Status of the radiator quality test

Roland Hohler
for the GSI PANDA barrel DIRC Group

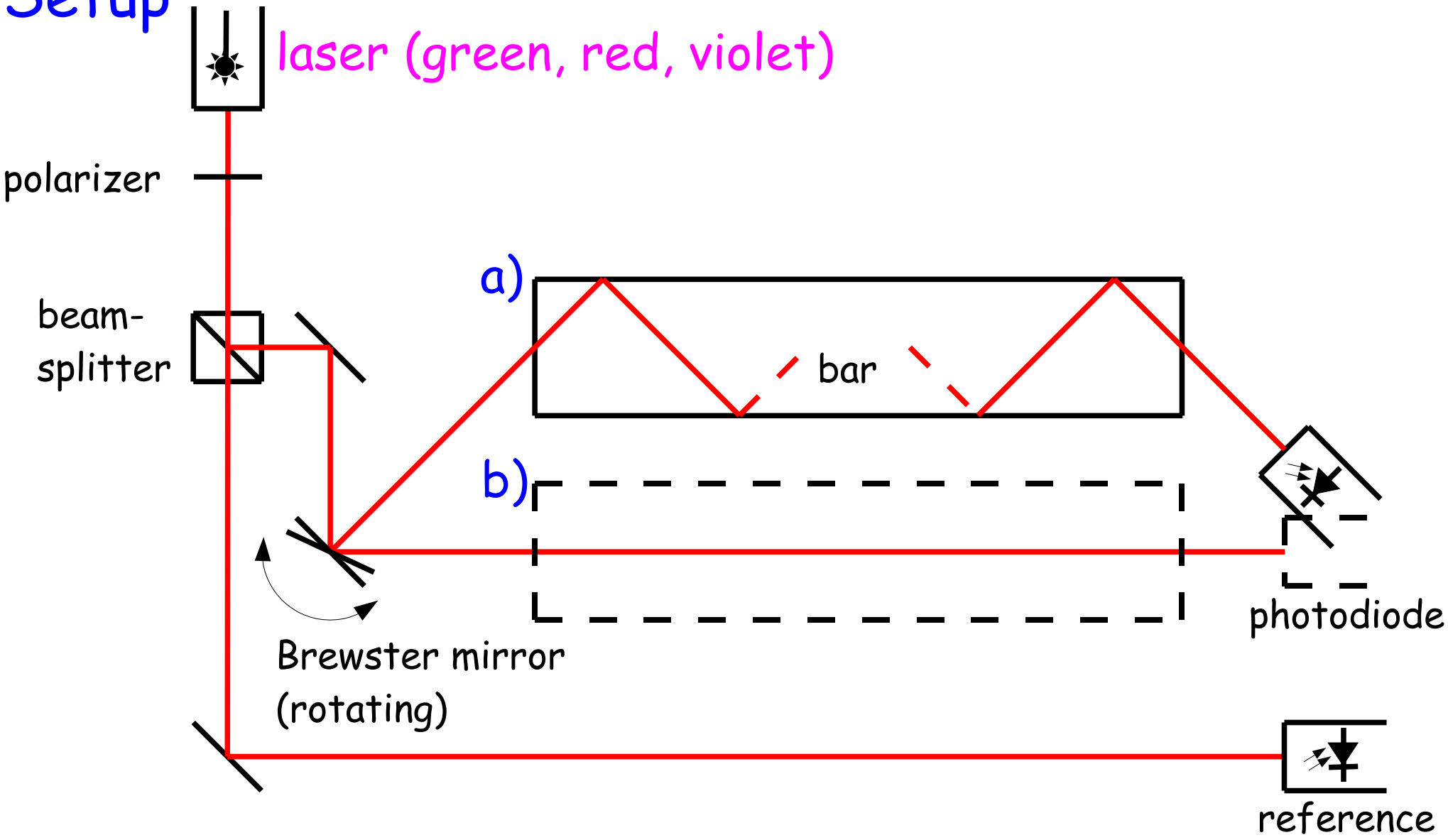
GSI, Darmstadt
Goethe University Frankfurt

PANDA Collaboration Meeting
December 7-11, 2009
at GSI

Outline

- Setup for the radiator quality test
- Systematics of multiple wavelengths
- Bulk attenuation measurement
- Systematics of the Brewster mirror
- Internal reflection coefficient measurement

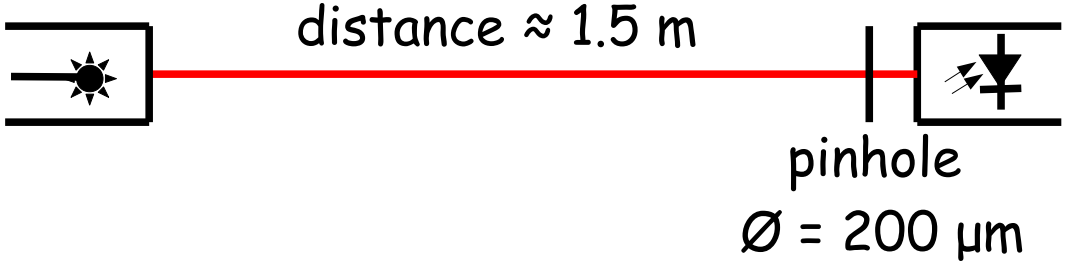
Setup



a) internal reflection coefficient

b) bulk attenuation

Laser beam profiles

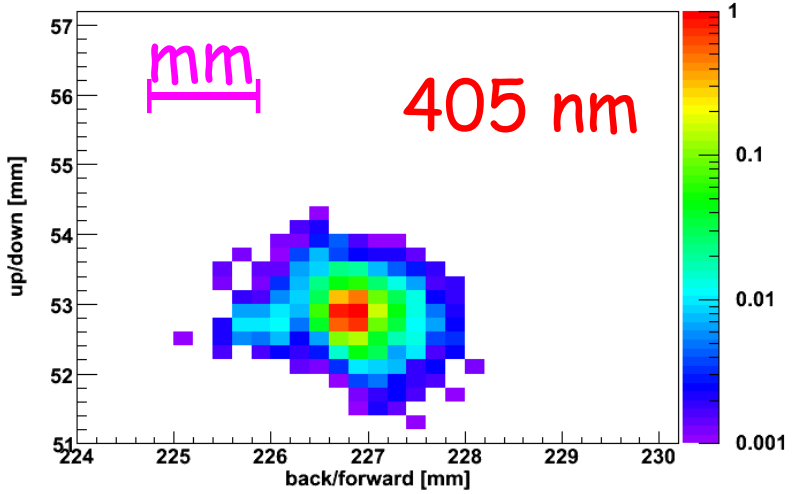


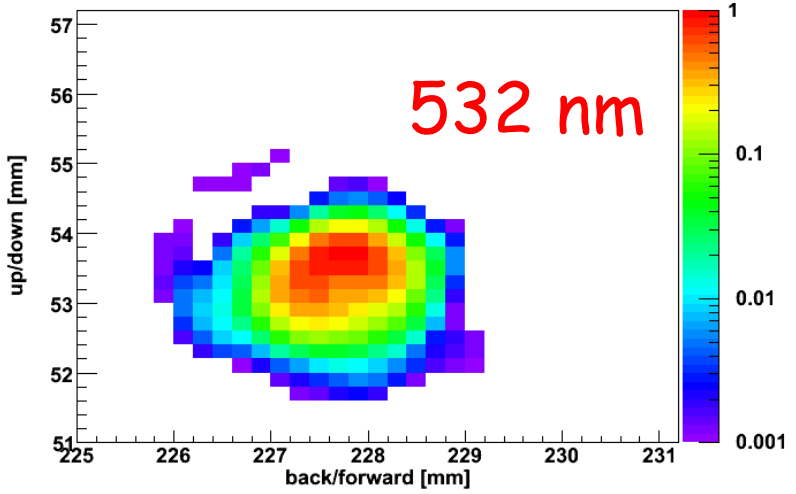
2D-Gauss-fit

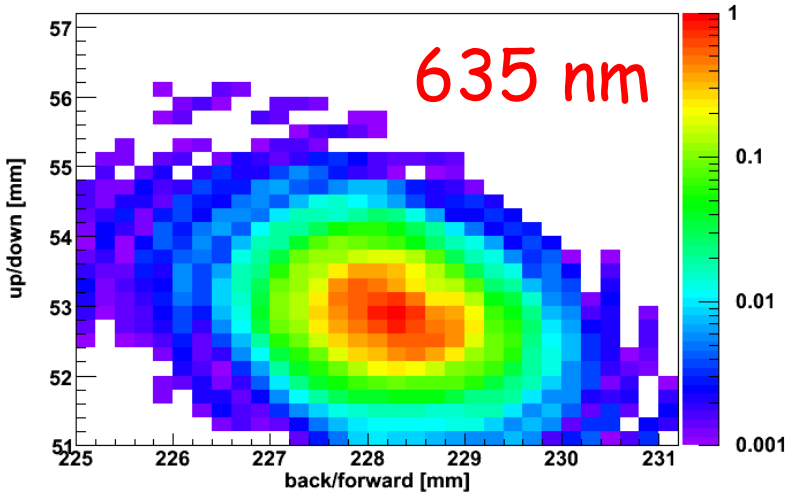
405 nm: σ = 0.16 ± 0.10 mm

532 nm: σ = 0.39 ± 0.04 mm

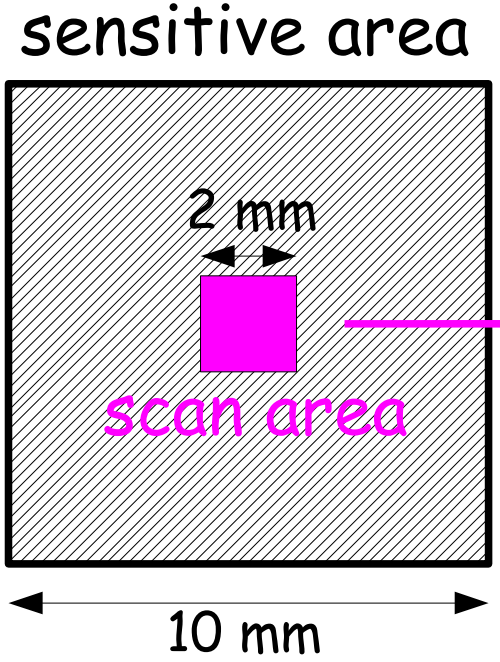
635 nm: σ = 0.52 ± 0.05 mm



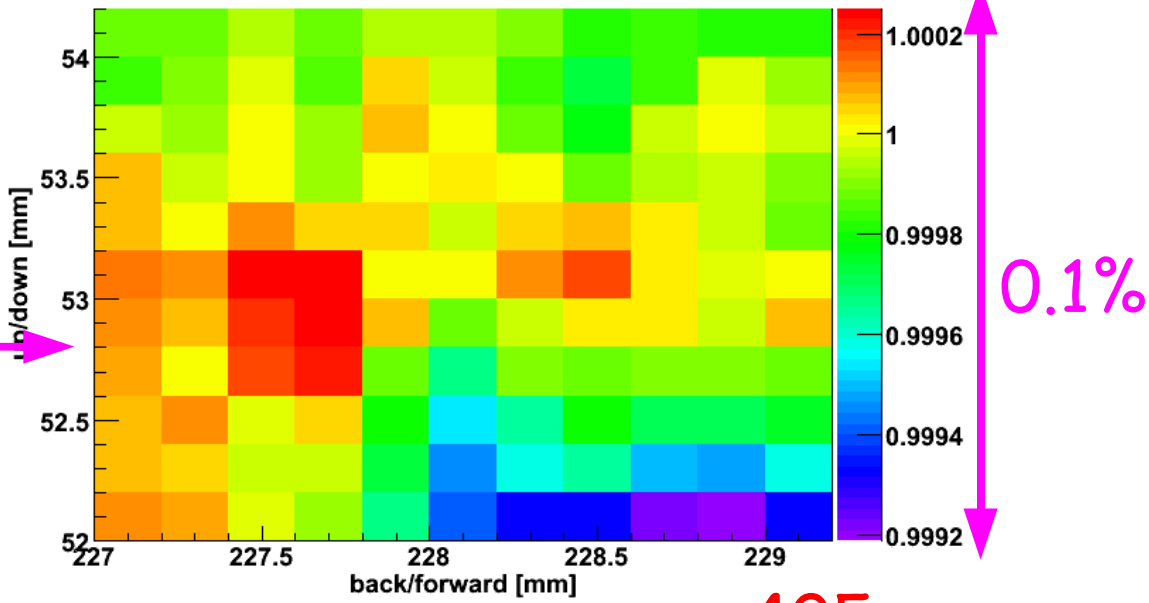




Photodiode uniformity

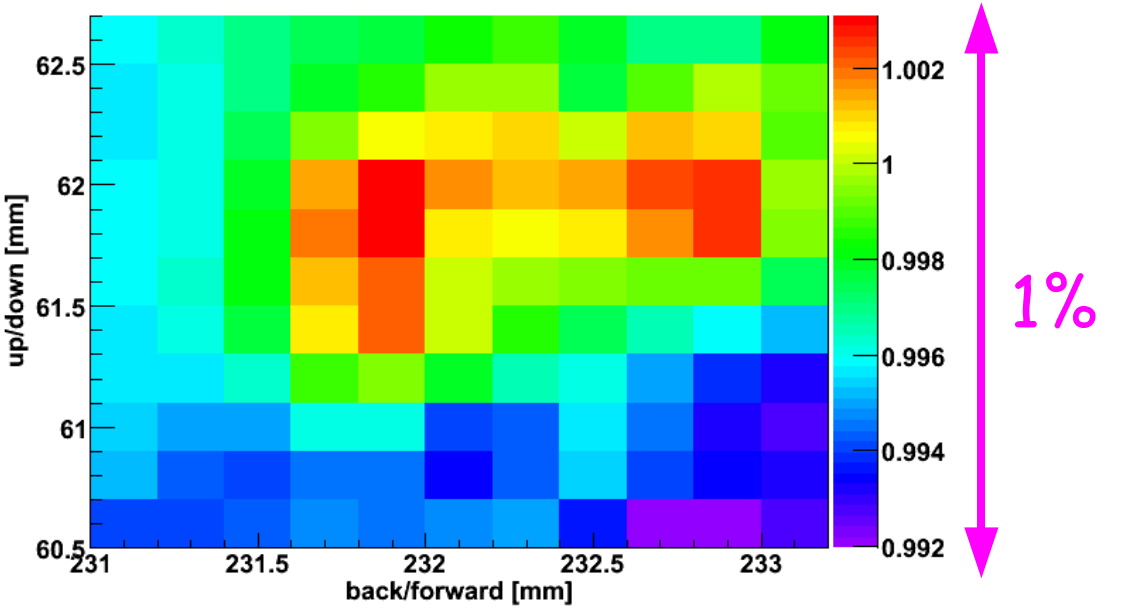


532 nm



0.1%

405 nm



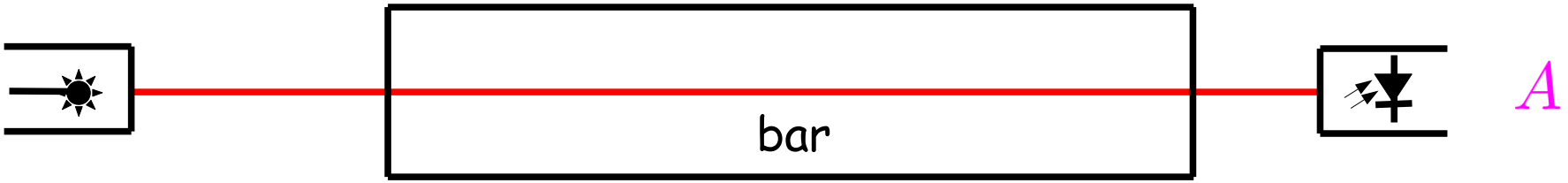
1%

405 nm: Δ_{uni} = 2.8 ‰

532 nm: Δ_{uni} = 0.27 ‰

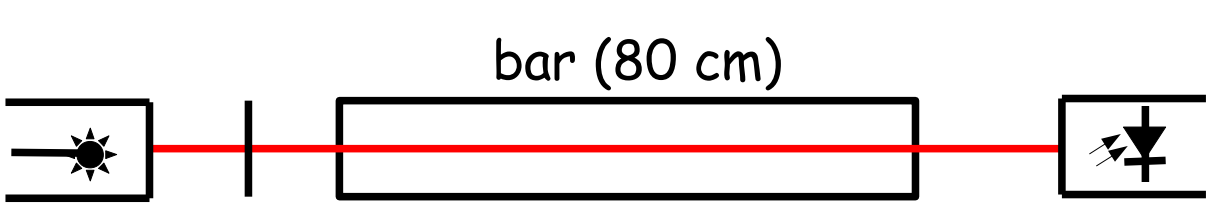
635 nm: Δ_{uni} = 0.21 ‰

Bulk attenuation measurement

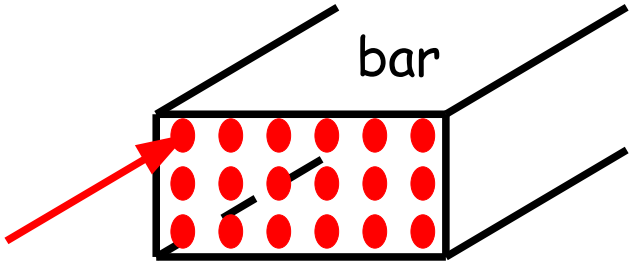


transmission: $T = \frac{A}{B}$

Bulk attenuation (635 nm, Lithotec bar)



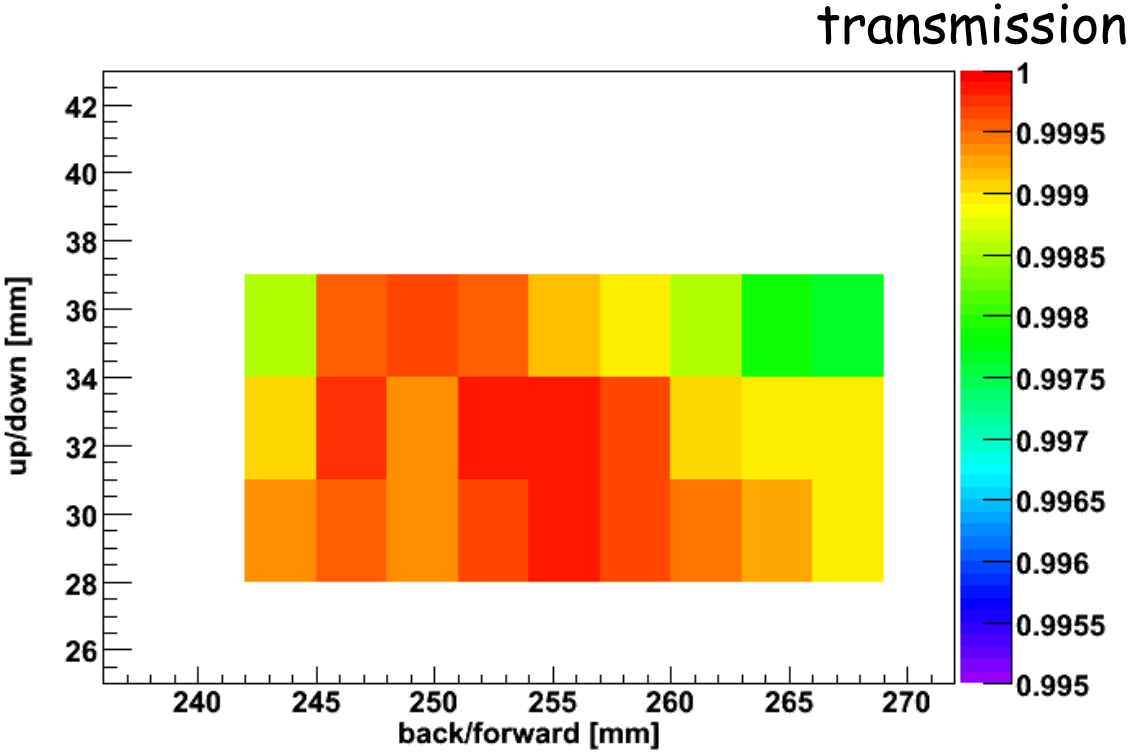
aperture
5 mm



w/o aperture => T >1

T = 0.99923 ± 0.00056

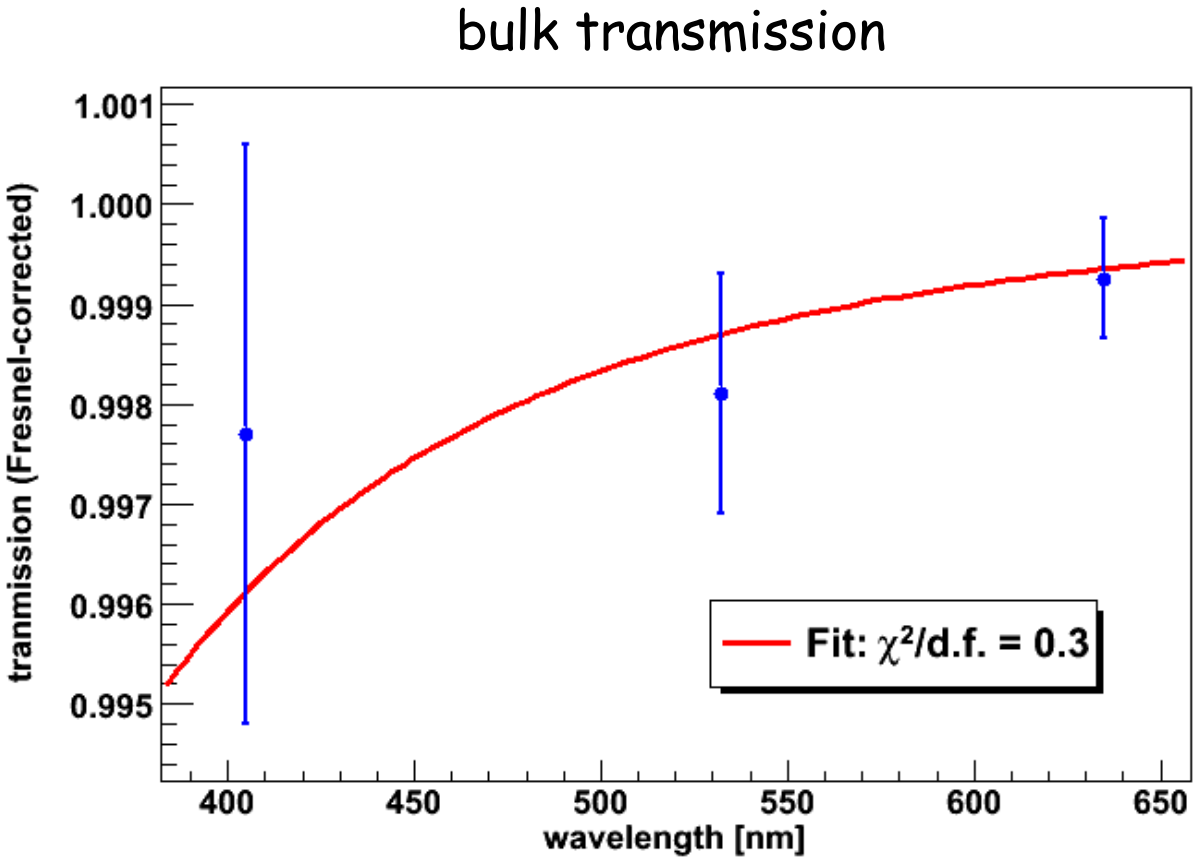
$$T = \exp\left(-\frac{L}{\Lambda}\right)$$



Λ = 973 ± 760 m

T/[m] = 0.99897 ± 0.00060

Bulk transmission vs. wavelength (Lithothec bar)



405 nm: uncertainty dominated by photodiode inhomogeneity

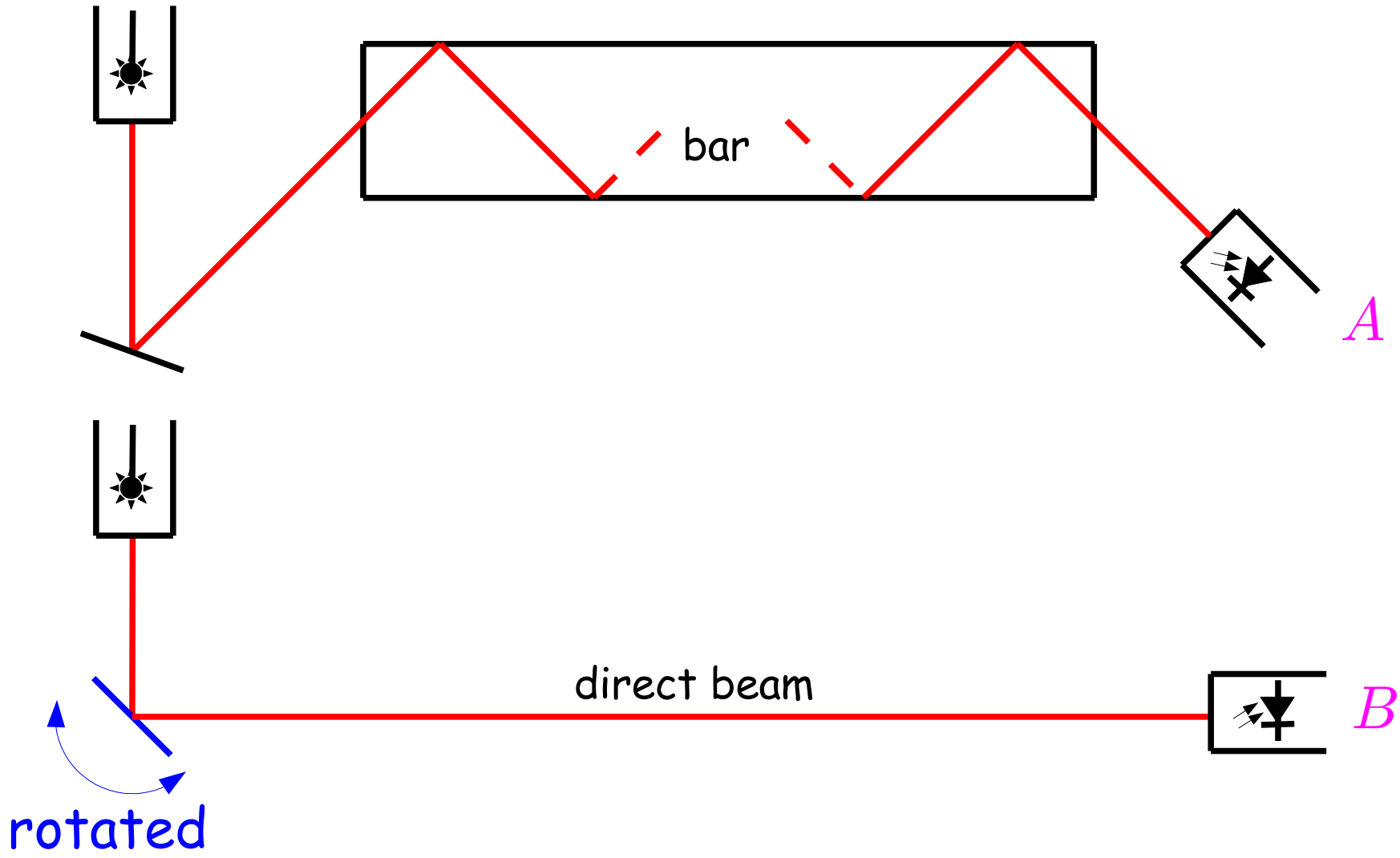
532/635 nm: uncertainty dominated by bar inhomogeneity

$$T = \exp\left(-\frac{L}{\Lambda_0} \cdot \left(\frac{\lambda_0}{\lambda}\right)^4\right)$$

Rayleigh scattering

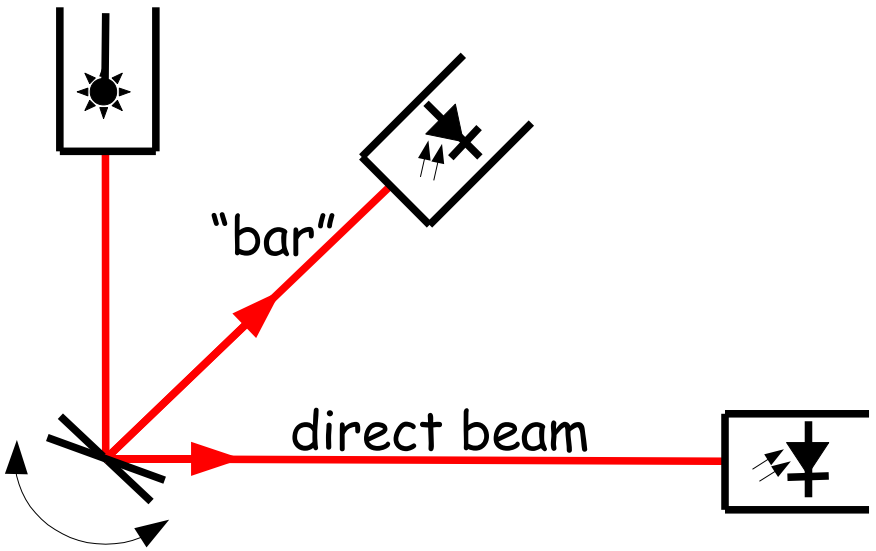
data is consistent with the expectation

Internal reflection coefficient measurement



transmitted intensity: $I = \frac{A}{B}$

Mirror correction



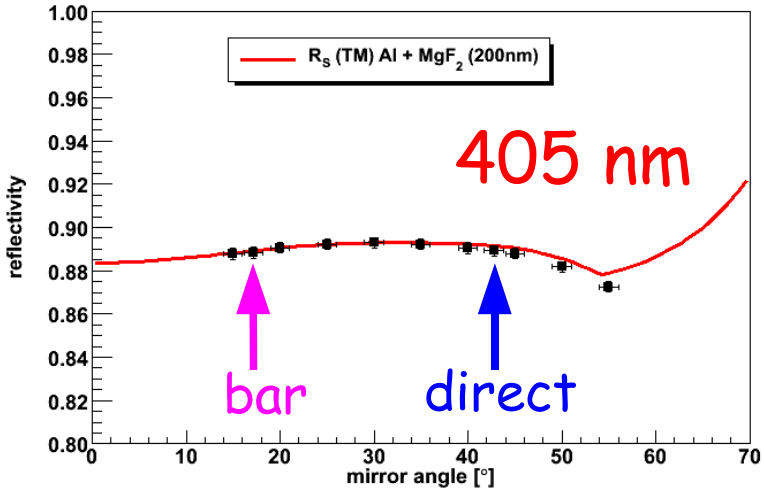
mirror: Al + MgF_2 (200 nm)

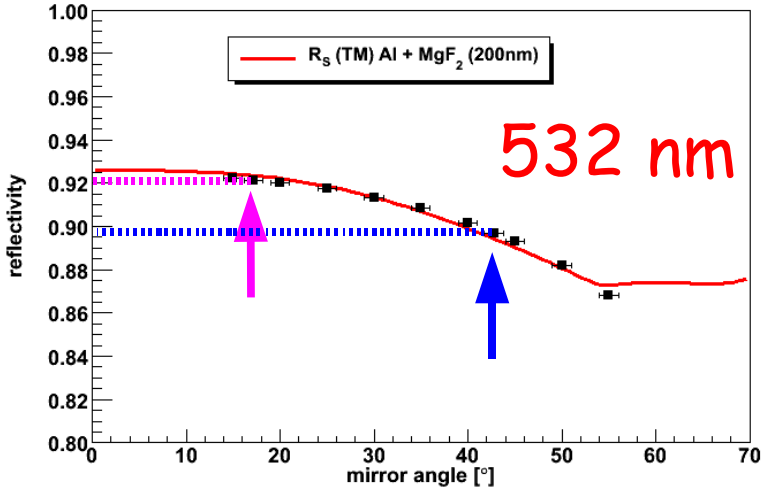
$$\text{correction factor} = \frac{\text{direct}}{\text{bar}}$$

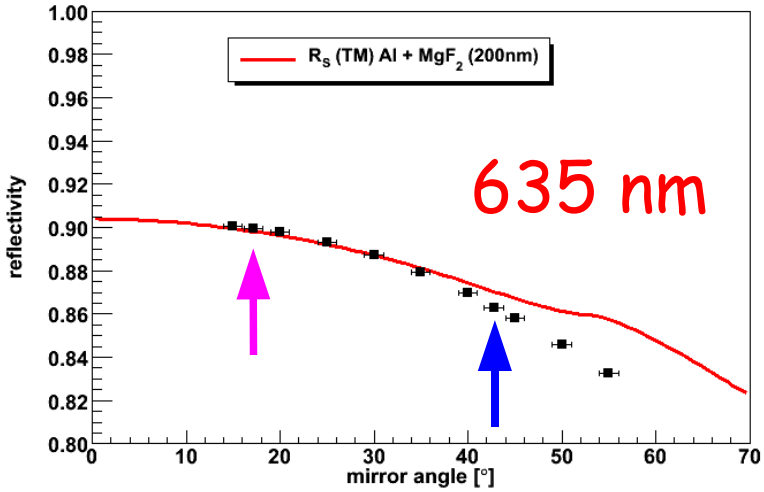
405 nm: 1.0010 ± 0.0040

532 nm: 0.97356 ± 0.00043

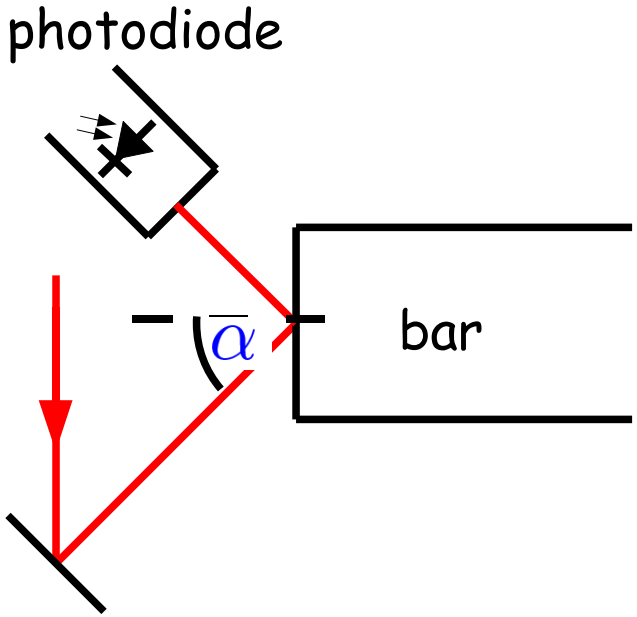
635 nm: 0.95917 ± 0.00029

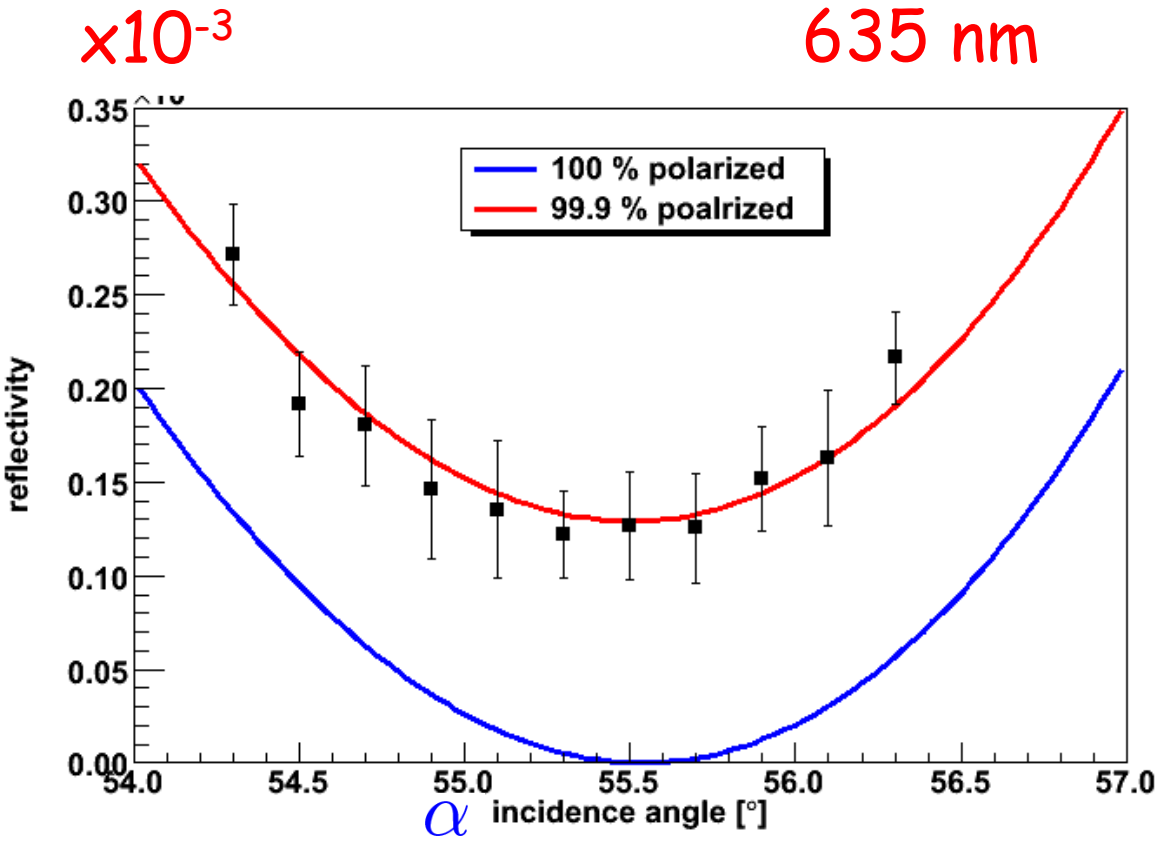






What happens if we miss the Brewster angle ?



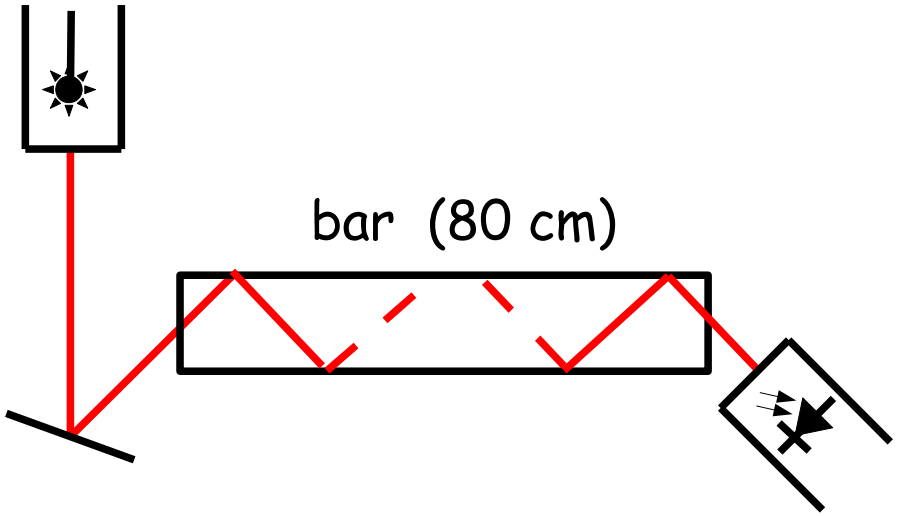


Brewster: α_B = 55.6°

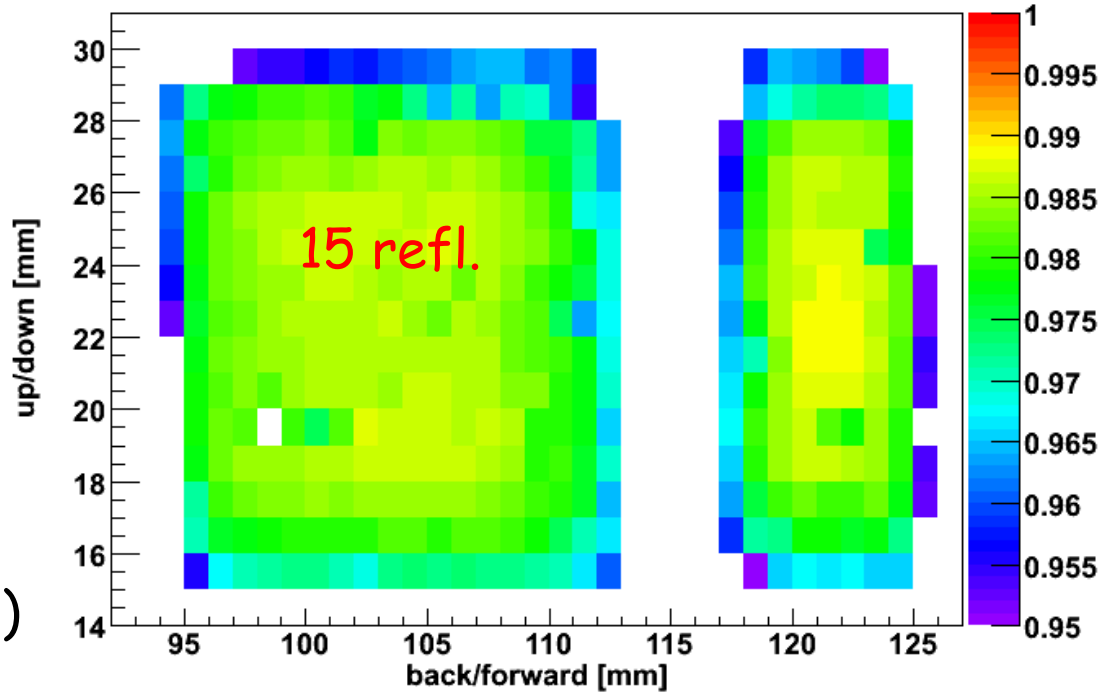
polarization degree: 1000:1 (polarizer)

influence is negligible

Internal reflection coefficient (405 nm, Lithotec)



$\Lambda = 322 \pm 405$ m
(from bulk attenuation measurement)



$$I = R^N \cdot \exp\left(-\frac{L}{\Lambda}\right)$$

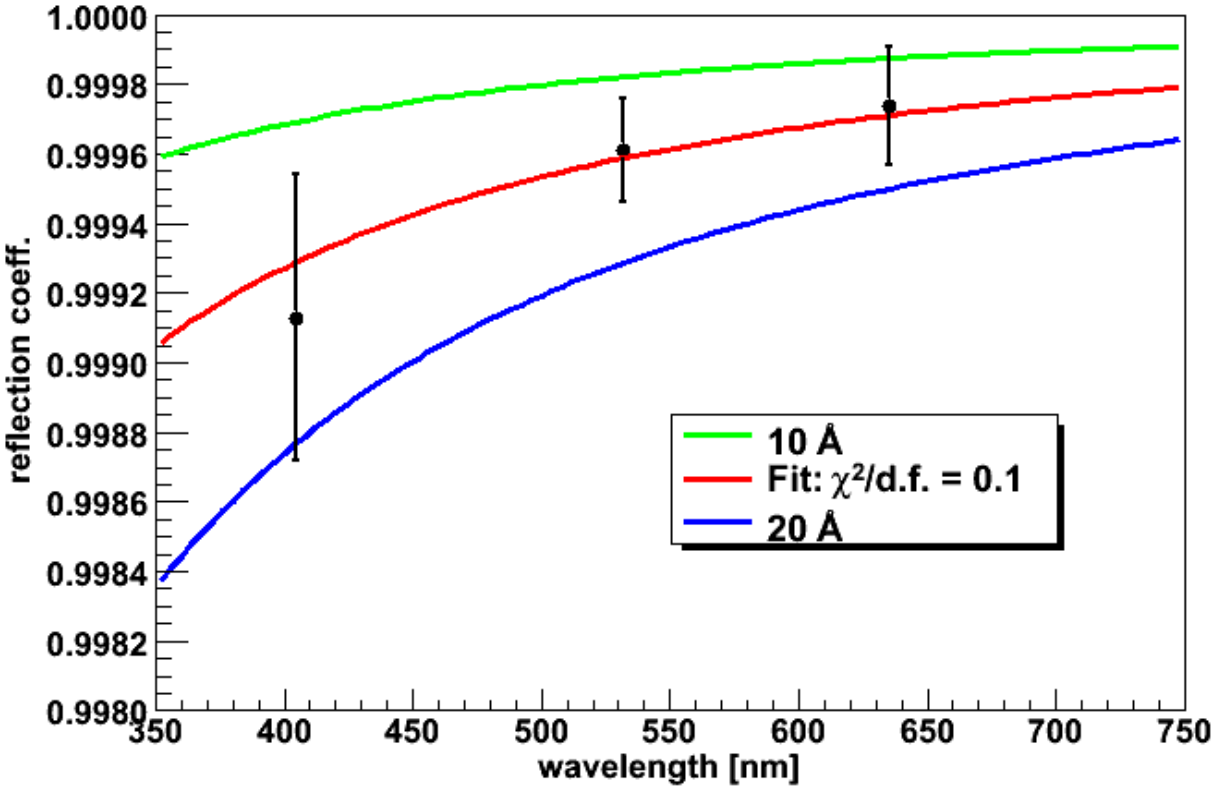
N = 15 refl:

R = 0.99914 ± 0.00041

R error contribution:

I:	0.00027
Λ:	0.00025
Δ_{uni}:	0.00018
polarization:	0.00002
α :	$< 10^{-6}$

Reflection coefficient vs. wavelength (Lithotec)



spec.: 10 - 20 Å

<σ> = 15.5 ± 2.3 Å

scalar theory: $$R = 1 - \left(\frac{4\pi \cdot \sigma \cdot \cos(\alpha_B)}{\lambda} \right)^2$$

data is consistent with the expectation

Summary & Outlook

- Results for the bulk attenuation with multiple wavelengths consistent with Rayleigh scattering
- Measured internal reflection coefficients with multiple wavelengths consistent with the scalar theory
- Measured surface roughness and the specification in agreement

- Expand wavelength range using a UV-laser (266 nm) to increase sensitivity of the bulk attenuation and of the reflection coefficient
- Repeat measurements with the InSync Inc. bars and the Heraeus bars