eurizon
European network
for developing new horizons for RIs

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Conceptual design of high brilliance cold source model

The conceptual design of low-dimensional cold neutron source is presented. The low-dimensional cold neutron source will consist of two moderators of sizes (3 x 3 x 20) cm^3 filled with liquid para-hydrogen and arranged in the reactor channel as shown in the Fig.1. Exact size of each moderator can be adapted for the needs of neutron instruments. For instance, one of them can be kept as 3x3 cm^2 serving small-angle scattering diffractometer (SANS), while another one can be modified to 1x10 cm^2, which is better suited for reflectometers.

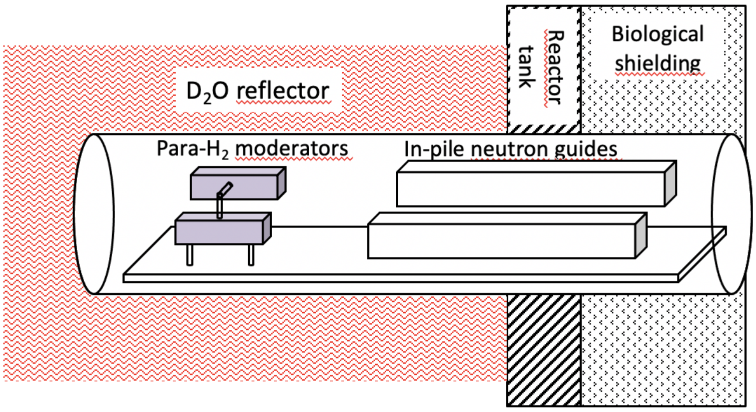

Fig. 1. Two moderators filled with liquid parahydrogen arranged in the reactor channel.

Beside significant, 2.5-3 times, increase in cold neutron brilliance, such arrangement allows for the bi-spectral extraction, when the neutron guide is illuminated both by cold neutrons from the low-dimensional moderator and thermal neutrons emitted from the reactor channel and propagating next to the body of cold moderator.

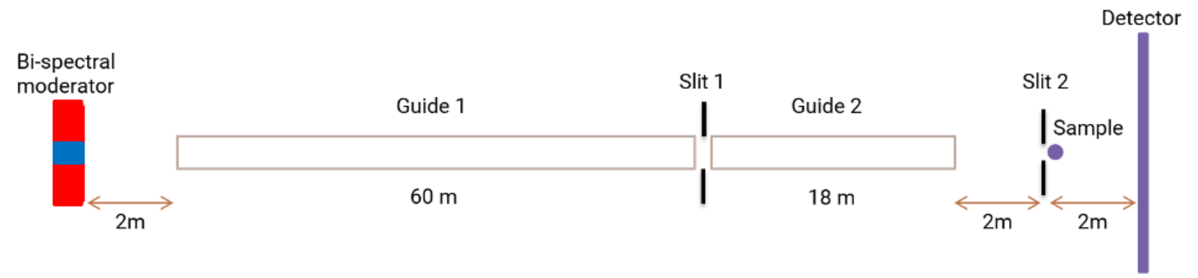

Fig. 2. “Direct” bi-spectral extraction system feeding SANS instrument. Shown in red is thermal moderator, shown in blue is cold moderator. For neutron guide description see text.

Such illumination allows for the enrichment of cold neutron spectra in its higher energy area, that allows for extension of dynamic Q-range available for instruments.

Fig. 2 shows a sketch of a SANS instrument served by a bi-spectral moderator. Note that no additional supermirrors are required.

VITESS Monte-Carlo simulations have been performed to test whether neutron beam at the exit of the guide is sufficiently homogeneous. The cold moderator of 3x3 cm^2 cross-

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section is surrounded by a large thermal moderator (Fig. 2). Guide 1 is the straight neutron guide of 4x4 cm^2 cross-section and length of 20 m. Guide 2 is the curved neutron guide of 20 m length that eliminates the direct line of sight. It has 4 channels 1 cm wide each.

Fig.3 shows results of simulations for neutrons emitted only from the cold moderator, while Fig. 4 exhibit similar results for neutrons emitted only from the thermal moderator. One can conclude that the beam properties are good enough for neutron experiments and our solution of the "direct" bi-spectral extraction is viable.

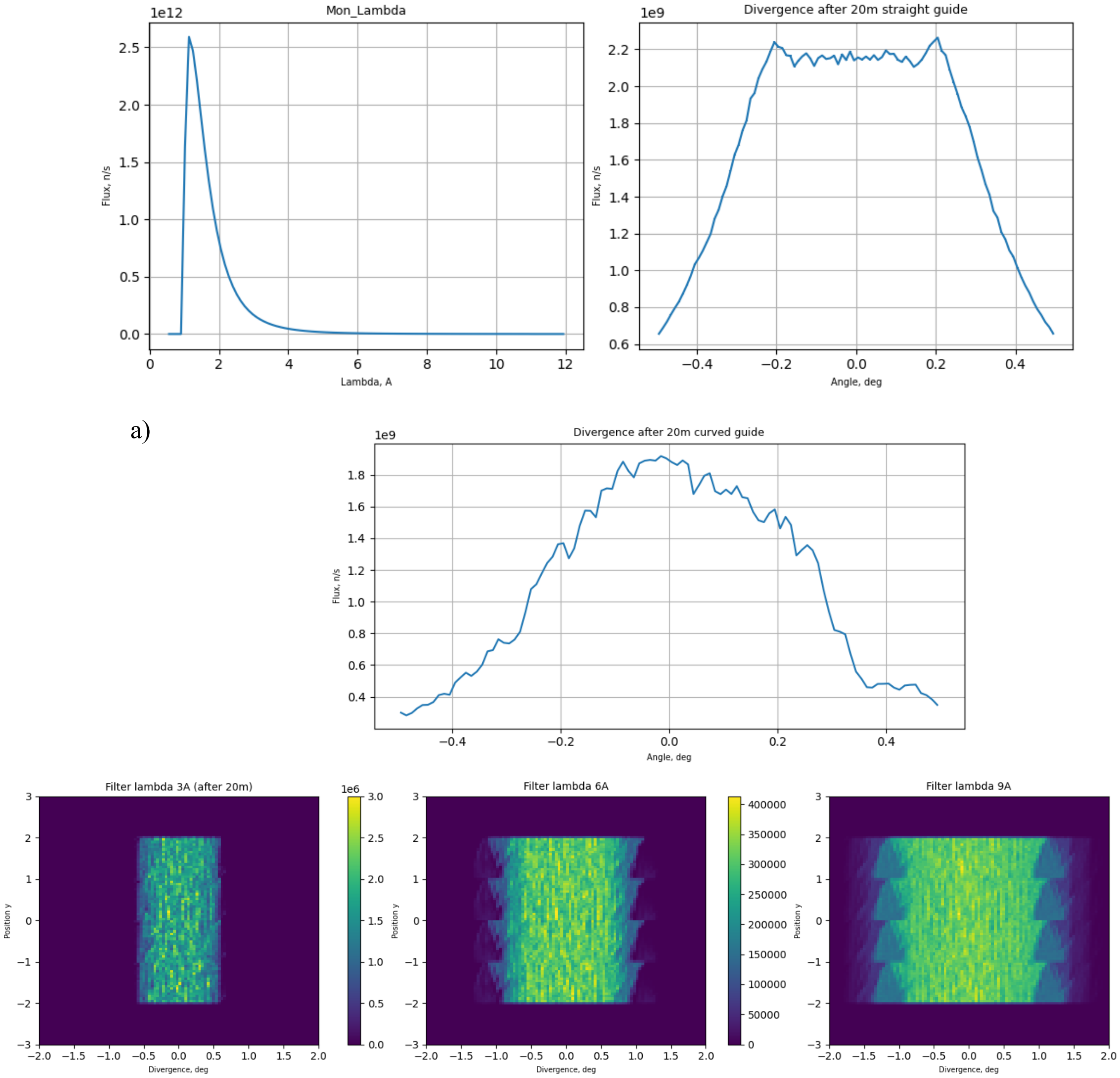

Fig.3. Simulation results for neutrons produced in thermal moderator. From left to right: incident beam spectrum; divergence profile after the straight part. Middle row: divergence profile after the curved part. Lowest row: phase space diagrams after the curved part for 3Å, 6Å and 9Å neutrons.

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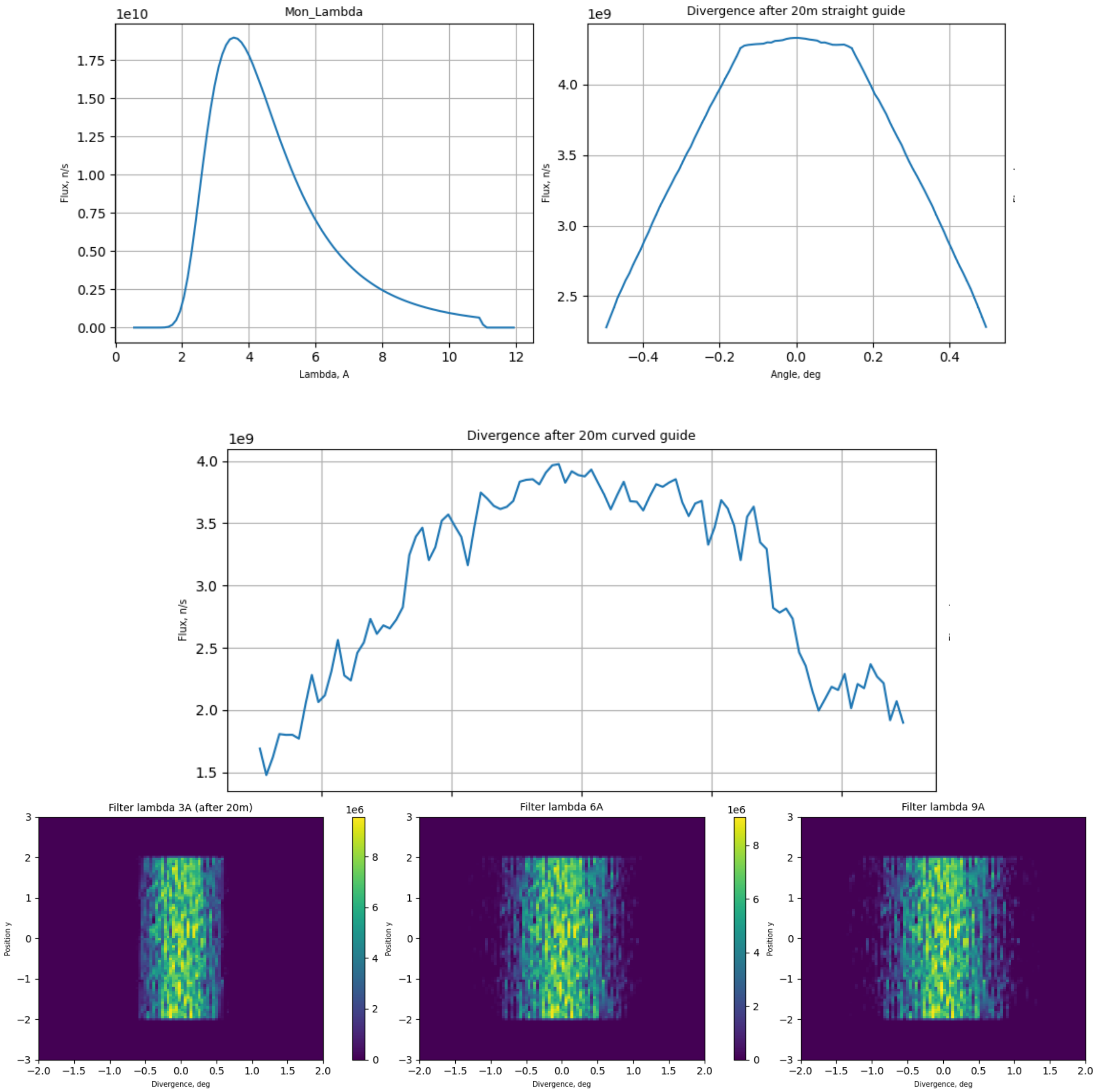

Fig.4. Simulation results for the neutron produced in the cold moderator. From left to right: incident beam spectrum; divergence profile after the straight part. Middle row: divergence profile after the curved part. Lowest row: phase space diagrams after the curved part for 3Å, 6Å and 9Å neutrons.

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