Physikalisch-Technische Bundesanstalt
Braunschweig and Berlin
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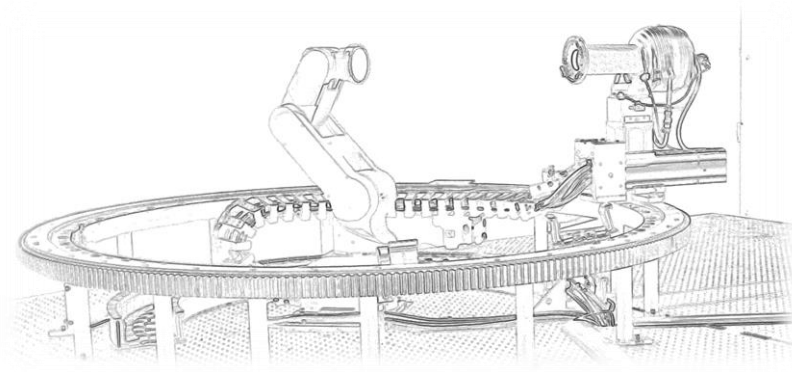


BxDiff WP1:

Remarks on uncertainty determination for BxDiff-BRDF comparison measurements

**Alfred Schirmacher, Tatjana Quast,
Irina Santourian, Kai-Olaf Hauer**

Remarks on uncertainty determination…

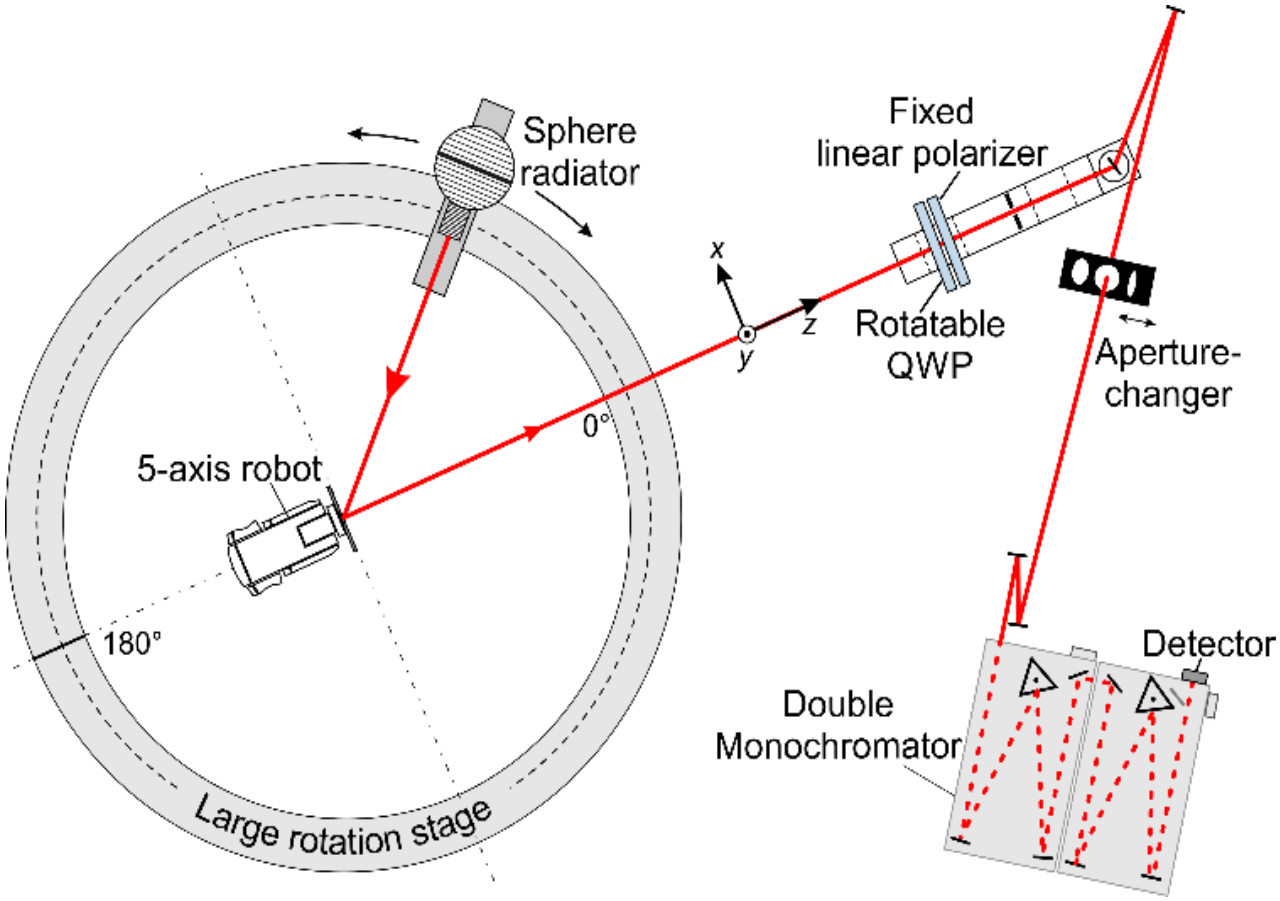


Fig.1 Robot-based Goniometer at PTB

radiator-based approach

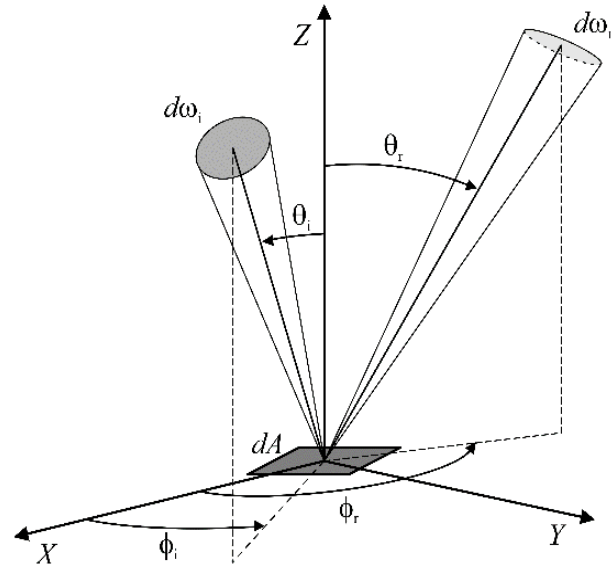
$$\beta(\lambda) = \frac{L_r(\lambda)}{L_r^{PRD}(\lambda)}$$

spectral radiance factor

Remarks on uncertainty determination…

$$\beta(\theta_i, \Phi_i, \theta_r, \Phi_r, \lambda) = \frac{L_r(\theta_i, \Phi_i, \theta_r, \Phi_r, \lambda)}{L_r^{PRD}(\theta_i, \Phi_i, \theta_r, \Phi_r, \lambda)}$$

$$\beta(\lambda) = \frac{\pi R^2}{A_Q \cos(\theta_i)} \cdot \frac{S_r(\lambda) - S_{rd}(\lambda)}{S_i(\lambda) - S_{id}(\lambda)}$$



Model for uncertainty calculation

$$\beta\left(\lambda, R, A_Q, \Delta T, \vec{\Delta}, \vec{\Gamma}, \vec{\mathrm{K}}, \vec{C}_{\mathrm{sens}}, \vec{S}, T_f, f_{\mathrm{br}}, f_{\mathrm{bi}}, f_{\mathrm{pol}}, f_{\mathrm{fluo}}\right)$$

$$= \frac{\pi R^2}{A_Q(\Delta T)\cos\left(\theta_i\left(\vec{\Delta}, \vec{\Gamma}, \vec{\mathrm{K}}\right)\right)} \cdot T_f \cdot f_{\mathrm{pol}}$$

$$\cdot \frac{(c_{\mathrm{sens}\,11} + c_{\mathrm{sens}\,12})S_r \cdot f_{br} \cdot f_{\mathrm{fluo}} - (c_{\mathrm{sens}\,21} + c_{\mathrm{sens}\,22})S_{rd}}{f_{bi} \cdot (S_{i1} + S_{i2}) - (c_{\mathrm{sens}\,31}S_{id1} + c_{\mathrm{sens}\,32}S_{id2})}$$

described in detail in

Remarks on uncertainty determination…

Metrologia

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Uncertainty budget for PTB's gonioreflectometers and ways to improve it in the short VIS spectral range

Irina Santourian[2,1], Tatjana Quast[1] and Alfred Schirmacher[1]

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Development of an LED-radiator, description and reduction of uncertainty budget in short VIS

Remarks on uncertainty determination…

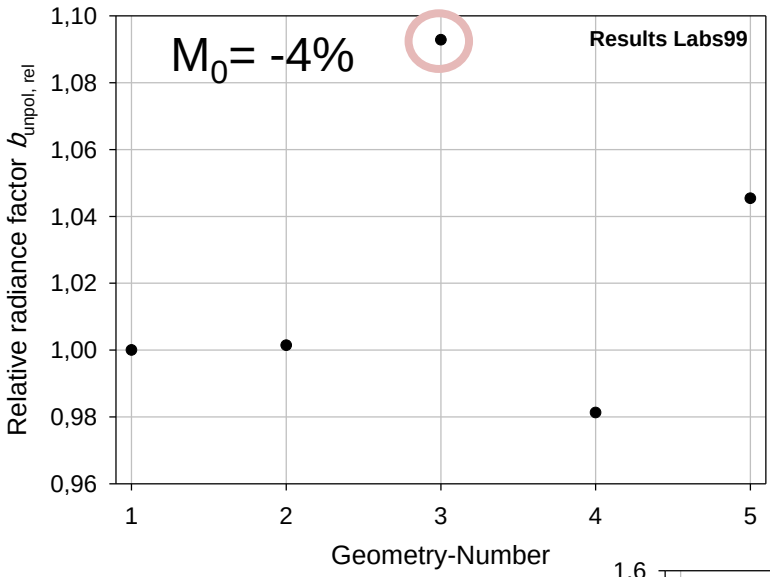
Geometry- and sample-specific aspects

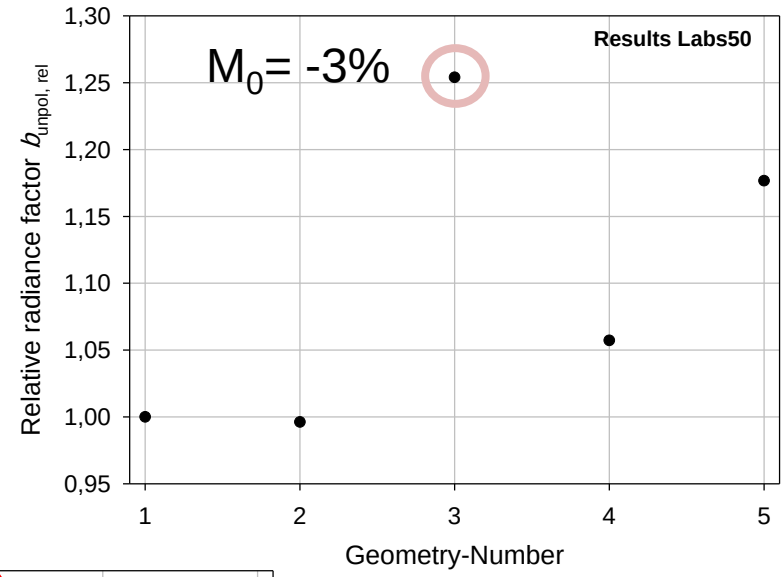
Name / designation		Angle settings	Relative targeted uncertainty (k=2)
in plane	Geo1	(45°,0°) : (0°,0°)	0.1% unrealistic, too small
	Geo2	(0°,0°) : (45°,180°)	
	Geo3	(45°,0°) : (60°,180°) **Sample Gloss5A**	
out-of-plane	Geo4	(45°,0°) : (45°,90°) unusual geometry	< 4% too high ?
	Geo5	(45°,0°) : (50.1°,146.6°) **Sample Gloss5A** unusual geometry	

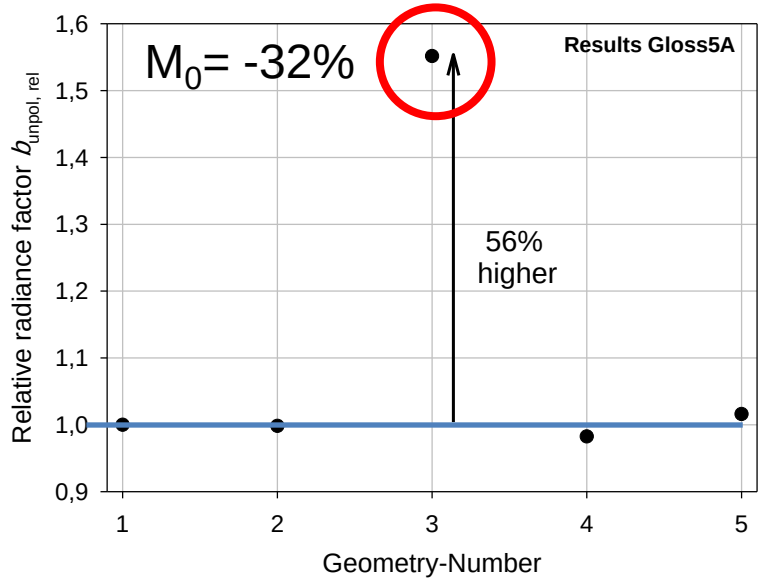
close to specular:

- highly polarised, - convolution error for apparatus function,
- highly sensitive to robot angle positioning

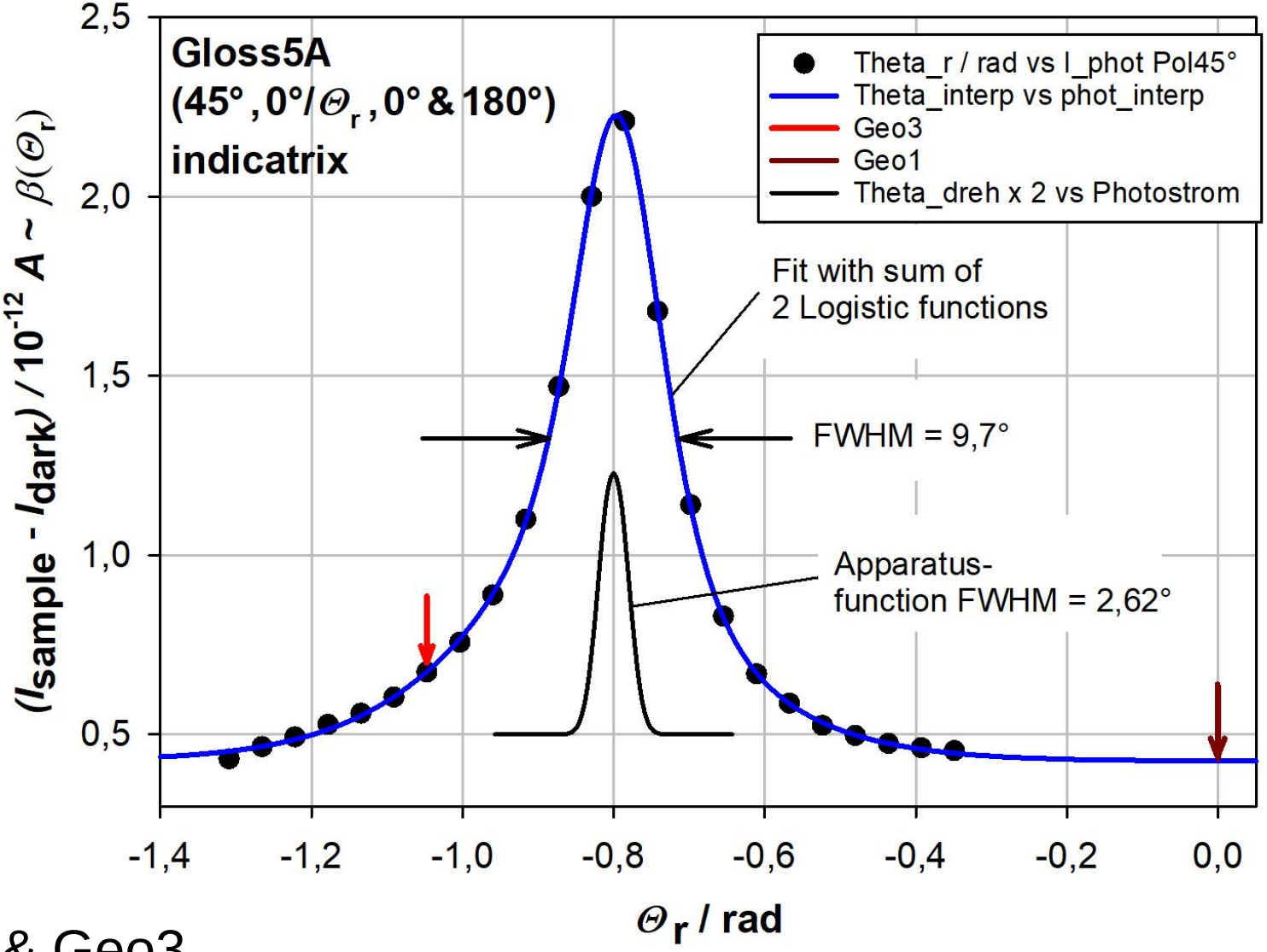
Remarks on uncertainty determination…





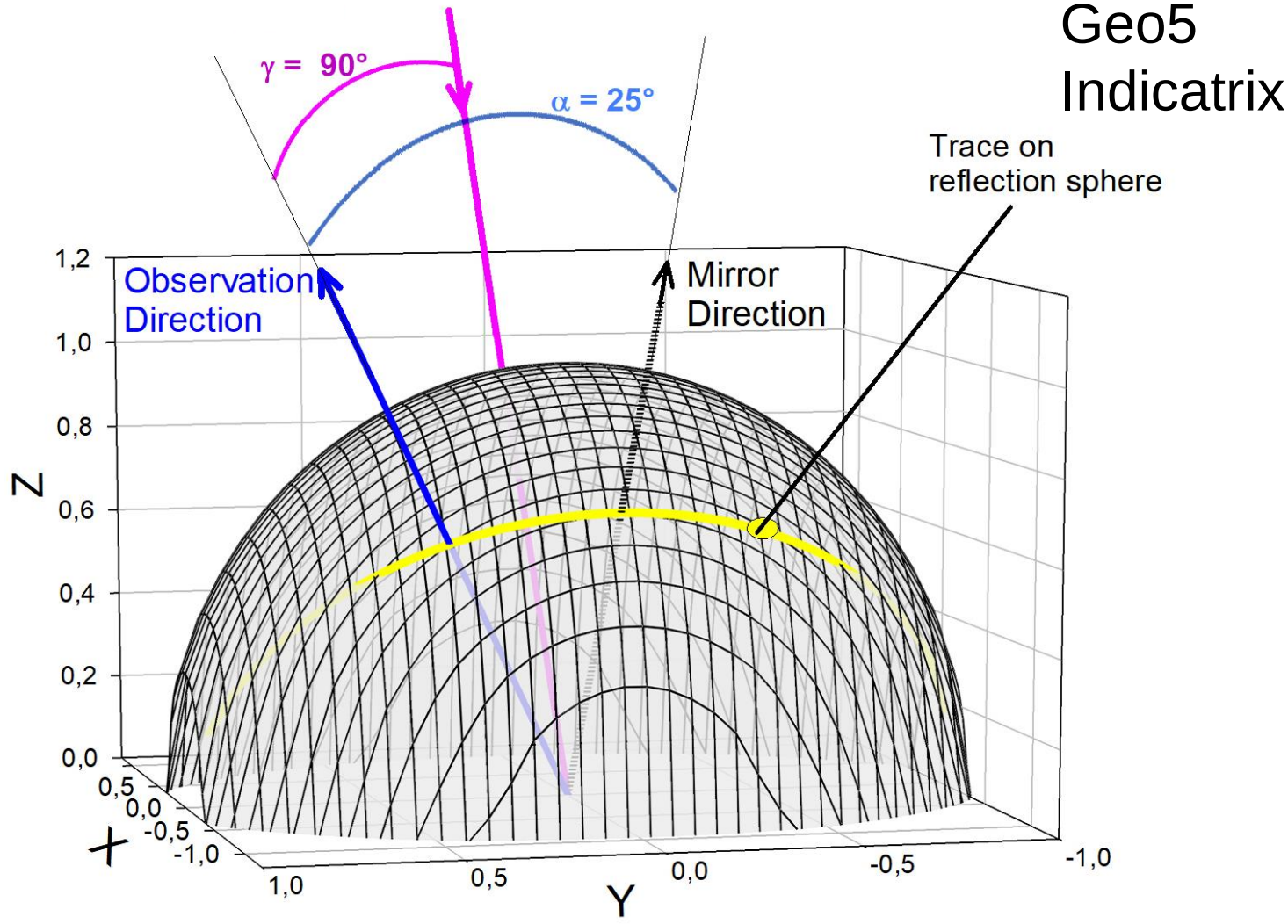


Remarks on uncertainty determination…

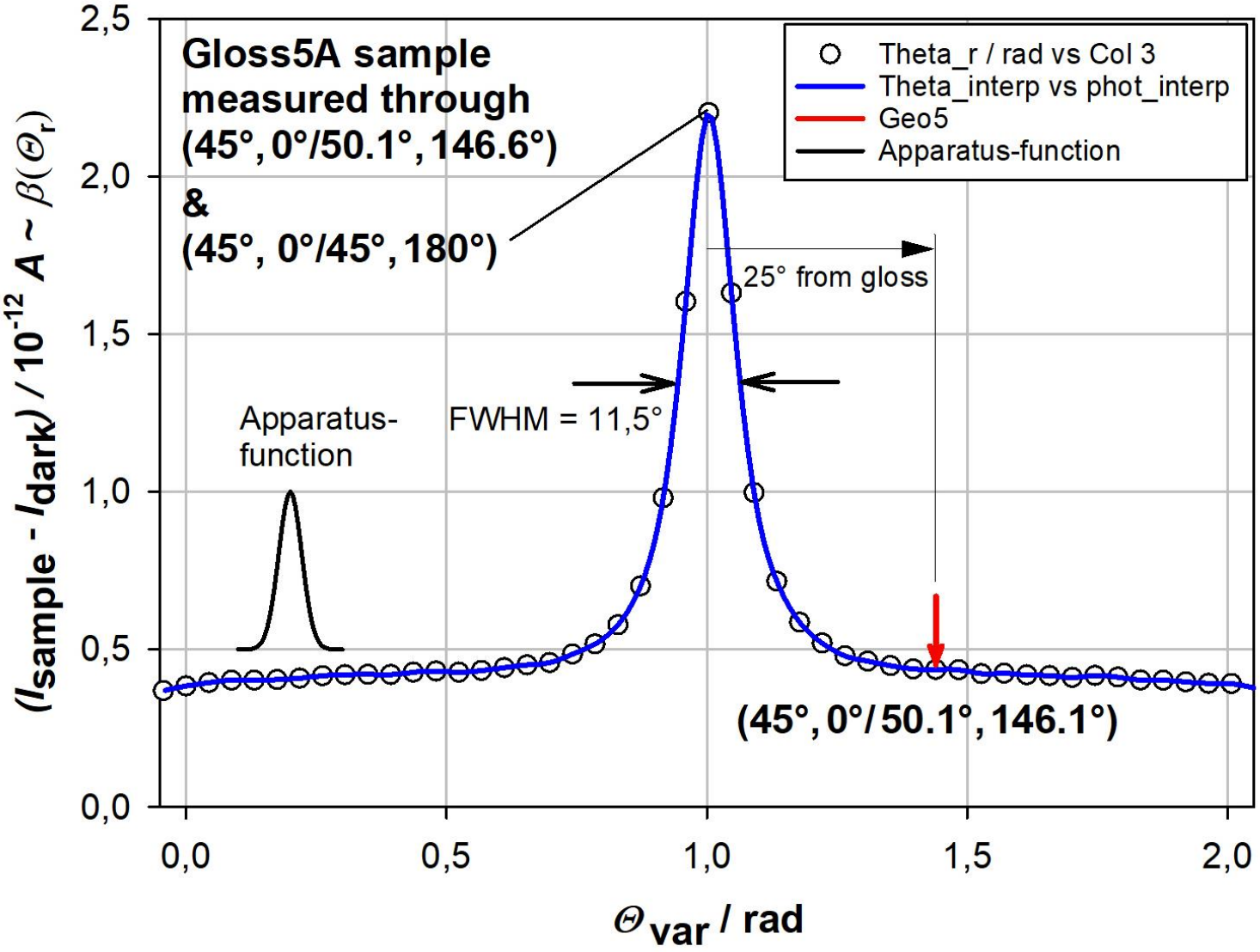


Geo1 & Geo3

Remarks on uncertainty determination…

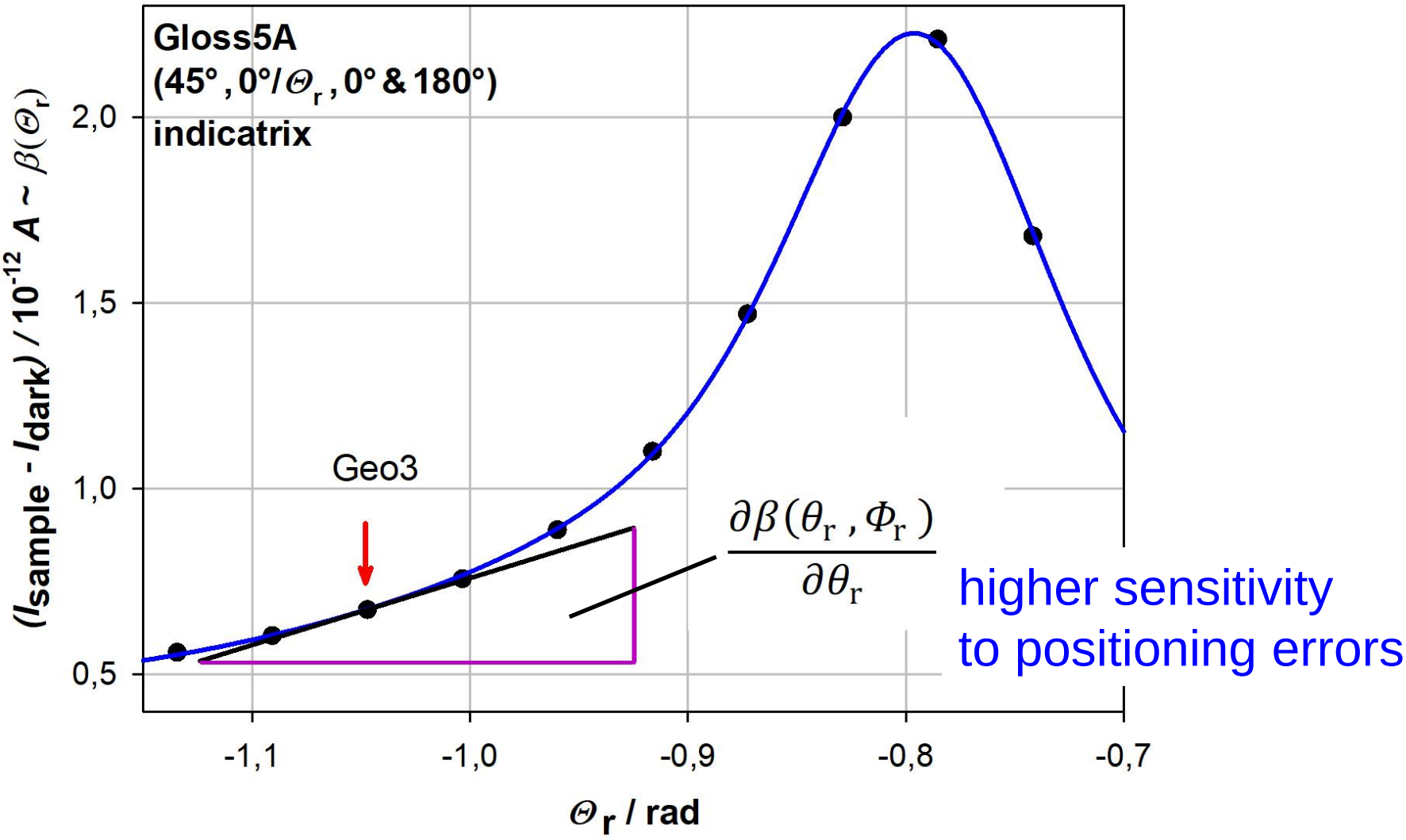


Remarks on uncertainty determination…



Geo5

Remarks on uncertainty determination…

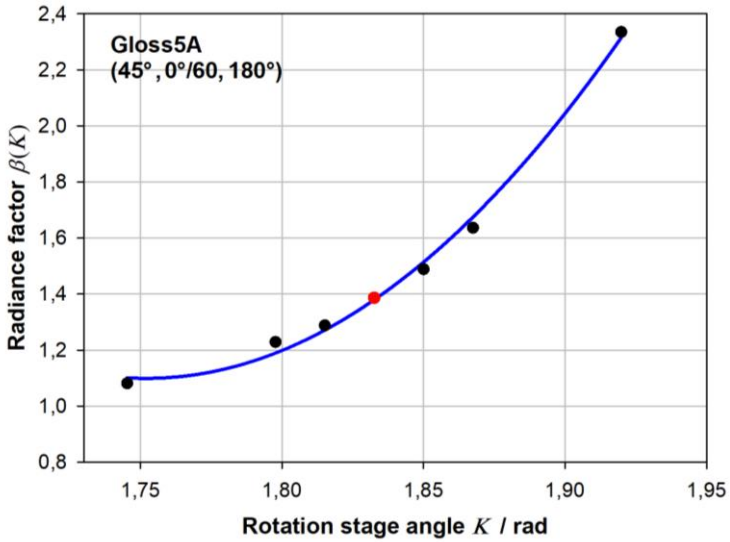


Remarks on uncertainty determination…

Geometry determined by system
(rotation stage & robot) - coordinates

$$\beta = \beta\left(\Theta_{\mathrm{i}}\left(\vec{\Delta}, \vec{\Gamma}, \vec{K}\right)\right)$$

Get sensitivity coefficients by variation of system - coordinates around the specific measurement geometry



$$\frac{\partial \beta}{\partial K} = 6.96\ \mathrm{rad}^{-1}$$ Gloss5A Geo3

0.125 rad^{-1} Labs99 Geo3

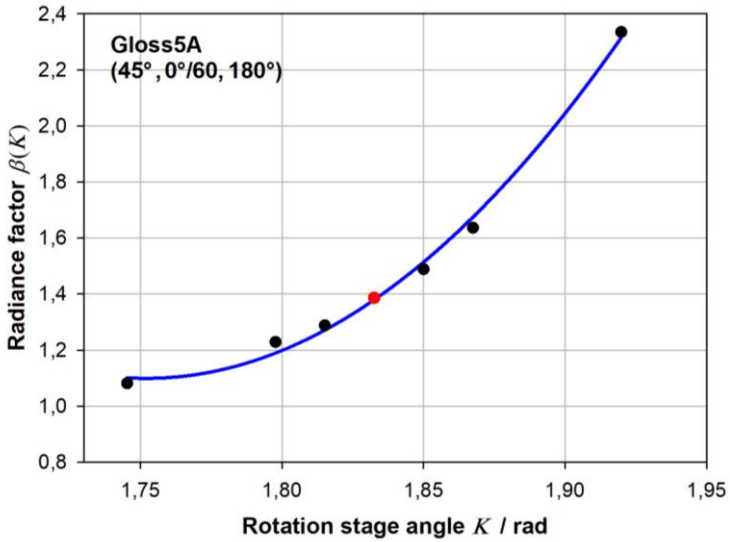
0.05 rad^{-1} Labs99 Geo1

Remarks on uncertainty determination…

Geometry determined by system
(rotation stage & robot) - coordinates

$$\beta = \beta\left(\Theta_{\mathrm{i}}\left(\vec{\Delta}, \vec{\Gamma}, \vec{K}\right)\right)$$

Get sensitivity coefficients by variation of system - coordinates around the specific measurement geometry



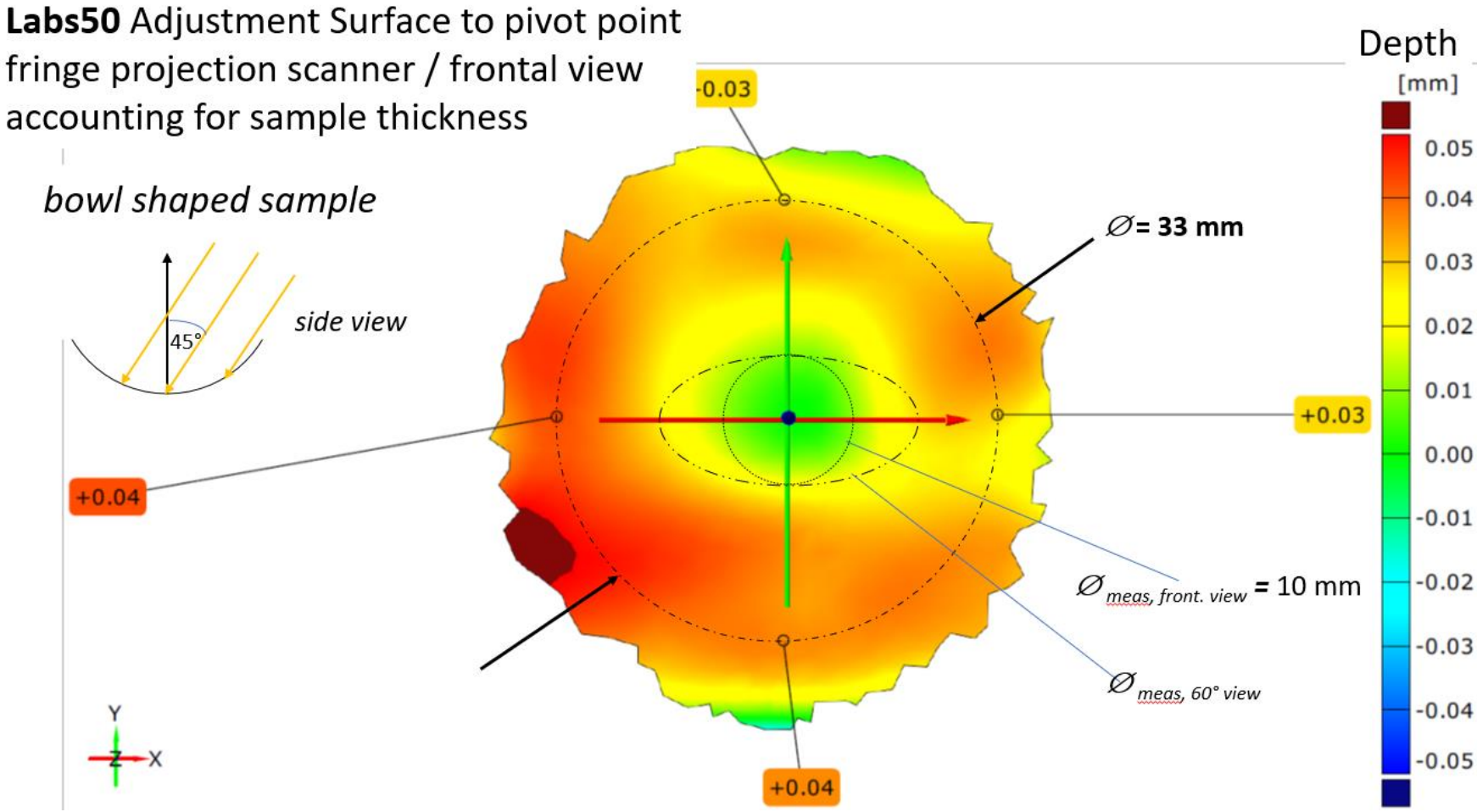
system-movements are correlated

e.g.

in-plane geometries Geo1 to Geo3

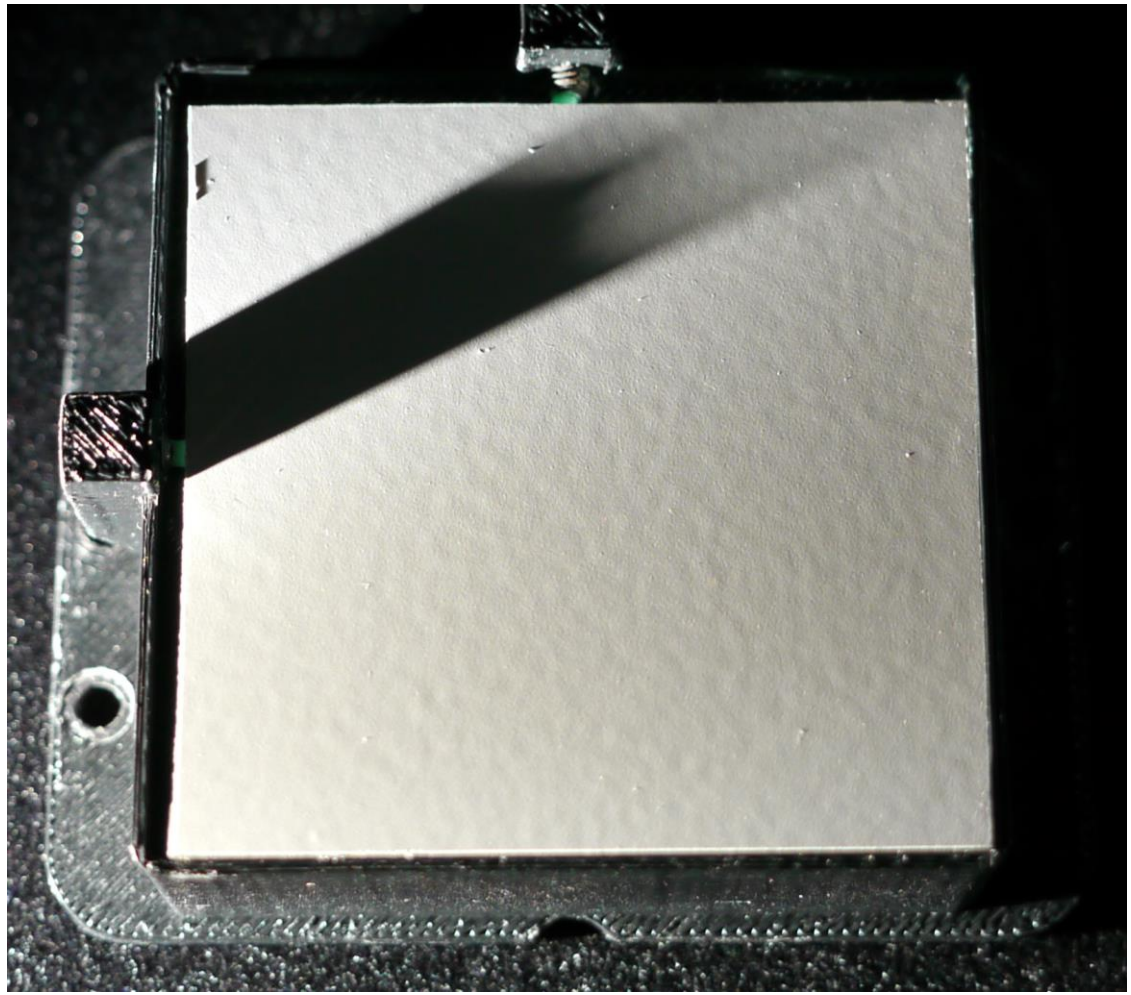
$$r(\Delta, \mathrm{K}) = 1$$

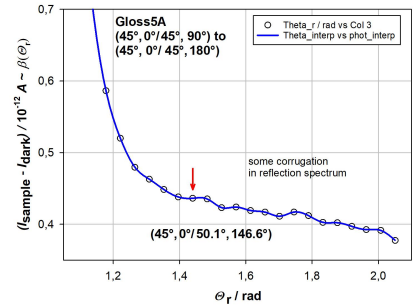
Remarks on uncertainty determination…



Labs50: Bowl shape not considered because of small spot

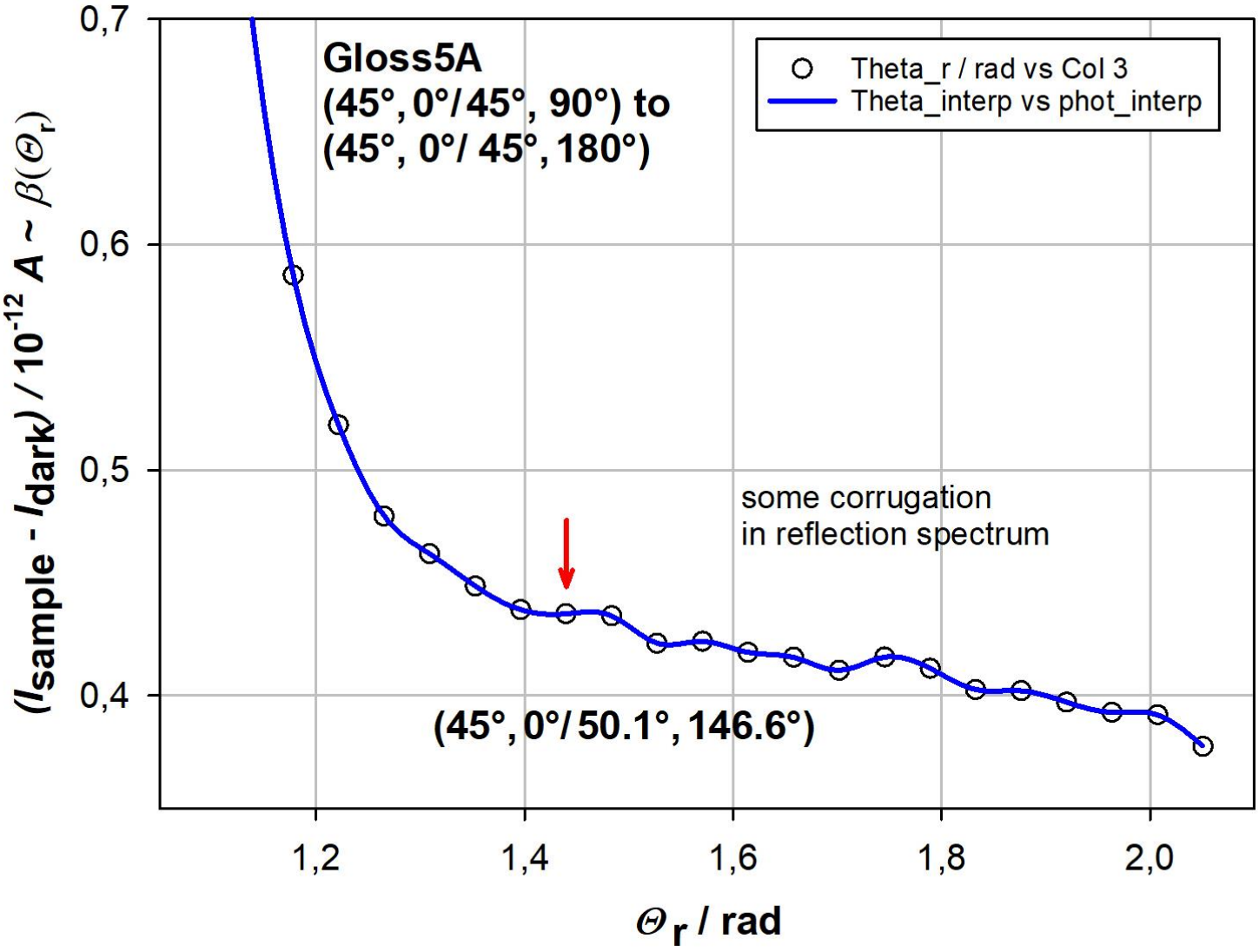
Remarks on uncertainty determination…



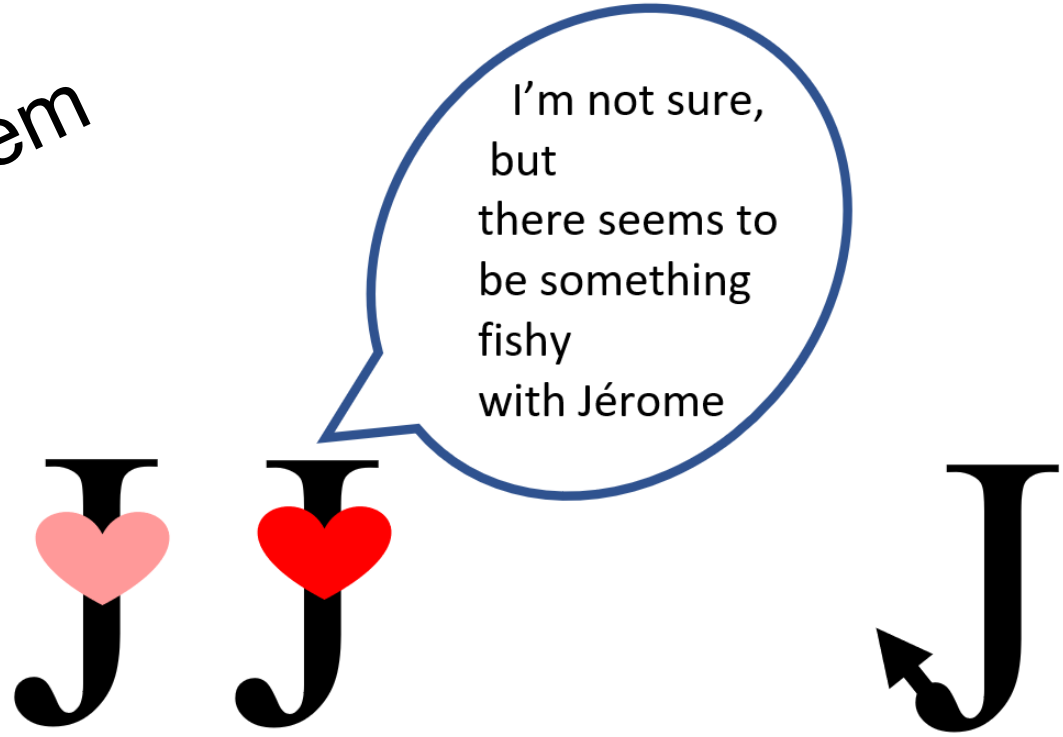


Gloss5A: Some waviness of surface / causes add. uncertainty

Remarks on uncertainty determination…



Uncertainty, a common problem



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