Synthetic neutron camera and spectrometer in JET based on AFSI-ASCOT simulations

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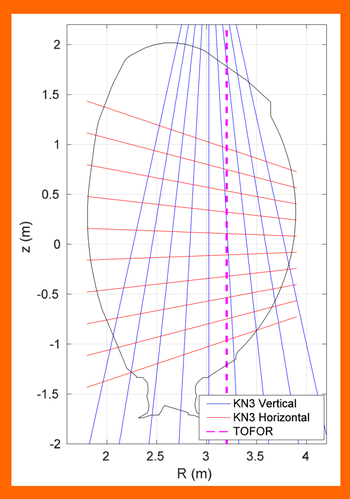
Experimental background



Neutron measurements in JET

- **Total rate**: Fission chambers (KN1) [1]
- **Profile**: High Spatial Resolution Neutron camera (KN3) [2]
  - 9 vertical
  - 10 horizontal lines of sights
- **Spectrum**: Time of Flight spectrometer (**TOFOR**, KM11) [3]

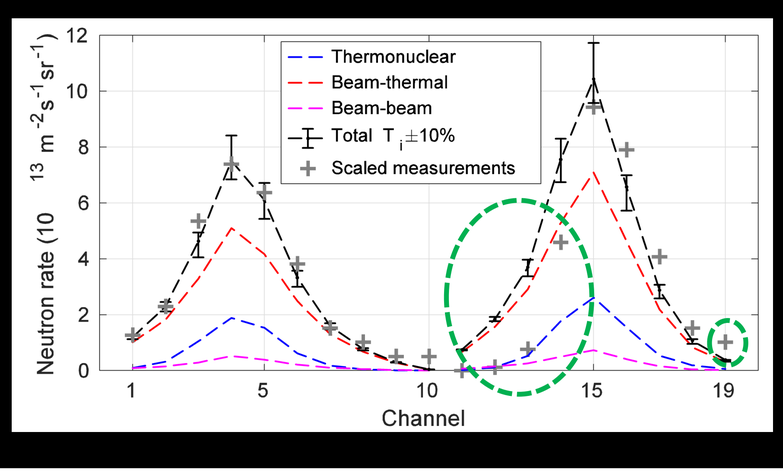
Synthetic neutron camera

JET #86614

Ideal diagnostics without detector related effects
Line integrated production rate (line integration and interpolation in (R, z, E, pitch) -space)

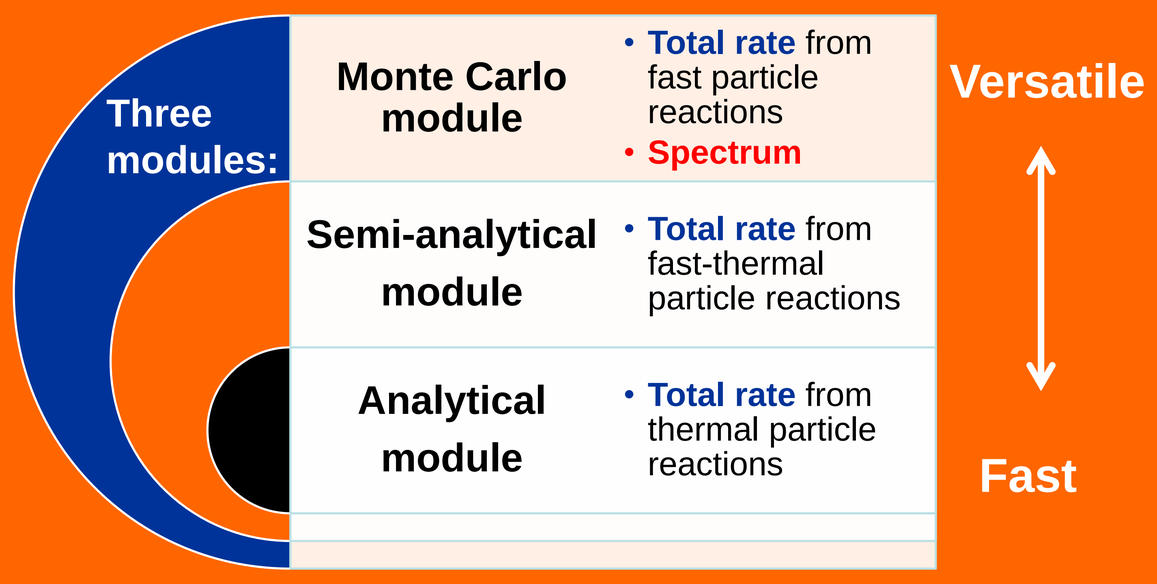
Compared with experimentally measured scaled values and the error estimates when T_i varies ±10%

- good qualitative agreement in in **horizontal channels**
- **overestimated** in outermost vertical channels (11,12, 13) possible affected by the equilibrium construction
- **underestimated** in channel 19, possibly due to scattering in the edge channel



AFSI ASCOT Fusion Source Integrator [4]

Modular tool for defining fusion product distributions in 4D grid (R, z, v∥,v⊥)
Uses given input distributions of reactants, usually from ASCOT



- Production in DD, DT and DHe3 fusion reactions are included based on Bosch-Hale cross sections [5]
- Validated with the experimental total neutron rate from KN1 in several shots [4]
- Suitable for calculating neutrons, alphas and He3

→ **synthetic diagnostics**
neutron or heat source (neutronics, balance-of-plant)

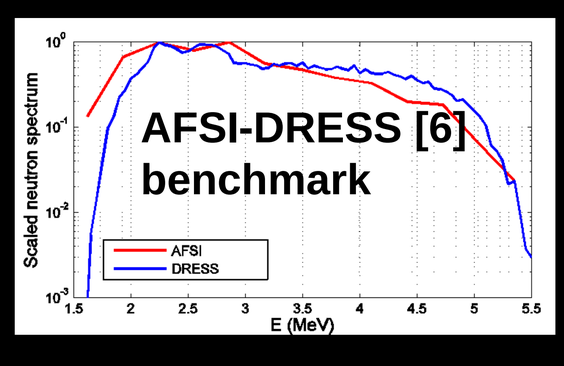
INPUT:
4D distributions of products from AFSI

OUTPUT:
Line-integrated neutron fluxes, neutron spectra for each channel

Synthetic spectra

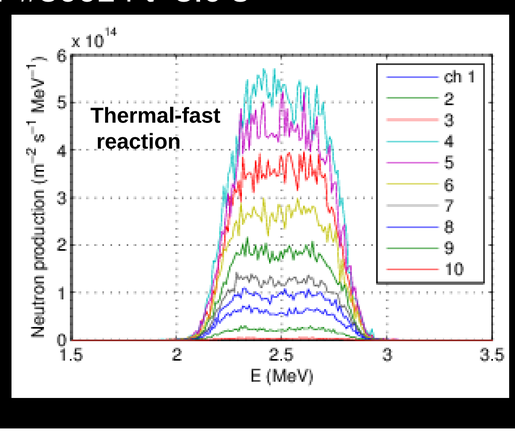
JET #86459 t=10.5-12.1 s

TOFOR



JET #86614 t=8.0 s

KN3 horizontal



Conclusions and future work

Synthetic neutron (rate and spectrum) diagnostics have been implemented based on AFSI calculations
Results have been validated quantitatively with the data from neutron camera and TOFOR spectrometer
AFSI can be applied as a part of calculation chain from the plasma fuel modelling to the neutronics and balance of plant analysis
possible to extend to real diagnostics with the modelling of detector effects with Serpent neutron and gamma transport code [7]

References:
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[2]Adams J.M. et al. 1993 The JET neutron emission profile monitor. Nucl.Inst. Methods A 329 277-90
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[5]Bosch H.S., Hale G. 1992 Nucl. Fusion 32 611
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