
DTU

HighNESS general meeting 08/05/2023 – WP4

SD_2 UCN Source in the twister

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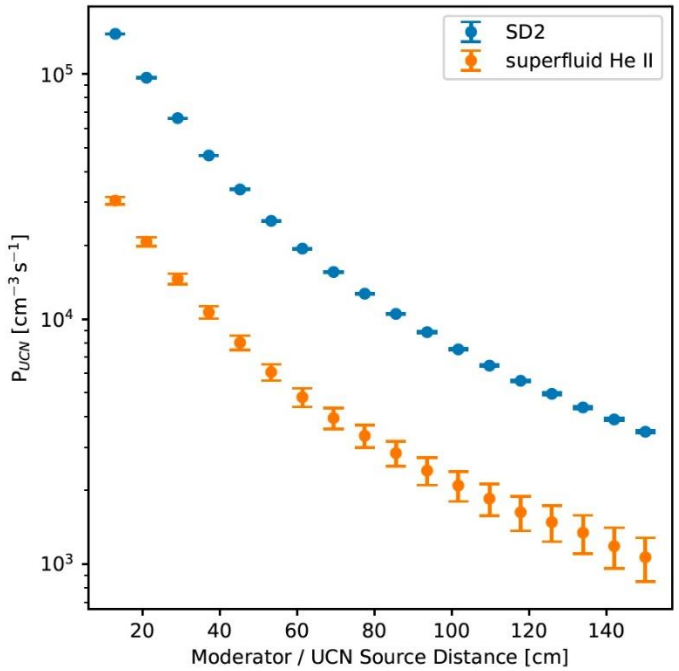
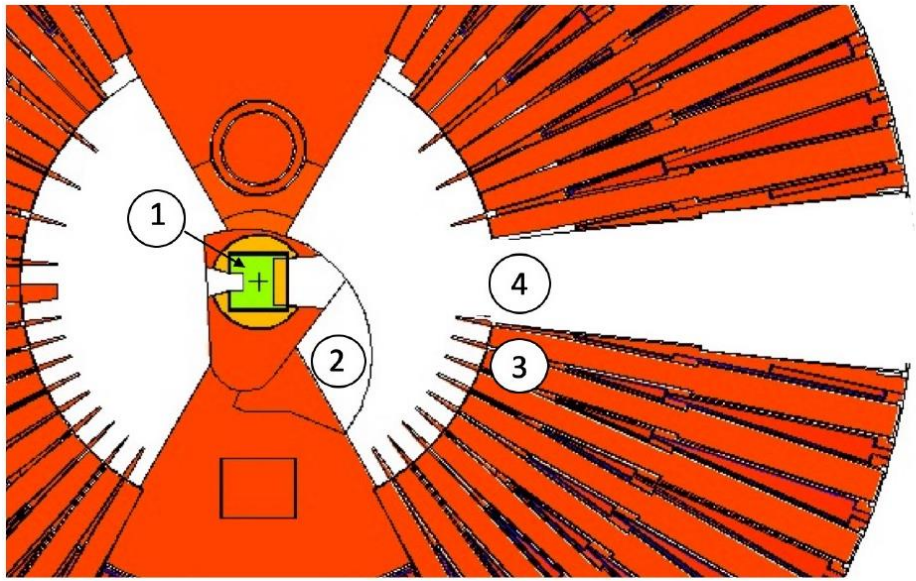
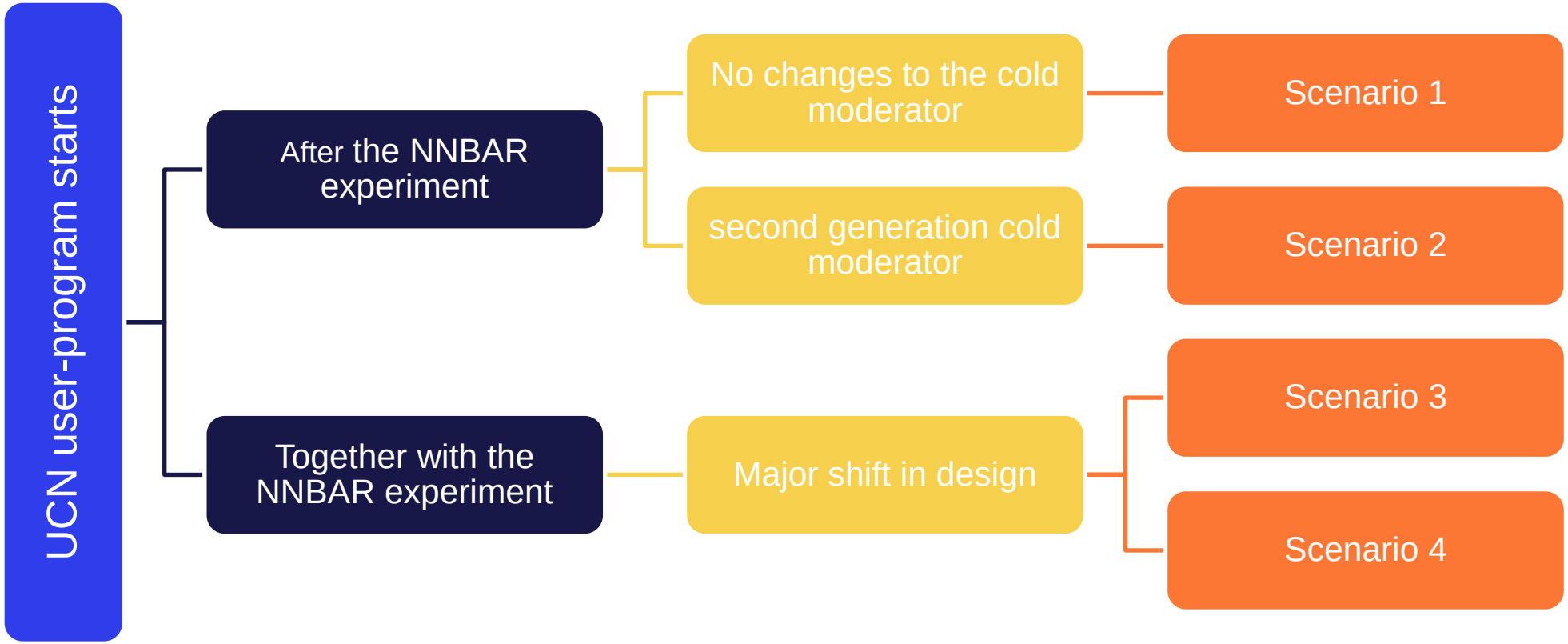
SD_2 in the Twister

- The rationale behind this concept is to maximize the cold flux delivered to the UCN converter





UCN scenarios



Scenario 1

- The UCN program starts after the NNBAR experiment, and minimal to no changes in the LD_2 moderator are foreseen

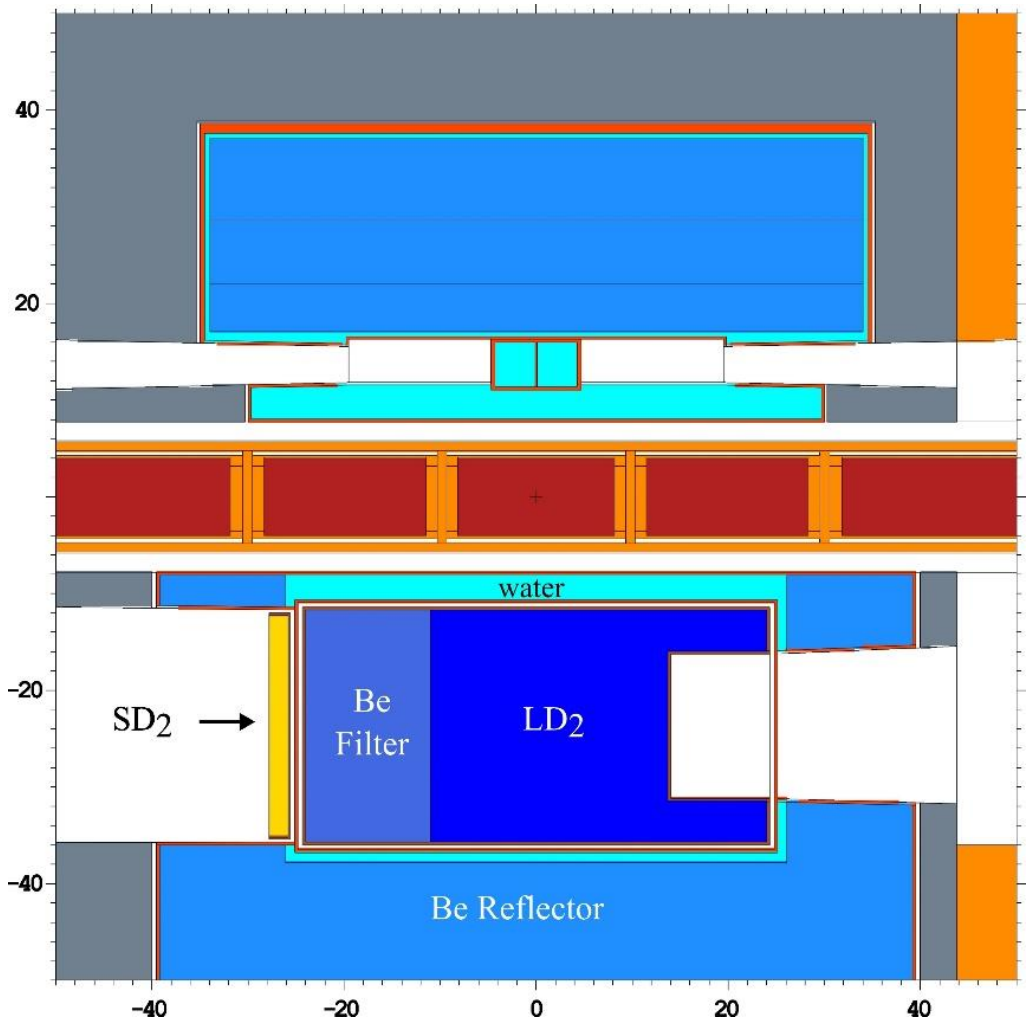
  Volume = 1.81 L

  P_{UCN} = 3.07E+5 UCN/cm³/s

  Prompt Heat-load = 760 W

- Independent from the LD_2 source
- Be filter could be removed for higher performances

- Possible lack of space to accommodate the cooling infrastructure within the pre-designed cold moderator frame



Scenario 2

- The UCN program starts after the NNBAR experiment, and a second-generation cold moderator is foreseen

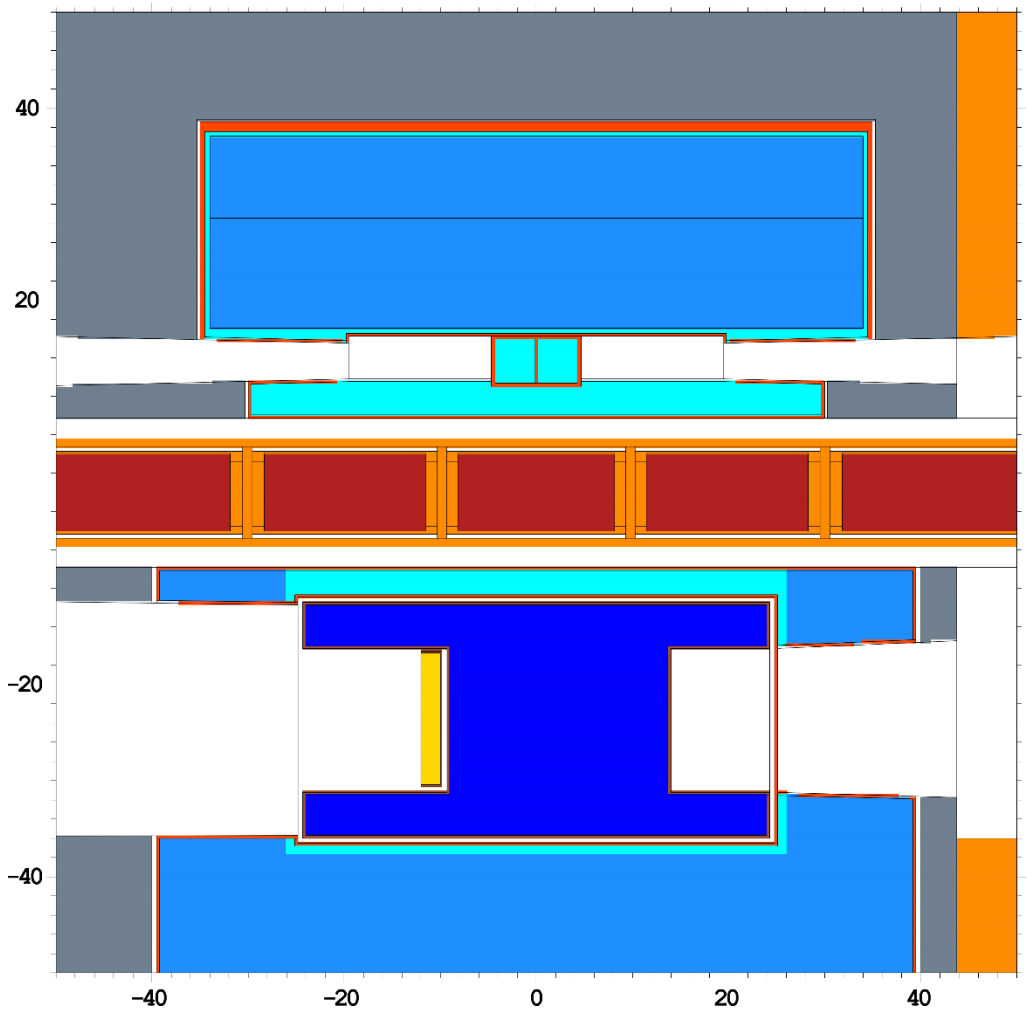
  Volume = 0.38 L

  P_{UCN} = 1.31E+6 UCN/cm3/s

  Prompt Heat-load = 560 W

- Design not too far from the first generation
- Optimization process includes one of the FOM for UCN production
- The lack of space could be solved by the redesign process

No need of large volumes if close to the hot spot of cold neutron production



Scenario 3

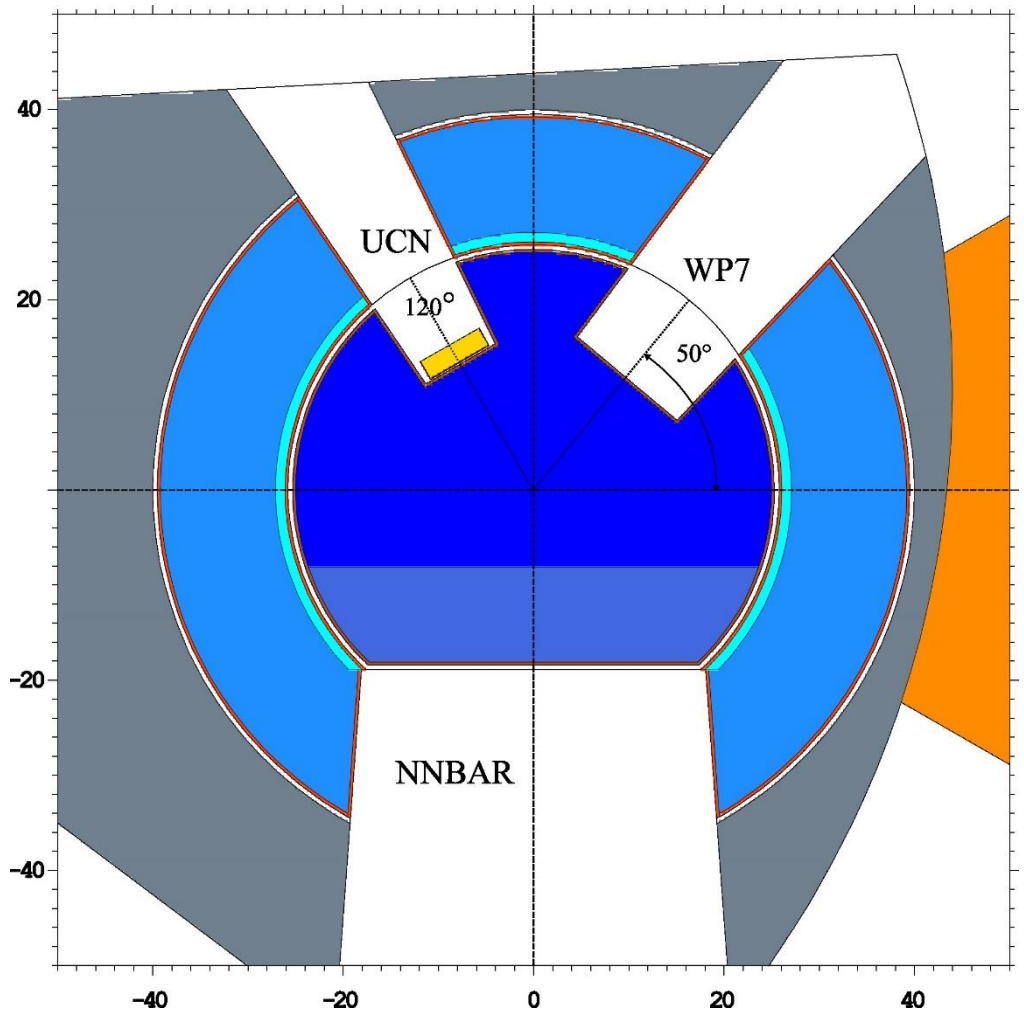
- The UCN program runs together with the NNBAR experiment, which means that a major shift in the design is needed.

  Volume = 0.13 L

  P_{UCN} = 1.74E+6 UCN/cm^3/s

  Prompt Heat-load = 520 W

- Cylindrical shape allows for a third opening
- Preliminary simulations have shown that the losses for NNBAR and WP7 are far from being crippling
- This design has many parameters and three figure of merits, so one should expect a long and complex optimization process



Scenario 4

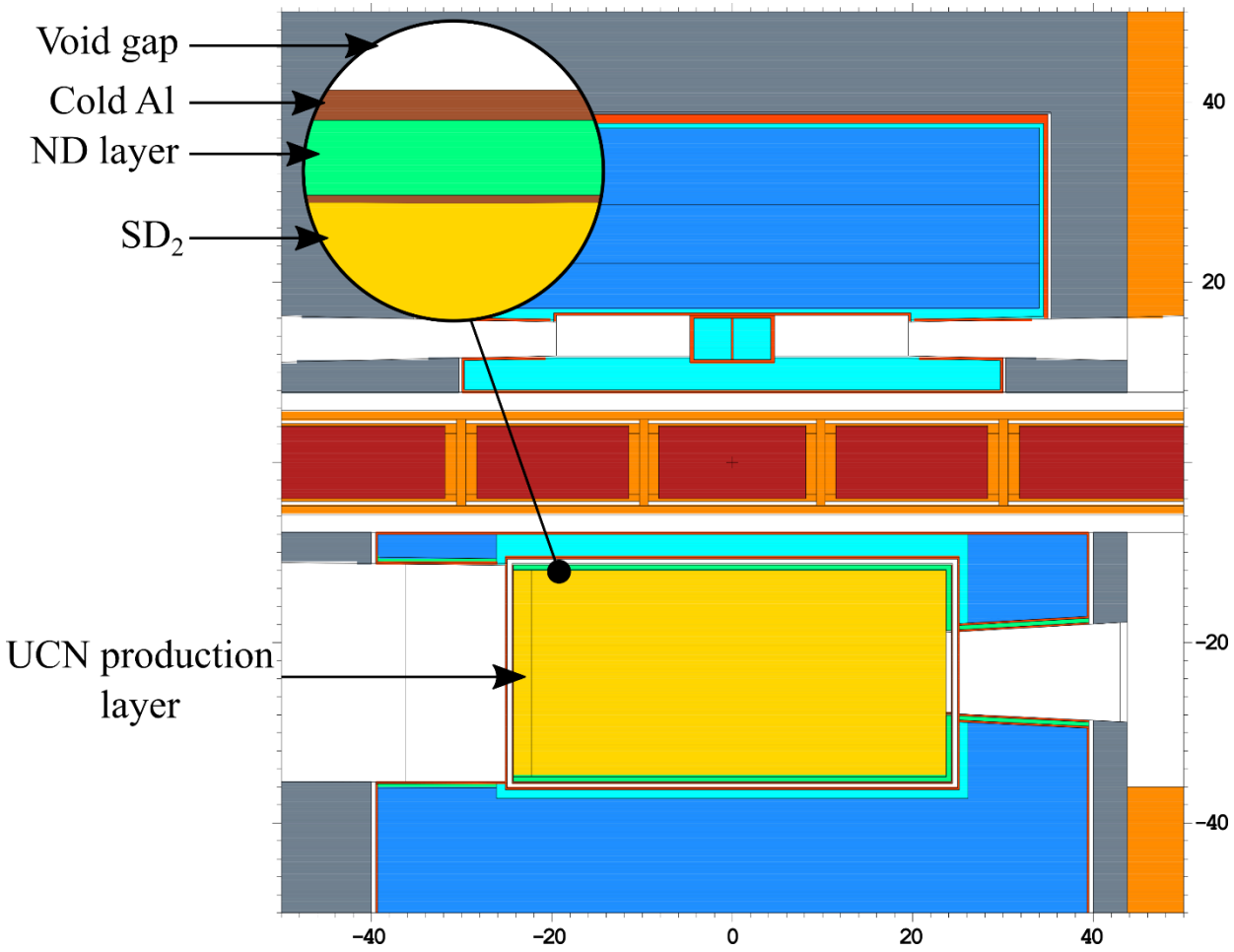
- Large SD_2 crystal that could serve the NNBAR experiment, but most likely after

  Volume = 48.2 L

  P_{UCN} = 9.13E+5 UCN/cm^3/s

  Prompt Heat-load = 40 kW

- High VCN intensity
- UCN “for free” produced in the last centimeters
- This design is the most challenging of all both in terms of design and engineering



Conclusion

- All the designs presented have their strengths and their limitations
- Some of the ideas are challenging

	SD_2 Volume [L]	P_{UCN} [n/s/cm^3]	$\dot{N}_{UCN}$ [n/s]	Heat-load [W]	WP7 FOM [n/s/sr]	NNBAR FOM [nÅ^2/s/sr]
Baseline + UCN	1.81	3.07×10^5	5.56×10^8	760	3.23×10^{15}	-
No Be filter + UCN	1.81	4.70×10^5	8.51×10^8	1000	3.06×10^{15}	-
Optimized UCN-only	1.75	7.72×10^5	1.35×10^9	2910	-	-
Reentrant Hole	0.38	1.31×10^6	5.03×10^8	560	2.81×10^{15}	-
Optimized depth	0.38	1.63×10^6	6.26×10^8	730	2.28×10^{15}	-
Optimized size	0.007	2.41×10^6	1.64×10^7	28	2.96×10^{15}	-
3-openings cylinder	0.13	1.74×10^6	2.22×10^8	520	2.84×10^{15}	2.33×10^{17}
Optimized cylinder	0.07	2.34×10^6	1.66×10^8	550	2.33×10^{15}	2.30×10^{17}
Full SD_2 moderator	48.2	6.56×10^5	1.32×10^9	39886	-	-

The future of the ESS user-program CAN be UCN, and, despite the challenges, the in-twister option WILL provide unprecedented intensity

Thank you
for the attention