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for developing new horizons for RIs

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1		Alexander Ioffe (et al.)	

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Final design of bi-spectral extraction system

The design of bi-spectral extraction system with no additional optics has been further investigated and refined. To test the viability of the proposed design (described in the 1st technical report) we have performed extensive Monte-Carlo calculations using VITESS program package. The sketch of the instrument model is shown in Fig.3.2.1. Special attention has been made to virtual scattering experiments.

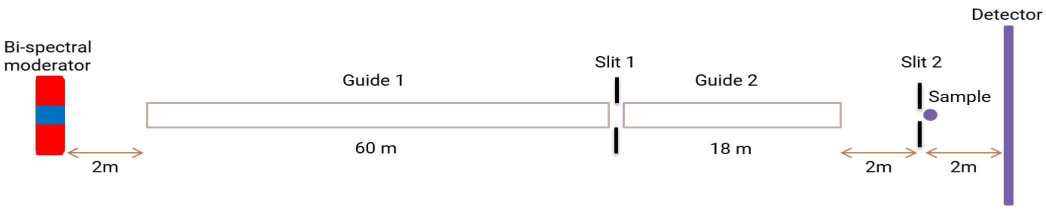

Fig.3.2.1. SANS instrument used in virtual experiments.

We have optimized the curved neutron guide to evenly mix thermal and cold neutrons produced by spatially separated moderators. Fig.3.2.2. shows beam properties of unoptimized combination of the straight and curved guide when only thermal moderator is taken into account. Since this moderator has "hole" in the center (where cold neutron moderator is placed) there is noticeable under-illumination of the guide entrance, which in turn leads to erratic, "gothic-like" divergence profile at the guide exit. To mitigate this problem, we introduced four channels in the curved neutron guide. Fig.3.2.3 shows beam properties of optimized combination of the straight and multi-channel curved guide. Note how smooth the divergence profile at the guide exit is. Fig.32.4 depicts phase space volume of the neutron beam at the exit of the optimized guide and its structure.

Similar simulations have been performed for the beam produced exclusively by the cold moderator. The divergence profile of the beam after four channel curved guide appeared smooth too. Since both thermal and cold neutron beam divergences do not have visible peaks and dips or asymmetry, one can say that both beams are well intermixed, proving that our proposed design of bi-spectral extraction is viable.

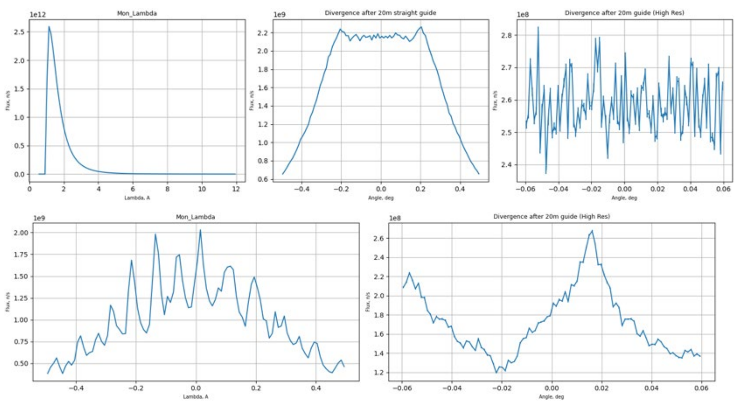

Fig.3.2.2. Beam properties at the various points of the unoptimized neutron guide. From left to right: neutron spectrum at the guide exit; beam divergence after 20 m of straight guide; high-

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resolution close-up of the beam divergence after 20 m neutron guide; beam divergence after the curved guide; high-resolution close-up of the beam divergence after the curved guide.

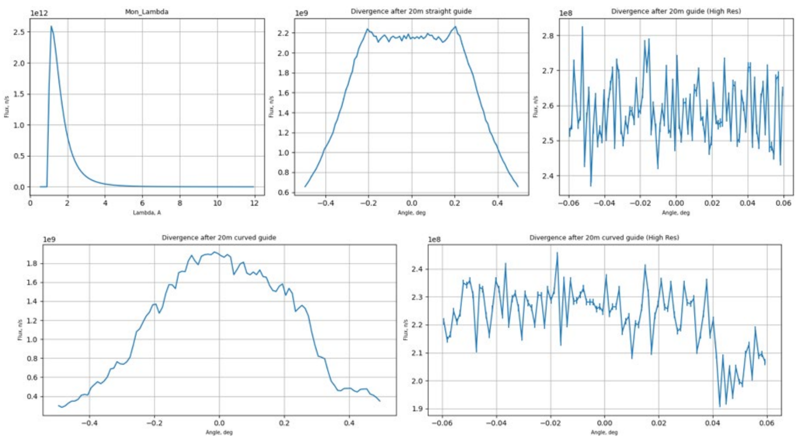

Fig.3.2.3. Beam properties at the various points of the optimized neutron guide. From left to right: neutron spectrum at the guide exit; beam divergence after 20 m of straight guide; high-resolution close-up of the beam divergence after 20 m neutron guide; beam divergence after the curved guide; high-resolution close-up of the beam divergence after the curved guide.

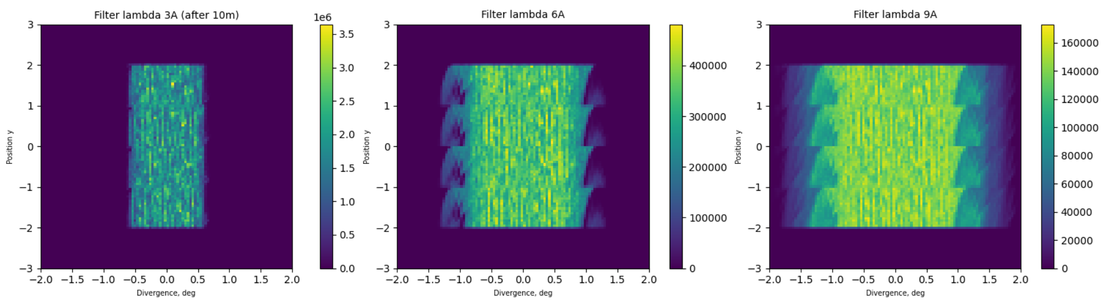

Fig.3.2.4. Phase space neutron beam representation at the exit of the optimized guide.

Using the optimized neutron guide we have performed several scattering experiments with different neutron wavelengths, collimation bases and scattering particle sizes. Fig. 3.2.5. demonstrates results of virtual experiments regarding two moderators separately. Note that for given momentum transfer either one or another moderator provides larger flux, meaning that combining both moderator can be beneficial over wide range of Q.

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Indeed, we demonstrated not only practical viability of the proposed bi-spectral extraction with no additional optics, but also showed its usefulness for exemplar SANS experiments.

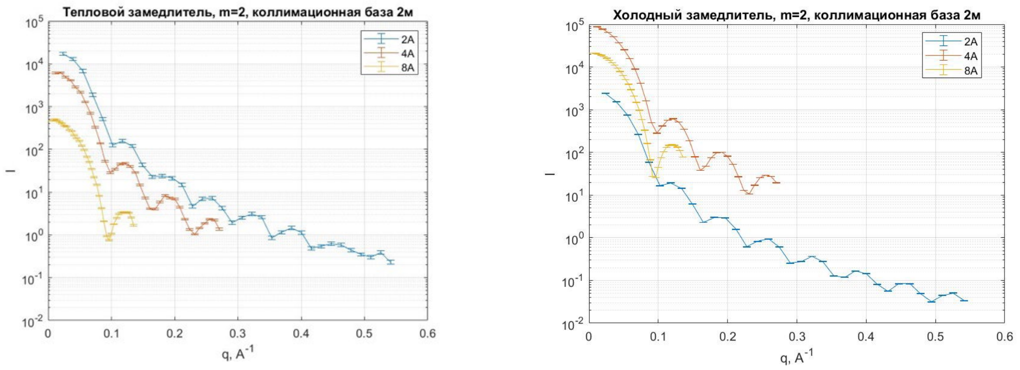

Fig. 3.2.5. Scattering curves obtained in virtual experiment using only thermal (left) or only cold (right) moderators.

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