



4th Progress Meeting of JRP BxDiff



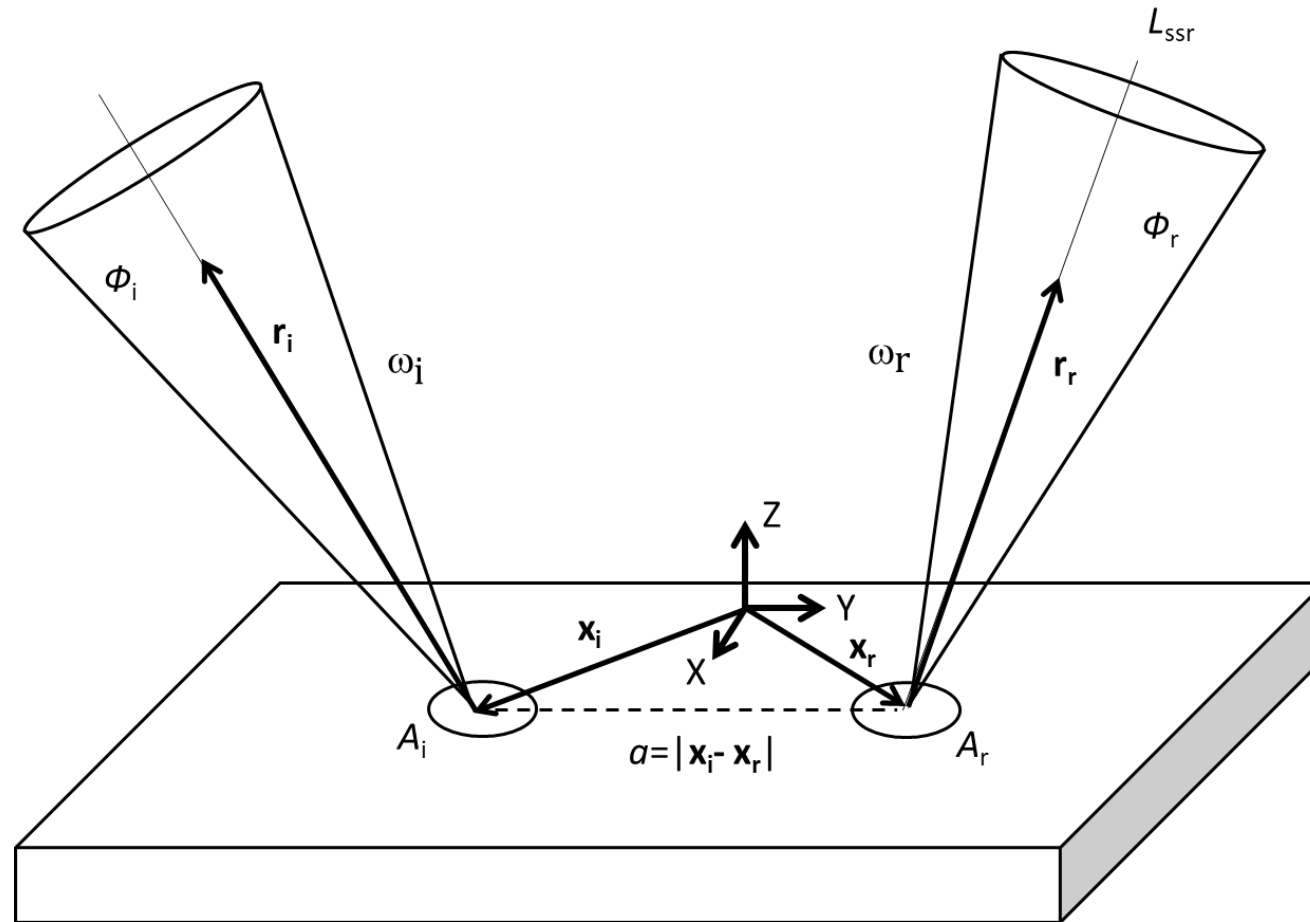
BSSRDF measurements at CSIC & Comparison of BSSRDF

Pablo Santafé Gabarda

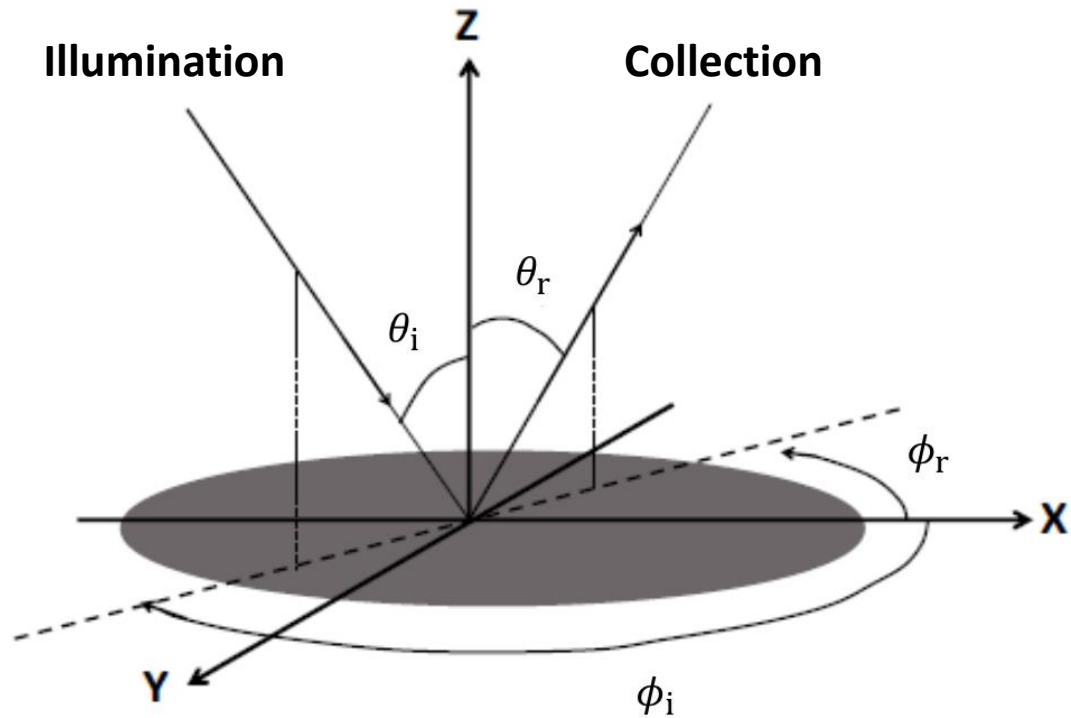
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BSSRDF measurement



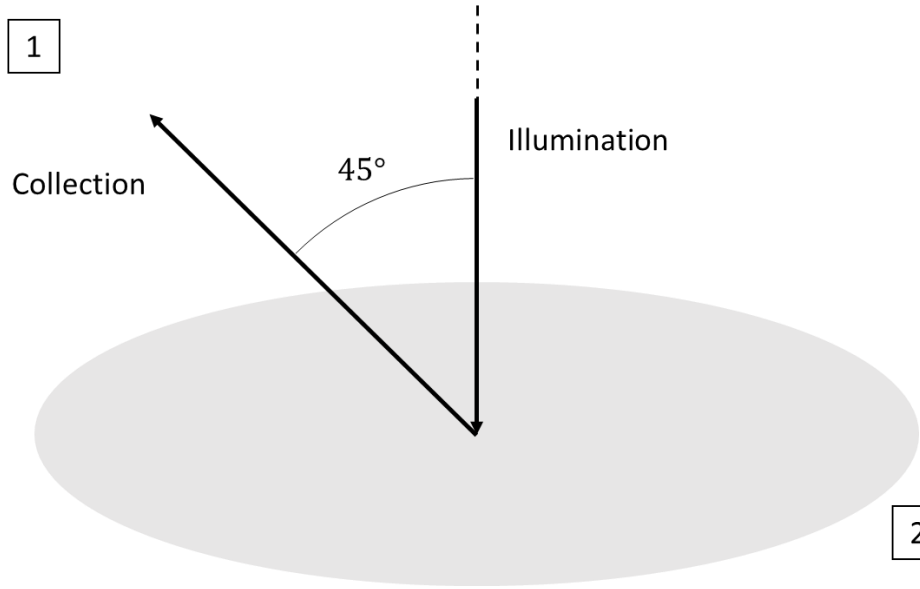
Protocol



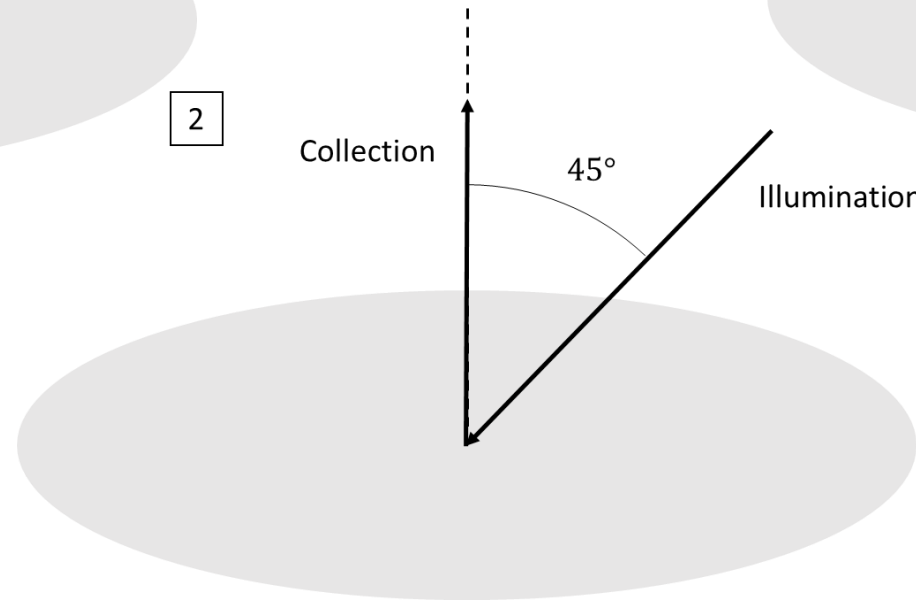
Geometries	$\phi_i / ^\circ$	$\theta_i / ^\circ$	$\phi_r / ^\circ$	$\theta_r / ^\circ$
1	0	0	180	45
2		45		0
3		60		15

Protocol

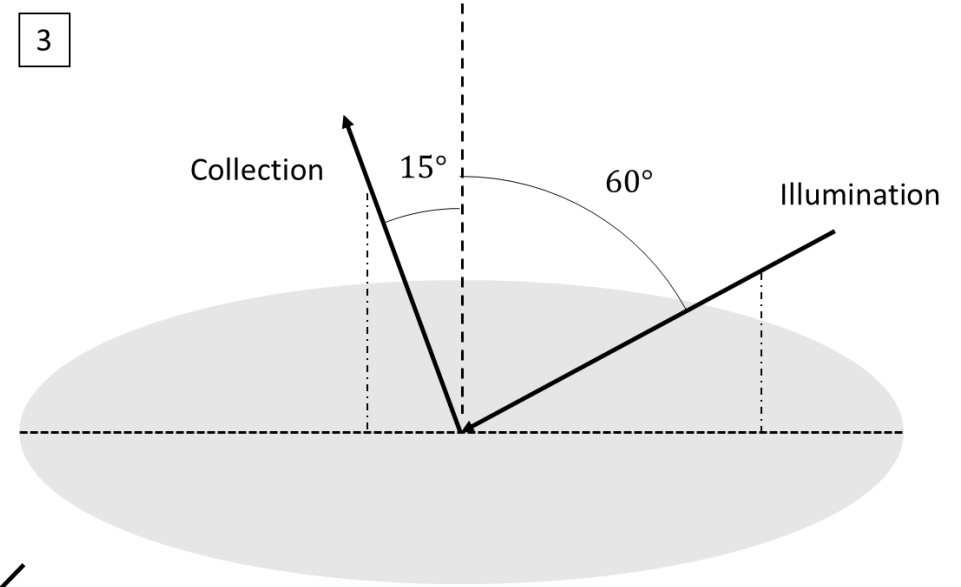
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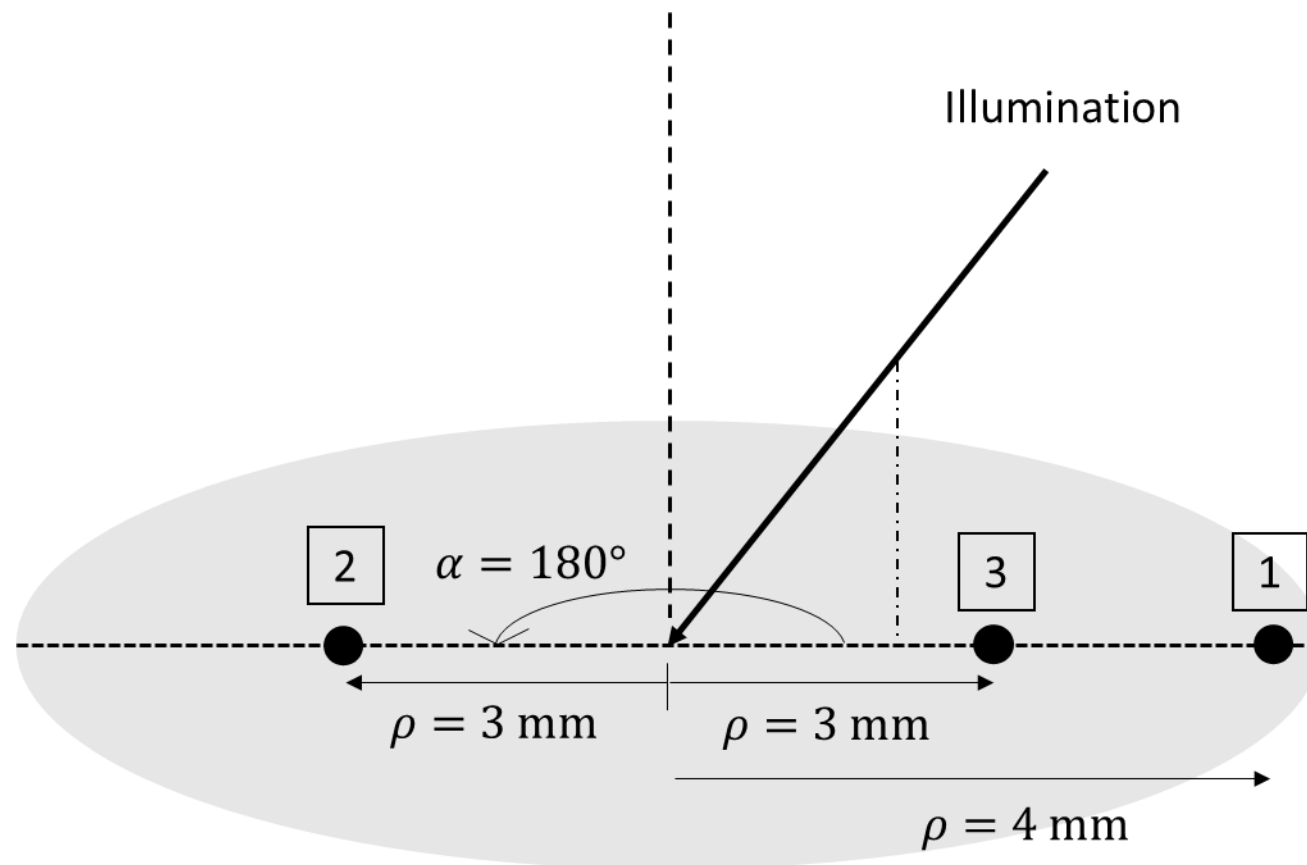
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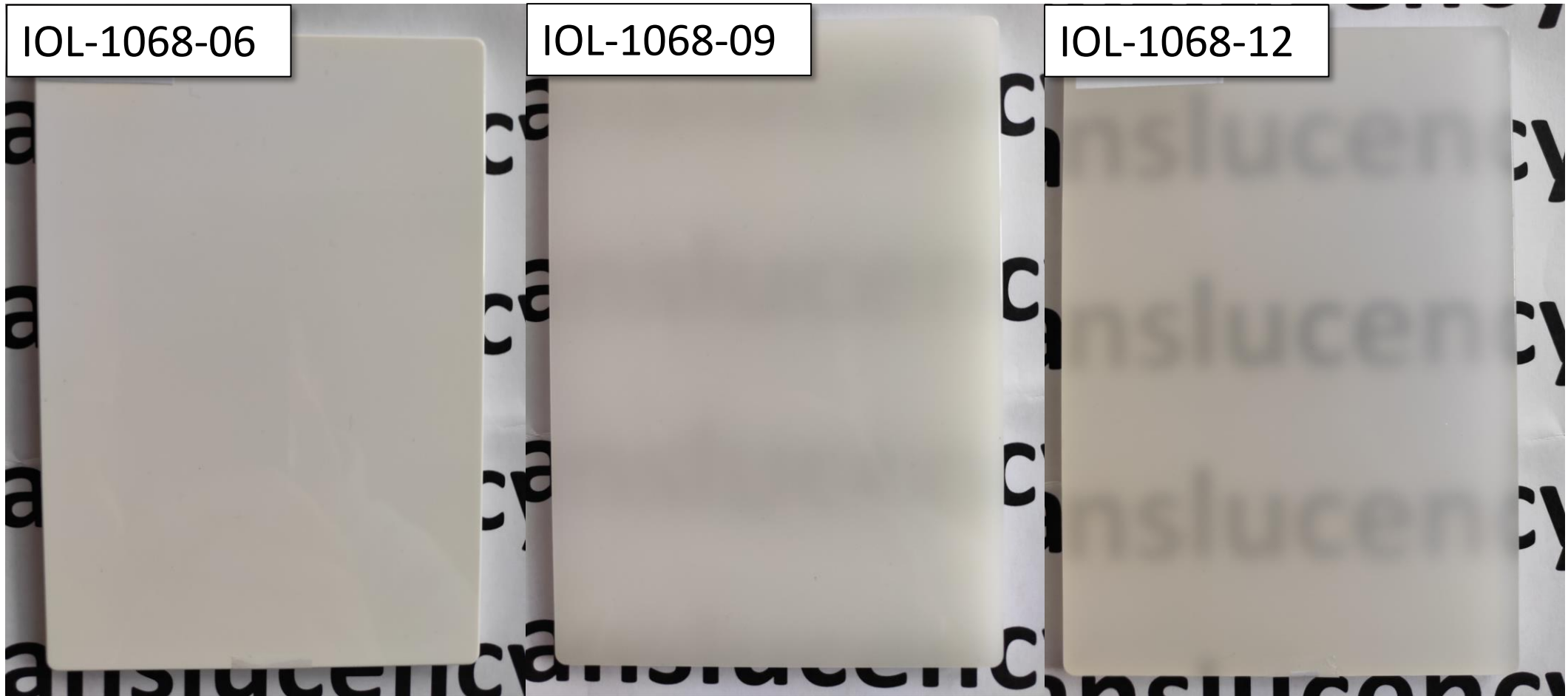
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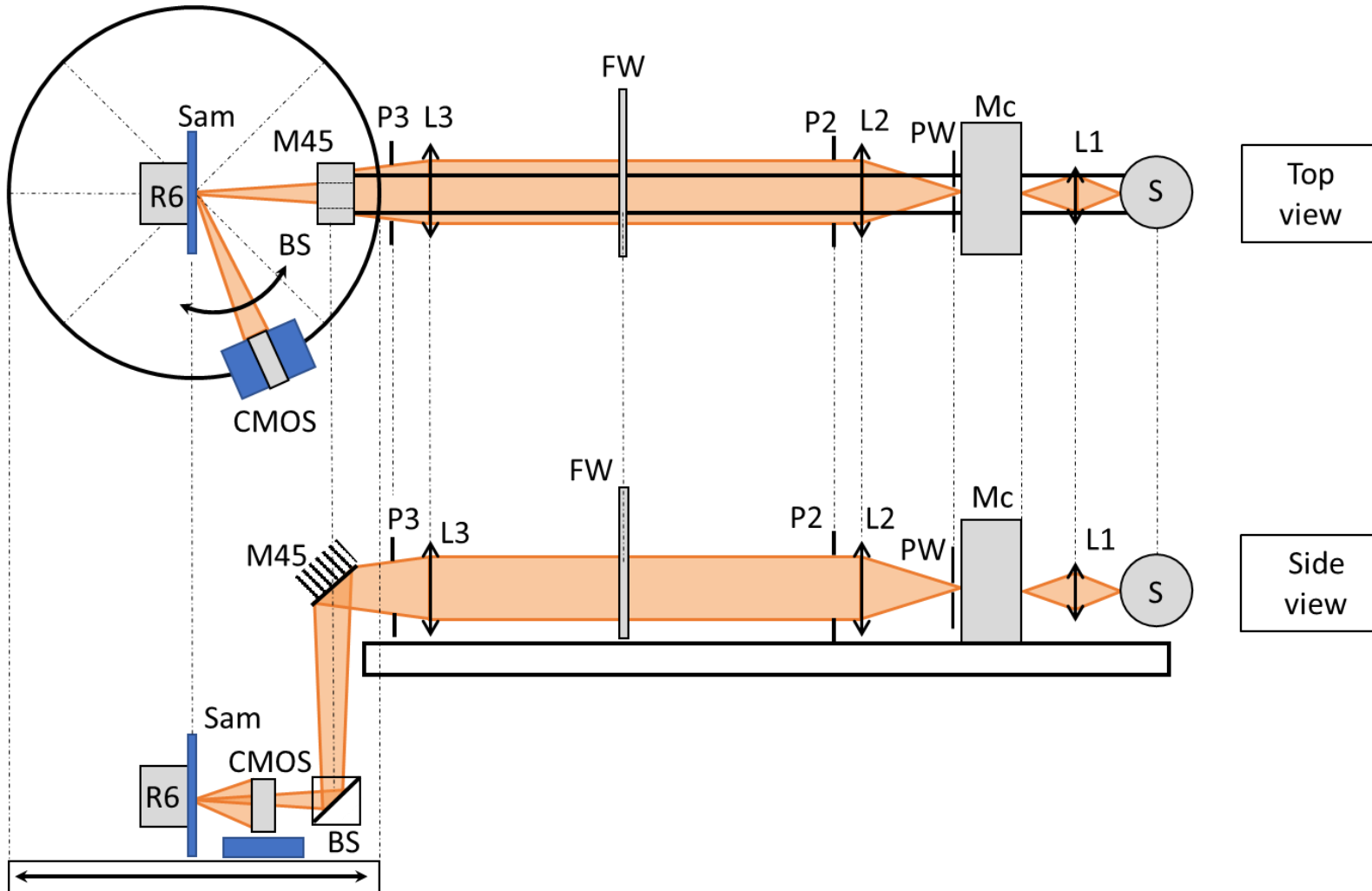
Protocol



Protocol



Experimental setup

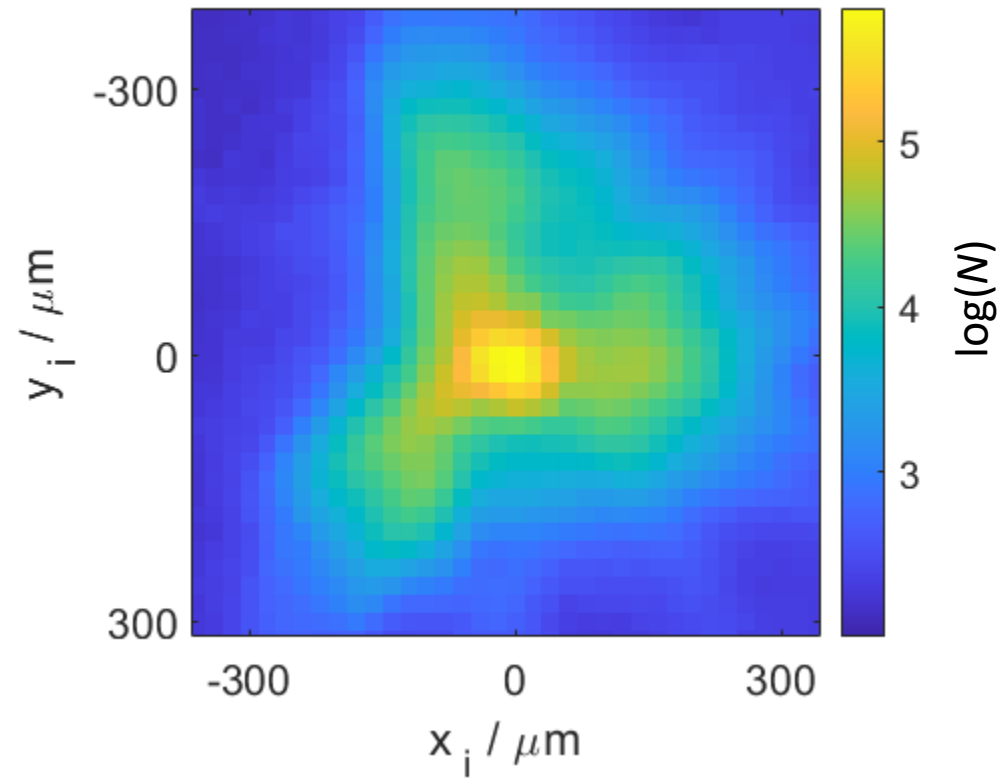


- R6:** 6-axis robot
- Sam:** Sample
- CMOS:** CMOS camera
- BS:** Beam Splitter
- M45:** Mirror at -45°
- P3:** Diaphragm 3
- L3:** Lens 3 (1 m)
- FW:** Filter Wheel
- P2:** Diaphragm 2
- L2:** Lens 2 (75 mm)
- PW:** Pinhole Wheel
- Mc:** Monochromator
- L1:** Lens 1 (35 mm)
- S:** Source (LDLS)

Measurement conditions

Measurement geometries	<ul style="list-style-type: none">• 0°:45°• 45°:0°• 60°:15°
Irradiation area	600 μm beam diameter
Irradiation wavelength	550 nm
Irradiation beam polarization	Unpolarized
Measurement area	12 mm × 12 mm
FOV of a single pixel (approx.)	20 μm × 20 μm
Collection solid angle	$(5.048 \pm 0.012) \times 10^{-3}$ sr
Room temperature	23 °C ± 1 °C
Relative humidity	Lower than 60%

Irradiation spot



N = pixel response in counts/s

Measurement equation

$$f_{SSR}(\mathbf{r}_i, \mathbf{x}_i; \mathbf{r}_r, \mathbf{x}_r) = \frac{dL_r(\mathbf{r}_i, \mathbf{x}_i; \mathbf{r}_r, \mathbf{x}_r)}{d\Phi_i(\mathbf{r}_i, \mathbf{x}_i)} \longrightarrow N \propto \Phi; \quad N \text{ in units of counts/s}$$

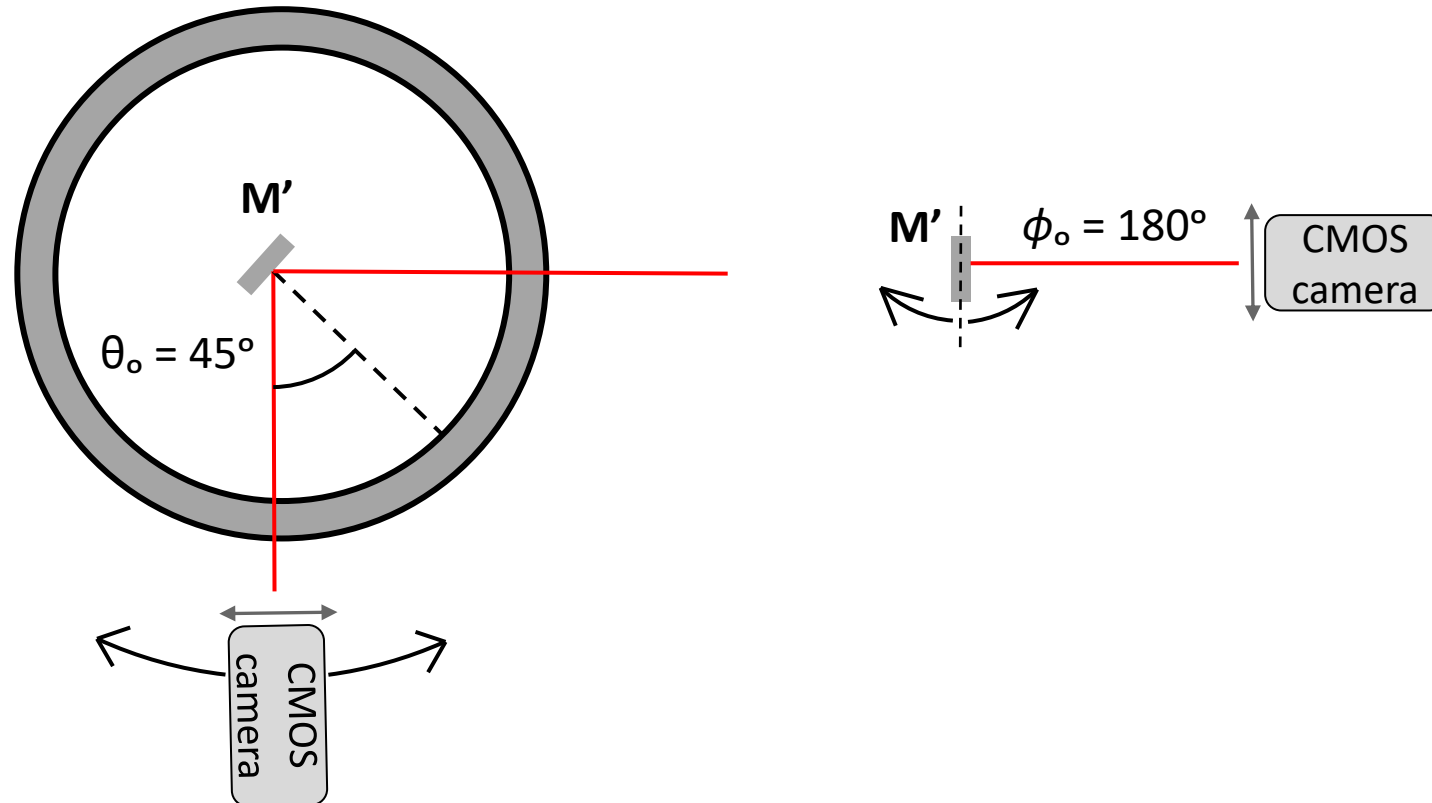
$$f_{SSR}(\mathbf{r}_i, \mathbf{x}_i; \mathbf{r}_r, \mathbf{x}_r) \cong \frac{L_r(\mathbf{r}_i, \mathbf{x}_i; \mathbf{r}_r, \mathbf{x}_r)}{\Phi_i(\mathbf{r}_i, \mathbf{x}_i)}$$

$$\longrightarrow L_r(\mathbf{r}_i, \mathbf{x}_i; \mathbf{r}_r, \mathbf{x}_r) \cong \frac{\Phi_r(\mathbf{r}_i, \mathbf{x}_i; \mathbf{r}_r, \mathbf{x}_r)}{A_r \cos \theta_r \omega_r}$$

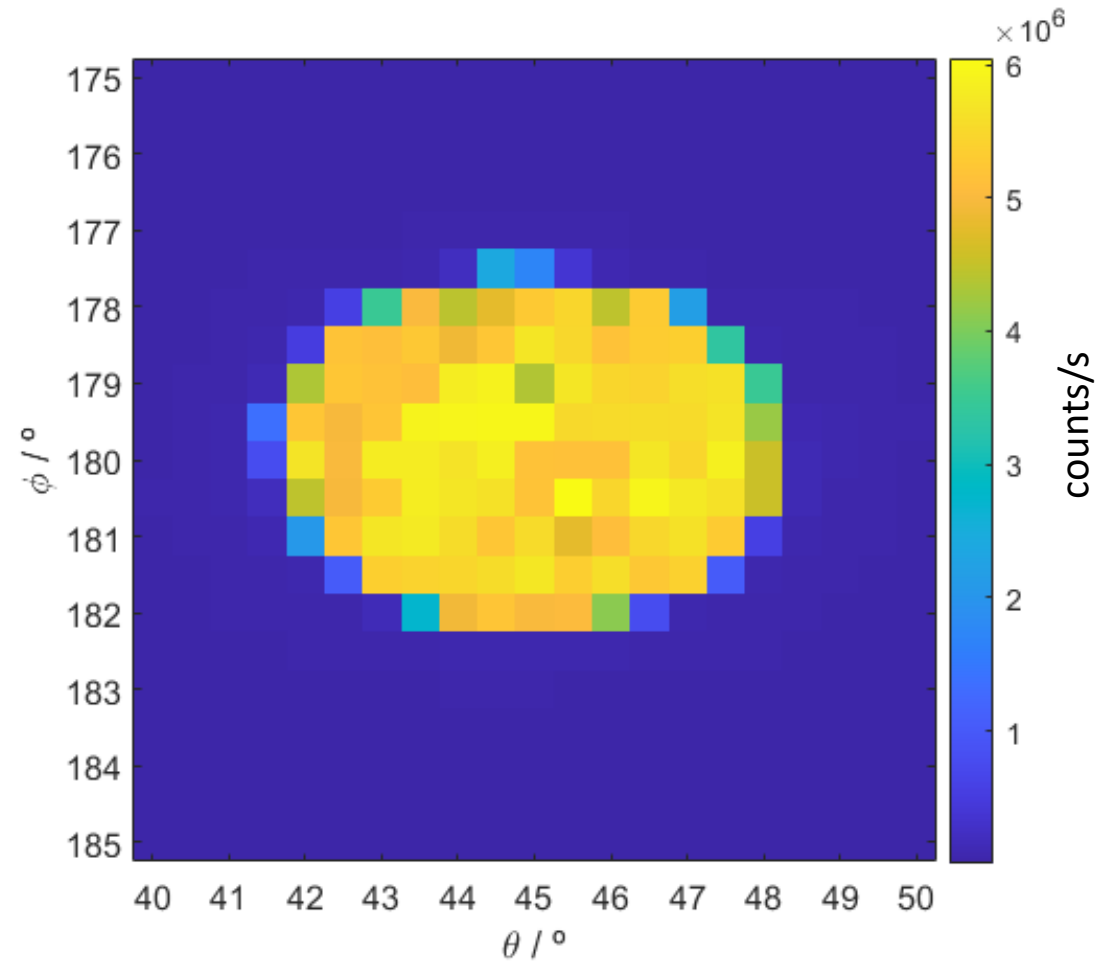
$$f_{SSR,k}(\mathbf{r}_i, \mathbf{x}_i; \mathbf{r}_r, \mathbf{x}_r) \cong \frac{\tau_i}{A_r \cos \theta_r \omega_r} \frac{N_{r,k}}{\sum_{k \in A_i} N_{i,k}}$$

$$f_{SSR}(\mathbf{r}_i, \mathbf{x}_i; \mathbf{r}_r, \mathbf{x}_r) \cong \frac{1}{A_r \cos \theta_r \omega_r} \frac{\Phi_r(\mathbf{r}_i, \mathbf{x}_i; \mathbf{r}_r, \mathbf{x}_r)}{\Phi_i(\mathbf{r}_i, \mathbf{x}_i)}$$

Collection solid angle



Collection solid angle



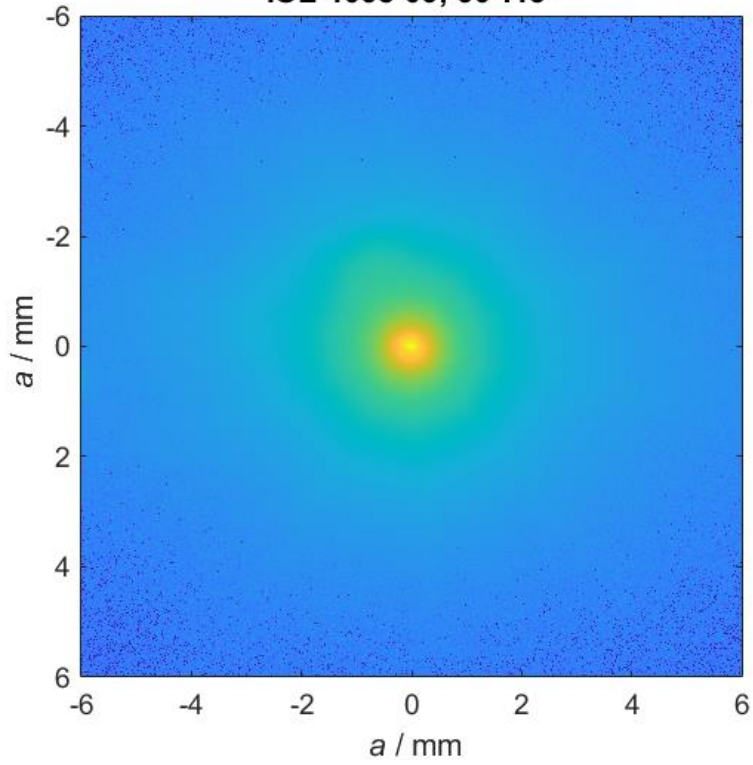
Detection system



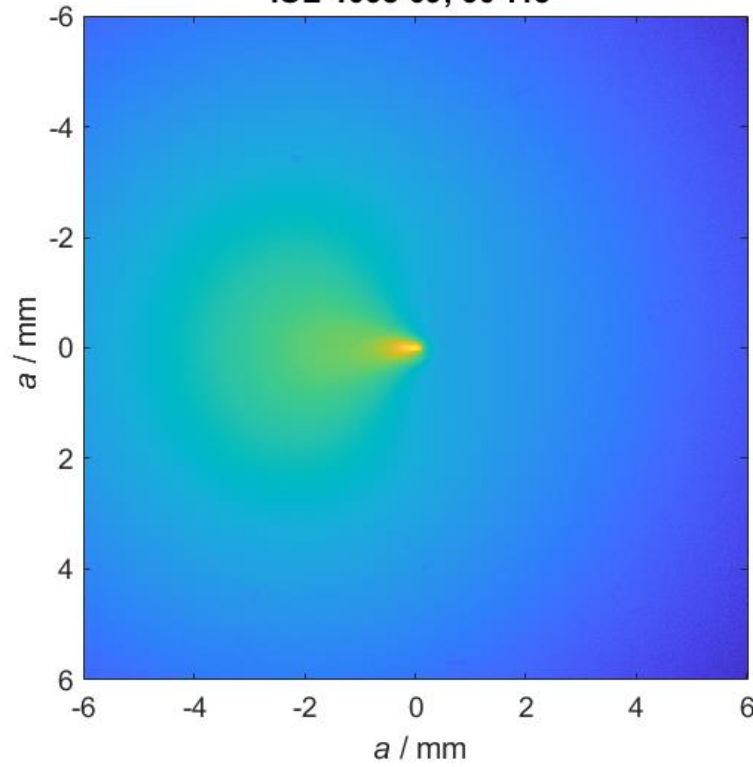
Sensor characteristics	Calculated value
Size	2048 pixels × 2048 pixels
Pixel size	6.5 μm × 6.5 μm
Readout noise, σ_r	0.86 electrons rms
Conversion factor, K	2.1 counts/electron
Dark current, s_t	0.011 electrons/s/pixel

Results

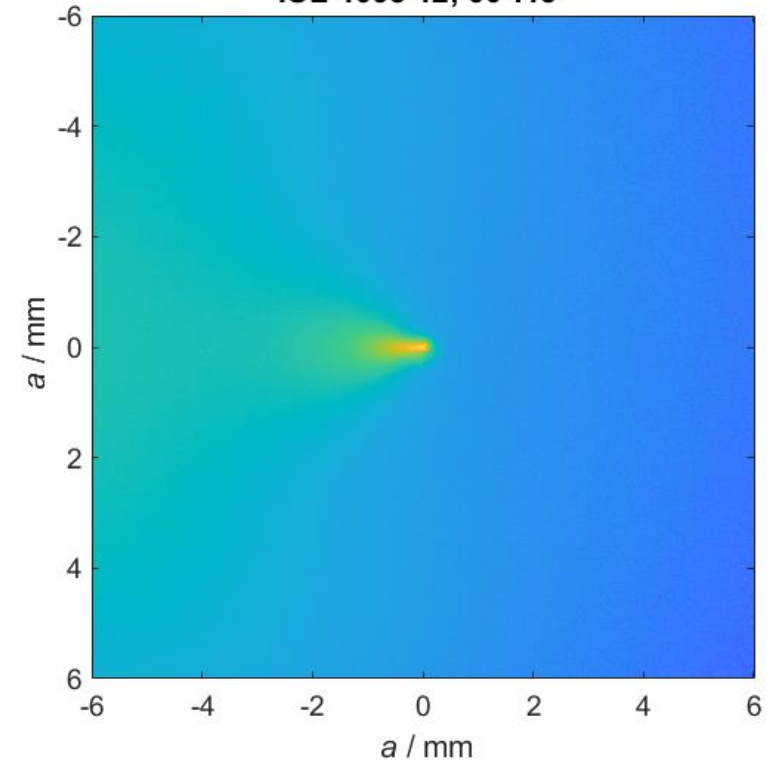
IOL-1068-06; 60°:15°



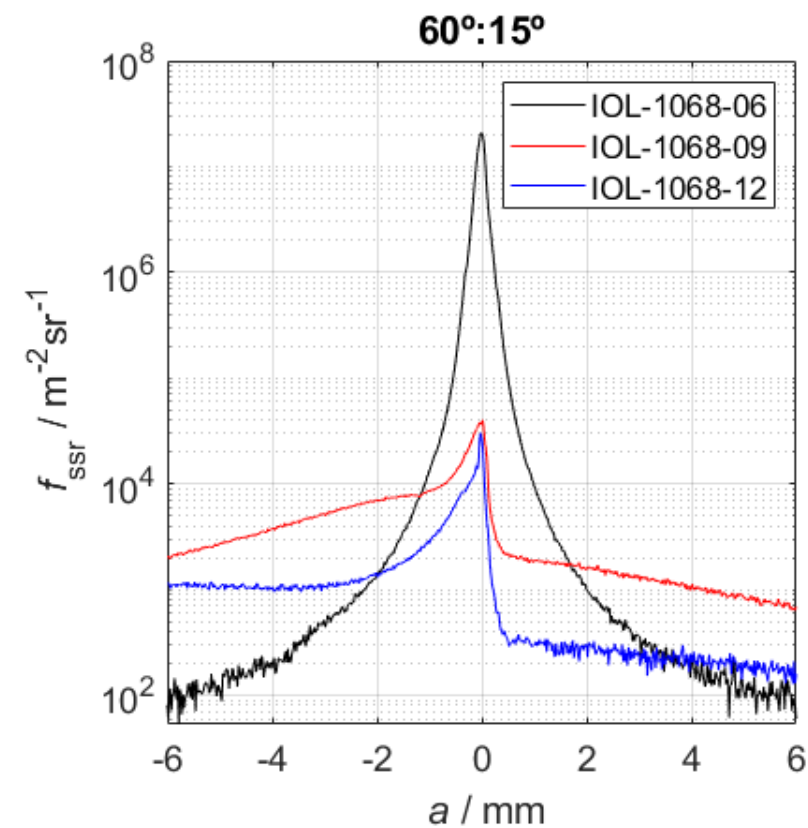
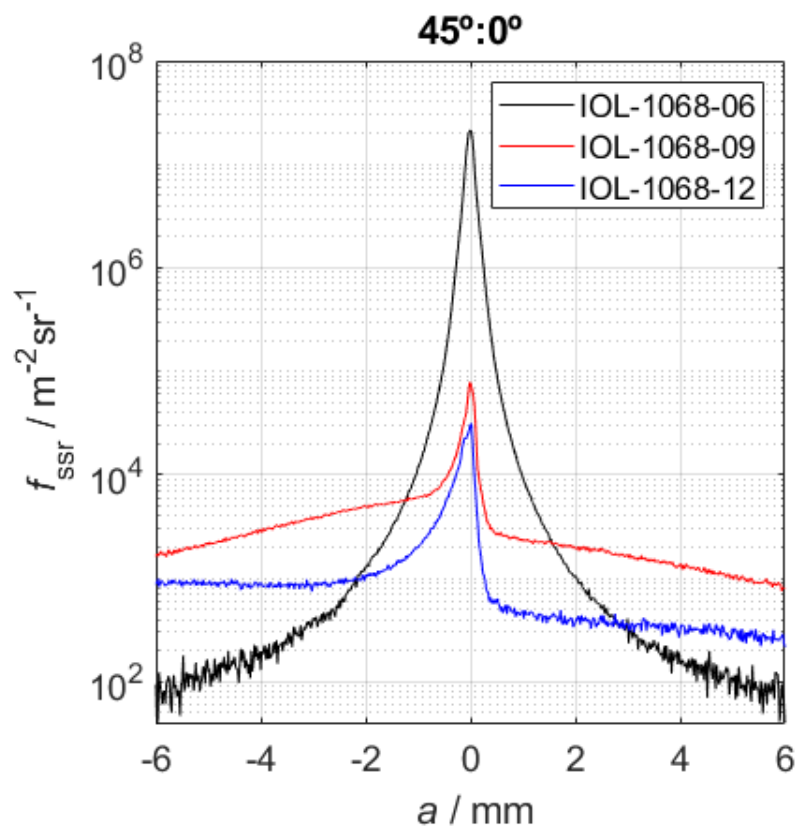
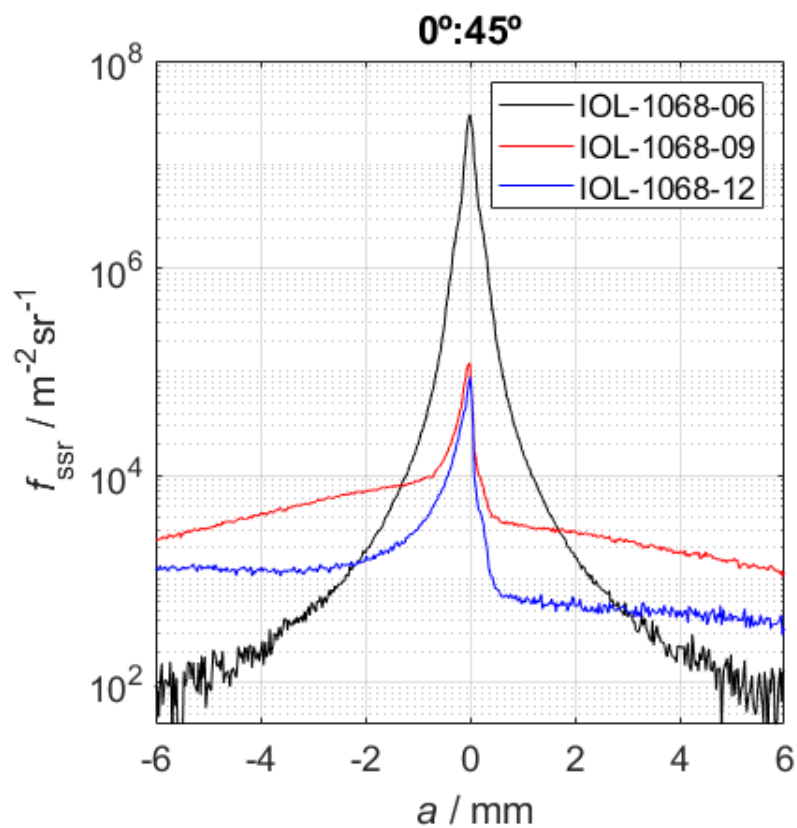
IOL-1068-09; 60°:15°



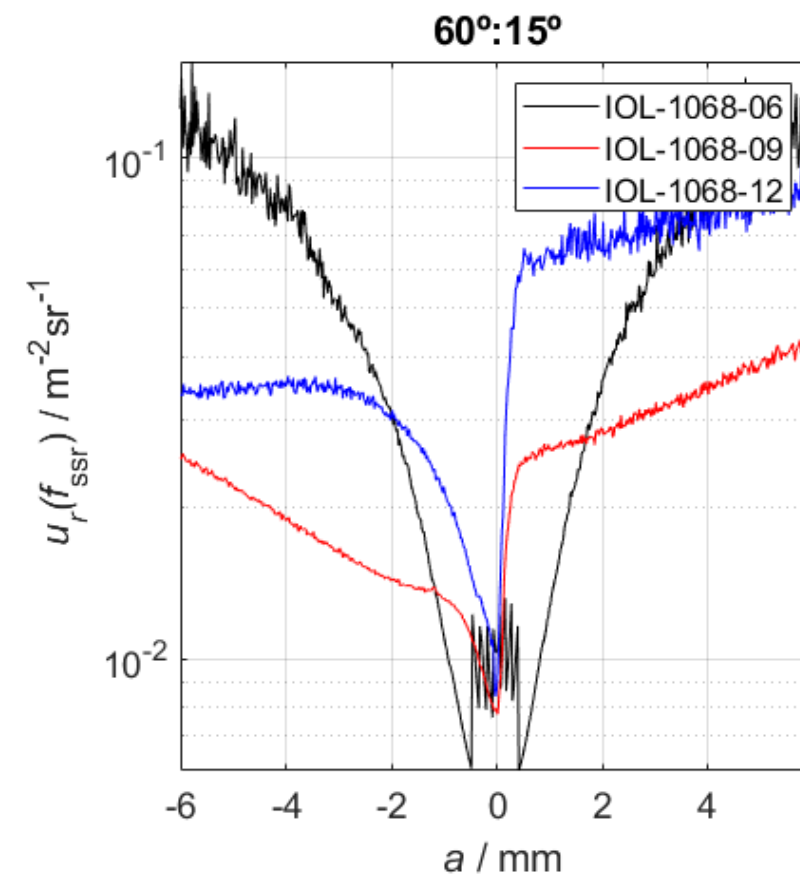
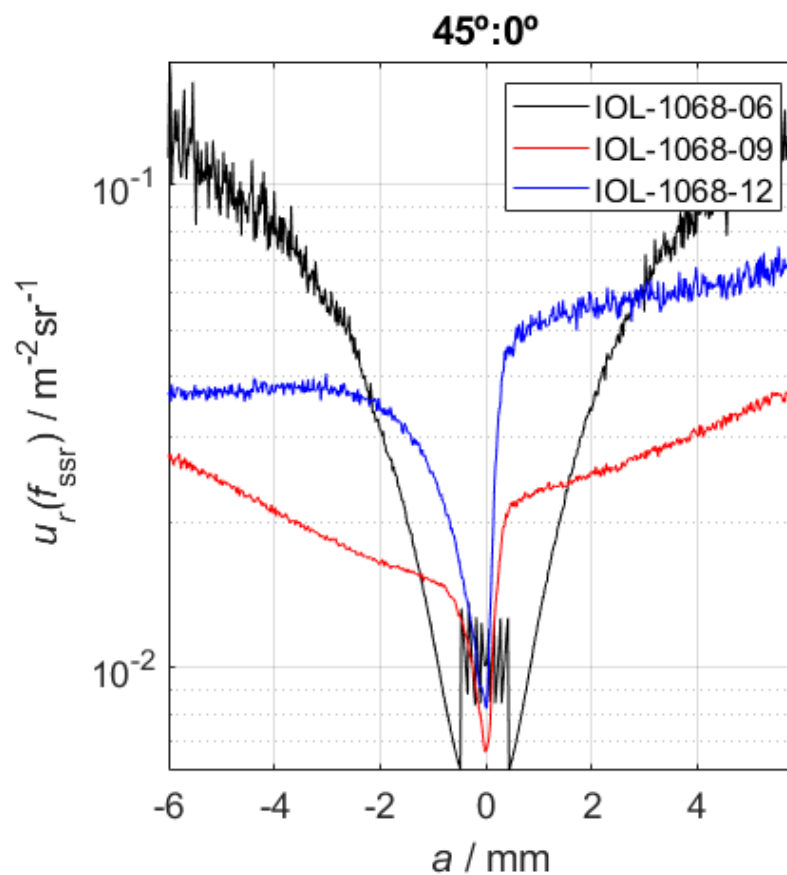
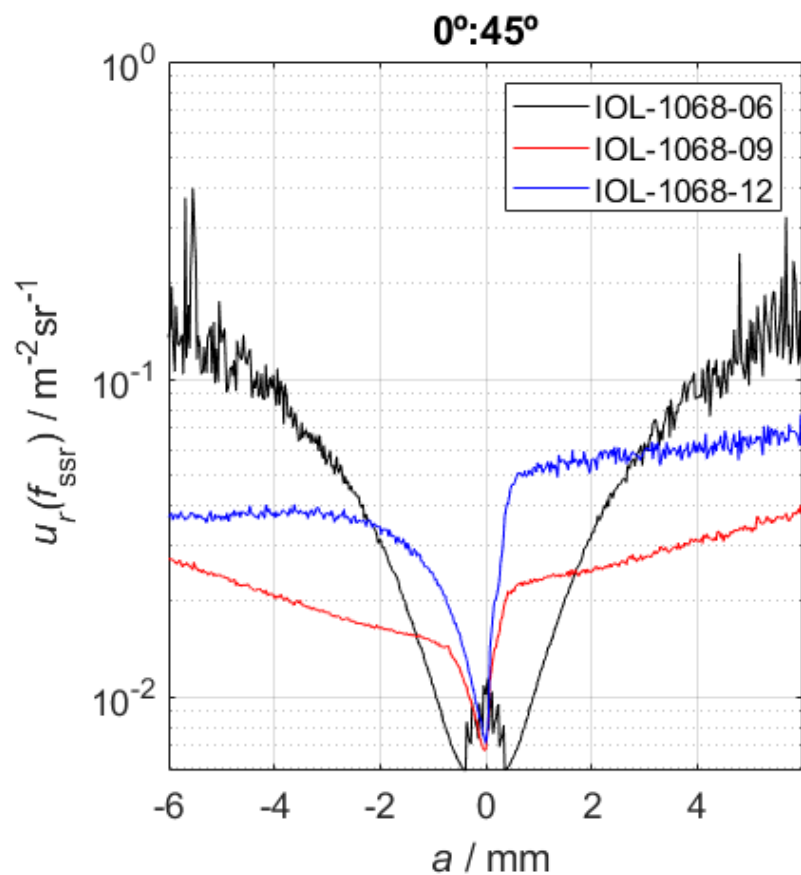
IOL-1068-12; 60°:15°



Results



Relative uncertainties (k=1)



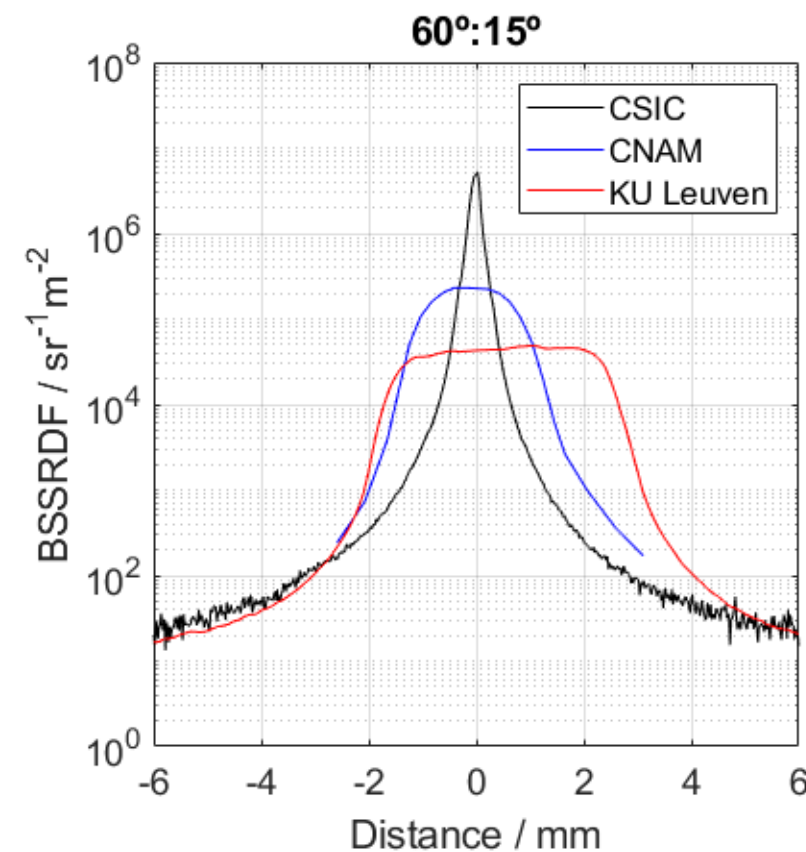
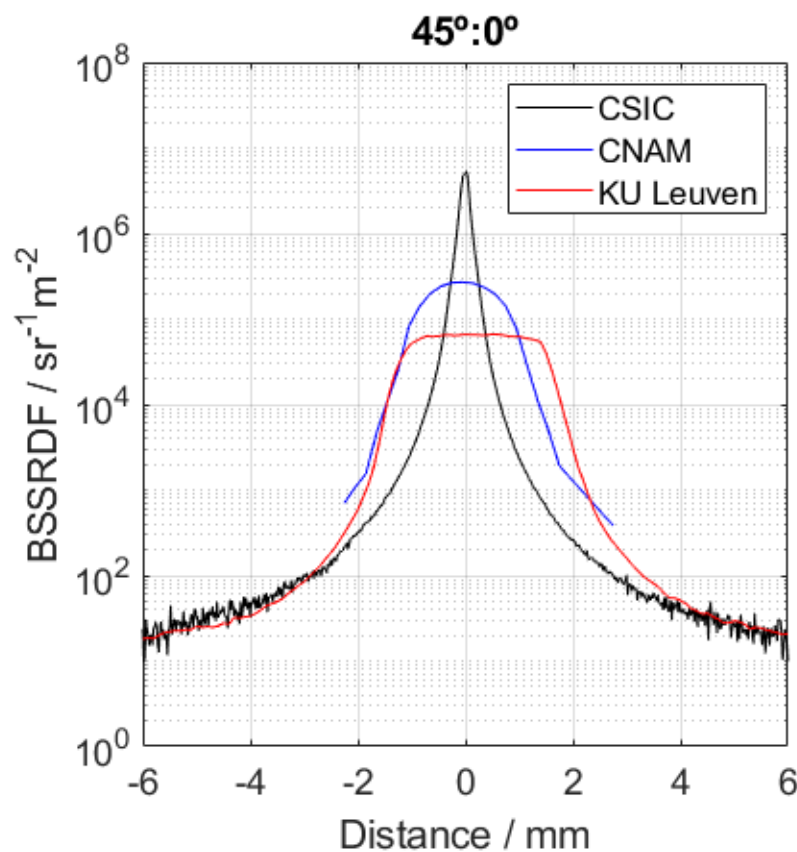
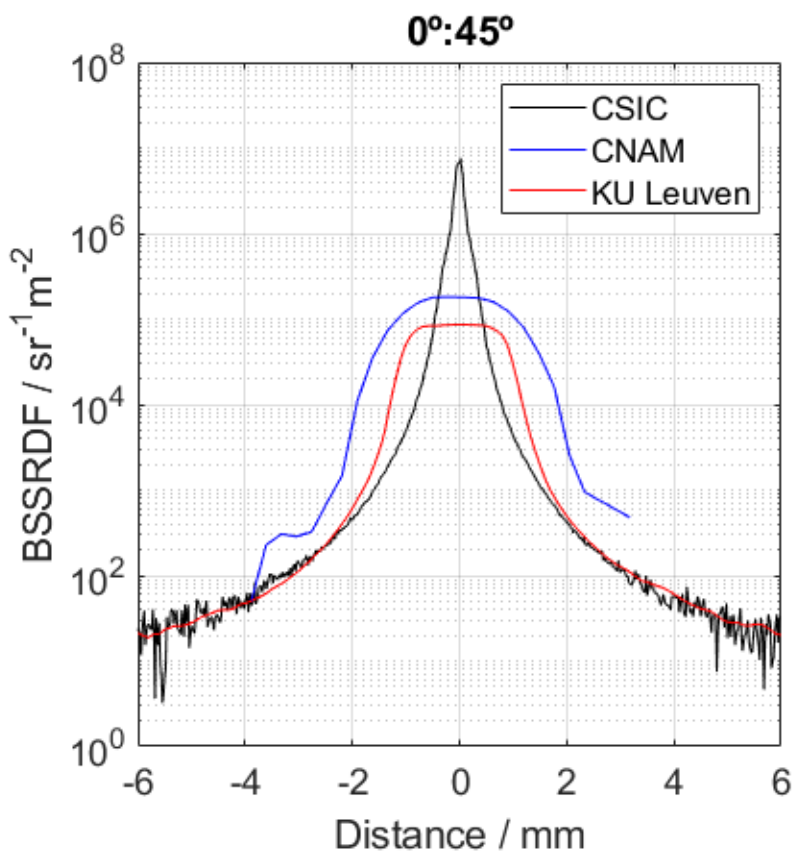


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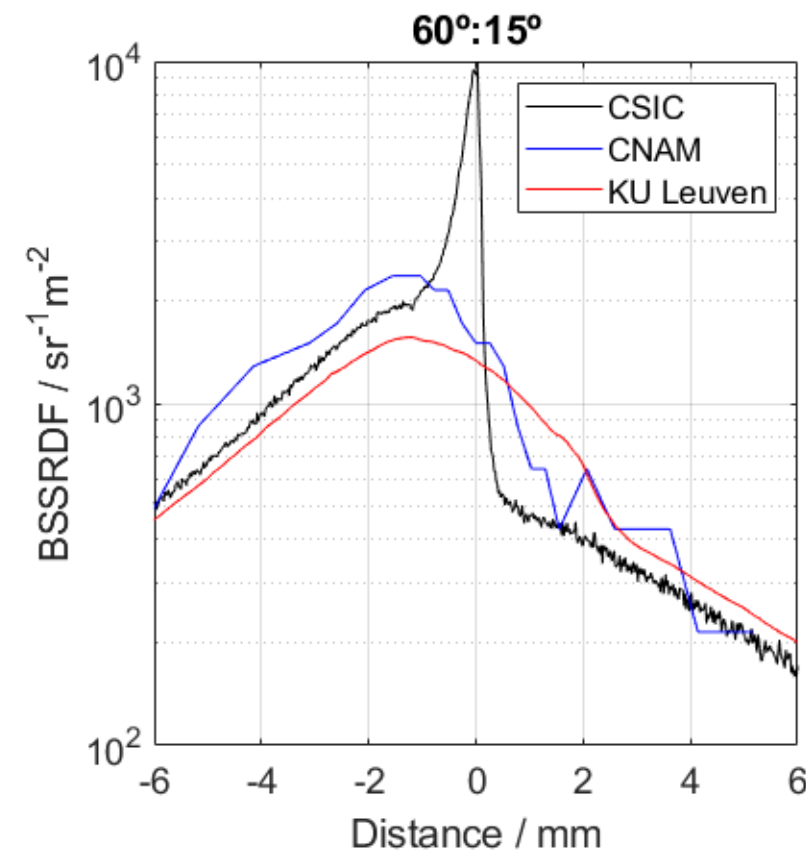
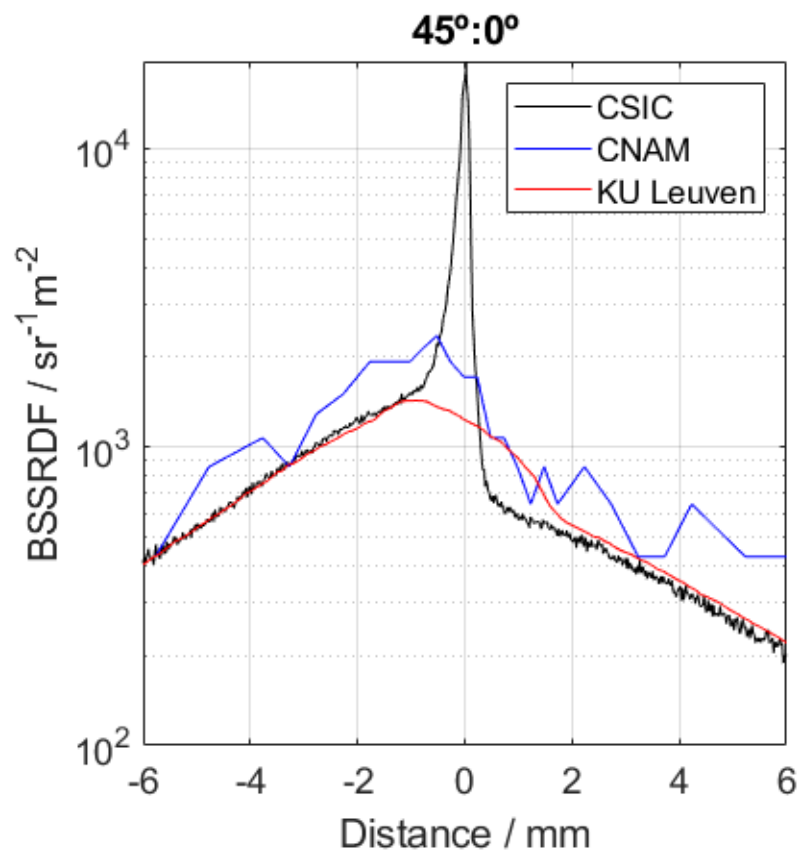
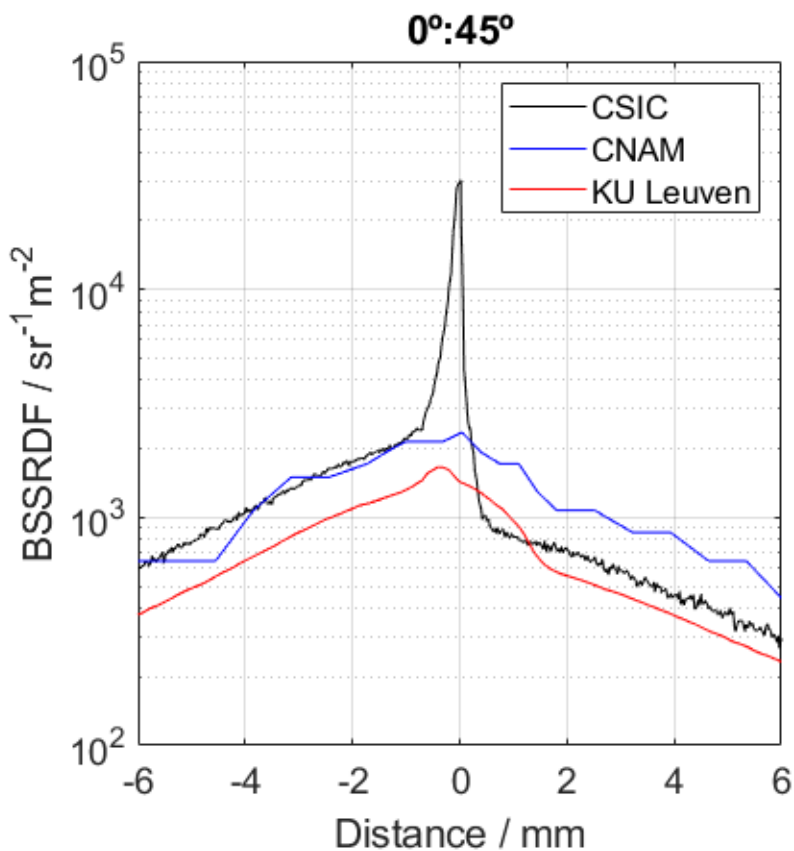


Comparison of BSSRDF measurements from KU Leuven, CNAM & CSIC

IOL-1068-06

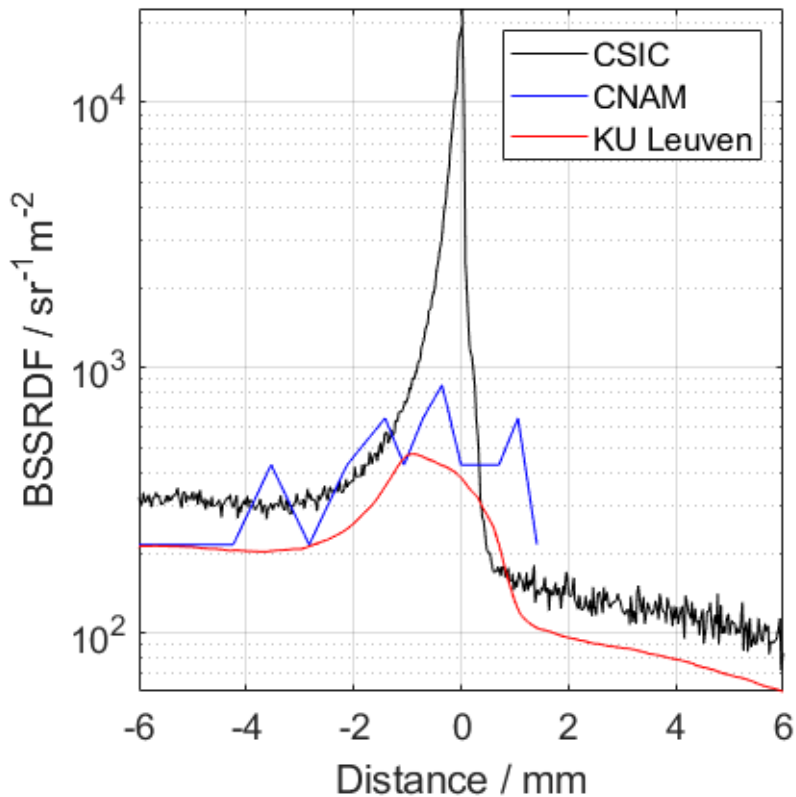


IOL-1068-09

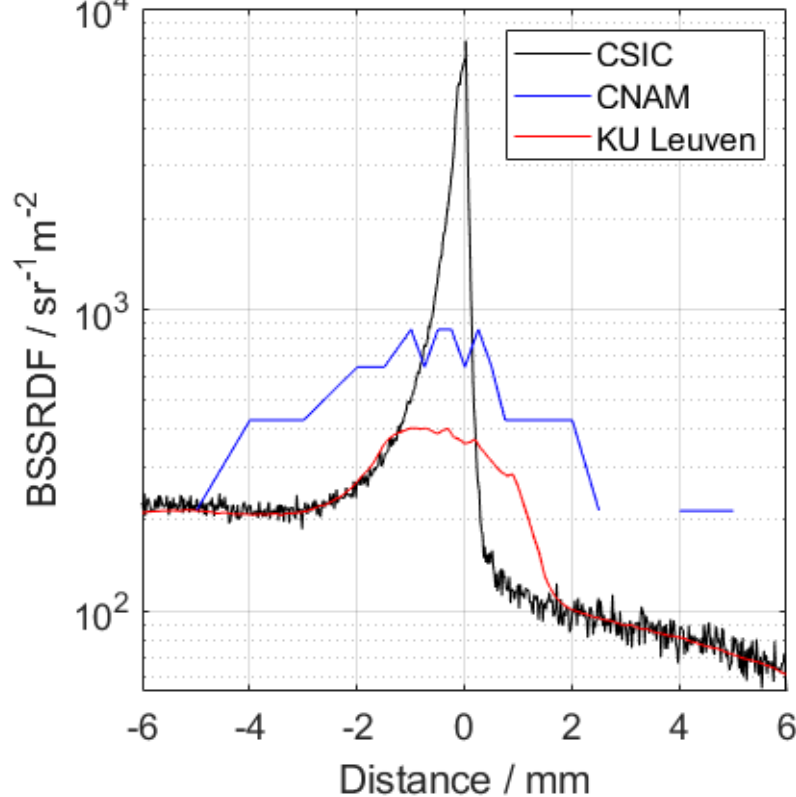


IOL-1068-12

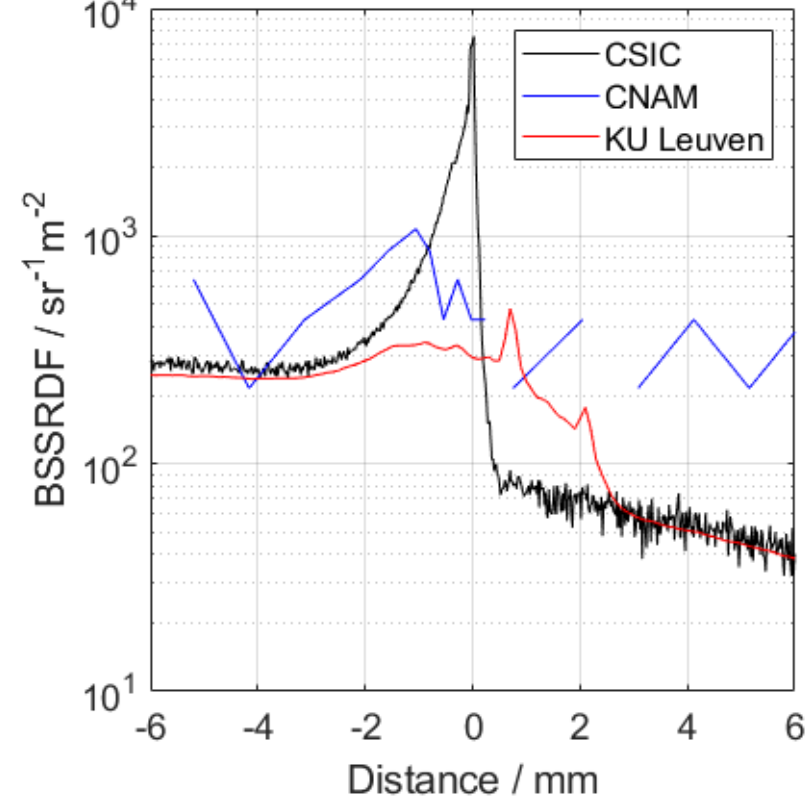
0°:45°



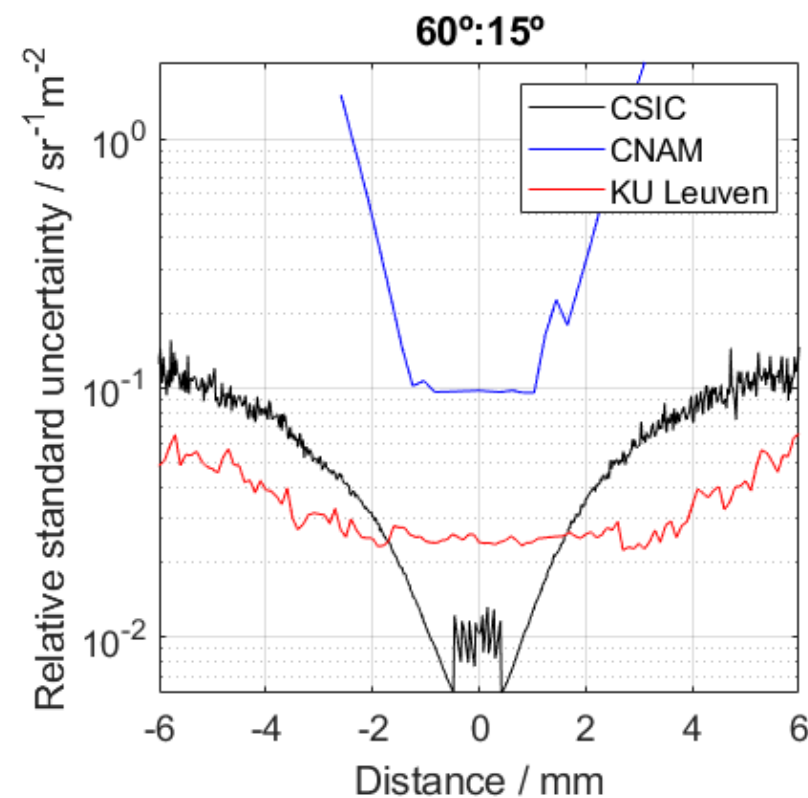
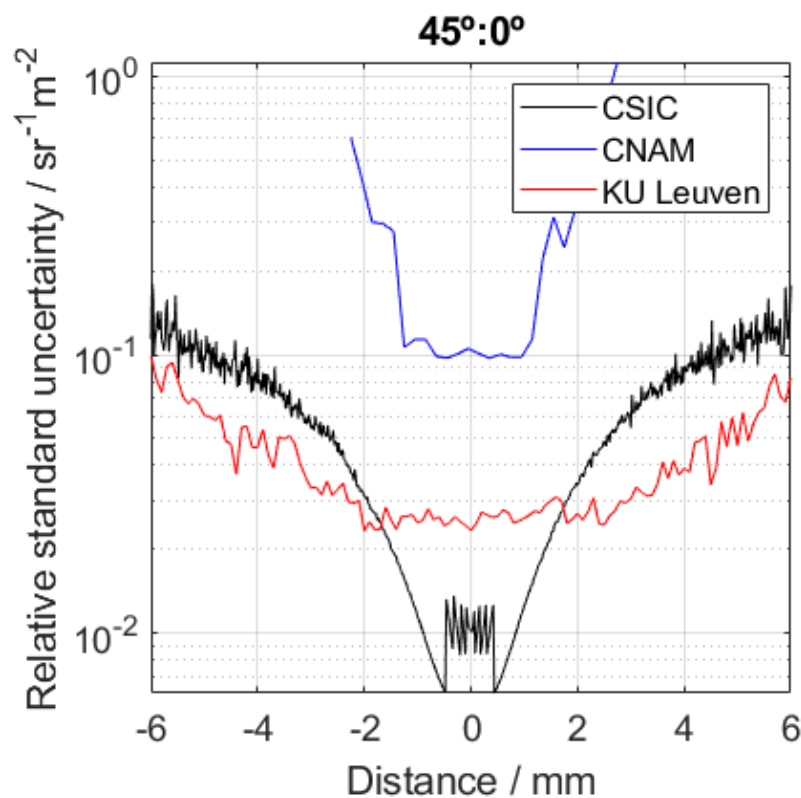
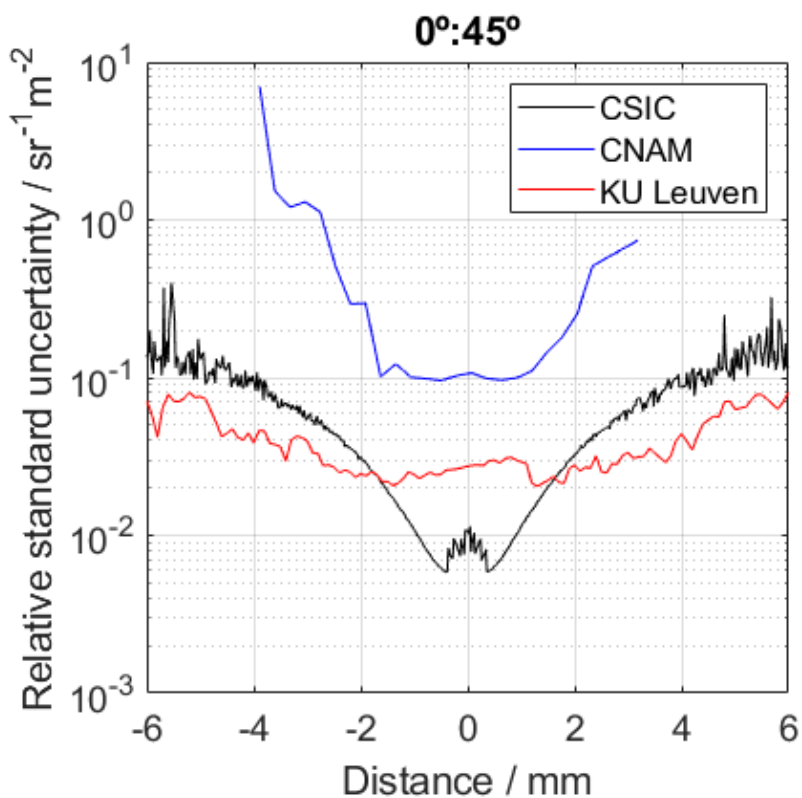
45°:0°



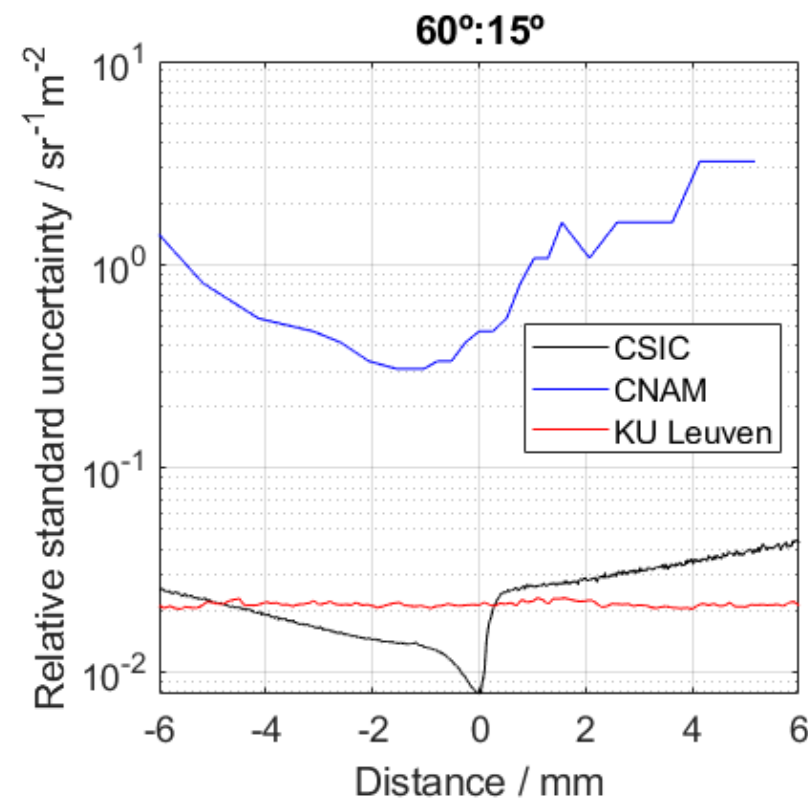
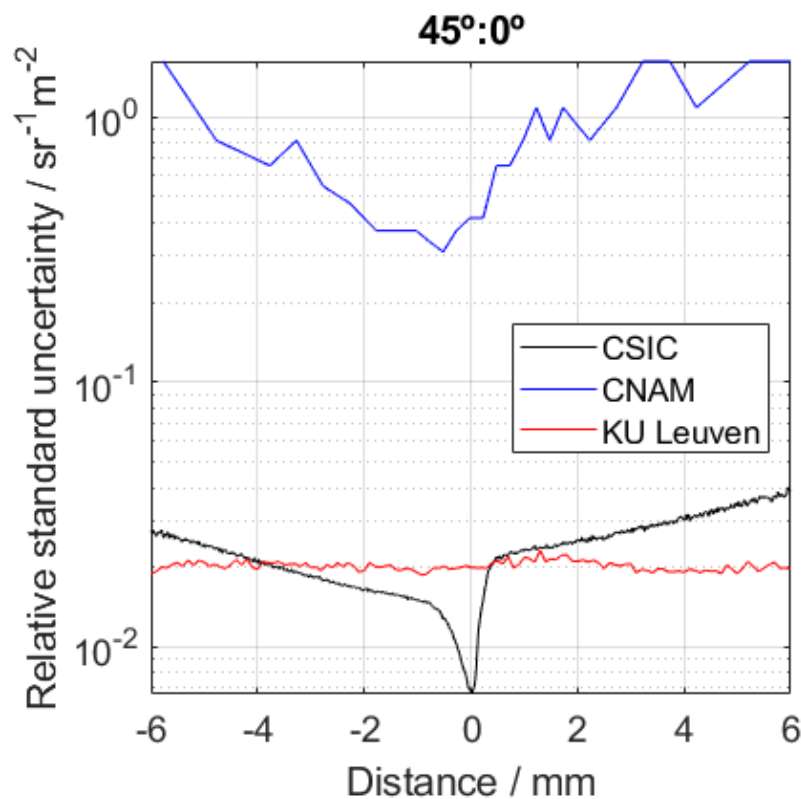
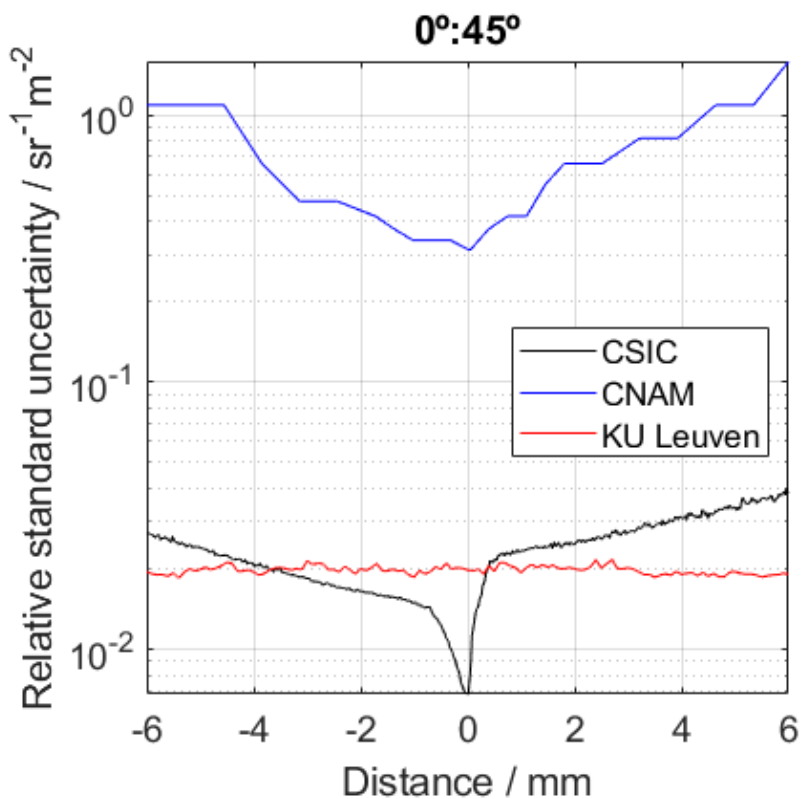
60°:15°



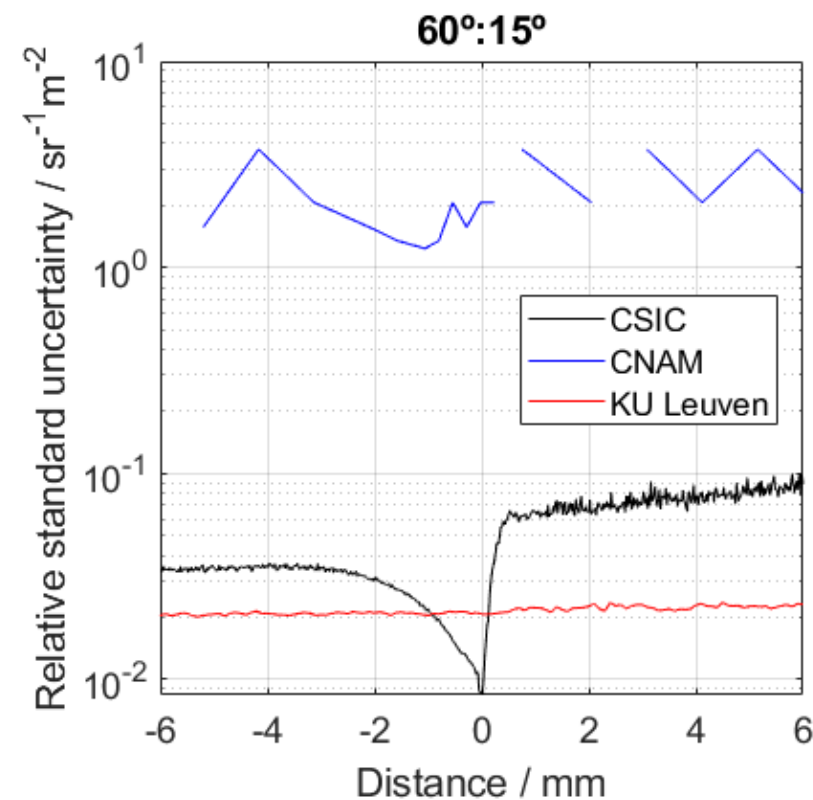
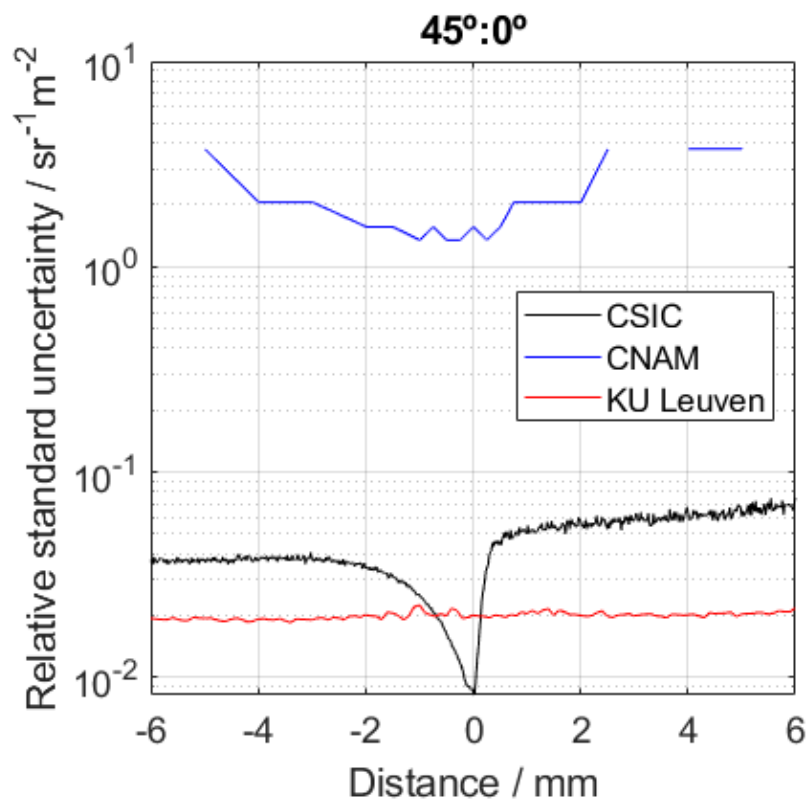
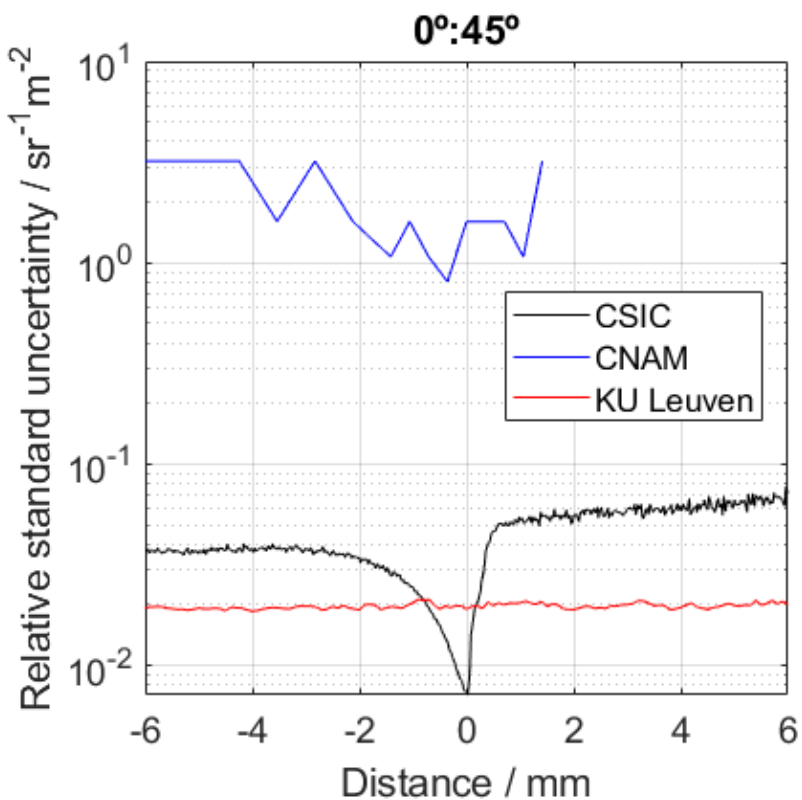
IOL-1068-06



IOL-1068-09



IOL-1068-12





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Thanks for your attention

