Outcome: WG2 UCN Source
-
Solid deuterium based

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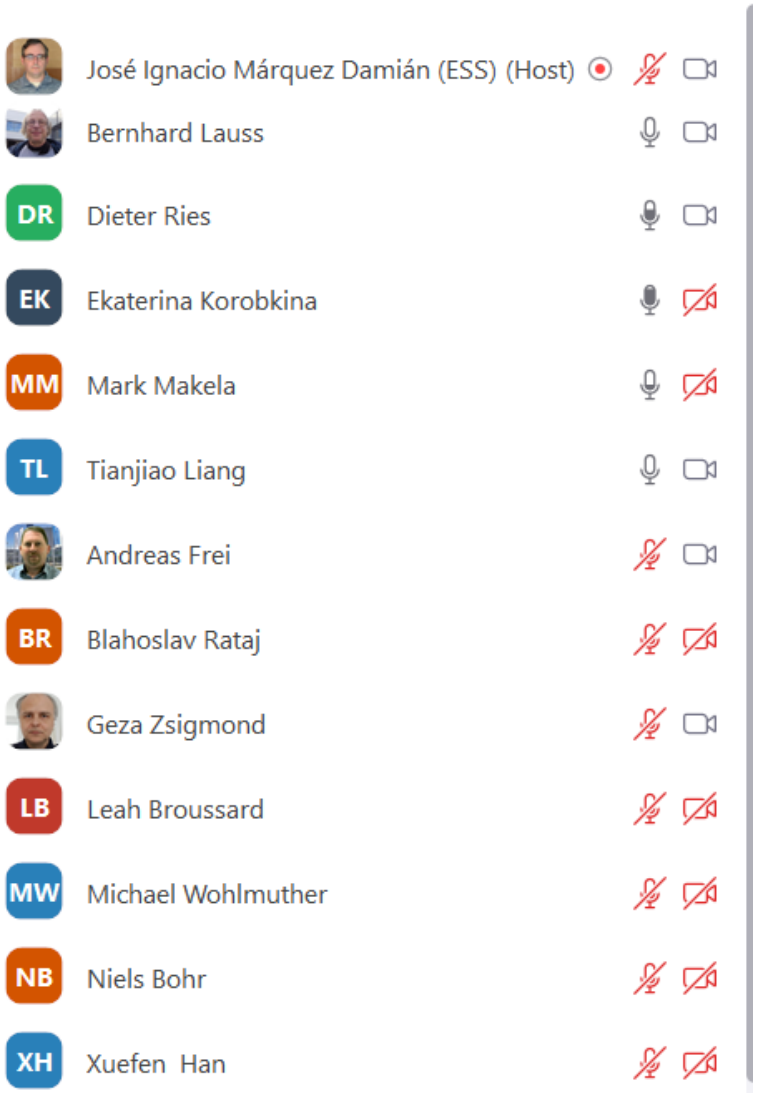
Working Group 2



Location / Geometry of a sD_2 UCN source

Y. Beßler:

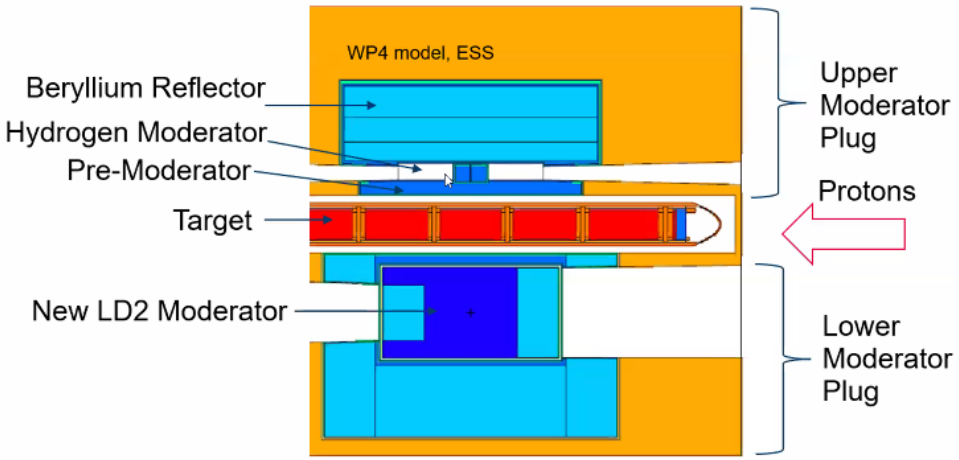
WORKSHOP ON VCN AND UCN AT ESS

6. Draft design of ortho-Deuterium Moderator –neutronic model

First model

- ca. 34L liquid ortho-Deuterium
- Pre-Moderator 25 mm H2O
- Be reflector, water cooled

- Heat load =56.6 kW
- Pressure =5 bar
- Mass flow =3.4 kg/s
- Temperature =22.5 K



– orange: steel (twister frame, inner shielding, etc),
– dark blue: liquid ortho-deuterium,
– blue: light water,
– light blue: beryllium,
– green: aluminum.

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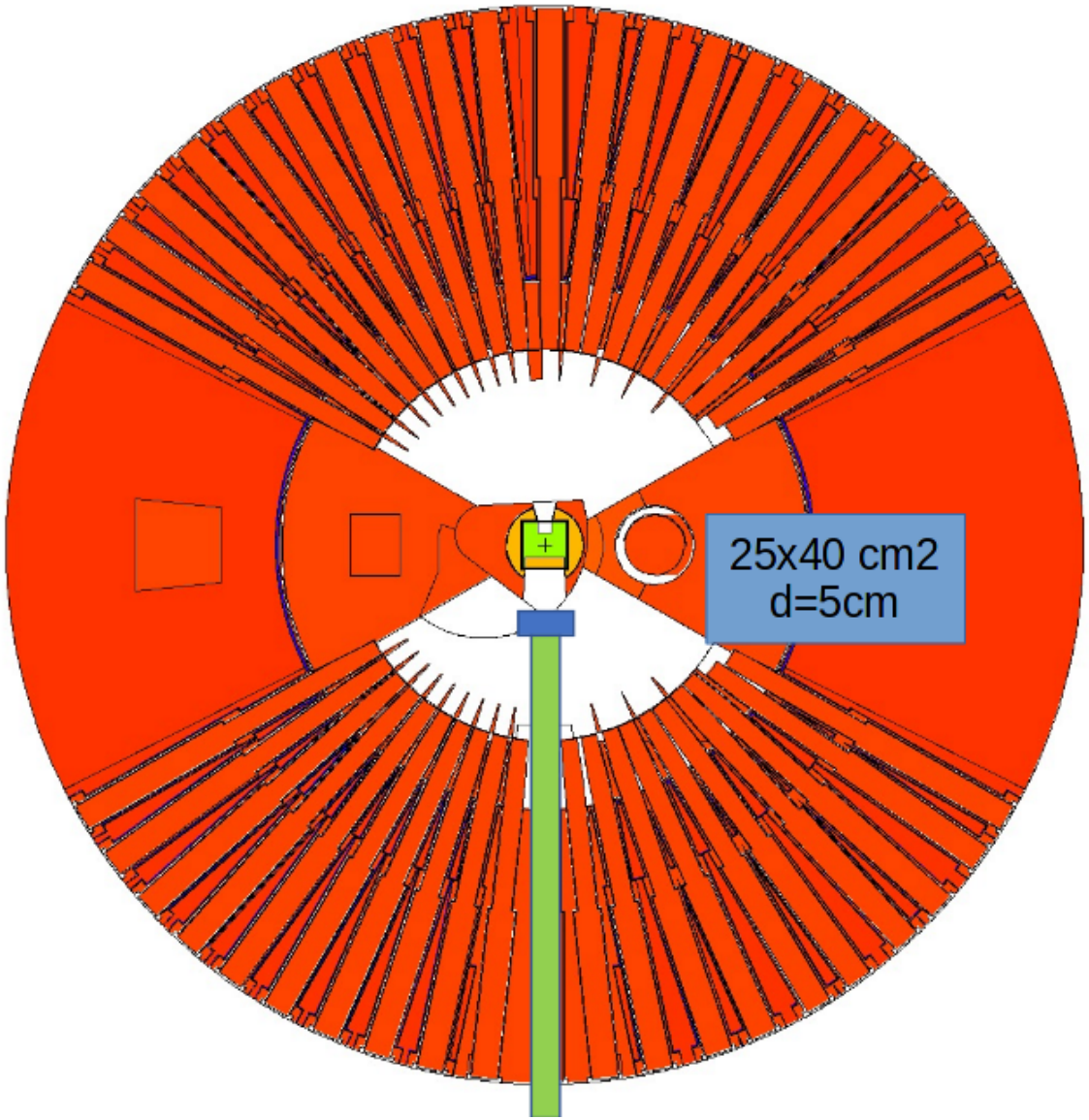
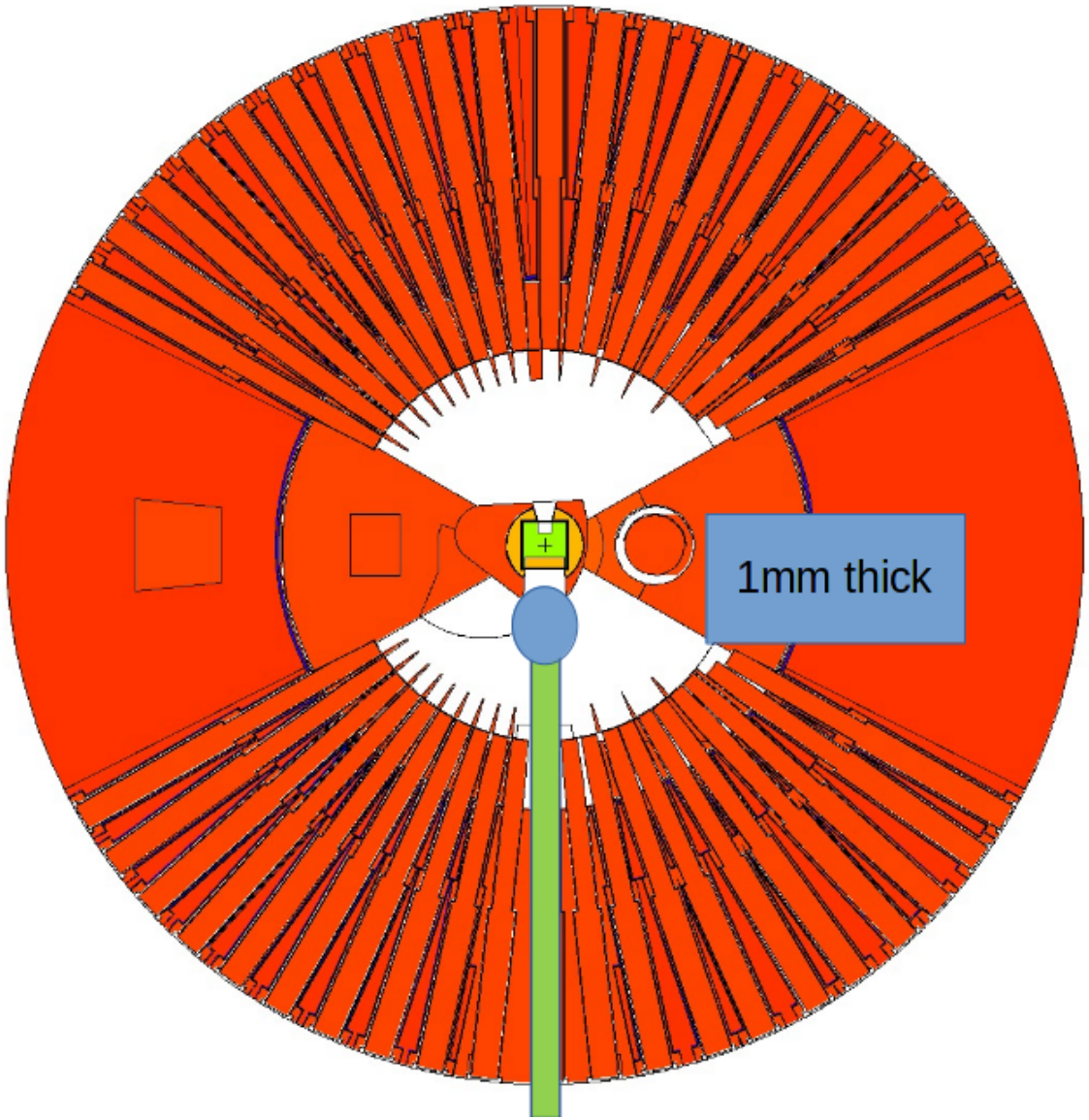
- sD_2 in/close to cold moderator / twister / MCB unrealistic
- heat load at PSI, LANL, FRM II: 400, ..., 500W @5K

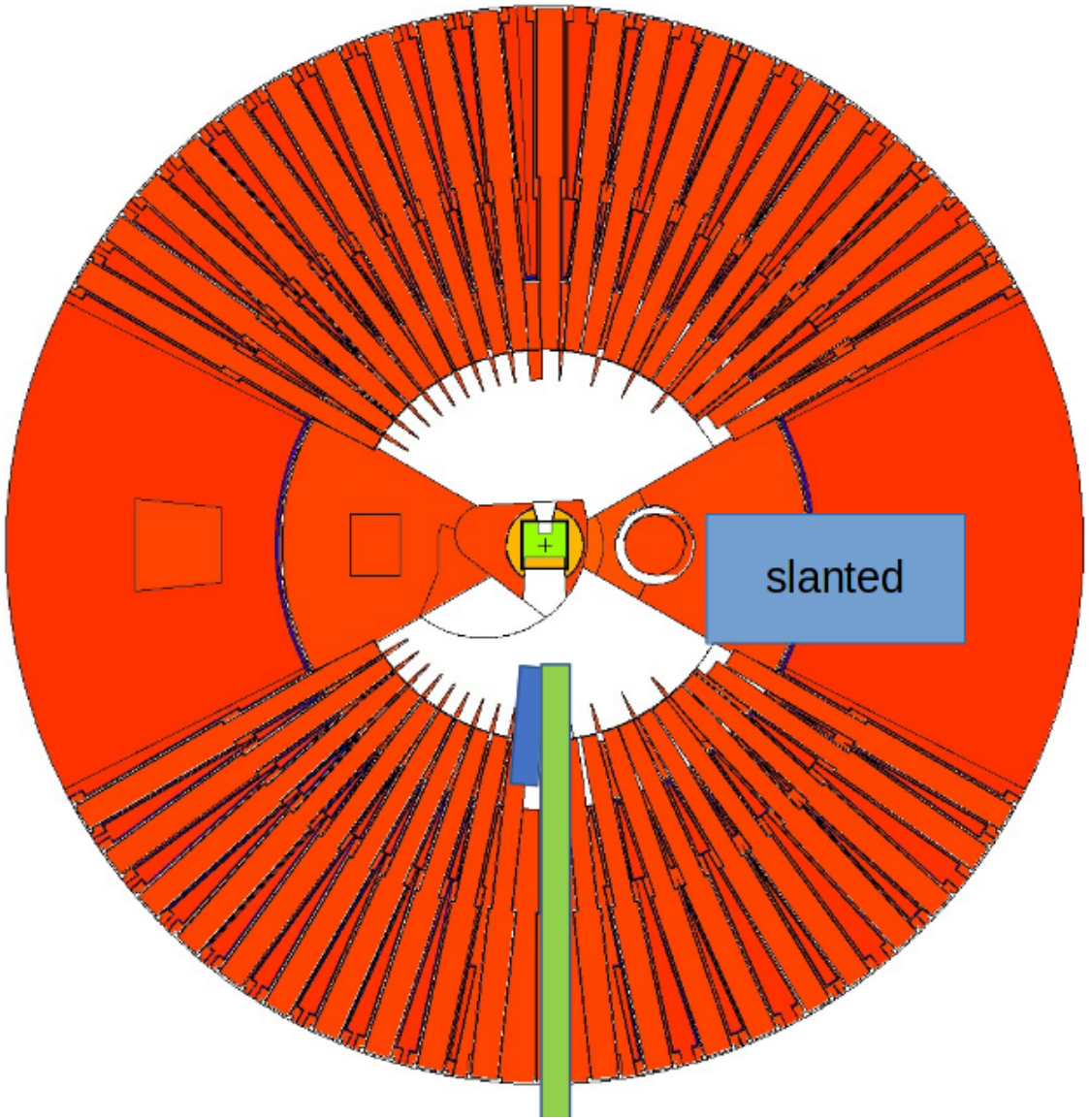
Options: Slab



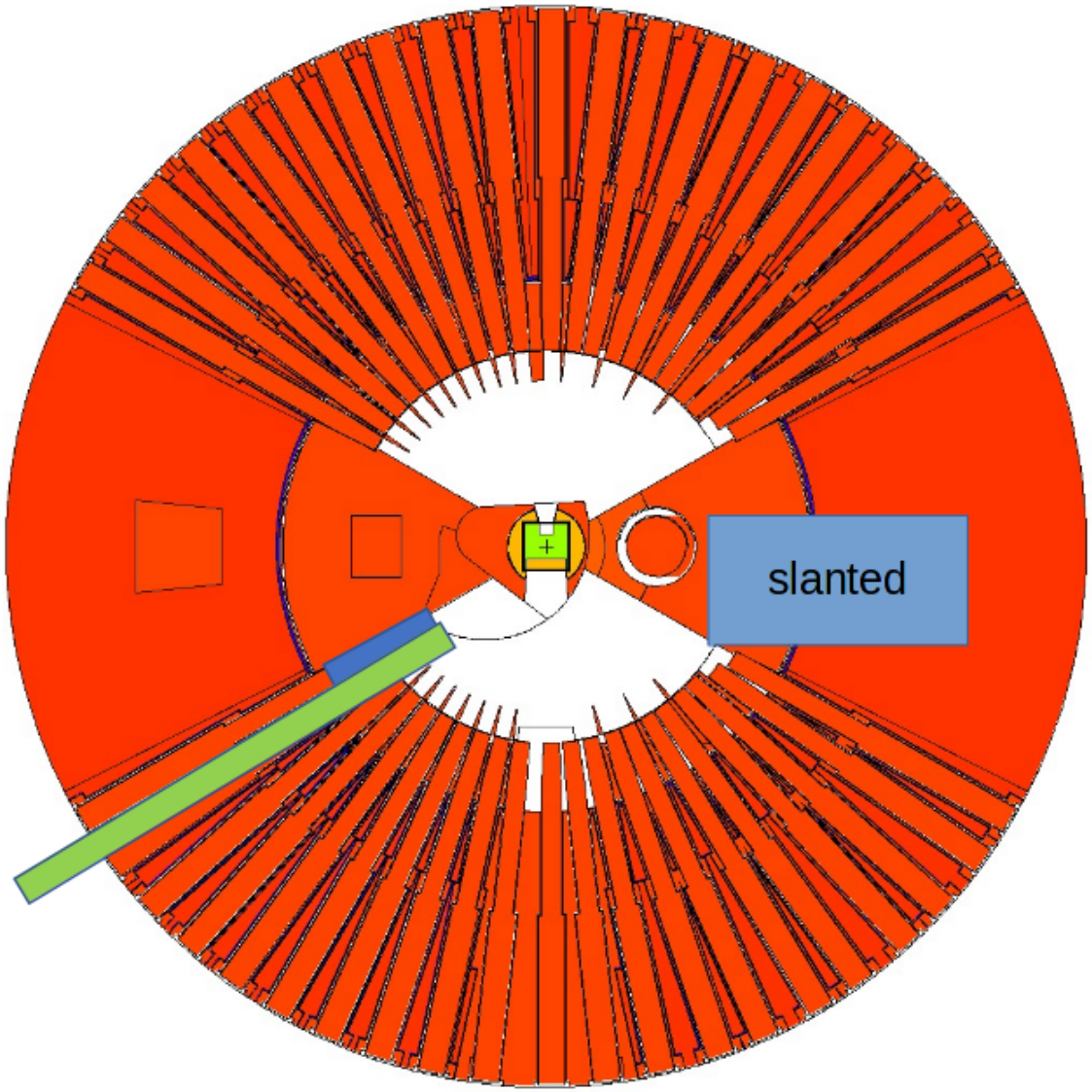
Options: Thin film



Options: Slanted



Options: Slanted



Location / Geometry of a sD_2 UCN source

- Between $N\bar{N}$ port / beamport and cold moderator
- Large surface area
- Position: tradeoff between flux and heat load
- Shape: Slab type (like LANL/PSI/FRM) or “thin film” sphere
- Possibly slanted slab, but extraction under angle
- Needs engineering study / flux calculations
- Possible heat shield / shutter
- Structural beryllium vs aluminum?
- Cold beam outside: Likely rather ℓHe

Source Characteristics

- CW operation
- High Flux
- High UCN density in source + guide

Transport

- Large production surface necessary
- UCN extraction guide diameter can be smaller
- 250mm inner diameter or less possible
- D_2 Fermi-potential: 100 neV helps, 1 m rise outside
- high efficiency transport already demonstrated, e.g.
  - FRM II
  - PSI
  - LANL

Infrastructure / Radiation safety

Infrastructure:

- Helium cooling plant necessary
- Deuterium handling coldbox etc
- Plumbing horizontal, space constraints likely no issue (PSI: similar size D2 crystal, all support in 100mm tube)

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Radiation safety:

- 1 m rise outside bunker
- beamdum in the horizontal plane
- $^3He \rightarrow ^3H$ in cooling: Same as cold source

Necessary tools / data

- UCN MC exists and in good shape
- UCN production in sD_2: from cold flux
- Cold flux data necessary!
- Heat load data necessary!

Summary

- sD_2 UCN source possible in $N\bar{N}$ port / beamports
- closer to cold moderator: Heat load tradeoff
- Transport feasible
- Infrastructure horizontal/outside feasible
- Simulation tools OK
- Need cold neutron flux and heat load data!