High Efficiency Multilayer coated Blazed Grating for tender X-rays

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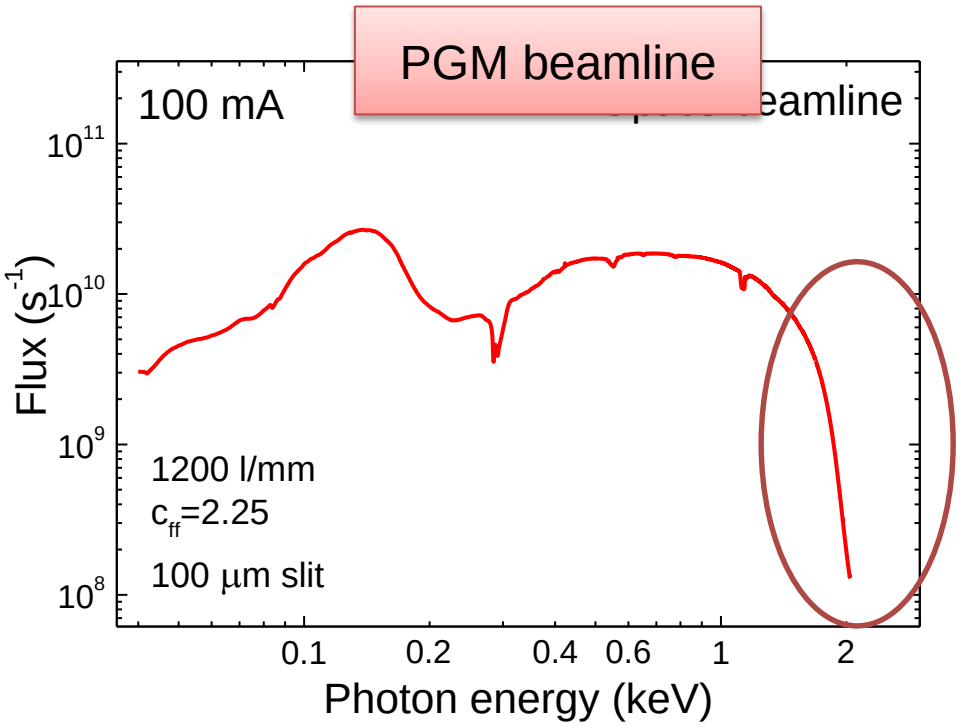
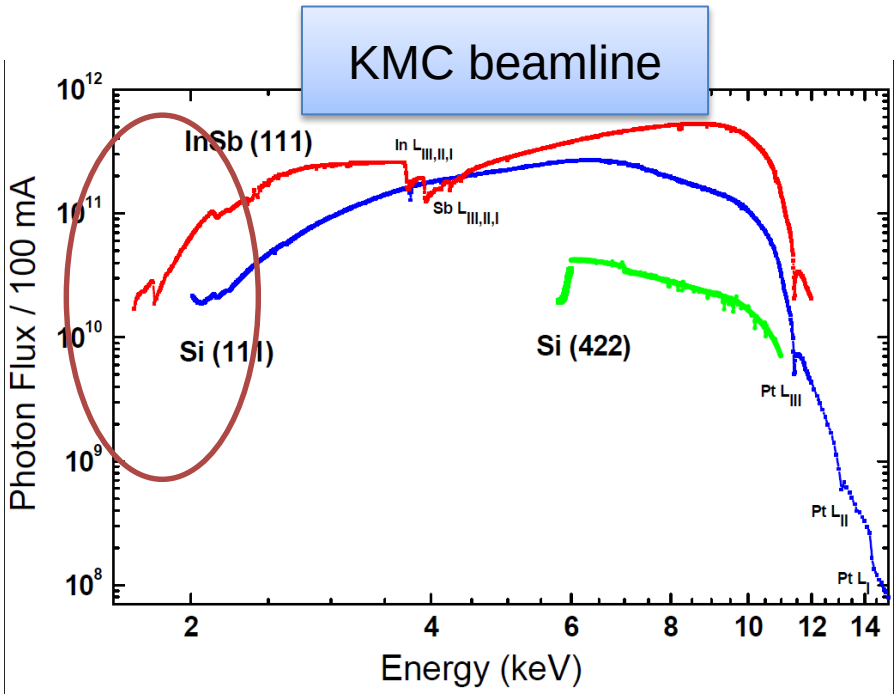
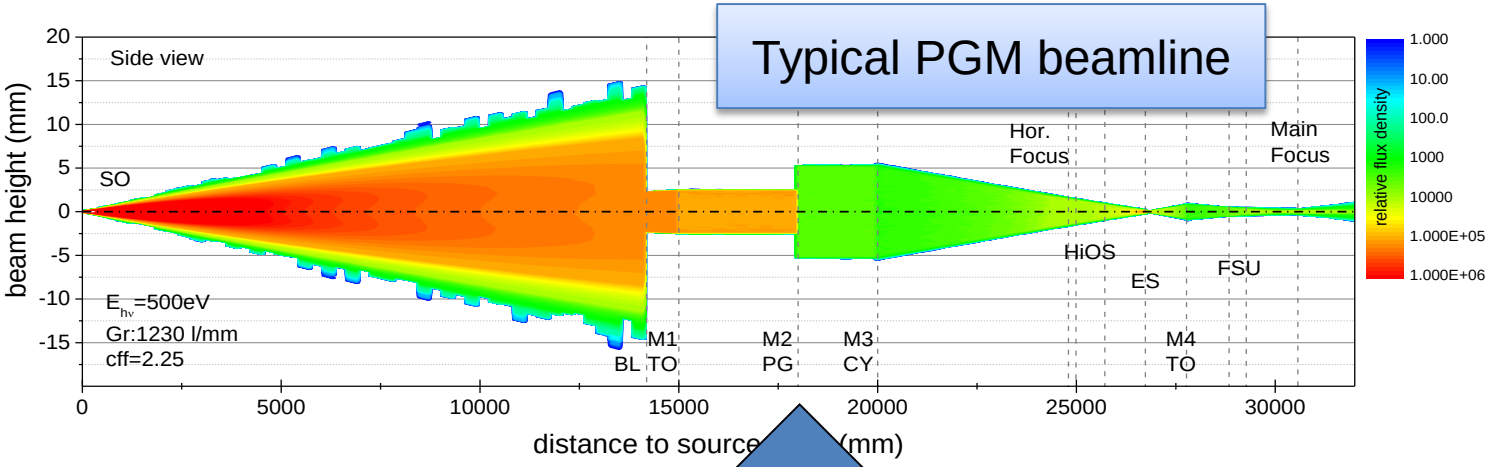
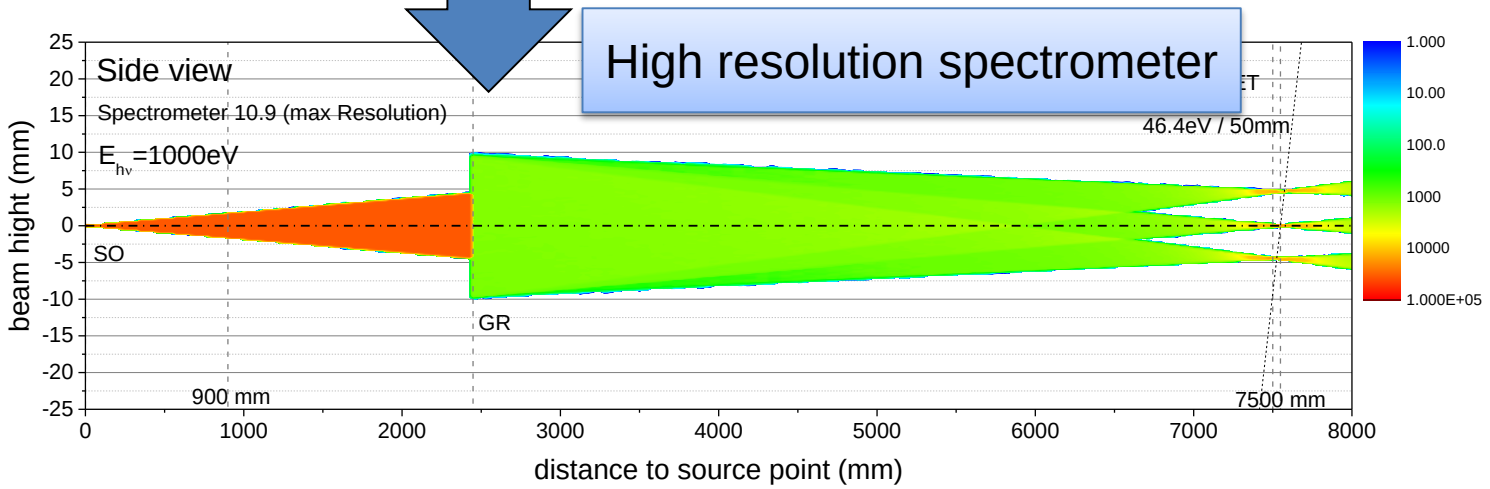
Both types monochromators have problematic performance in **tender x-ray range (1.5 - 2.5 keV)**





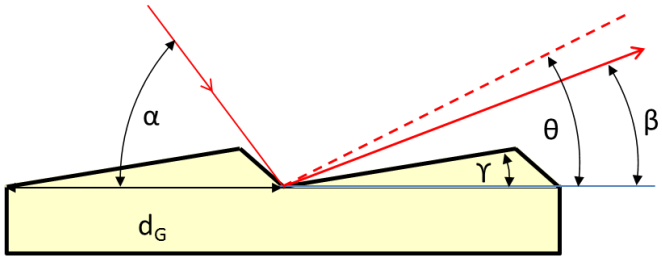


Transmission of high resolution grating is around 5%



blazed grating condition fitted to multilayer condition

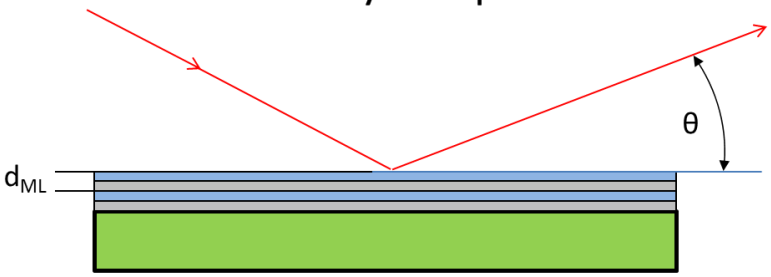
grating equation „on blaze“



$$\frac{\alpha+\beta}{2} = \theta$$

$$\frac{\lambda \cdot m}{d_G \cdot \sin \Upsilon} = 2 \cdot \sin \theta$$

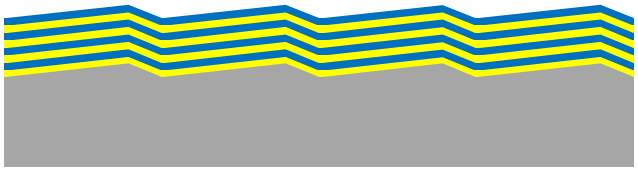
multilayer equation



$$\frac{\lambda \cdot n}{d_{ML}} = 2 \cdot \sin\theta \left(1 - \frac{2 \cdot \delta}{sin^2\,\theta}\right)$$

$$\frac{\lambda \cdot n}{d_{ML}} \approx 2 \cdot \sin\theta$$

MLbGR

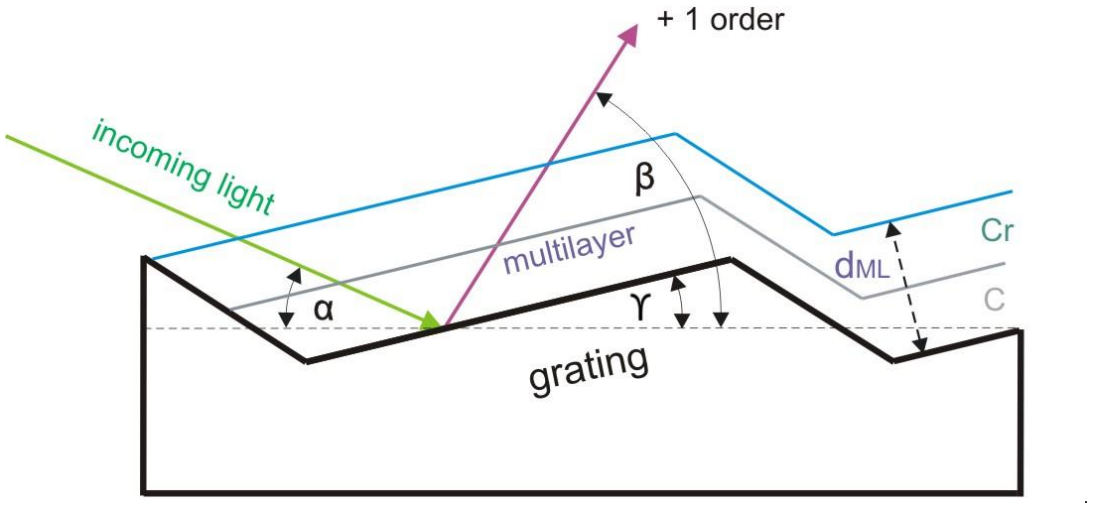


$$d_{ML} \approx \frac{n \cdot d_G \cdot \sin \Upsilon}{m}$$

$$d_{ML} \approx d_G \cdot \sin \Upsilon \qquad \text{for } n = 1 \text{ and } m = 1$$

parameters for multilayer grating

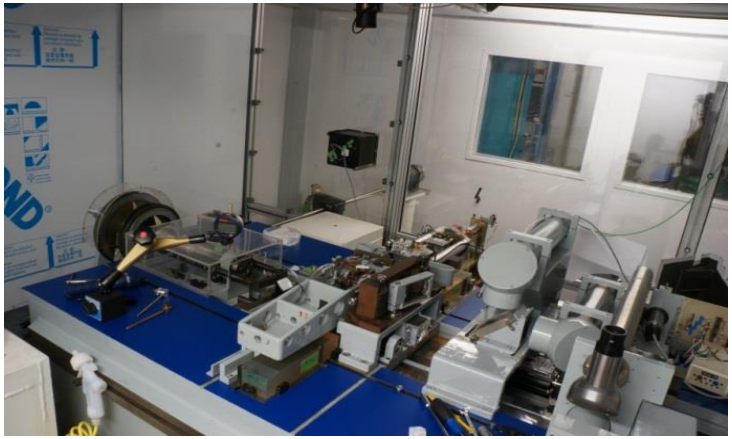
grating + multilayer

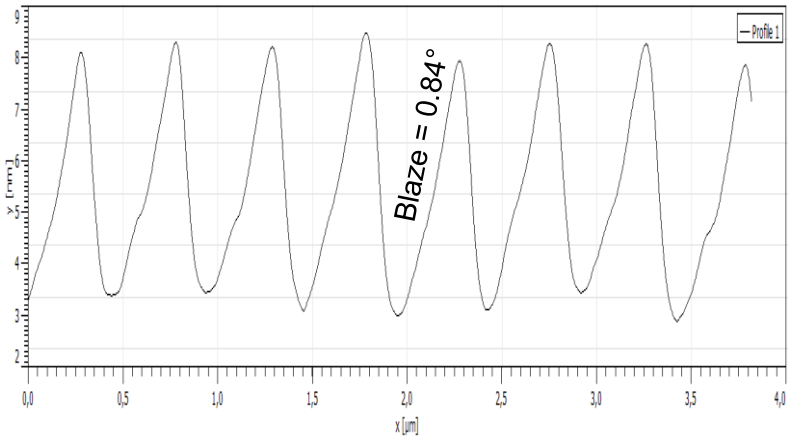


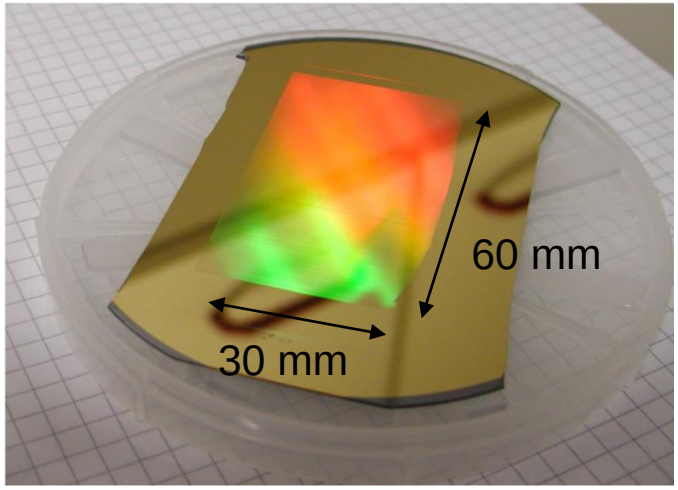
$$d_{ML} \approx d_G \cdot \sin \Upsilon$$

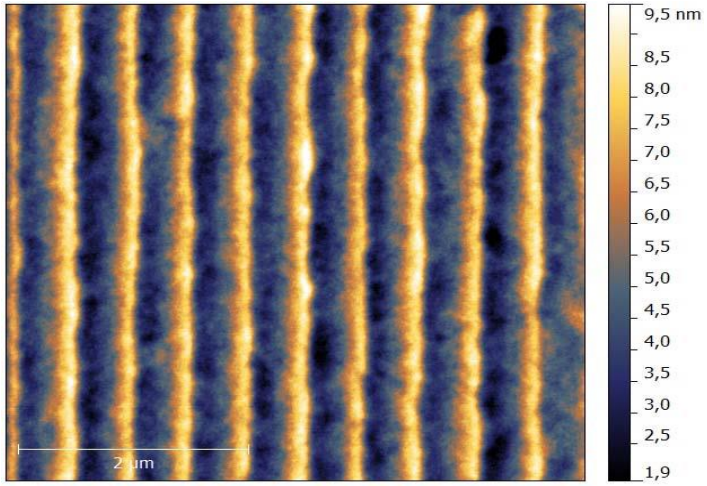
N =2000 *l/mm* , Υ = 0.84° → d_{ML} = 7.3 nm

Grating manufacturing



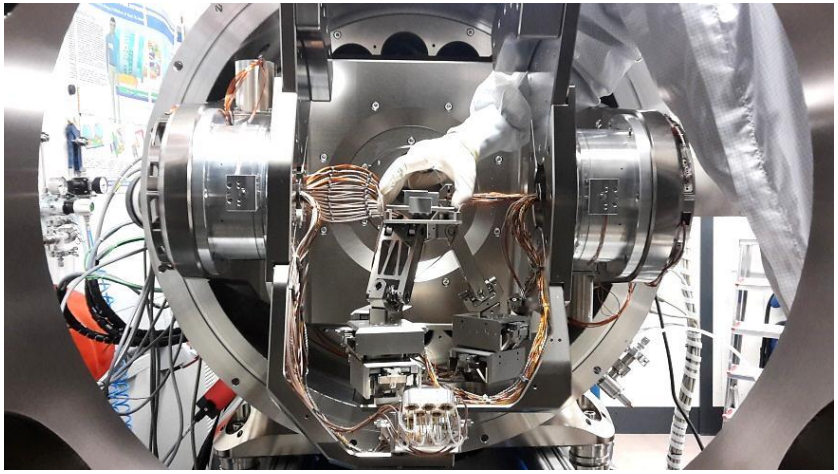


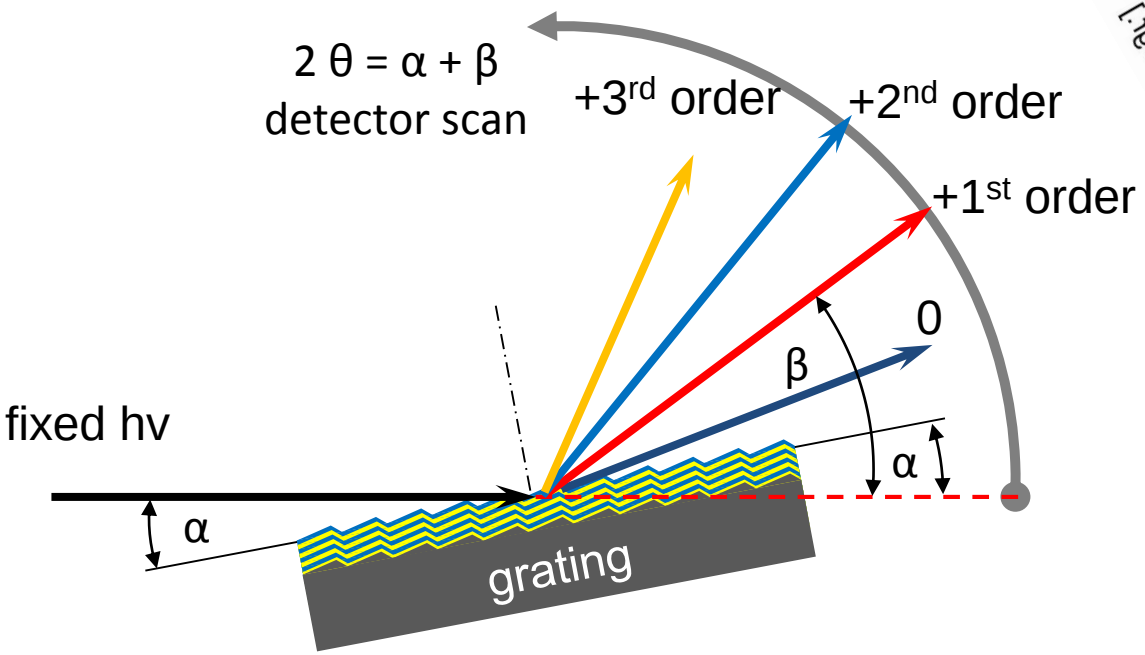


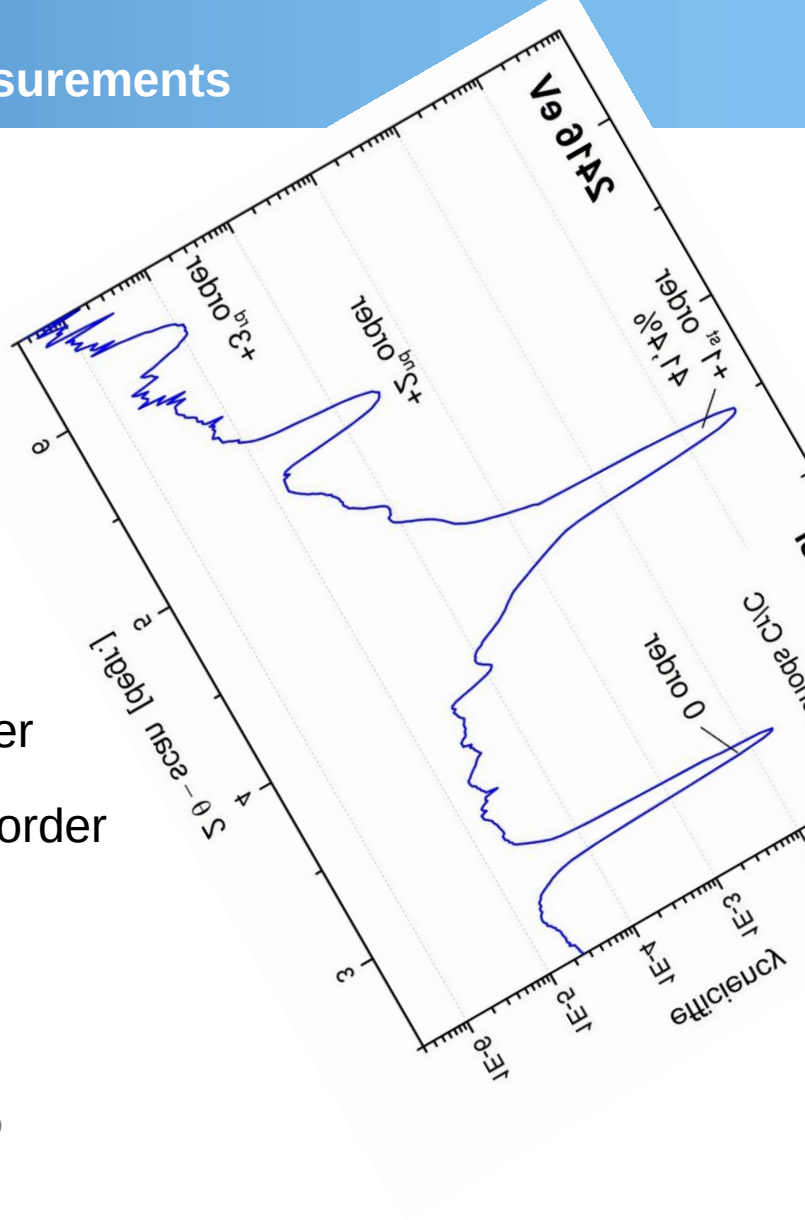


5 x 5 µm view field roughness: 0.20 nm rms

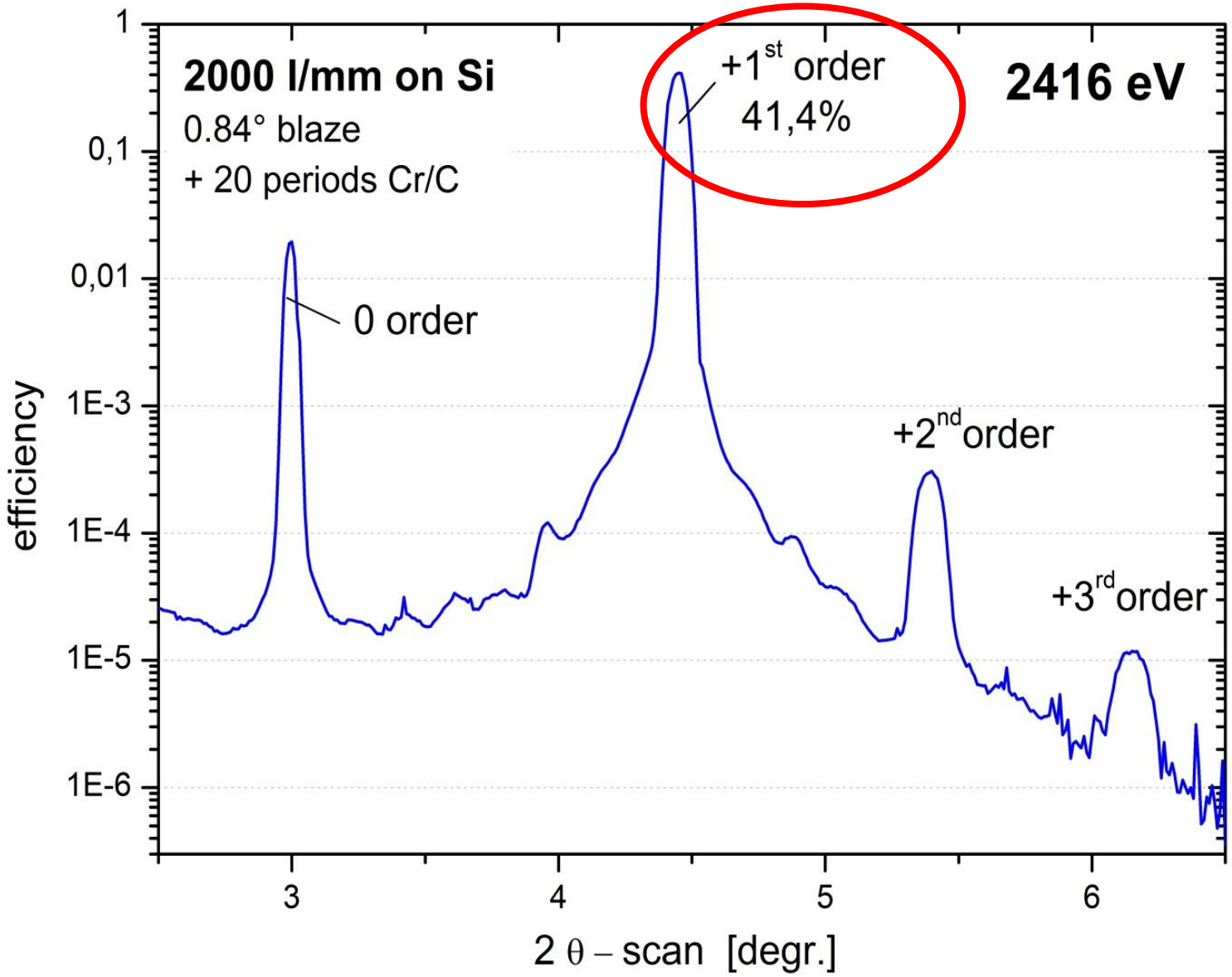
Setup in Reflectometer / efficiency measurements







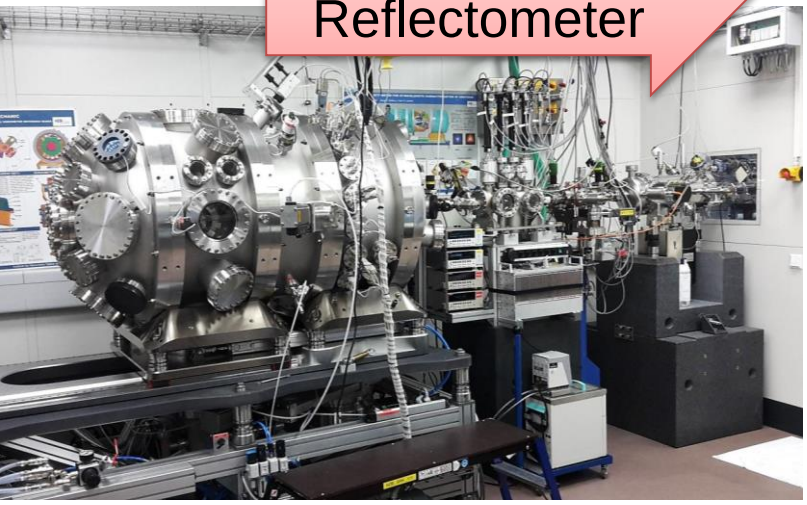
Reflectometer: 2theta scan at MLG

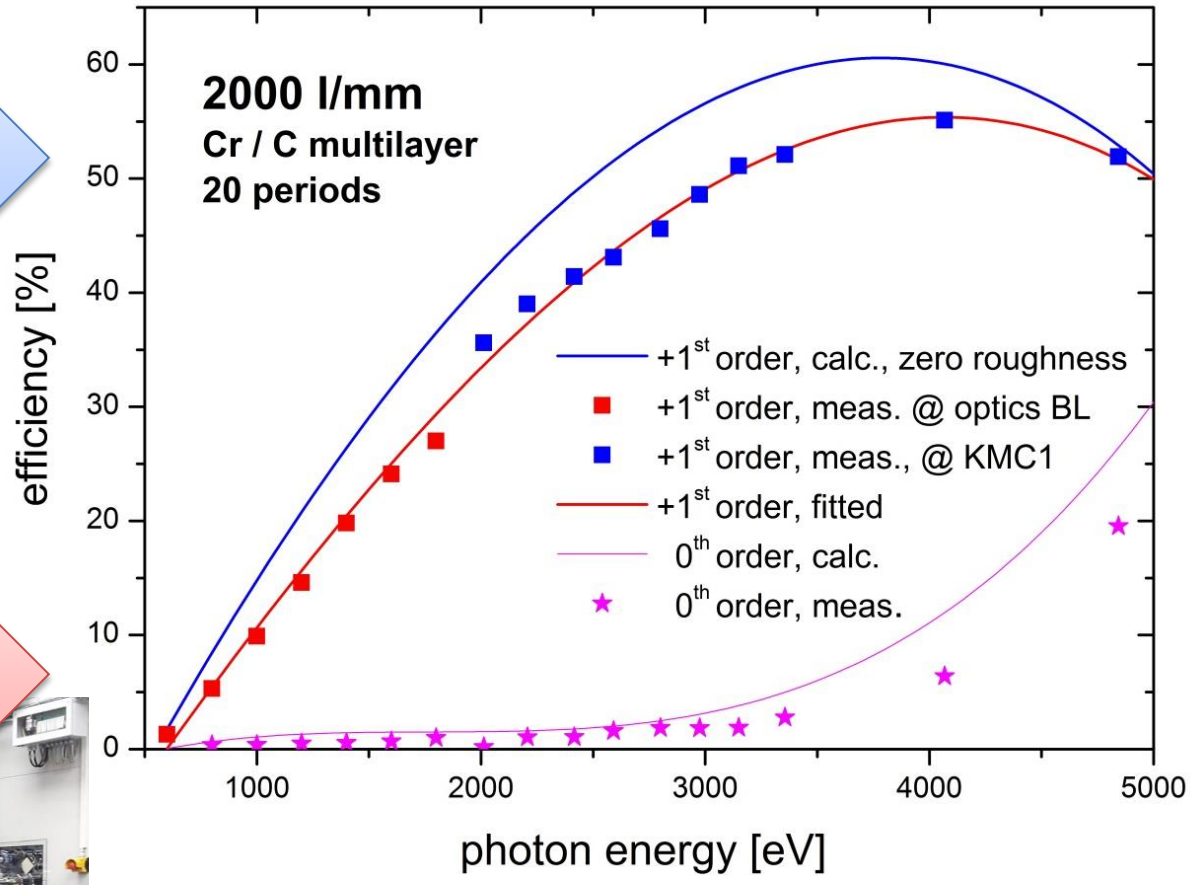


Spectral efficiency distribution

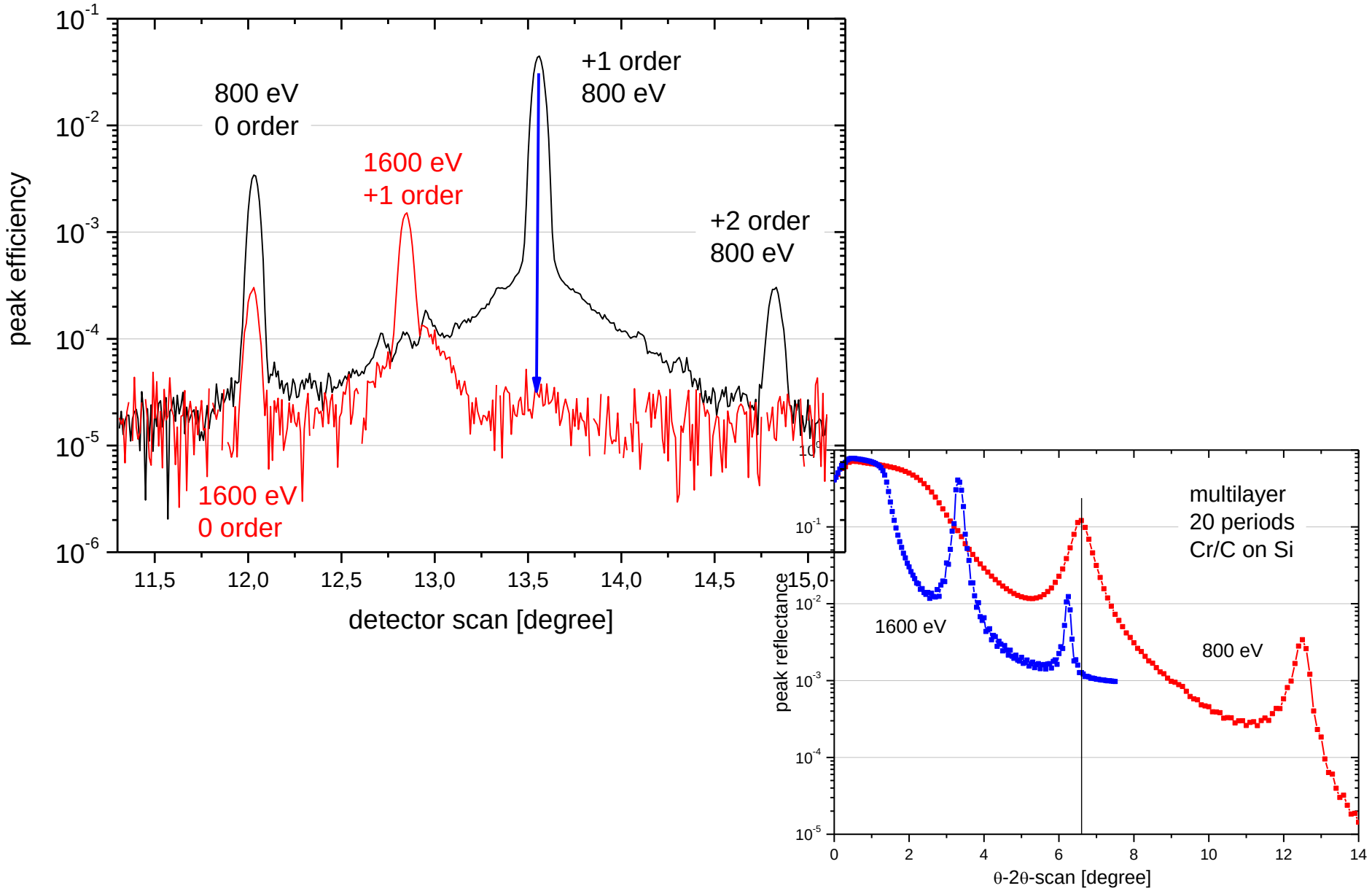
KMC-1
small Reflectometer

optics beamline
Reflectometer



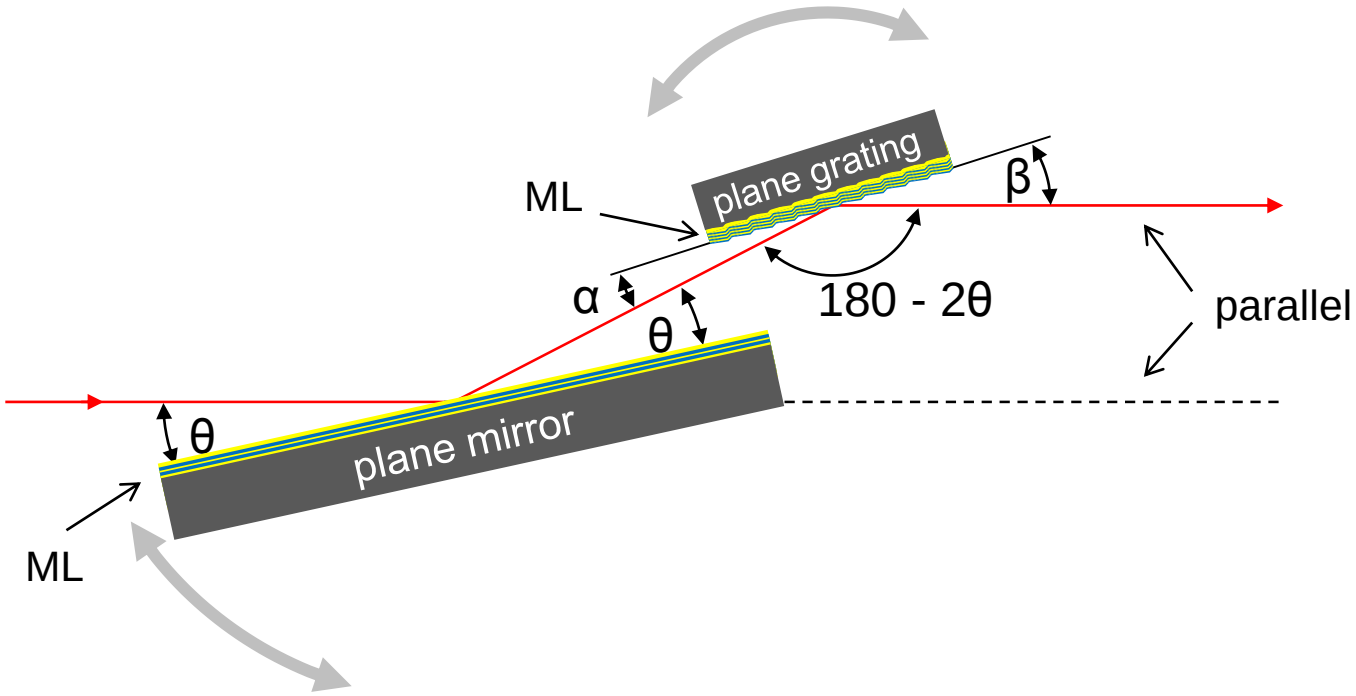


strong suppression of higher orders



BESSY-PGM

(PGM in vert. collimated light)



→ multilayer on both plane mirror and plane grating

Summary

- MLG can cover large energy ranges at high efficiency
- MLG strongly suppress higher orders
- for fixed angles only small working range
- MLG well suited for collimated PGM

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Thank you for your attention!