



Validation of nuclear data against accelerator experiments in SINBAD

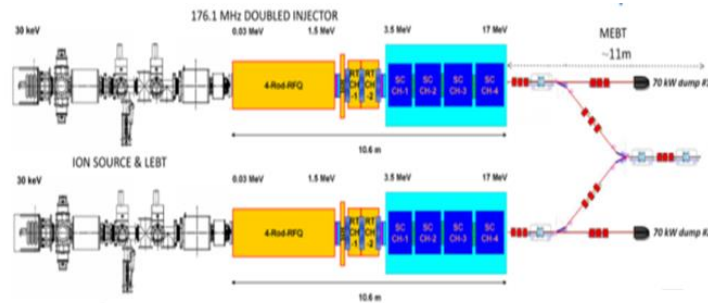
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MYRRHA-project: an Accelerator Driven System

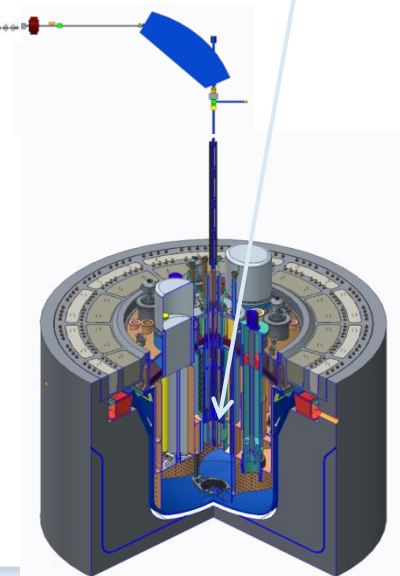
- MYRRHA – An Accelerator Driven System
 - Demonstrate the ADS concept at pre-industrial scale
 - Can operate in critical and sub-critical modes
 - Demonstrate transmutation
 - Fast neutron source → multipurpose and flexible irradiation facility

Target	
<i>main reaction</i>	spallation
<i>output</i>	$2 \cdot 10^{17}$ n/s
<i>material</i>	LBE (coolant)



Accelerator	
<i>particles</i>	protons
<i>beam energy</i>	600 MeV
<i>beam current</i>	2 - 4 mA

Reactor	
<i>power</i>	60 to 70 MW _{th}
<i>k_{eff}</i>	0.95
<i>spectrum</i>	fast
<i>coolant</i>	LBE



Experimental benchmarks in SINBAD

3 experiments are relevant to benchmark our codes for shielding calculations of 100 MeV accelerator and target stations:

- SINBAD-52P (NEA-1552/34)
- SINBAD-75P (NEA-1552/31)
- SINBAD-65P (NEA-1552/08)

Experimental benchmarks in SINBAD

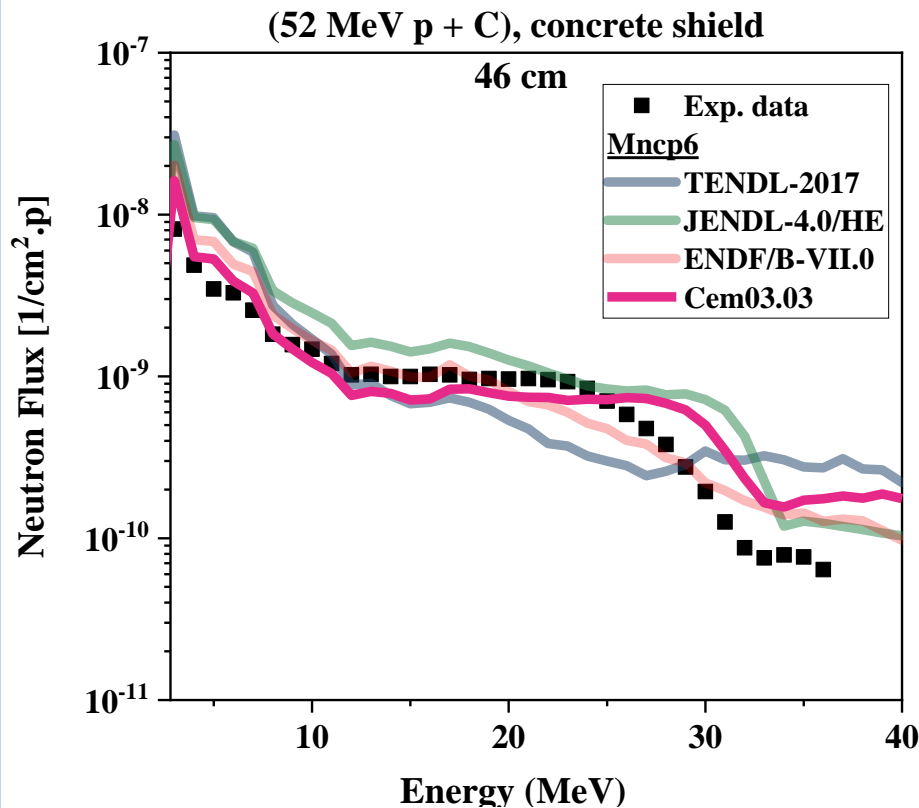
SCK & JAEA collaboration to validate Mcnp6.2, Phits codes, and nuclear data using SINBAD experiments

SINBAD abstract No.	Facility	Source	Shielding materials	outputs
NEA-1552/34	Cyclotron of the Institute of Nuclear Study at the University of Tokyo	Neutrons and photons at 0 degree produced by 52-MeV proton on a thick graphite	graphite, water, concrete, iron	neutron and photon energy spectra behind shieldings
NEA-1552/03	AVF cyclotron of the TIARA facility in JAERI	Neutrons at 0 degree produced by 43- and 68- MeV proton on a lithium	concrete, iron	neutron energy spectra behind shieldings
NEA-1552/23	KEK Spallation Neutron Source Facility (KENS)	Neutrons at 0 degree produced by 500- MeV proton on a thick tungsten	concrete	reaction rate at each depth in concrete
NEA-1552/15	Cyclotron in the Swiss Institute for Nuclear Research (SIN)	590-MeV proton	lead	neutron energy spectrum
NEA-1552/38	Intense spallation neutron source facility, ISIS, of the Rutherford Appleton Laboratory (RAL)	Neutrons at 90 degrees produced by 800- MeV proton on a thick tantal	iron+concrete	reaction rate at each depth in iron+concrete

Sinbad-experiment: 52 MeV p + C

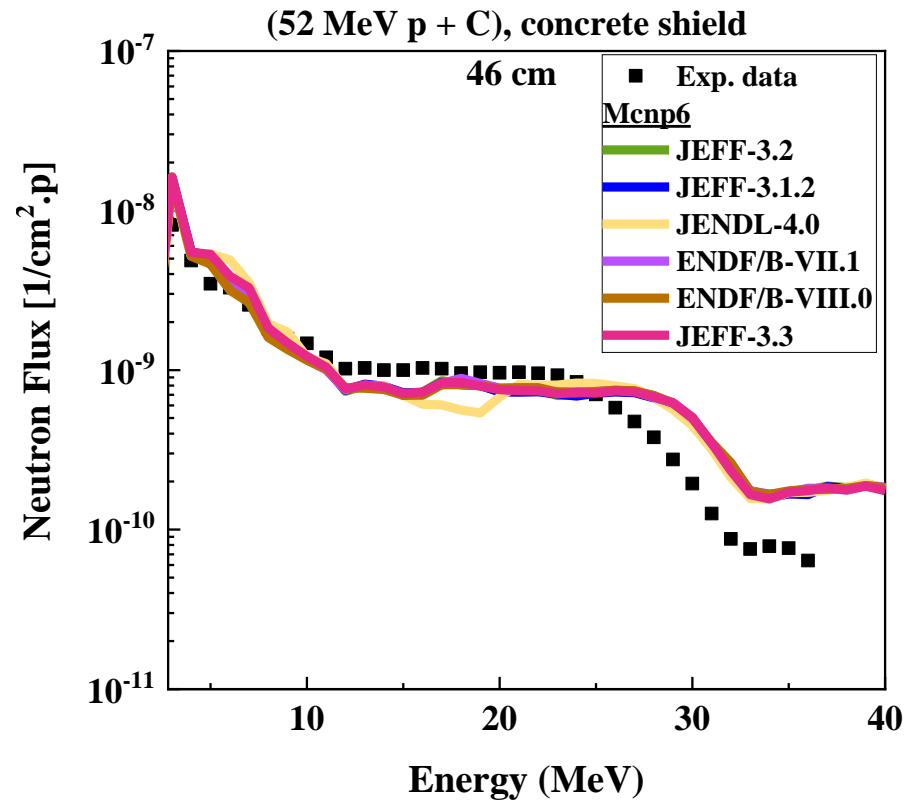
Transmitted neutron spectra measurement

Impact of proton induced libraries



neutron: Jeff-3.3

Impact of neutron induced libraries

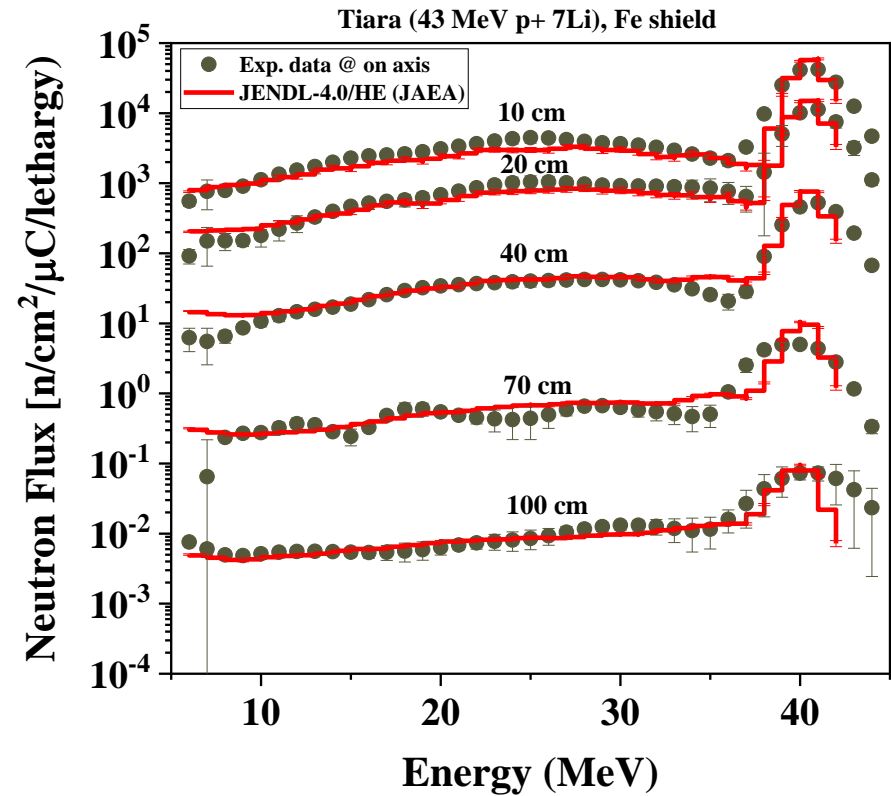
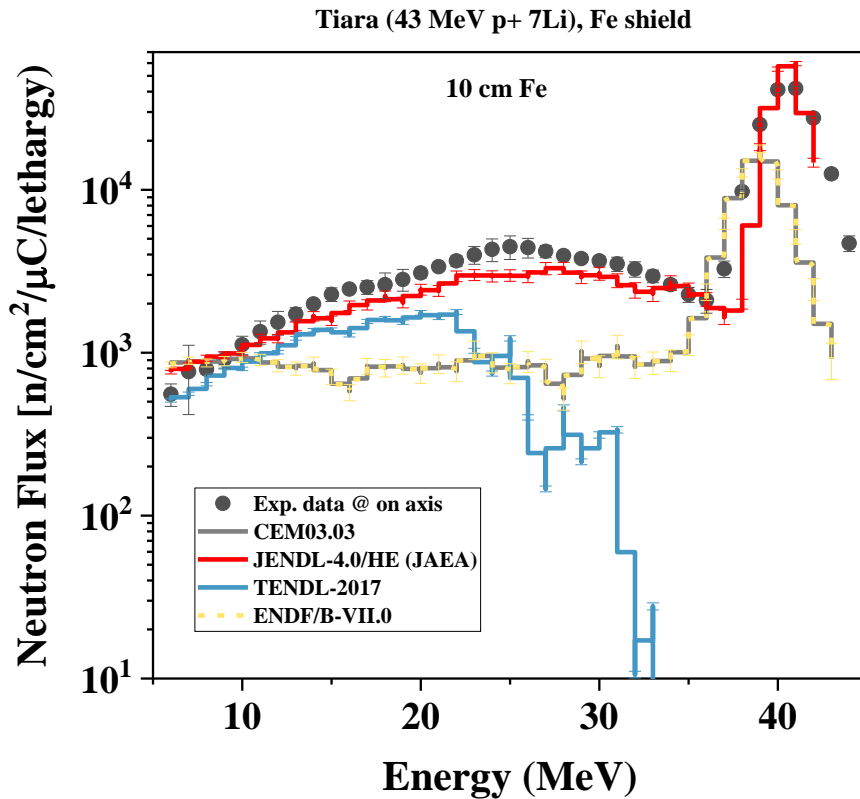


proton: Cem03.03

Sensitivity to neutron library is low

Sinbad-experiment: $Tiara=48\text{ MeV p} + 7\text{Li}$ Transmitted neutron spectra measurement

Impact of proton induced libraries



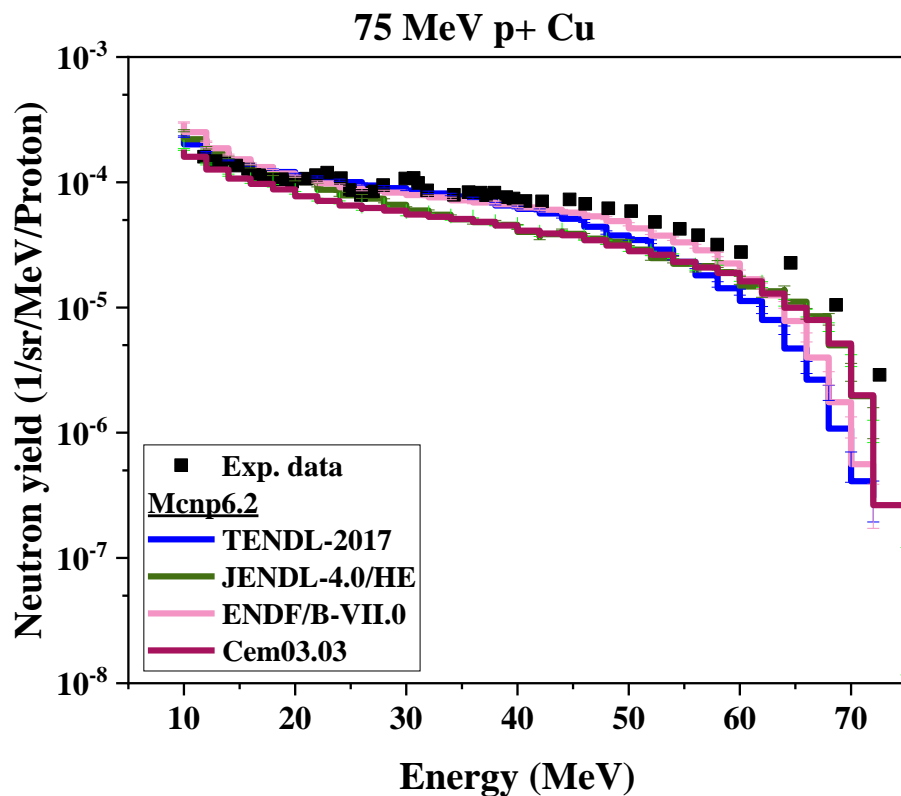
neutron:Jendl-4.0/HE

Proton data determines the shape of transmitted neutron spectra

Sinbad-experiment: $A_{vf}=75$ MeV p + Cu

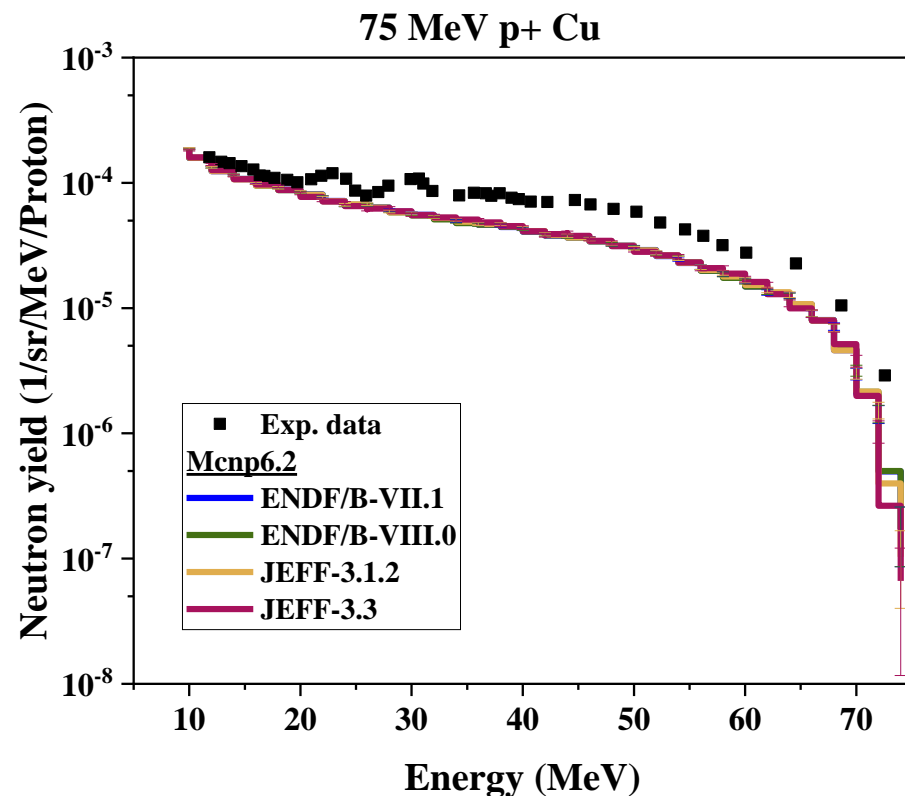
Neutron yield measurement

Impact of proton induced libraries



neutron: Jeff-3.3

Impact of neutron induced libraries



proton: Cem03.03

Conclusions

- The quality of experimental data is questionable. Uncertainties for the experiments should be provided in the SINBAD database. The quality of documentation of the experiments should be increased.
- There is no nuclear data or physics model accurately represent the experimental data of all considered experiments.
- Proton induced libraries are responsible for the production and spectra of the neutrons emitted from target materials.
- Neutron libraries reflect the flux profile determined by proton data/physics models.
- High quality proton induced library is required. Light-Z targets (Li, C) are more difficult to deal with and deserve special attention.
- More experiments at different energies and different target materials are necessary.



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