Neutron optics calculations for the NERA upgrade project

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Contents

1 Conclusion from previous reports

From previous reports we conclude several things:

1. Configuration of straight guide + nose are the same in terms of flux at the sample position to full elliptic guide.

2. Both nose options (elliptic and parabolic) provide good performance in the desired energy range. The guide width and height should be chosen to be around 18-22 cm, while the nose length is approx. 16-20 m for different configurations.

3. The curved guide option for eliminating direct line of sight cuts too much flux of desired wavelength range of 0.5-1 AA.

2 M value scans

Calculation on desired m value for straight guide and nose have been made. Fig 1 shows that optimal m value should be chosen 2.5-3.5. Difference between 2.5 and 3.5 is around 10% of total flux. Fig 7 shows that m value of nose should increase from 3 to 6. It will depend on the chosen m for the straight guide.
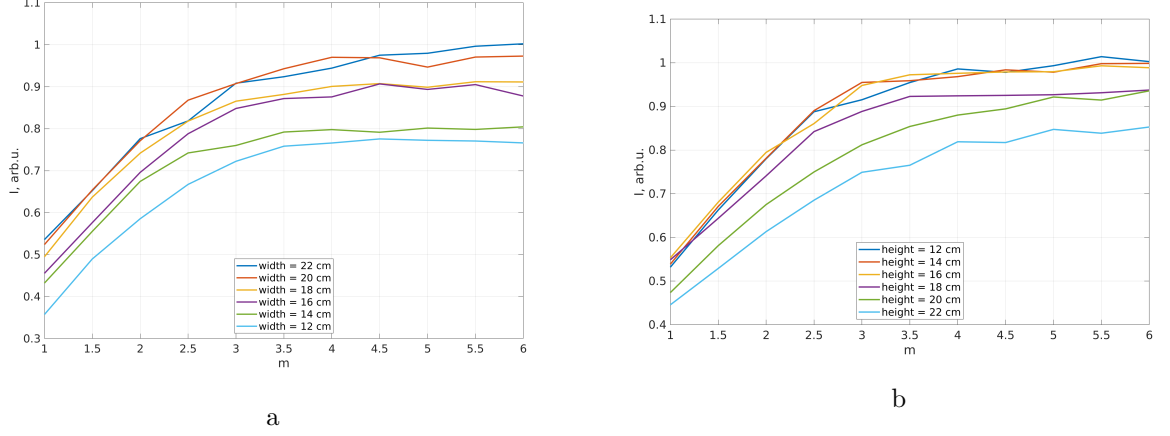

Figure 1: (a) Flux at the sample position depending on the straight guide m value of side mirrors. (b) Flux at the sample position depending on the straight guide m value of top/bottom mirrors.
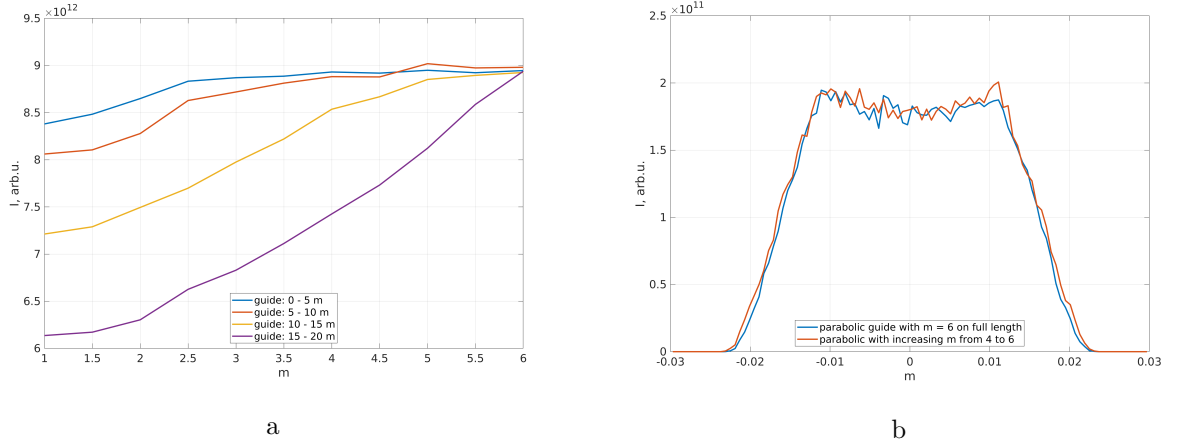

Figure 2: (a) Distribution of flux at sample position depending on parabolic guide m value. (b) Distribution of flux at sample position depending on horizontal coordinate for two configuration: when m=6 is the same whole time or changing from 4 to 6.

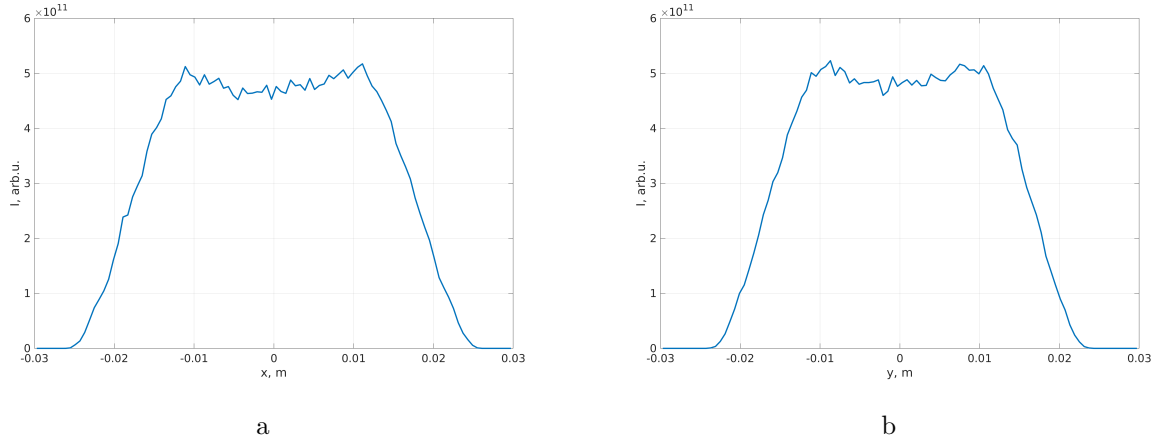# 3 Flux distribution at the sample position

a

b

Figure 3: (a) Distribution of flux at sample position depending on horizontal coordinate. (b) Distribution of flux at sample position depending on vertical coordinate.
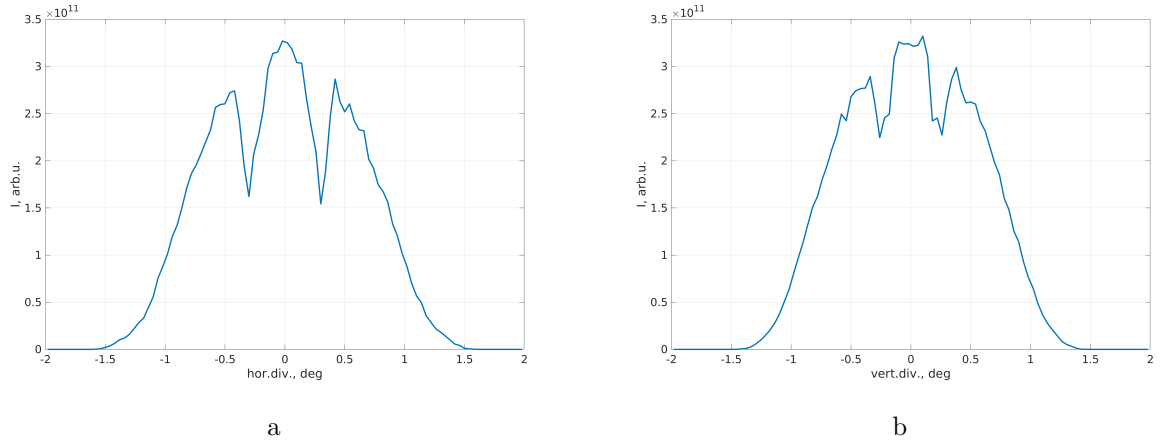

a

b

Figure 4: (a) Horizontal divergence at sample position. (b) Vertical divergence at sample position.

4 Flux distribution at the nose exit

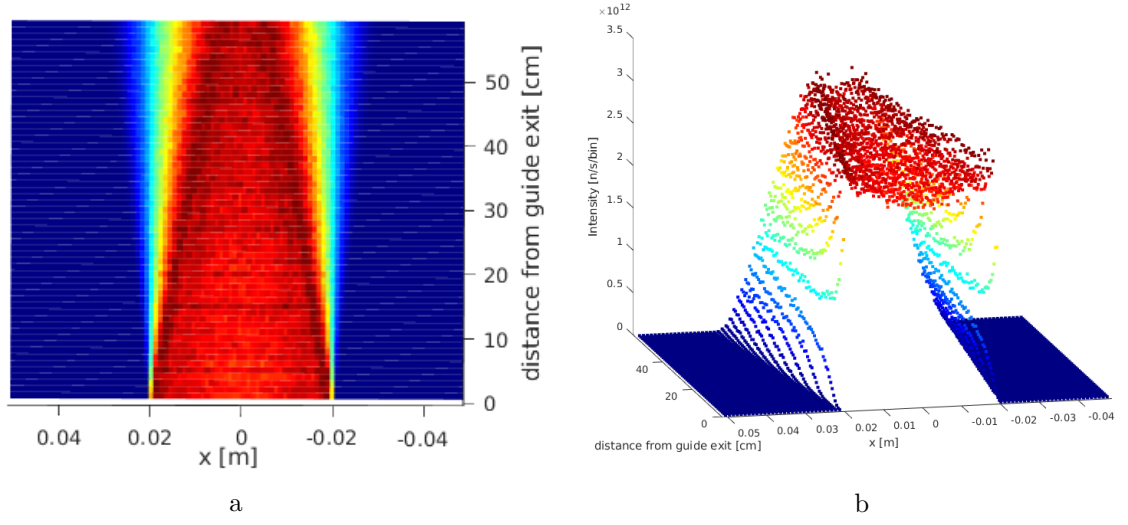a   b

Figure 5: Flux distribution at the parabolic guide exit in the direction of sample position in horizontal plane.
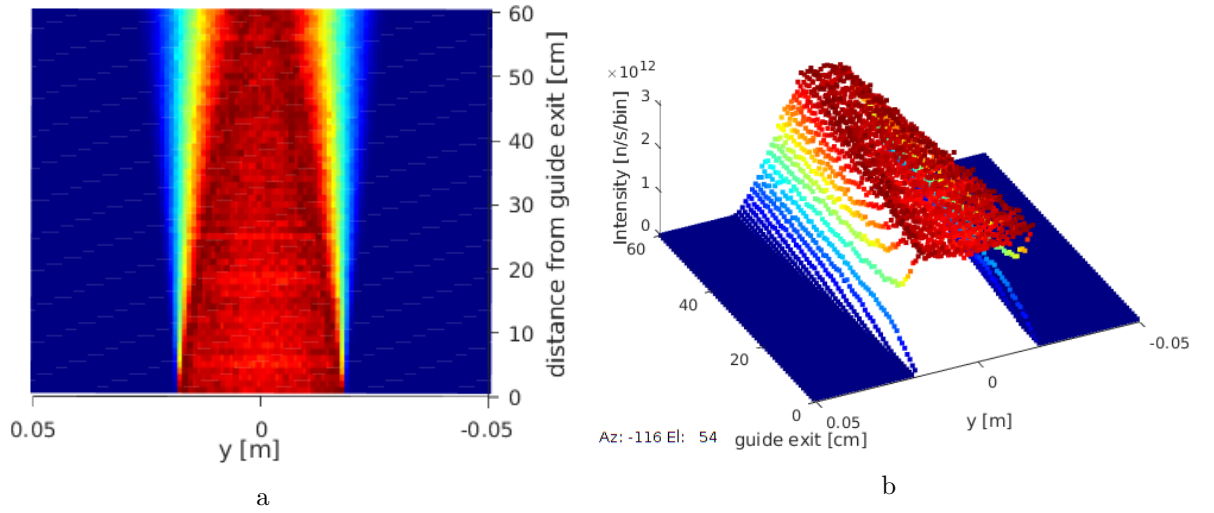

a   b

Figure 6: Flux distribution at the nose guide exit in the direction of sample position in vertical plane.

5 Changing last part of the nose to focus on smaller samples

Last part of the nose can be changed as an option to focus on smaller sample. Guide was optimized for 1x1 cm^2 sample. Comparison between full parabolic guide and guide with replaced last 5 m shown bellow.
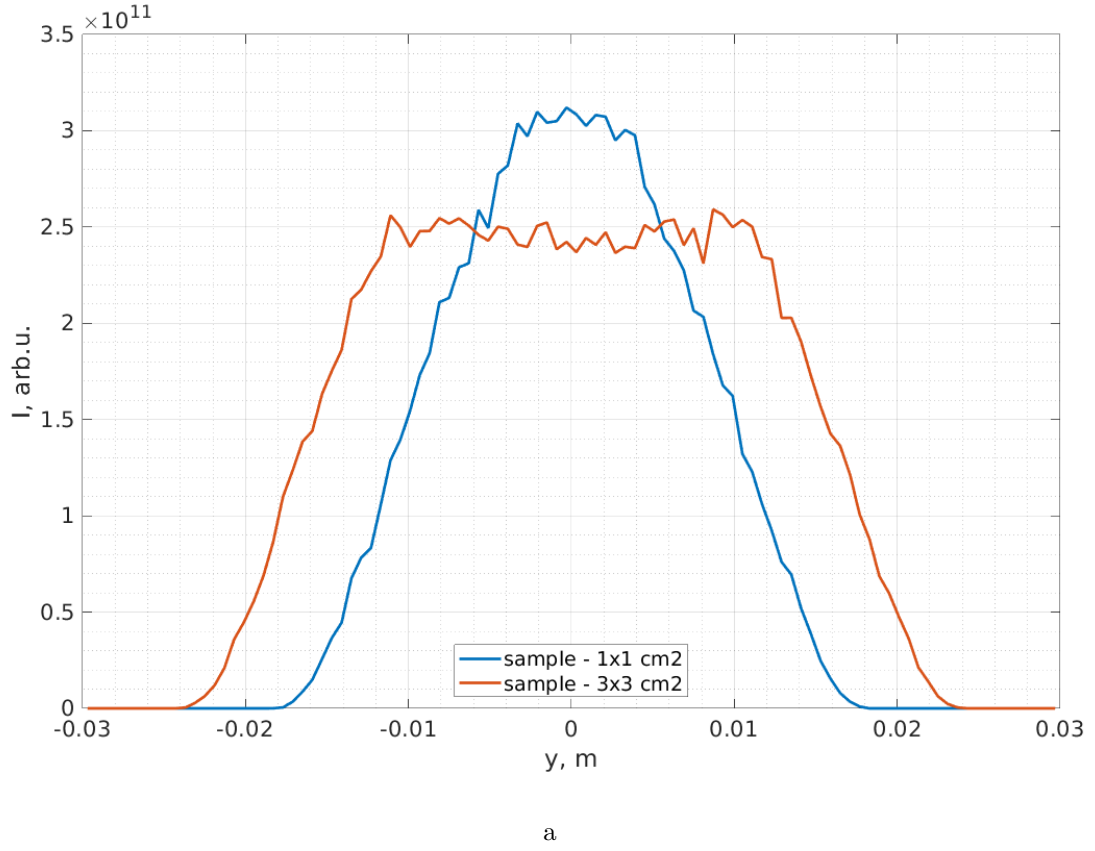

a

Figure 7: Distribution of flux at sample position for two configuration: 1) parabolic guide focused at the 3x3 cm^2 sample and 2) the same guide but last 5 m replaced with different guide to focus on smaller 1x1 cm^2 sample.

6 Conclusion

Final configuration:

1. Straight guide: W x H = 21 x 20 cm, m value should be around 3 for all sides.

2. Parabolic nose. Horizontal plane. Length 17 m, focus distance of parabola from the guide exit - 0.615 m, m value depends on the straight guide m value and goes from 3 to 6. Parabola curve equation for guide nose: $y^2 = 6.2588e^{-4} * x$.

3. Parabolic nose. Vertical plane. Length 20 m, focus distance of parabola from the guide exit - 0.682 m, m value depends on the straight guide m value and goes from 3 to 6. Parabola curve equation for guide nose: $y^2 = 4.7483e^{-4} * x$.