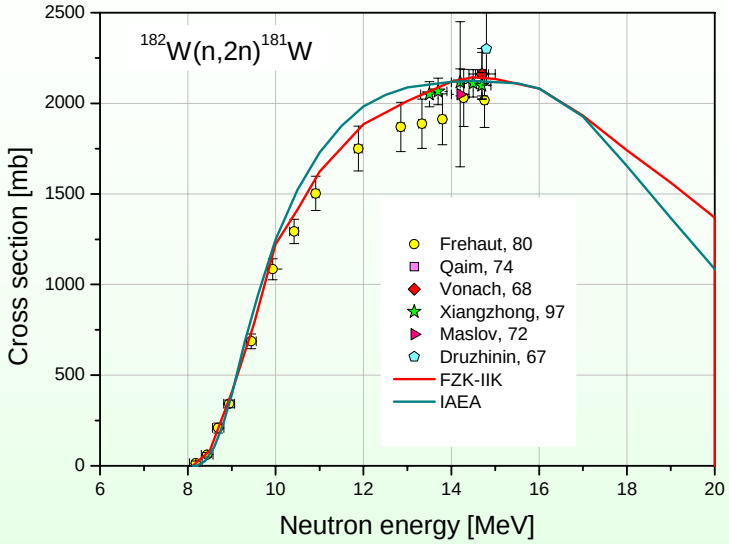


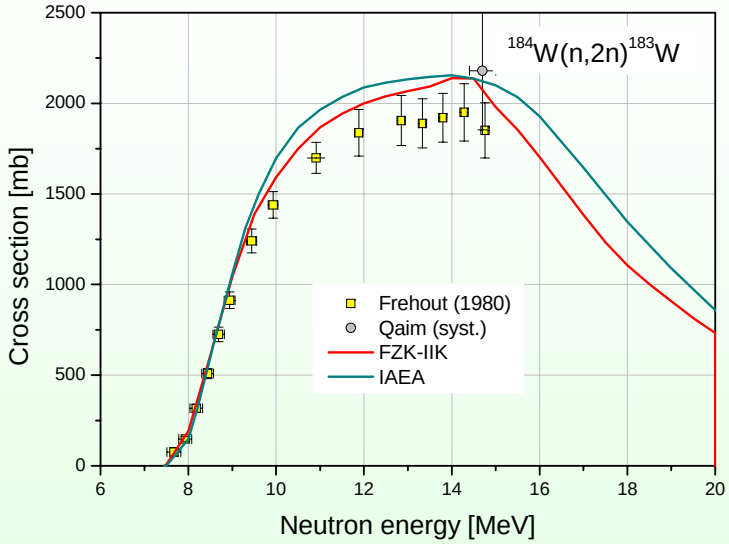


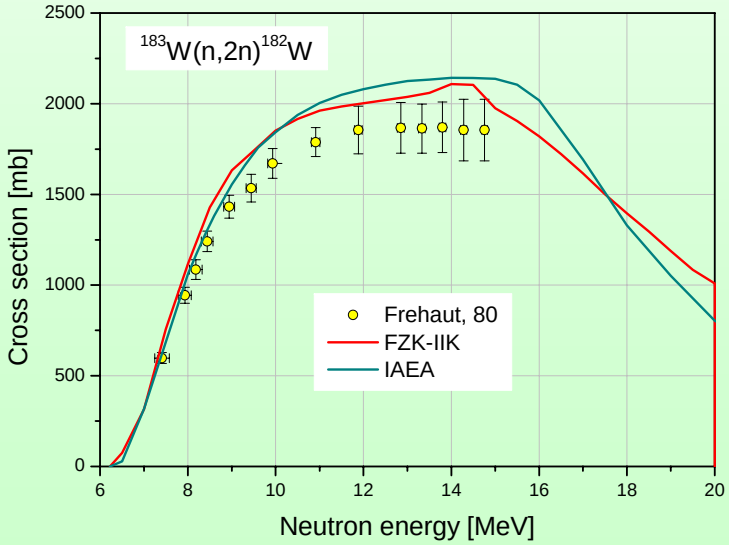


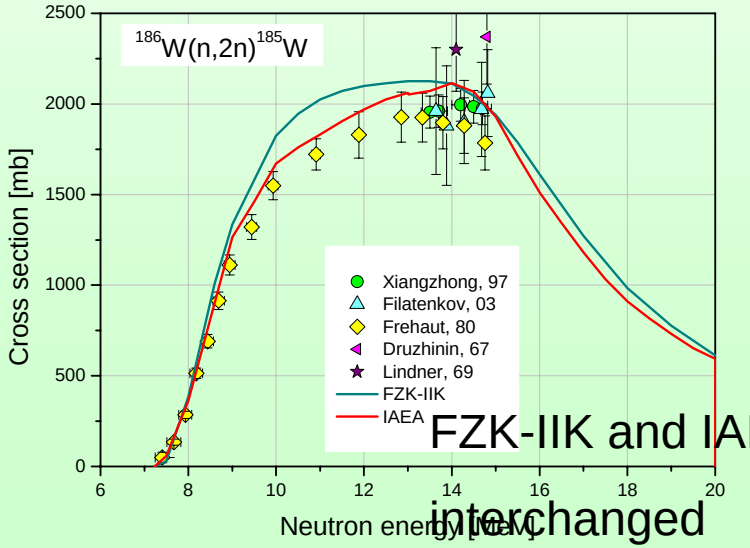


^{182,183,184,186}W (n,2n) cross-sections



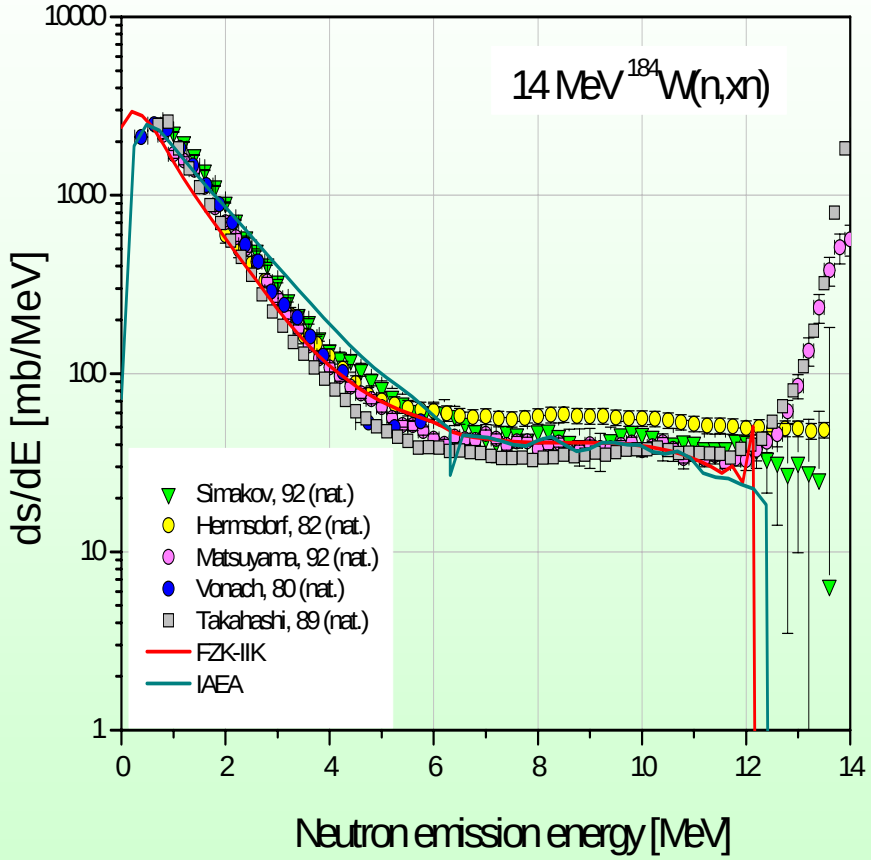


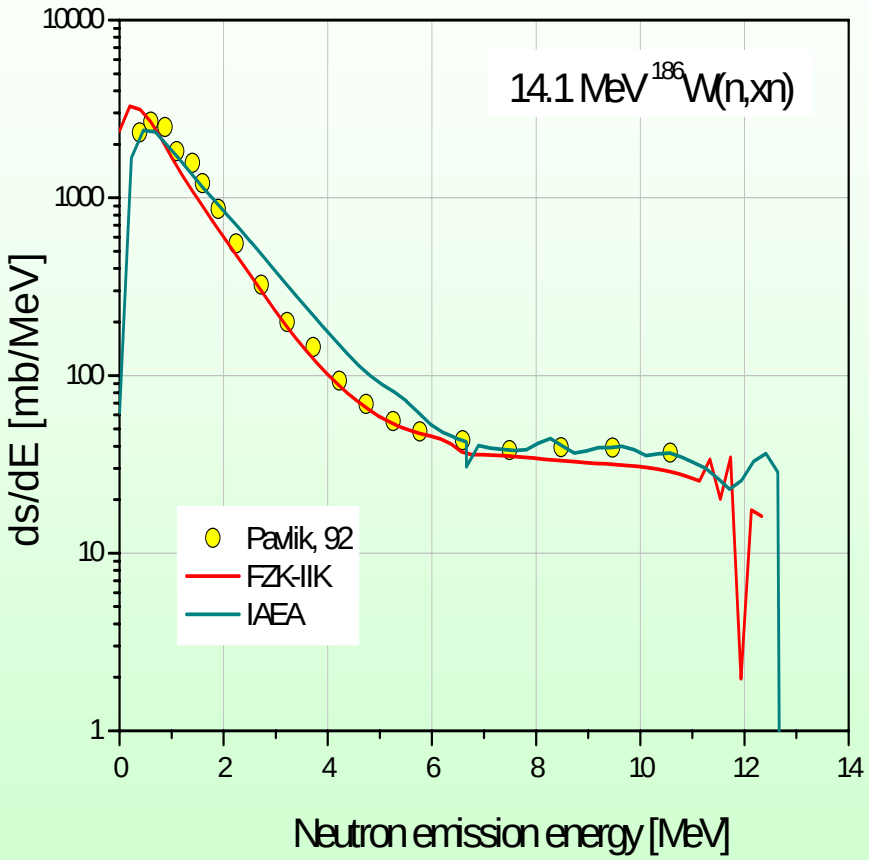




FZK-IIK and IAEA interchanged

^{184,186}W 14MeV neutron emission cross-sections





Conclusions

- Photon flux spectra satisfactorily reproduced
  - Overestimation of 10...30% below 5 MeV
  - Slightly better agreement with JEFF3.2T
- Neutron flux
  - Scattered neutron flux overestimated in small penetration depth (10...30%)
  - Fusion peak well produced in small penetration depth
  - General and increasing underestimation in large depth (10...30%)
  - Lower total flux for JEFF3.2T
  - IAEA-2007 shows better trend for large penetration depths
- Nuclear data
  - Previous sensitivity analysis indicated importance of (n,2n) and (n,n') cross sections
  - (n,n') c.s. around 14 MeV higher for FZK_IIK (JEFF-3.2T)
- Need for re-analysis of JEFF3.2T
  - Origin of differences not clear