

Studies on Directional Moderators for ESS

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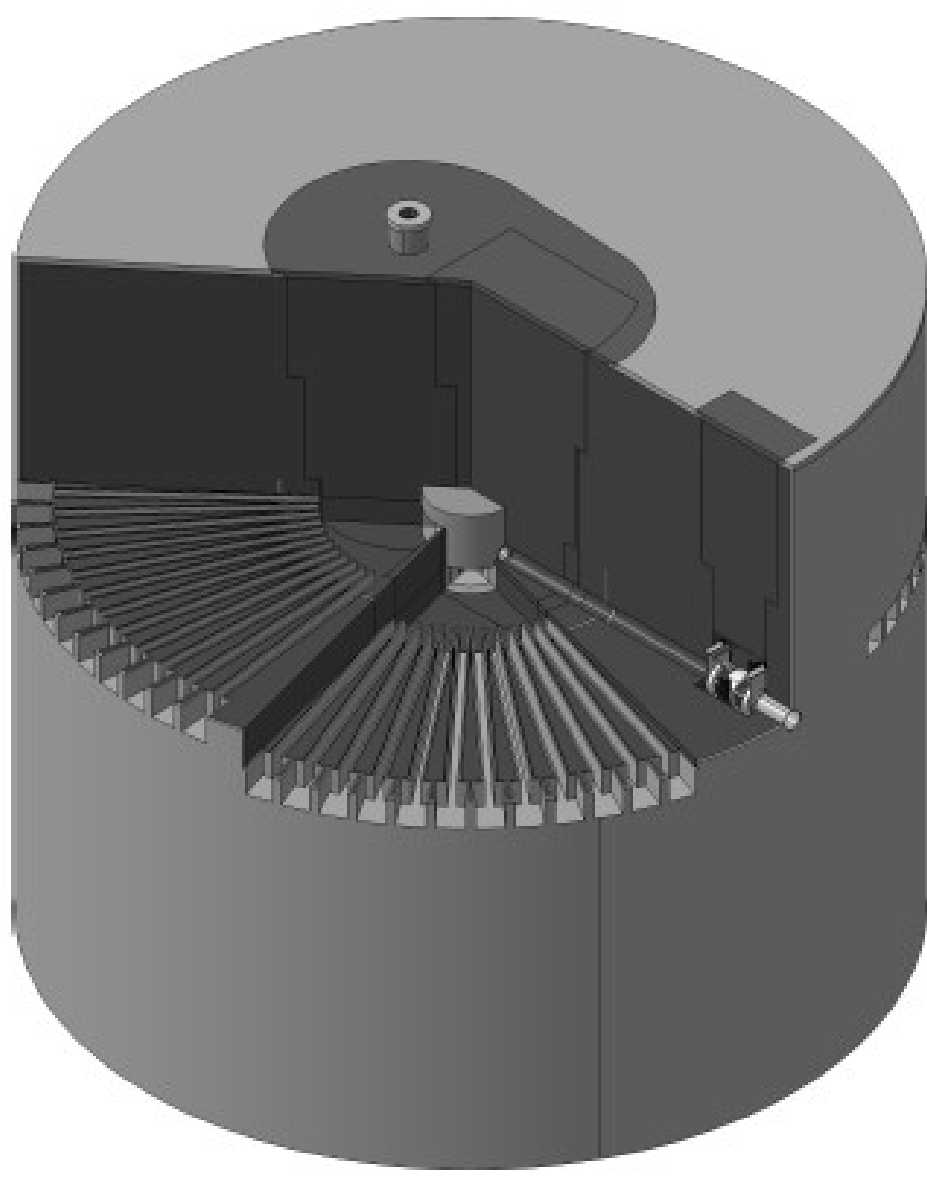
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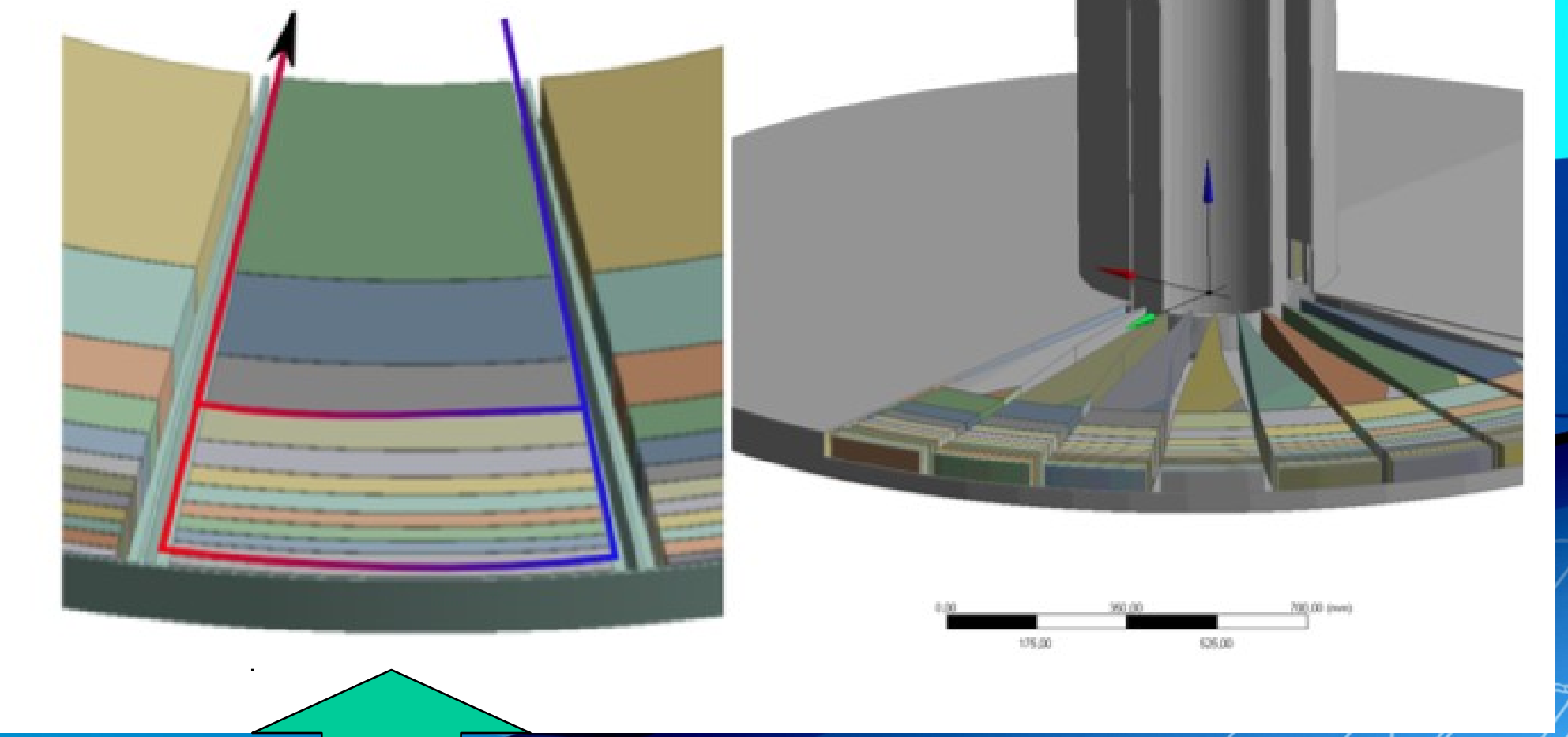


ESS target block

The ESS target

ESS will be a premier neutron source facility. Unprecedented neutron beam intensities are ensured by spallation reactions of a 5 MW, 2.5 GeV proton beam impinging on a tungsten target equipped with advanced moderators. The ongoing program of neutronic design of the target-moderator-reflector system concentrates on moderators for thermal and cold neutrons.

33 target sectors, W cooled by He flow.



2.5 GeV protons

Monte Carlo simulations for the design of the ESS target-moderator-reflector

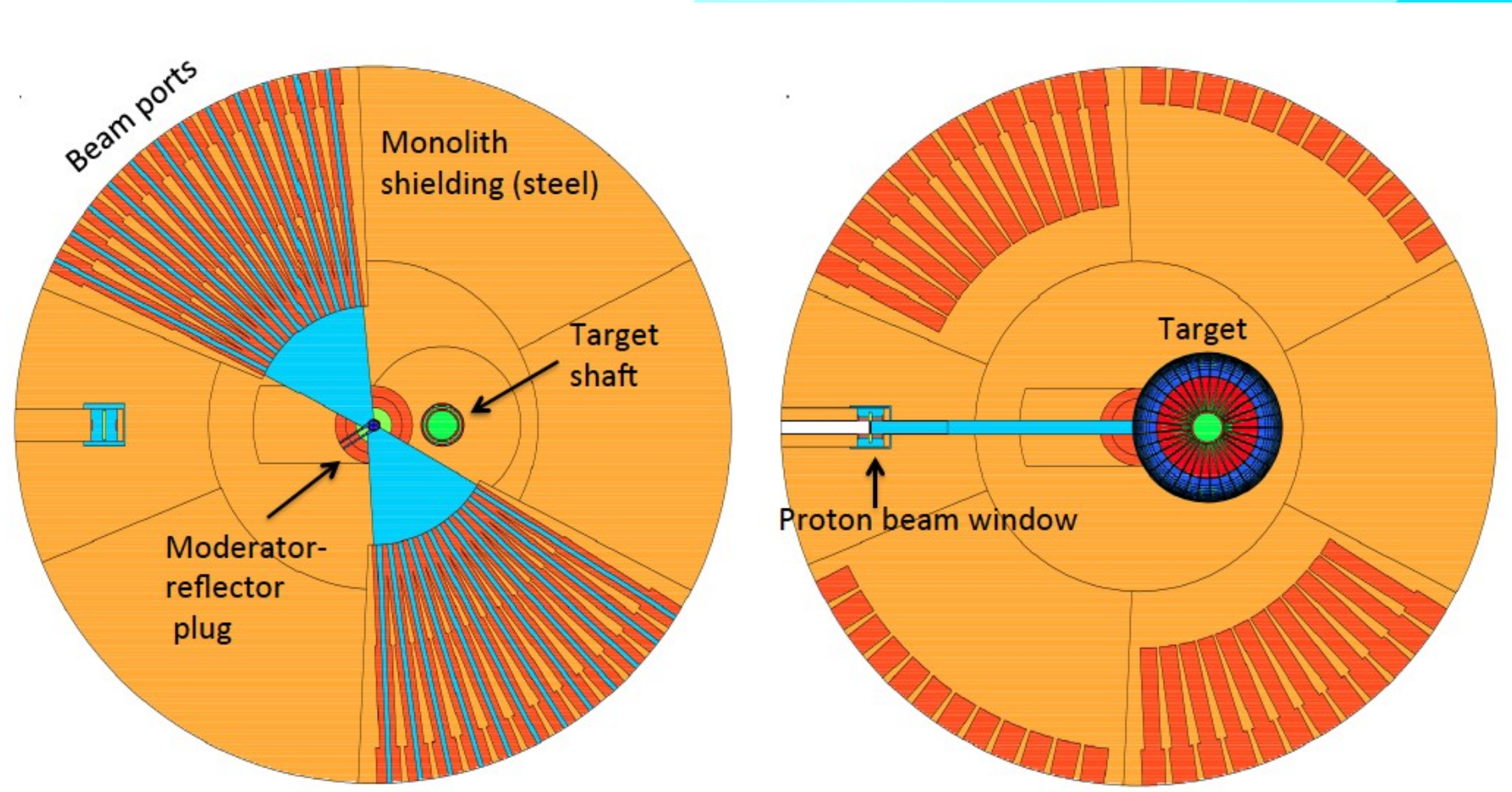
The neutronic design is performed using MCNPX and PHITS codes. Detailed modeling is necessary for reliable flux estimates. The baseline choice of moderator for the ESS startup (2019) is a coupled pure para-H₂ moderator which ensures an excellent neutronic performance.

However, for future upgrades during the lifetime of the facility, ESS is strongly interested in further increasing the brightness. One possibility is to use directional moderators.

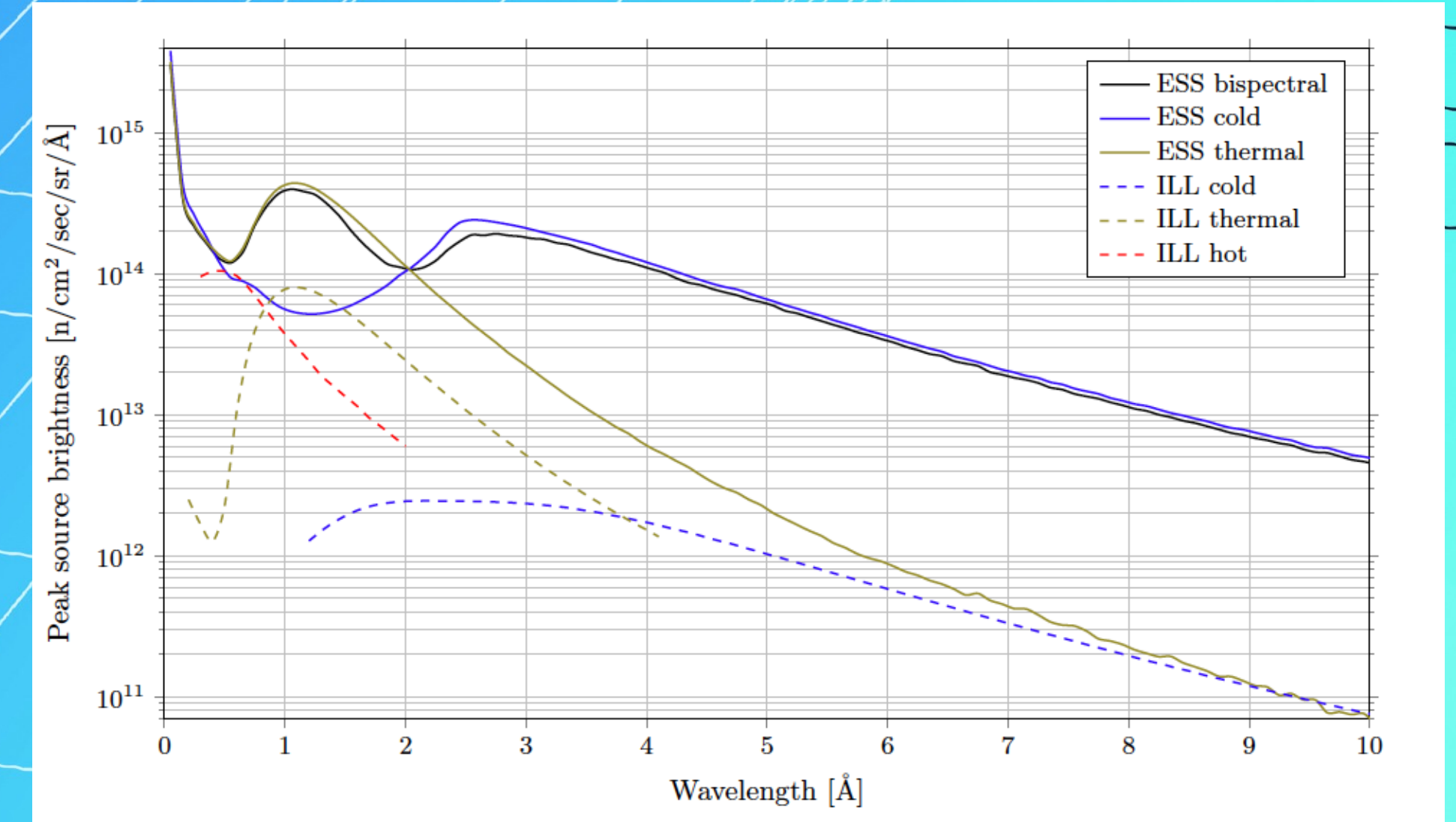
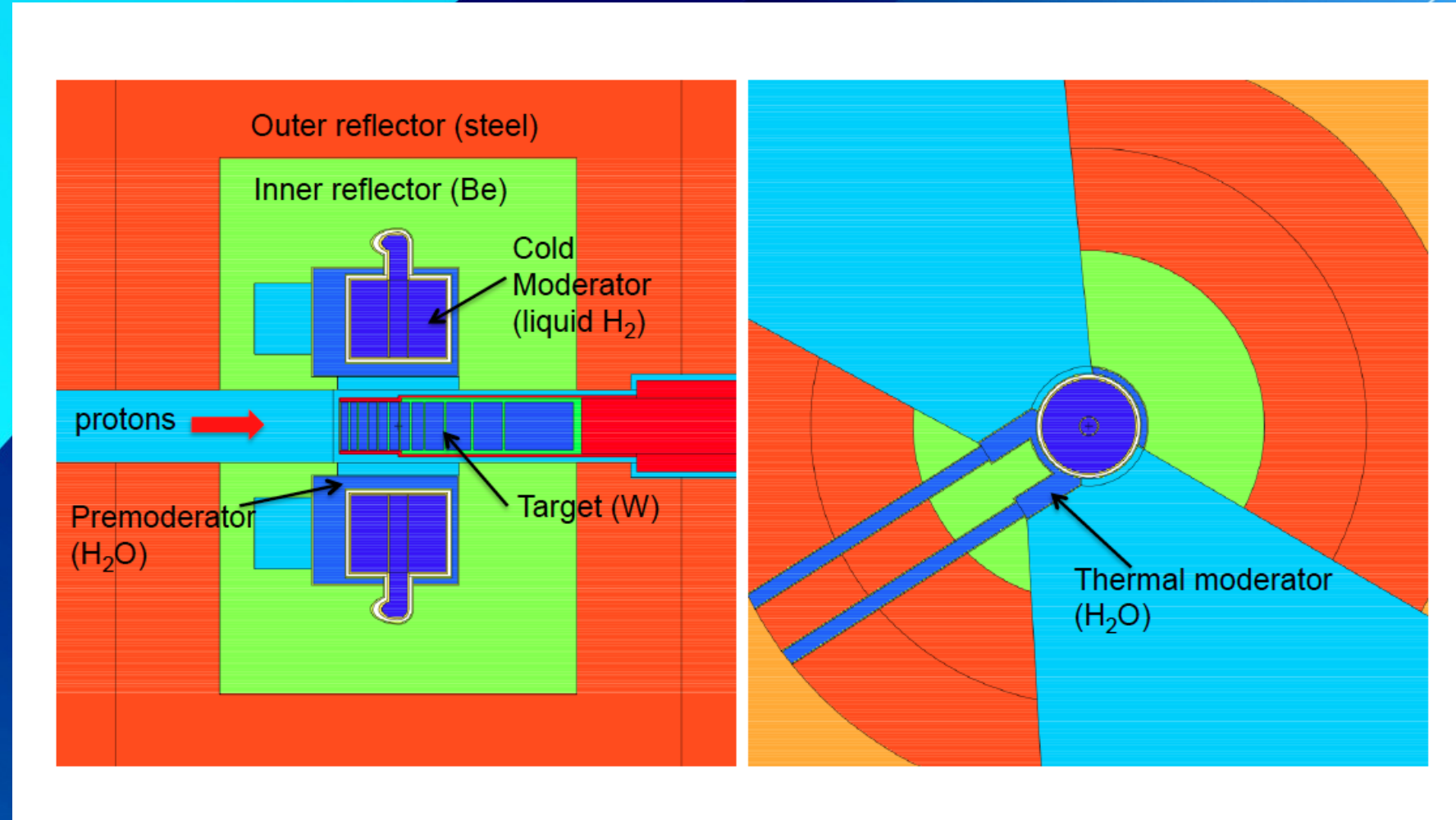
ESS monolith

Moderators and reflector

Neutronic performance



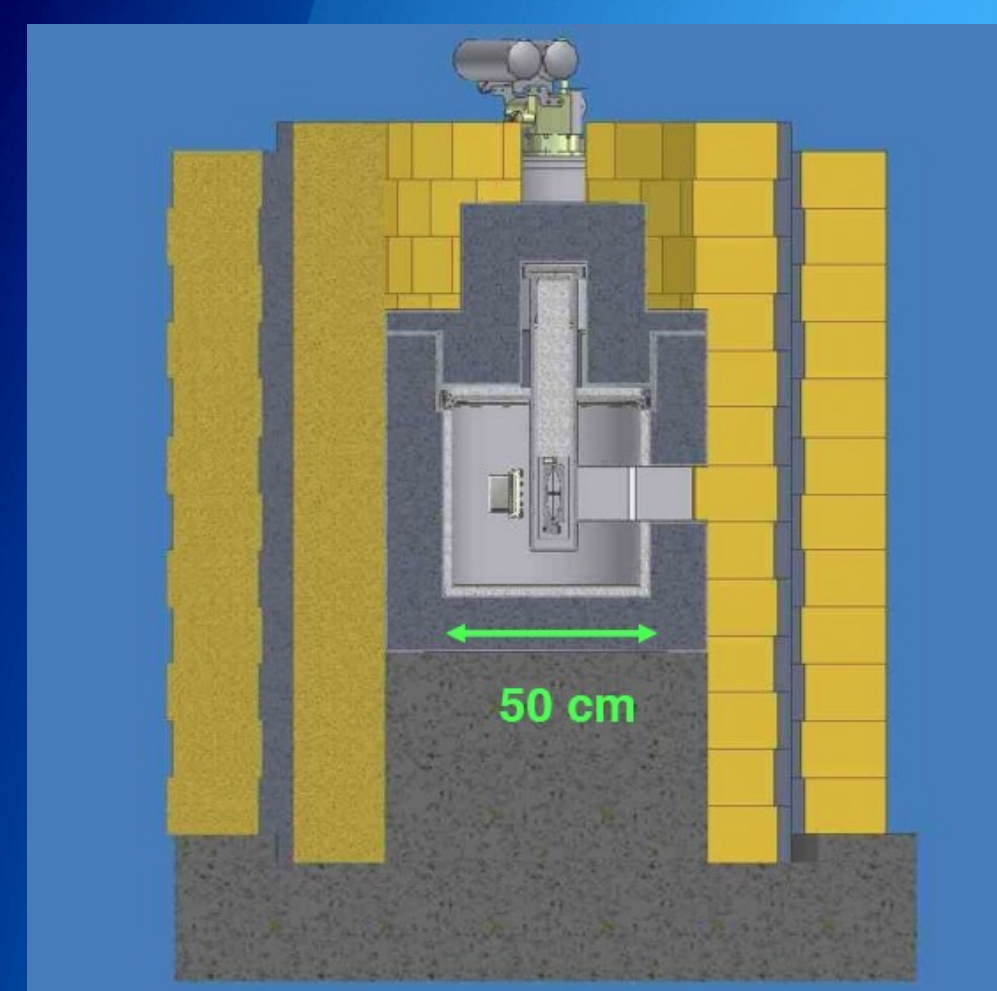
(MCNPX model)



Experiments on Directional Moderators



ESS target/moderator/reflector



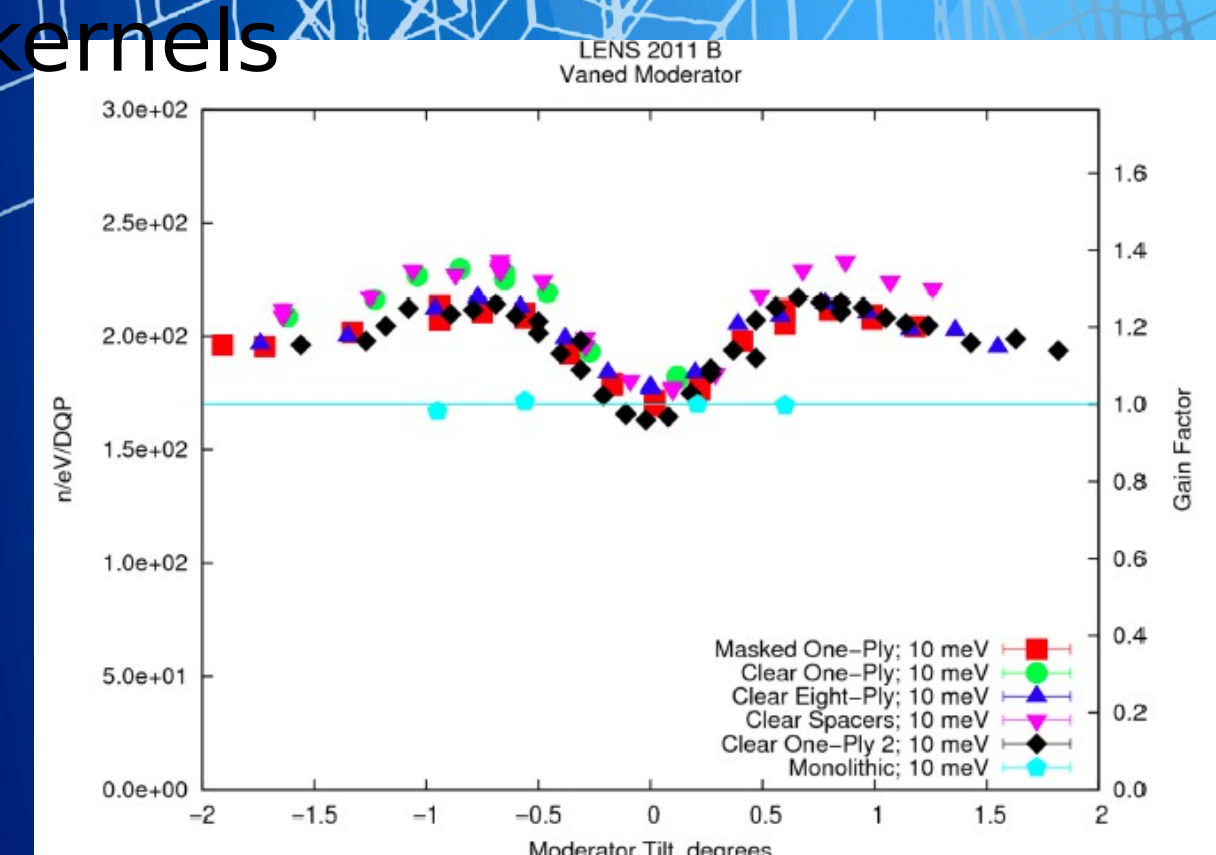
ESS participates to an experimental program to test directional moderators at the LENS facility in Indiana. At present we are studying the Convoluted Moderator.

Other concepts under study. New configurations and concepts will be tested.



Different types of moderating materials (polyethylene, water, H₂) with Si crystals (nearly transparent to neutrons)

- Studies of directional effects
- Full characterization of moderators (brightness and time response)
- Validation of scattering kernels



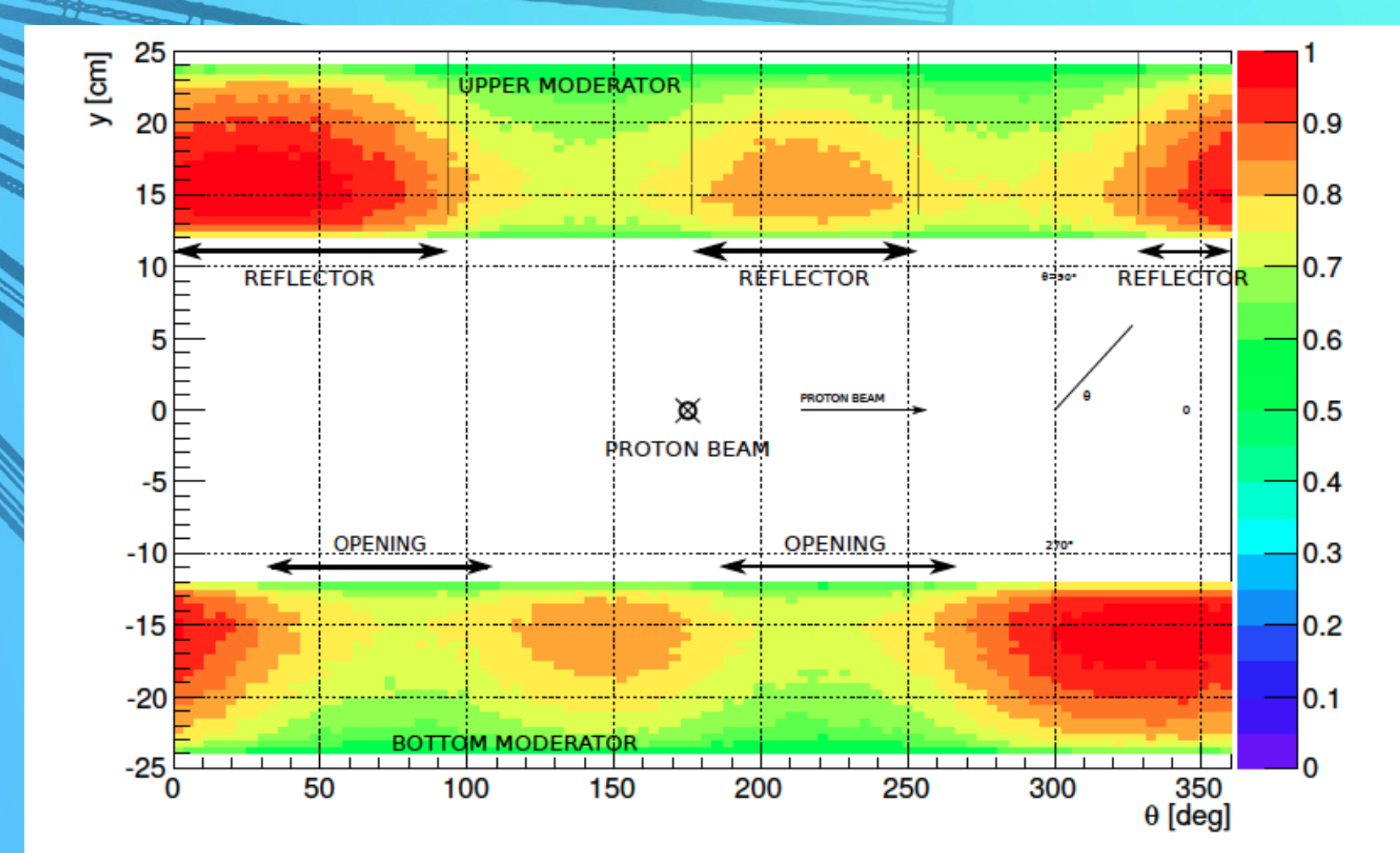
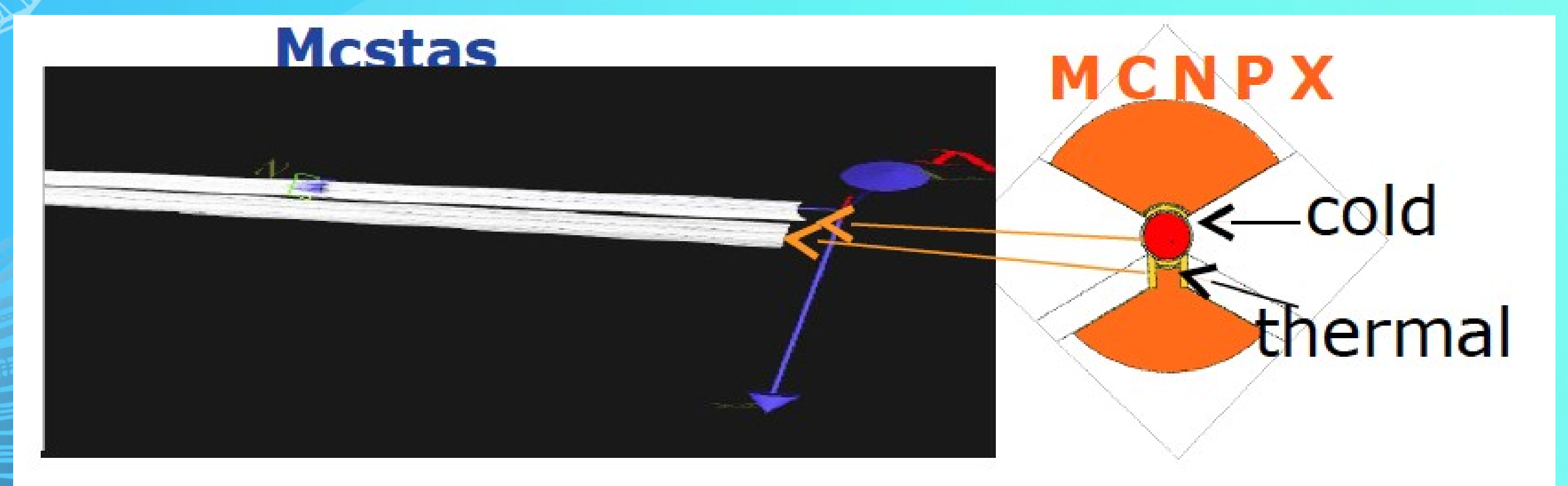
(E. Iverson, ICANS XX)

Simulations

Directional effects in neutron emission from moderators involves physics which is not present in conventional Monte Carlo codes, such as Bragg scattering and neutron refraction.

A computational effort has been undertaken to couple MCNPX to McStas ray tracing code to include coherent scattering physics in the simulations.

The first application has been on simulations of neutron guides.



SSW/SSR interface: Map of cold neutrons emitted from the surface of the moderator at different angles and longitudinal positions. This map is used as input for a McStas simulation.

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