Monte Carlo simulations for focusing elliptical guides

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Overview

- Motivation and goals
- Guide parameters at PGAA
- Test setup at PGAA
- First results
- Next steps and conclusions
- References

Motivation and goals

- To significantly increase the neutron flux
- Well defined beam characteristics
- Gain factor in intensity of over 20 compared to straight guides
- To improve the focusing of the neutron beam at the existing beamline PGAA (FRM II) by prolongation of the existing elliptic guide

Guide parameters at PGAA

Focusing guide at PGAA: Composed of 2 elliptic sections (coating *m* = 3):

- Section A: L = 5.80 m
- Section B: L = 1.09 m
- Performance:

Position	Neutron flux	Beam profile (HxW)	
End of the guide:	$6.0 \cdot 10^{9}$ n/cm^{2}s	28 x 62 mm^2	measured
Messposition 1 (30-35 cm from the end of the guide):	$7.3 \cdot 10^{9}$ n/cm^{2}s	14 x 38 mm^2	expected
Messposition 2 (9-10 cm from the end of the guide):	$2.0 \cdot 10^{10}$ n/cm^{2}s	4 x 11 mm^2	expected

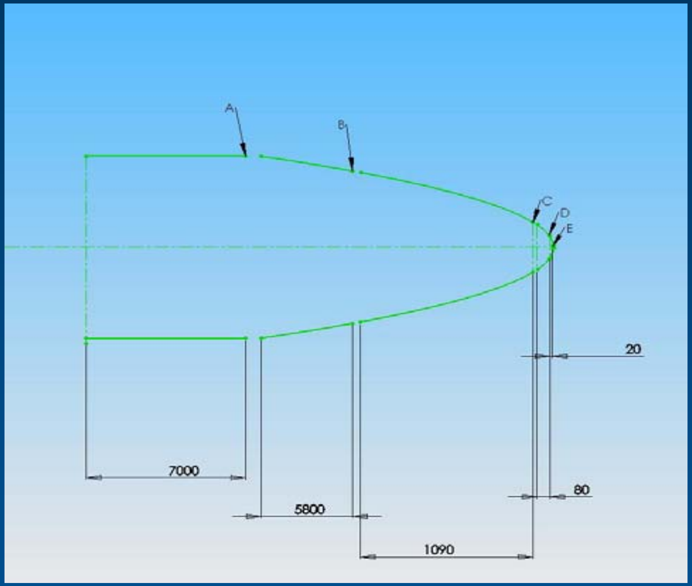

Table 1: Performance of existing elliptic guide at PGAA

Fig. 1: Neutron guide at PGAA

Test setup at PGAA

The initial simulations were made with a length for the additional guide of *L* = 75 mm and supermirror coatings *m* = 4, 5 and 6. In a next step, *L* was varied. The maximum gain is obtained for *L* = 80 mm.

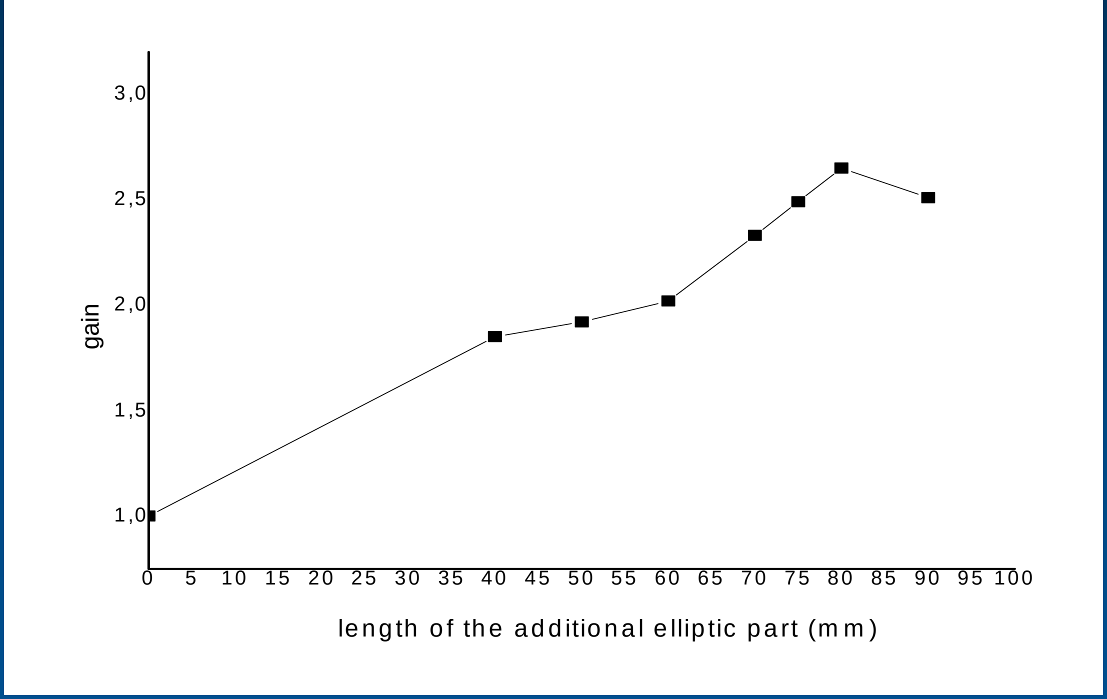

Fig.2 Gain factor over the length of the additional guide

First Results

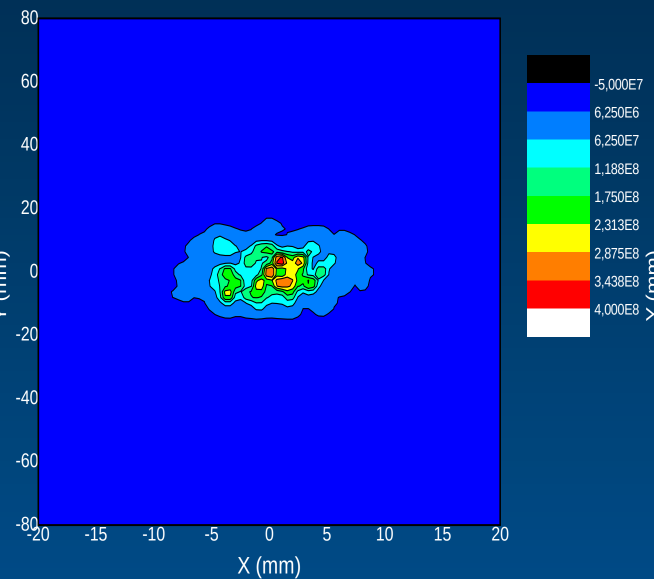

Fig.3 Neutron flux in focal point without the prolongation guide

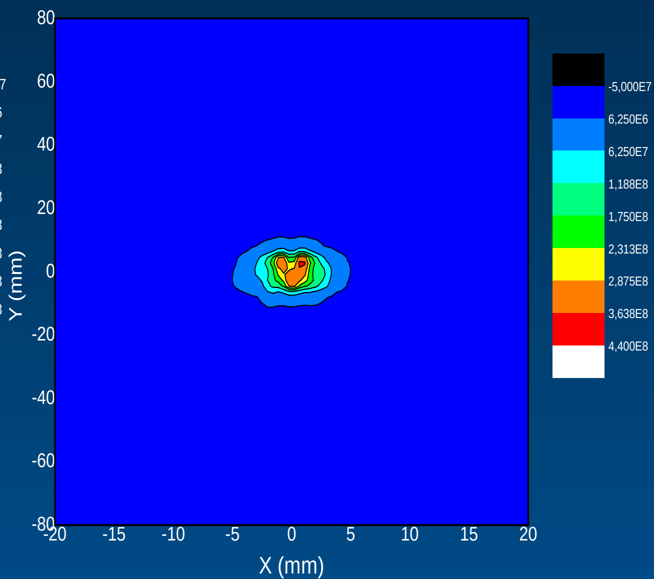

Fig.4 Neutron flux in the focal point for m=5 coating of the prolongation guide

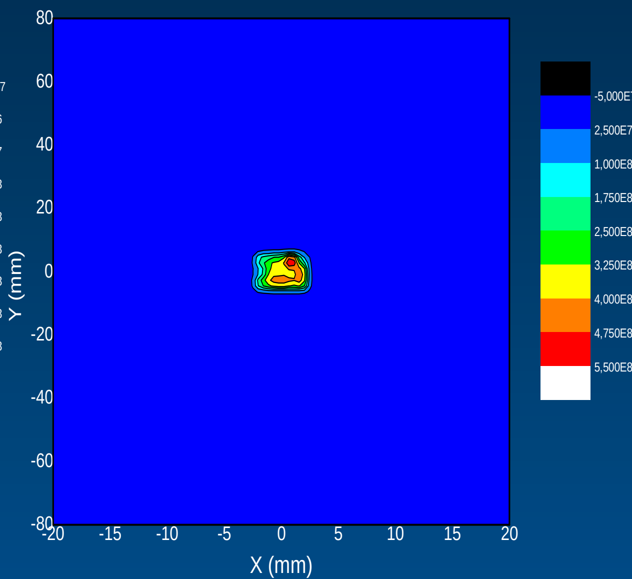

Fig.5 Neutron flux in the focal point for m=6 coating of the prolongation guide

Next steps and conclusions

• With the *m* value and the length of the guide fixed, a beam profile of 3×8 mm^2 is obtained after adding the third elliptic part. To reduce the beam further, apertures shall be introduced.

• We expect to observe a dramatic decrease in the size of the beam in the focal point after introducing an aperture: $30\ \mu m < D < 0.2$ mm. The results open wide possibilities in the field of neutron imaging and radiography as well as in probing very small samples.

• Next steps will be to build the third elliptic guide section and to introduce the aperture in order to compare the simulations with the test results obtained.

References

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4. C. Schanzer, P. Böni, U. Filges, T. Hils, *Advanced geometries for ballistic neutron guides*, Nucl. Instr. Meth. A **529** (2004) 63–68.