



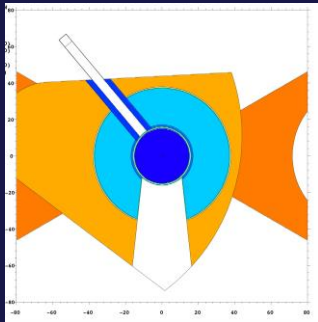
HighNess

HighNESS General Meeting – WP4

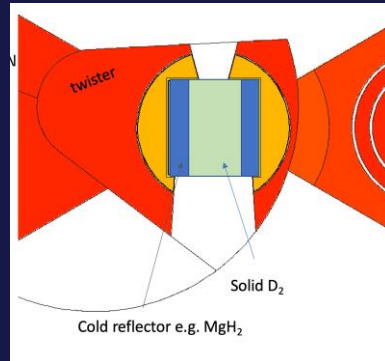
VCN source

Possibilities for VCN source

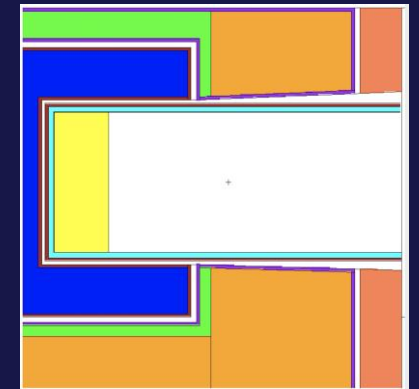
Use of advanced reflectors to increase transport of VCNs from the main cold source



Use of dedicated VCN converter



Combined use of LD₂, SD₂ and nanodiamonds

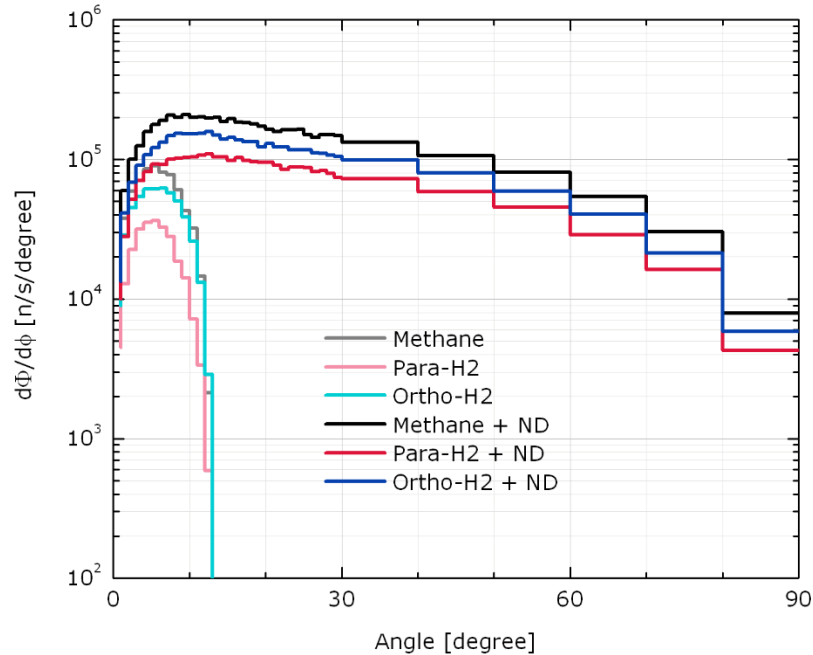
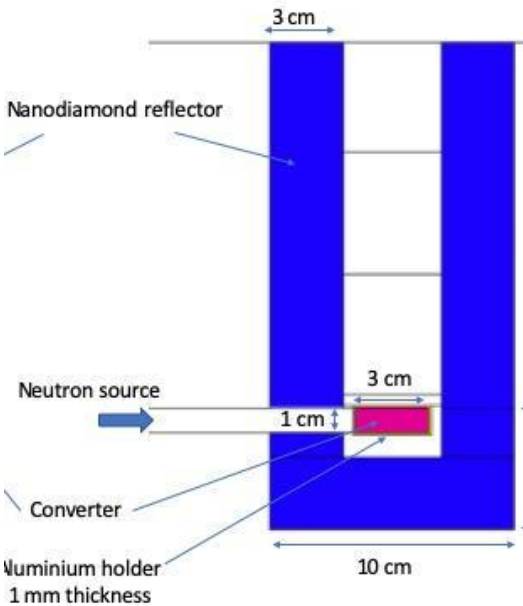
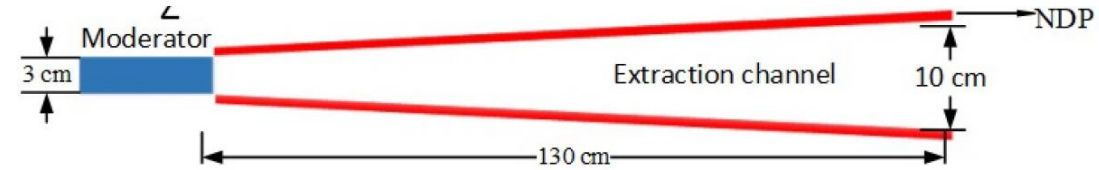


In the original HighNESS proposal

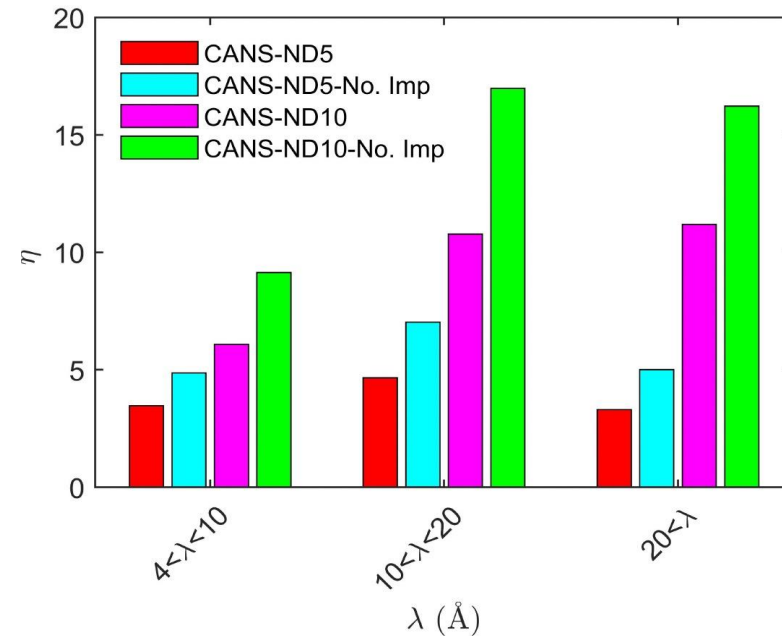
Recent concept by V. Neshvizevsky et al

Advanced reflectors with main cold source

- Abundance of evidences of enhanced VCN reflection by nanodiamonds (ND)

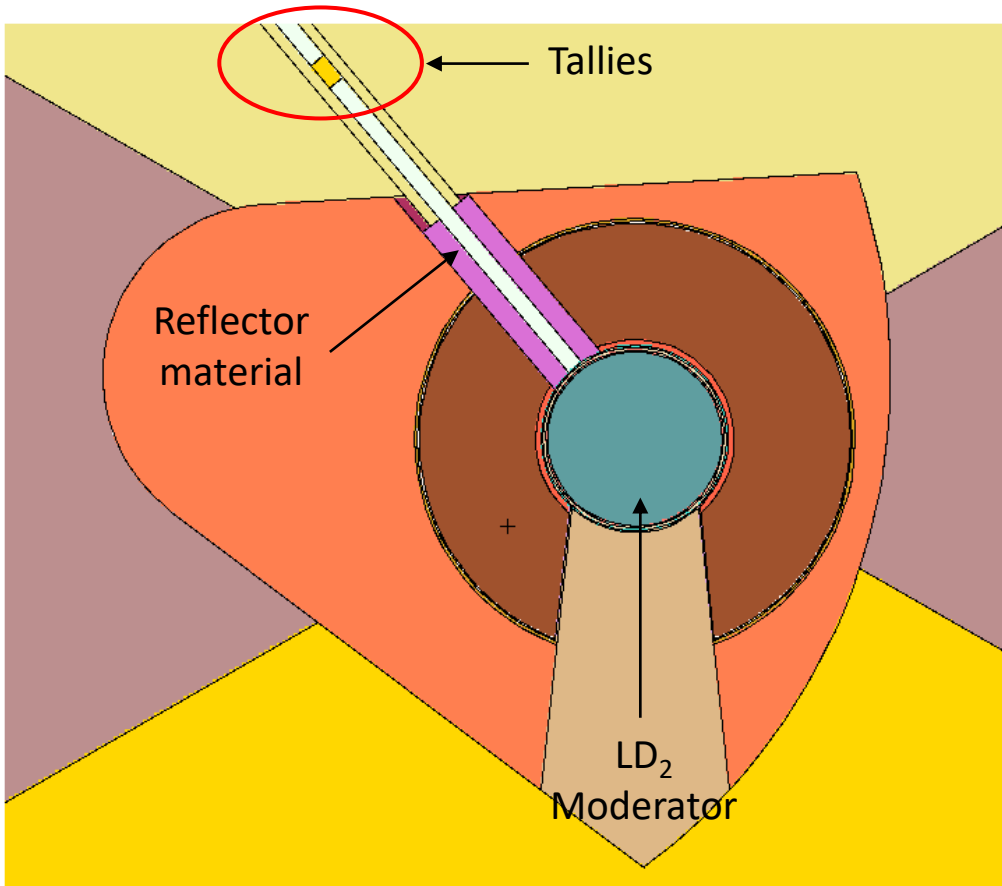


Courtesy of Zsofia Kokaj, CREMLIN+



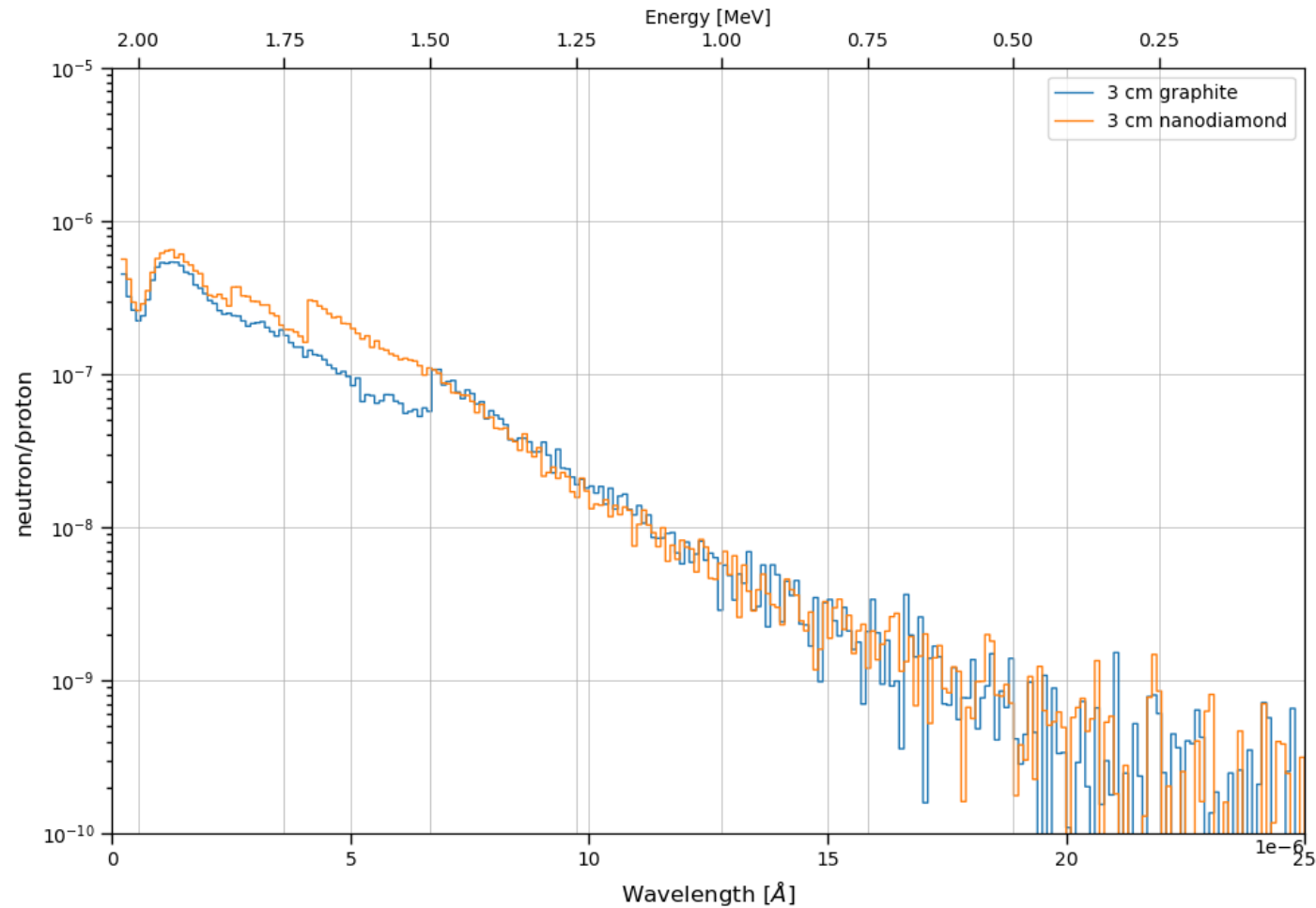
M. Jamalipour et al, Improved beam extraction at compact neutron sources using diamonds nanoparticles and supermirrors, Nuclear Inst. and Methods in Physics Research, A 1033 (2022) 166719

Cylindrical beam extraction tube for VCN source



- **Small cylindrical beam extraction tube:**
 - Old LD₂ moderator model
 - Placed in the Be reflector
 - 3 cm inner diameter
 - 3 cm reflector thickness
 - Point detector estimation not available with nanodiamond
 - Track-length and flux tallies at 23 cm distance from the VCN exit source (close tallies)
- **Reference geometries:**
 - No tube walls (100 μm Be in the Be reflector)
 - 3 mm Al tube
- **Tested materials**
 - Nanodiamond, Graphite, MgH₂

Neutron yield in the close track-length tally



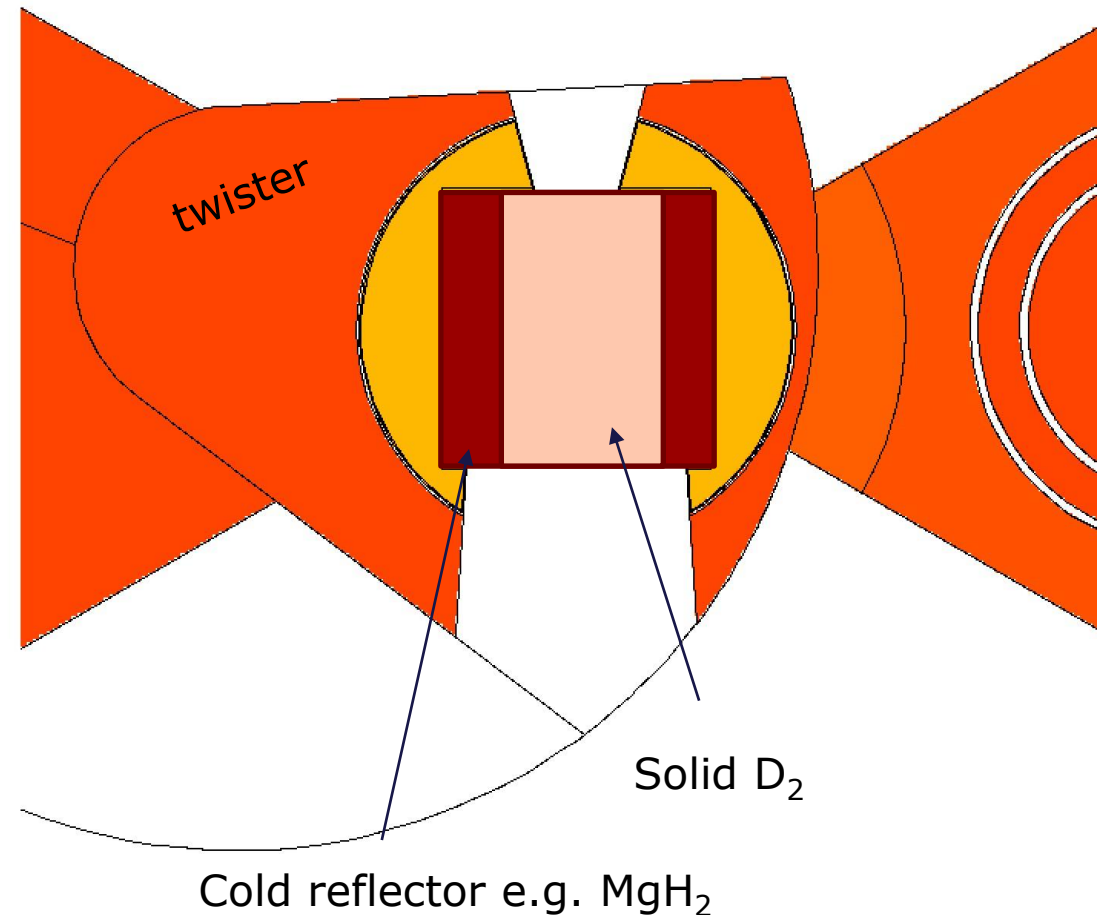
Second VCN option: dedicated source

Two materials considered for VCN converter:

- solid D_2 at 5 K
- Deuterated clathrate hydrates at around 2 K (missing library, currently under study)

Coupling with reflectors to increase performance such as nanodiamonds or MgH_2

Best location inside the twister, but **cooling is very challenging**



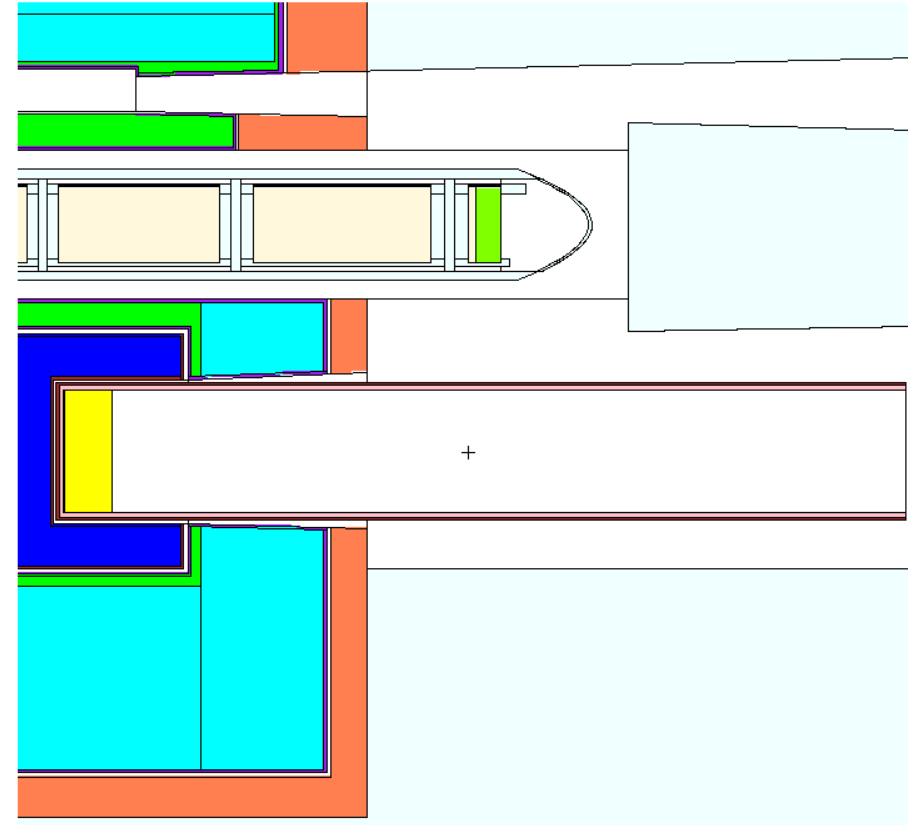
A possible implementation of a dedicated VCN converter at ESS*

Concept:

- solid D₂ VCN converter at 5 K
- A fluorinated detonation nanodiamond (F-DND) reflector increases the total flux of VCNs
- thin F-DND layer is nearly transparent for CNs, therefore, it virtually doesn't affect the initial CN beam

Technically challenging

We cannot fully test it in MCNP yet

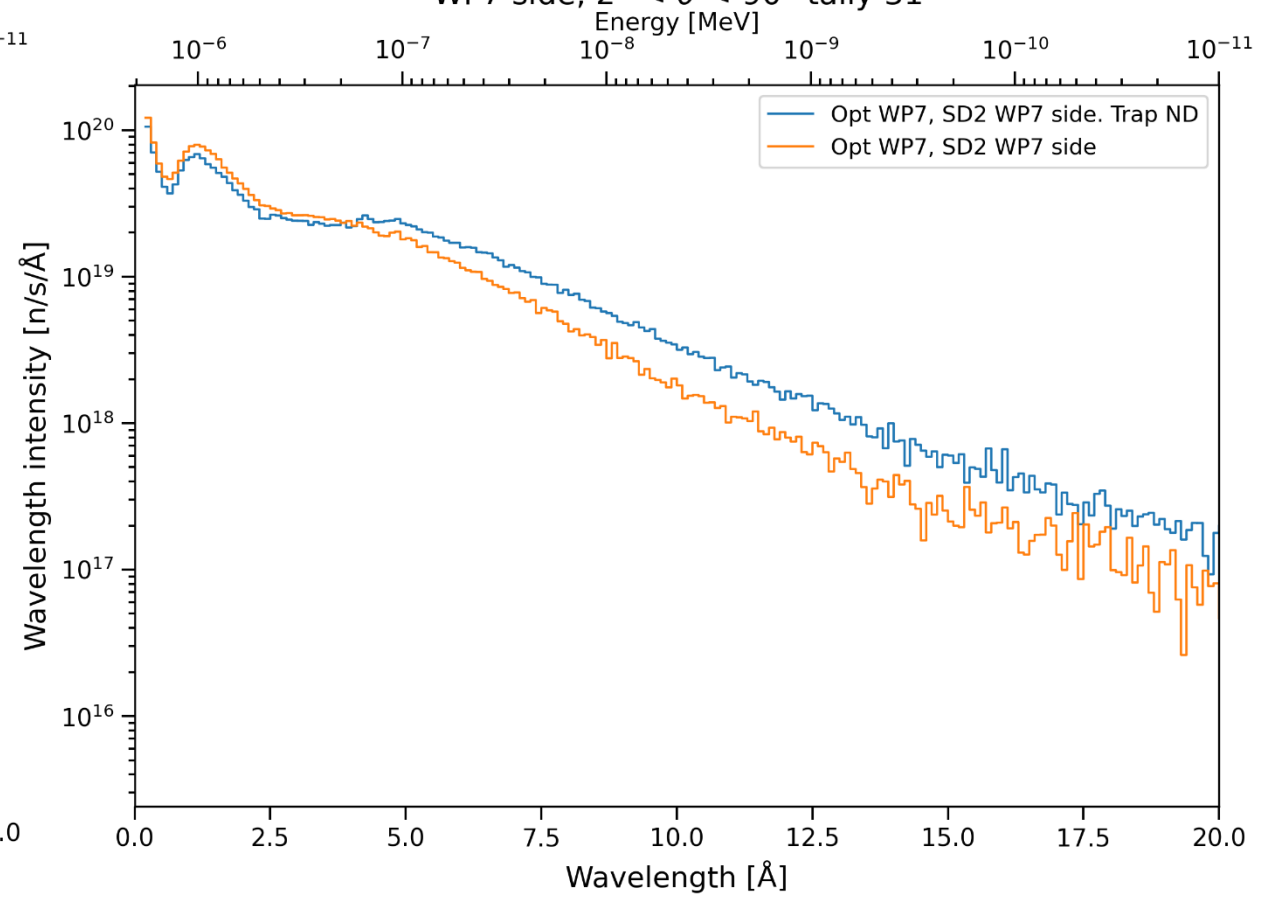
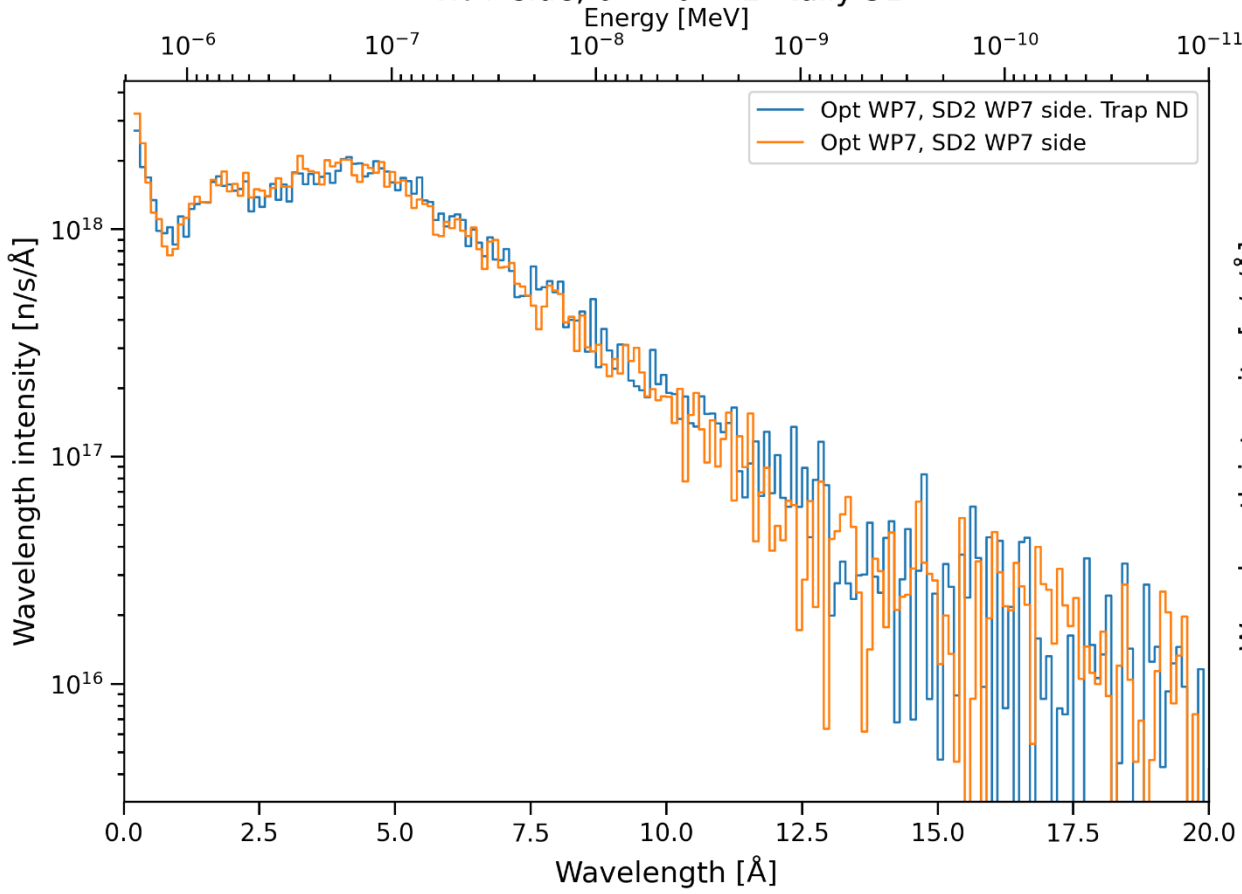


*from *Why very cold neutrons could be useful for neutron antineutron oscillation searches*, Valery Nesvizhevsky, Workshop on VCN and UCN at the European Spallation Source

Preliminary results with Free gas SD2

WP7 side, $0^\circ < \theta < 2^\circ$ tally 31

WP7 side, $2^\circ < \theta < 90^\circ$ tally 31



PHITS model and benchmarking

