

# Results of the radiator quality test

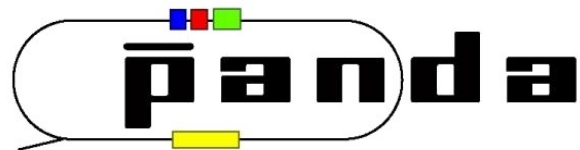
Roland Hohler



GSI, Darmstadt  
JWG University Frankfurt

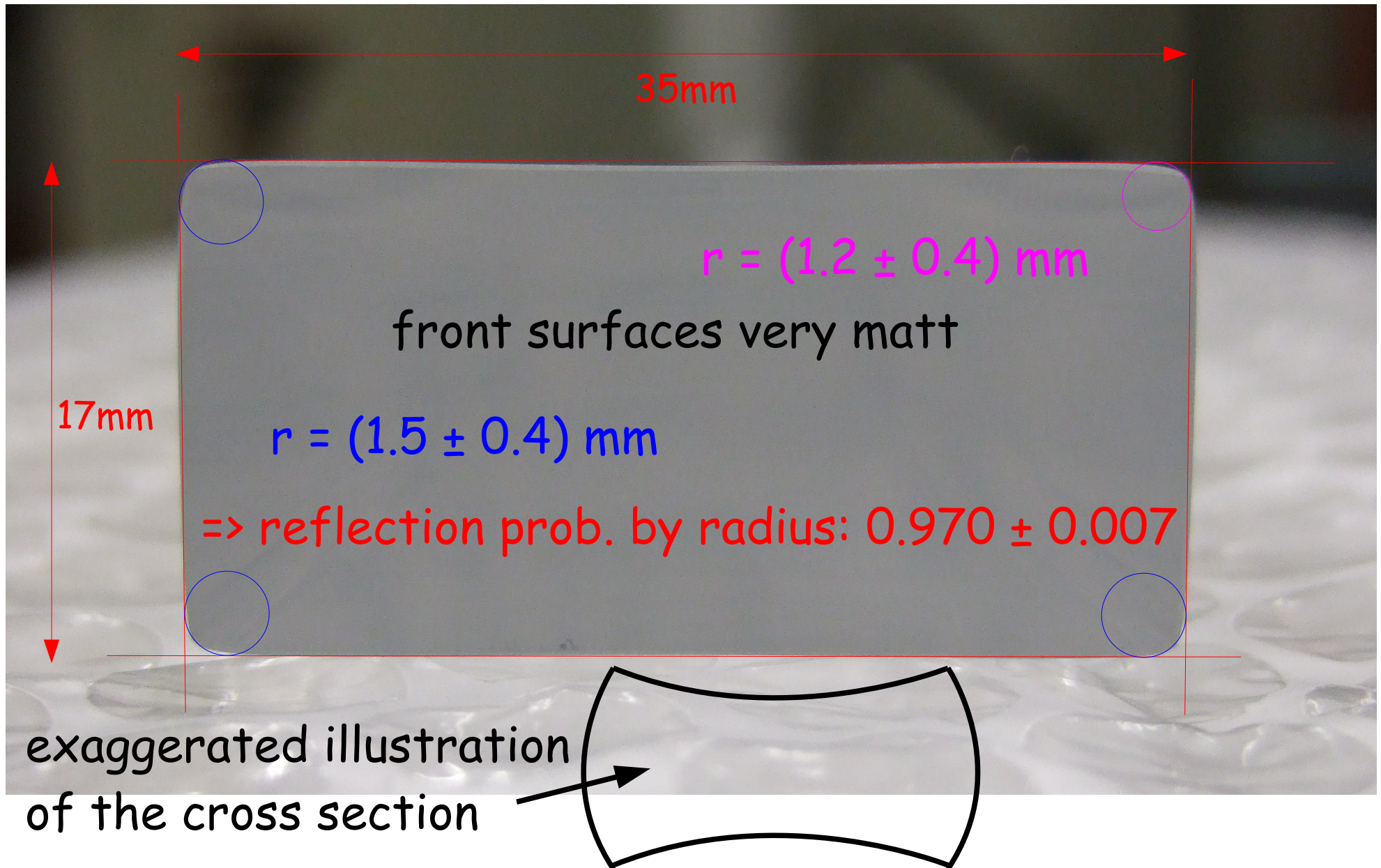


PANDA Collaboration Meeting  
March 2-6, 2009  
at GSI



# Heraeus bar (H3)

Delivered bars are rejections !



# Reflection coeff. uncertainty contributions

Statistics

$\approx 0.3\text{‰}$  for transmission

Bulk attenuation

$\Lambda_{\text{bar}} = 281 \pm 97 \text{ m (quartz)}$

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

Mirror correction

0.9718 (correction factor)

PD homogeneity

in this talk

Cleaning

in this talk

surface homogeneity

in this talk

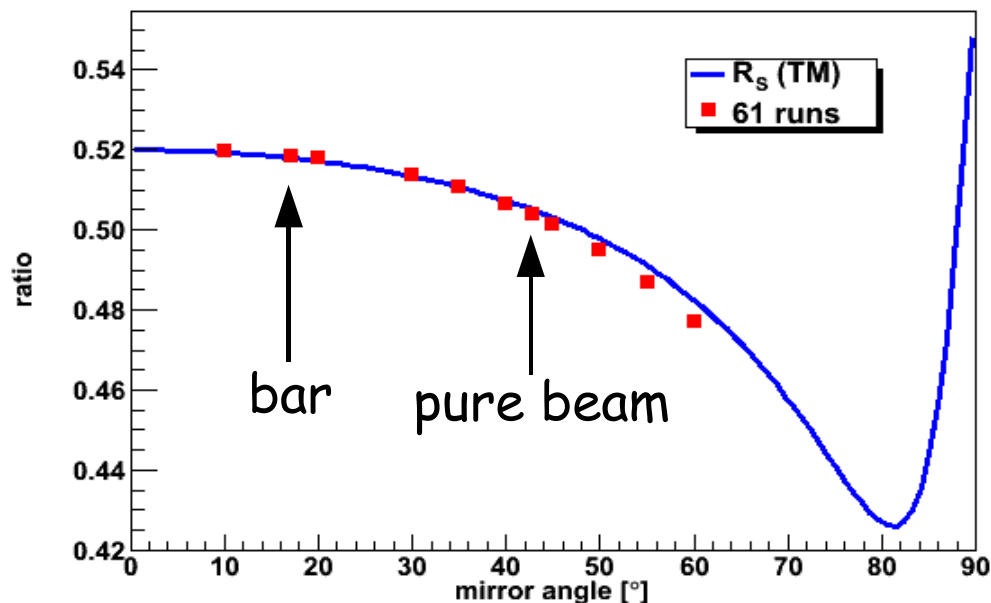
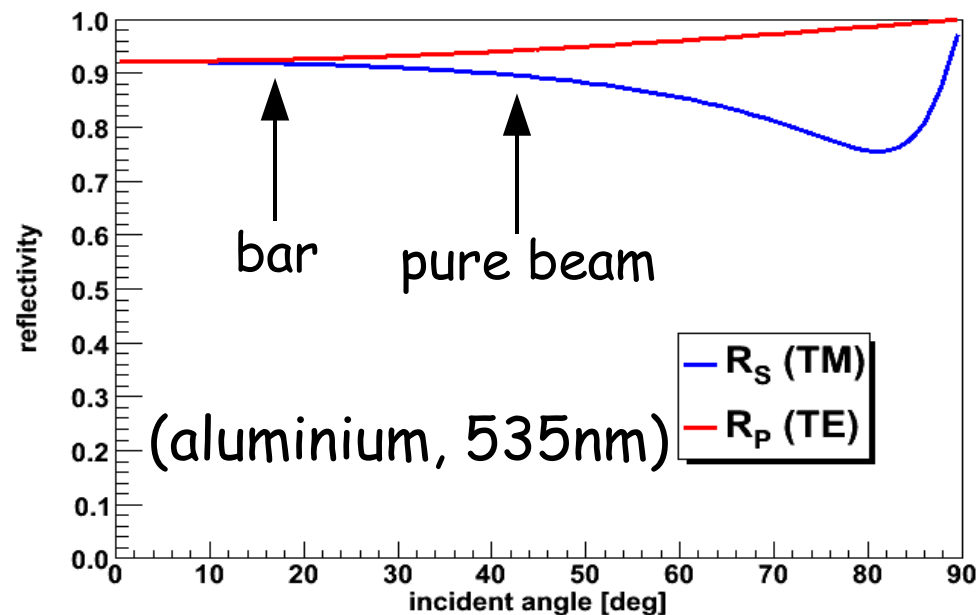
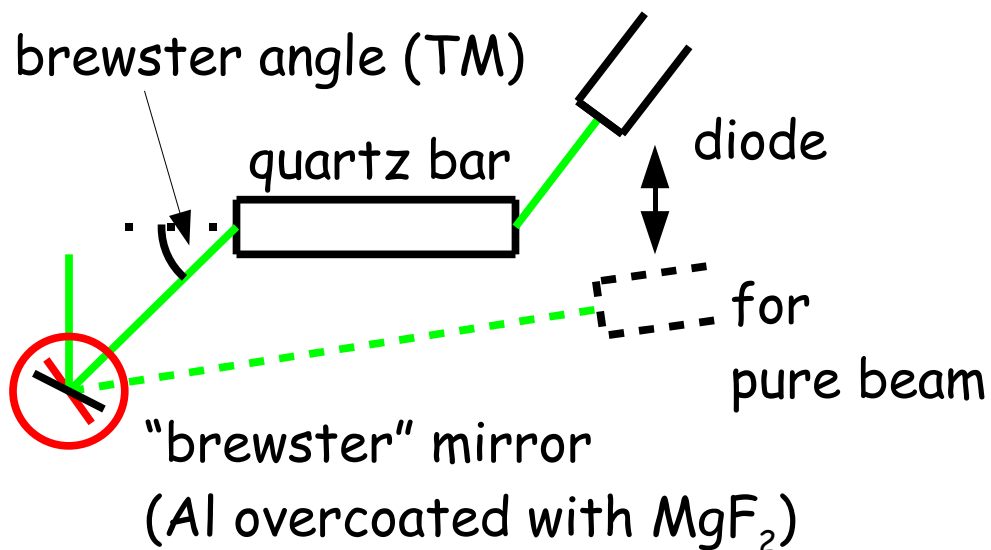
Front surface loss

???

Adjustment (Brewster angle)

???

# Mirror correction

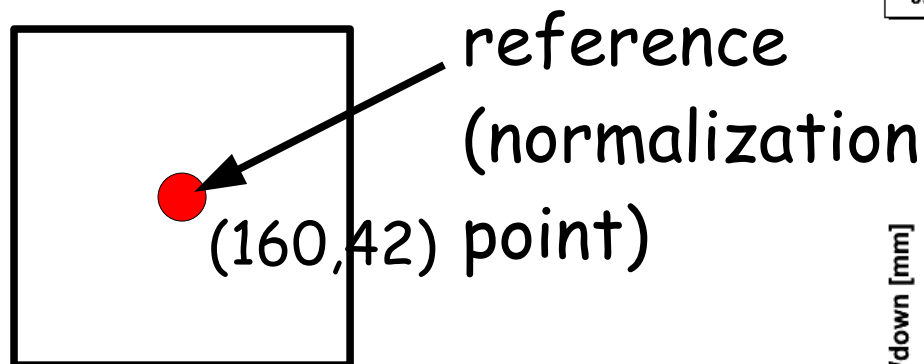


$$\text{cor} = 0.9718 \pm 0.0003$$

cor. transmission:

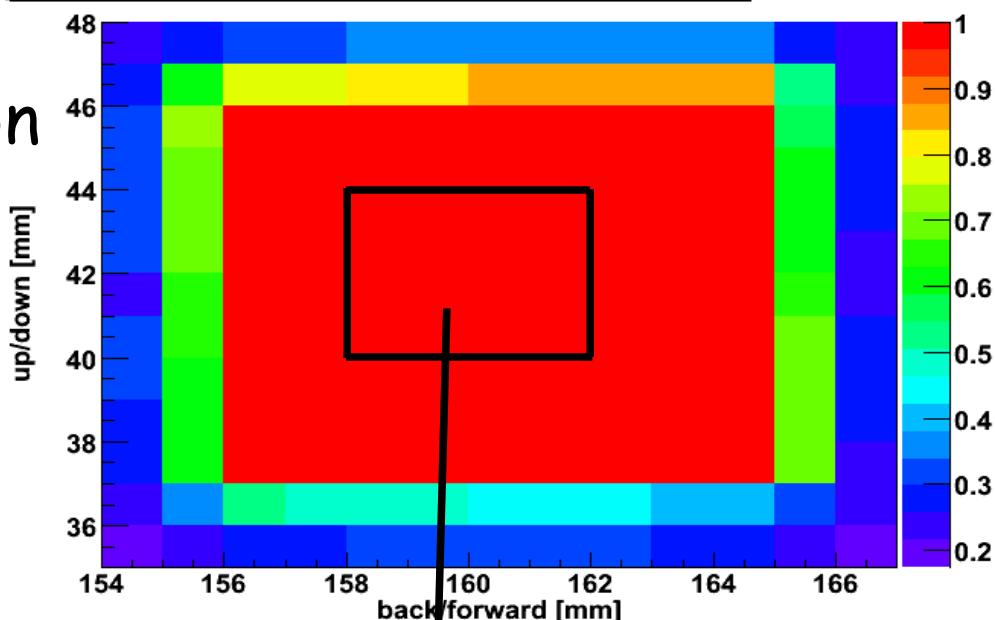
$$T_{\text{cor}} = T_{\text{meas}} \text{ cor}$$

# Homogeneity of the measurement diode

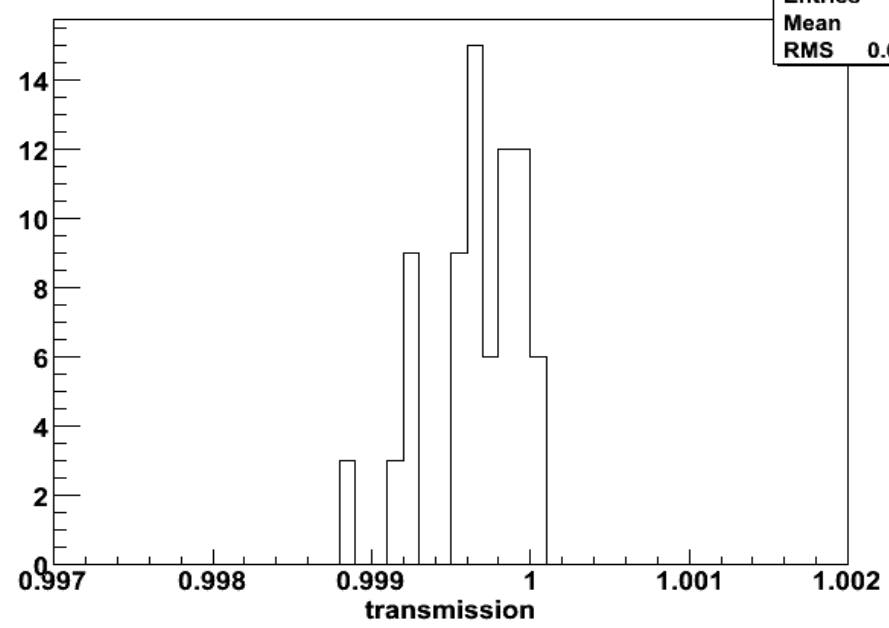


$$H = 0.9997 \pm 0.0003$$

090209\_homoVAL\_ref160-42\_covered: several bar positions (matrix)

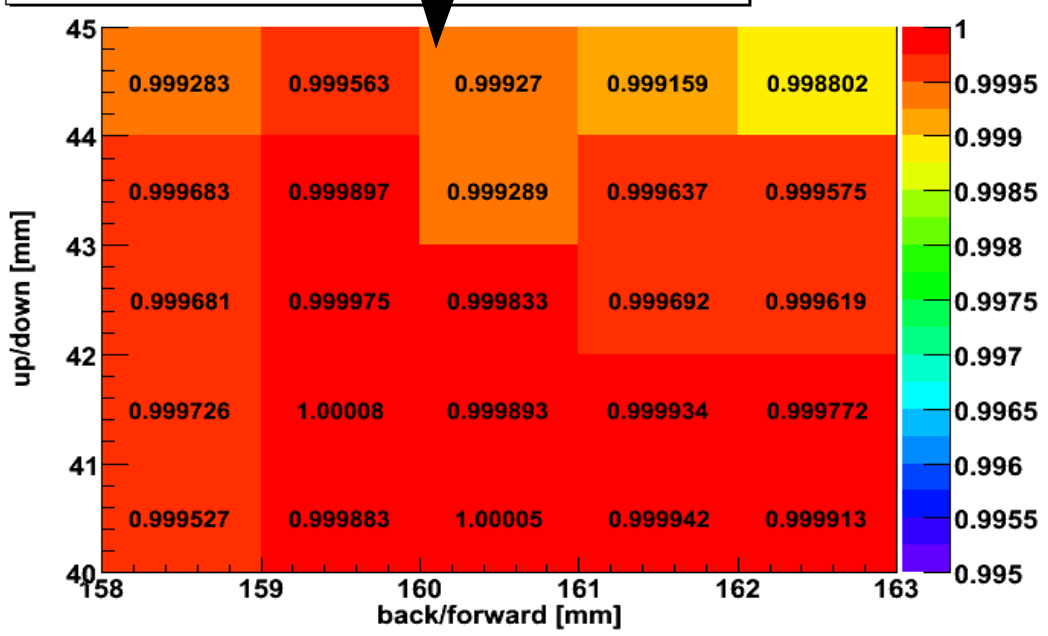


090209\_homoVAL\_ref160-42\_covered: transmission (matrix)



transHistoMatrix	
Entries	75
Mean	0.9997
RMS	0.0003039

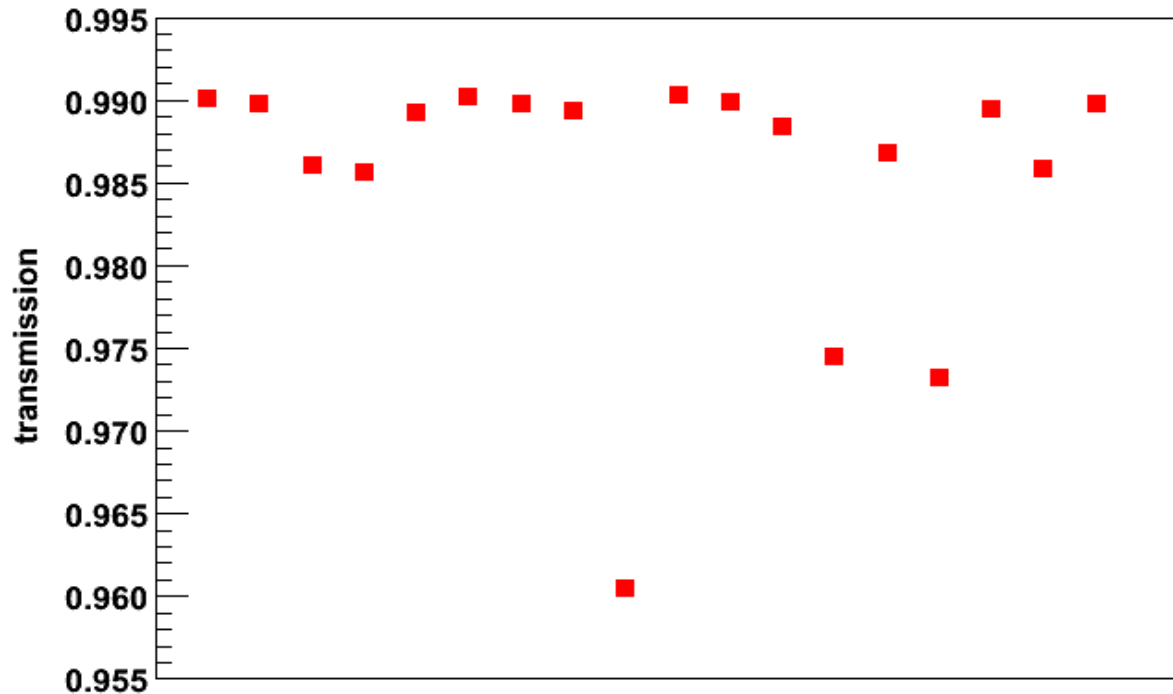
090209\_homoVAL\_ref160-42\_covered: several bar positions (matrix)



# Cleaning (Lithotec, L2)

whole bar cleaned with the "wipe & dry"-method and sidolin

defined pollution: saliva (20 - 90% loss)



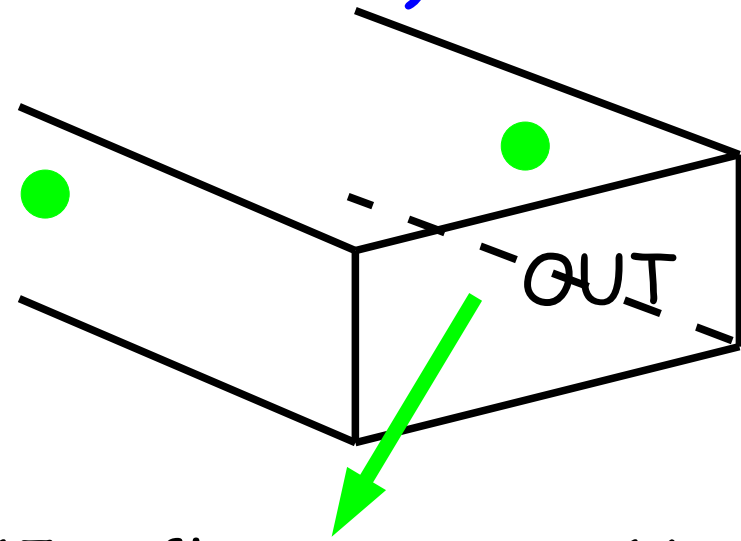
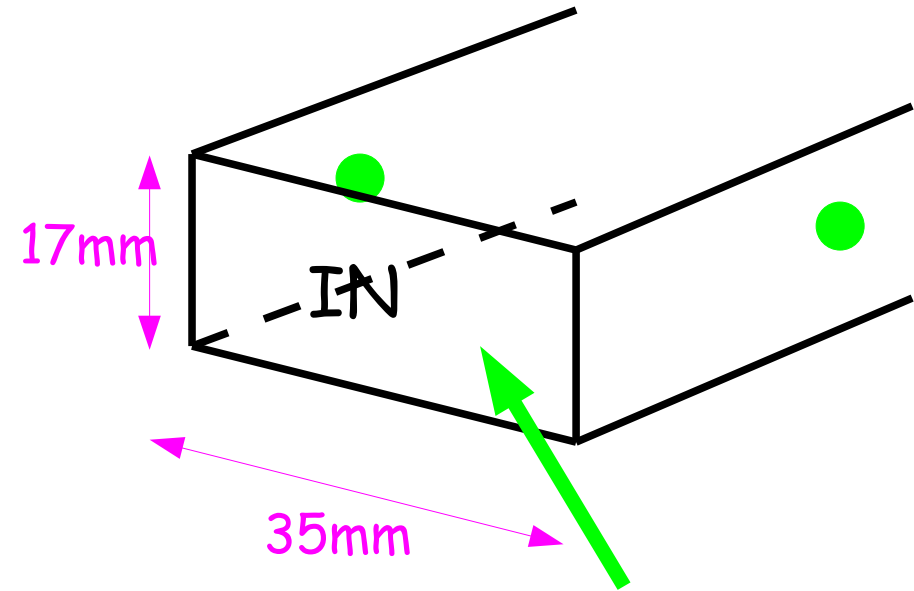
all:

$$T = 0.9855 \pm 0.0080$$

w/o outsider:

$$T = 0.9887 \pm 0.0017$$

# Transmission profile (L2, thin lateral)

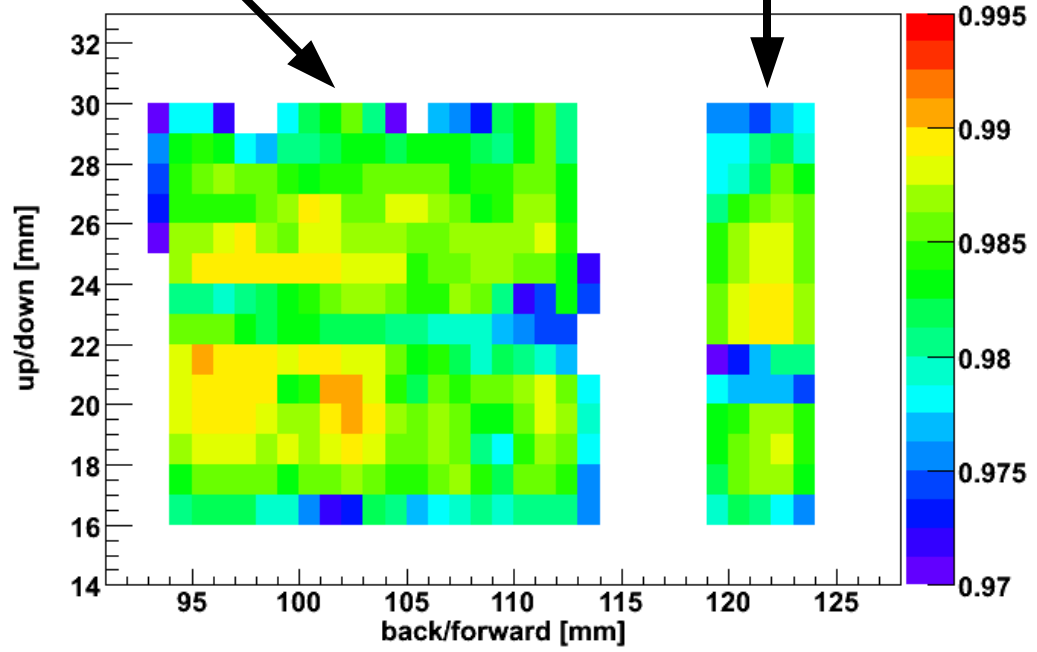
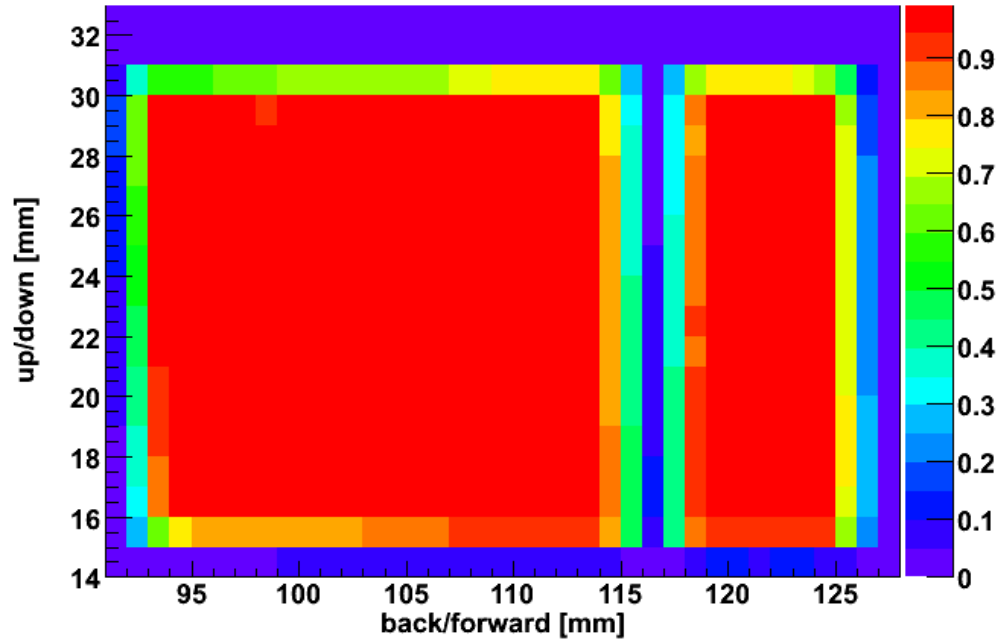


15 refl.

16 refl.

090213\_transMatrix\_EvenAndOdd\_covered: several bar positions (matrix)

090213\_transMatrix\_EvenAndOdd\_covered: several bar positions (matrix)

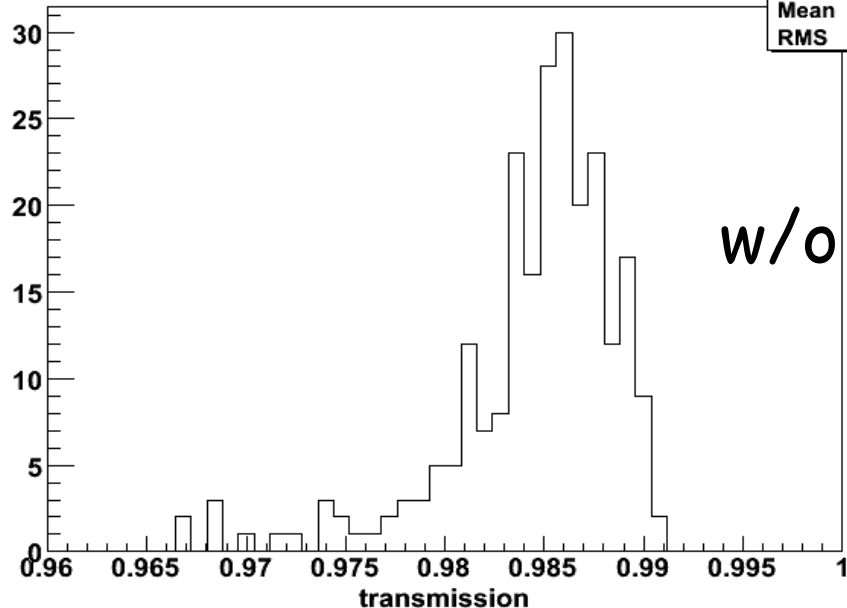


# Bar homogeneity (L2, thin lateral)

090213\_transMatrix\_EvenAndOdd\_covered: transmission (matrix)

transHistoMatrix

Entries	240
Mean	0.9844
RMS	0.004393



w/o edge effects

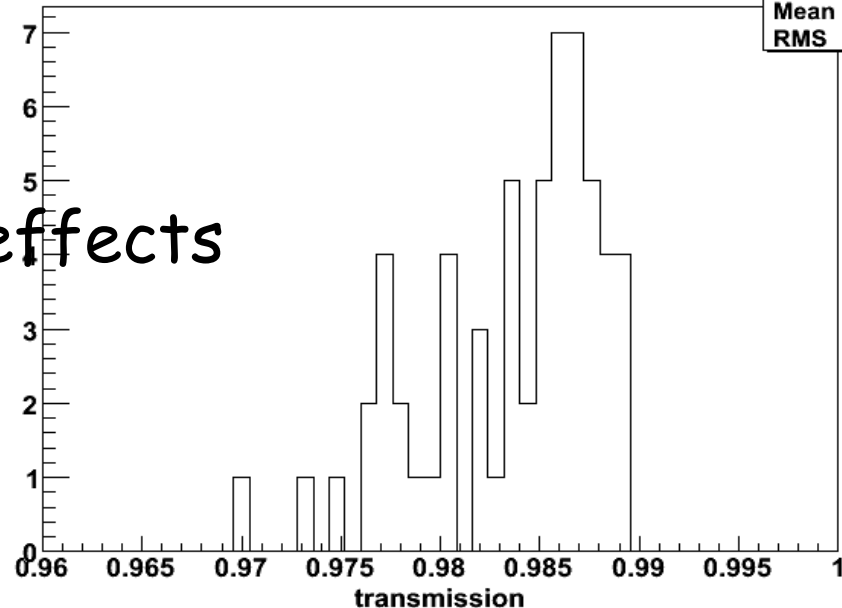
15 reflections

$$T = 0.9844 \pm 0.0044$$

090213\_transMatrix\_EvenAndOdd\_covered: transmission (matrix)

transHistoMatrix

Entries	60
Mean	0.9836
RMS	0.00444



16 reflections

$$T = 0.9836 \pm 0.0044$$

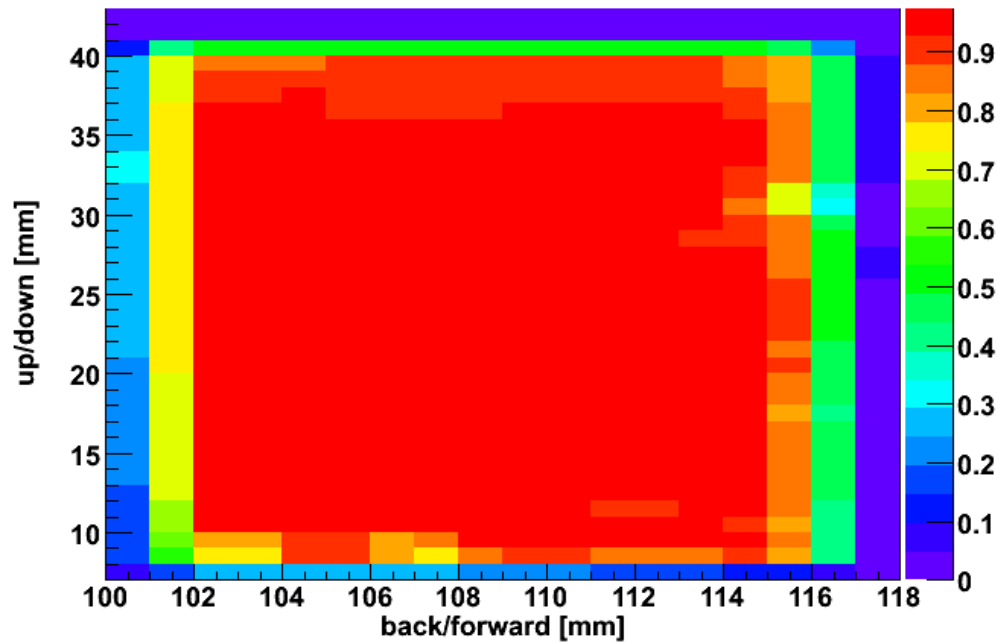
=> main error contribution

not enough statistic to separate between bar surface inhomogeneity and cleaning effect

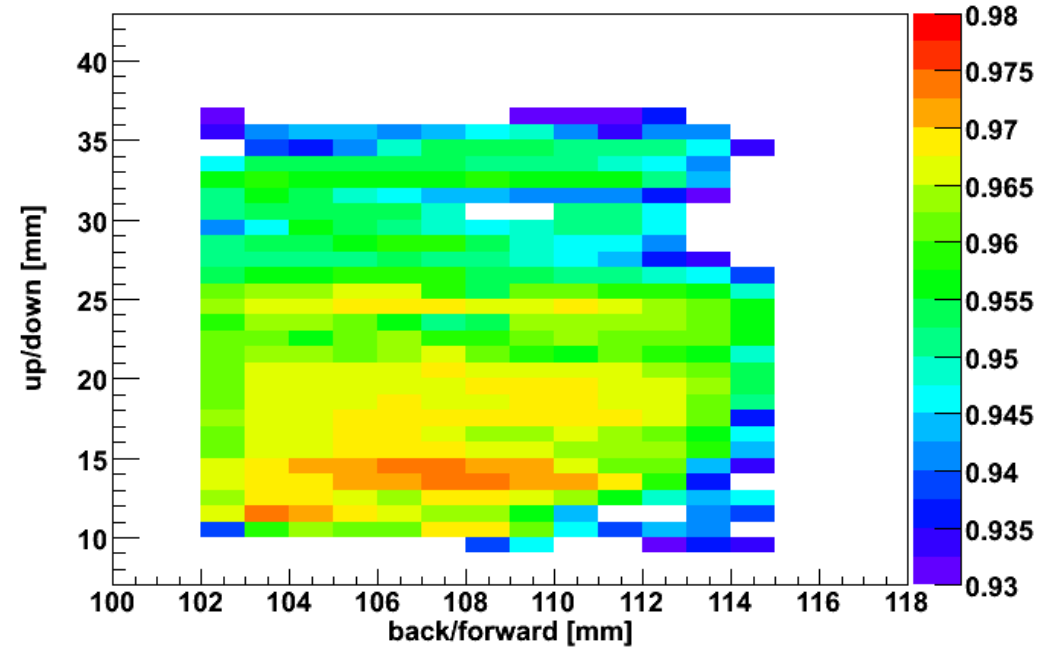


# Transmission profile (L2, wide lateral)

090228\_transMatrix\_L2\_wideLateral\_covered: several bar positions (matrix)



090228\_transMatrix\_L2\_wideLateral\_covered: several bar positions (matrix)



31 reflections

$$T = 0.9581 \pm 0.0095$$

cleaning of the wide lateral sides is more difficult than for the thin ones

# Reflection coefficient & roughness (L2)

N =	15 refl.	16 refl.	31 refl.
T =	$0.9844 \pm 0.0044$	$0.9836 \pm 0.0044$	$0.9581 \pm 0.0095$

$$T = R^N \cdot \exp\left(-\frac{L}{\Lambda}\right) \quad L = \sqrt{l^2 + b^2 \cdot N^2}$$

$$\Lambda_{\text{quartz}} = 281 \pm 97 \text{ m}$$

b =	35 mm	17 mm	
R =	$0.99918 \pm 0.00031$	$0.99918 \pm 0.00028$	$0.99873 \pm 0.00032$

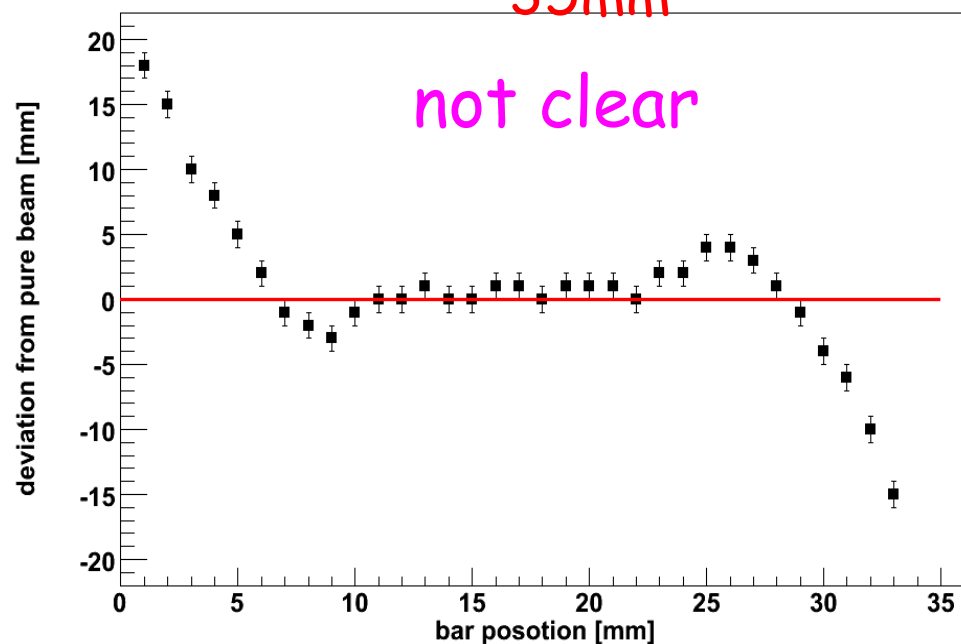
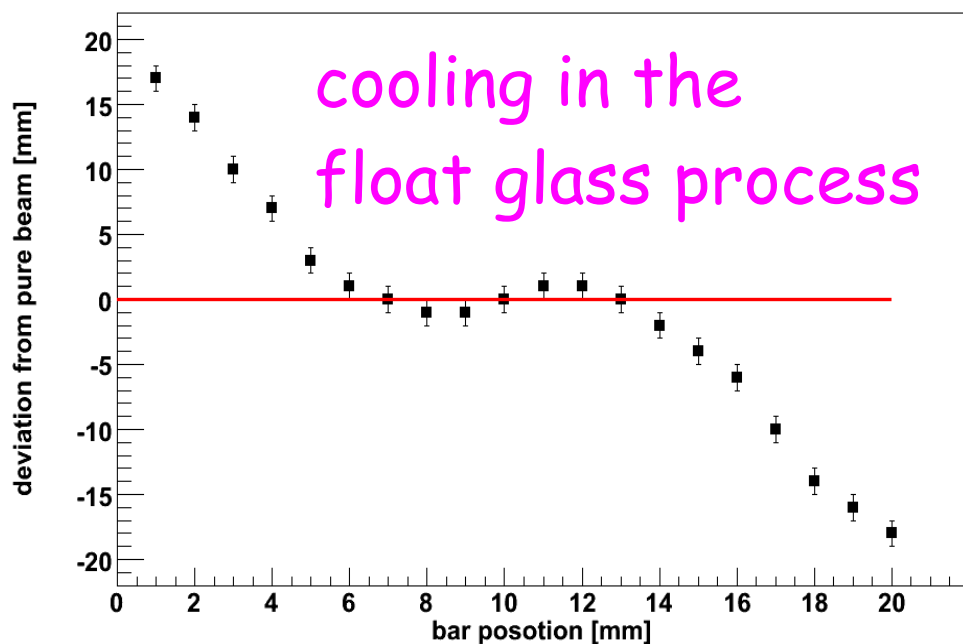
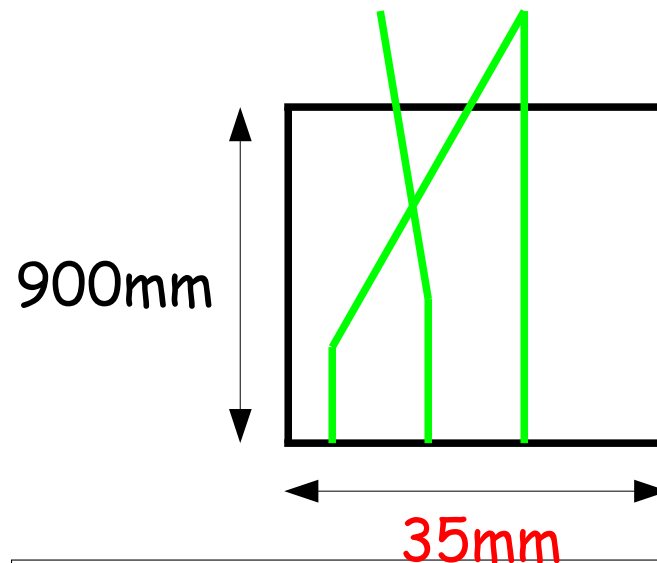
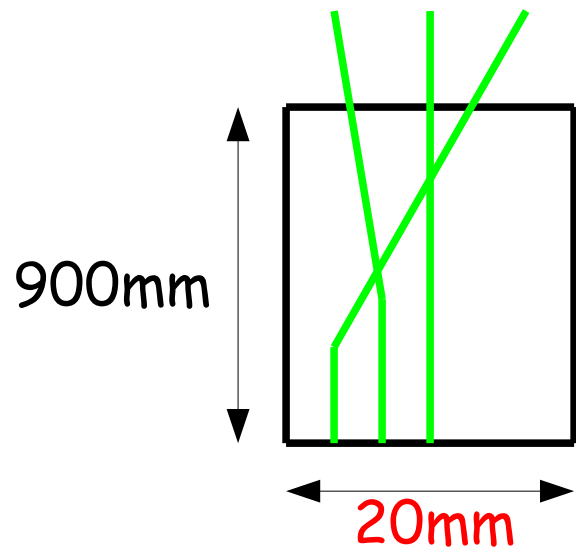
$$1 - R = \left(\frac{4\pi \cdot \sigma \cdot \cos \Theta}{\lambda}\right)^2 \quad \Theta = 55.6^\circ \text{ (Brewster)}$$

$\sigma =$	$21.6 \pm 4.1 \text{ \AA}$	$21.6 \pm 3.8 \text{ \AA}$	$26.9 \pm 3.4 \text{ \AA}$
------------	----------------------------	----------------------------	----------------------------

Lithotec specification:  $20 \text{ \AA}$

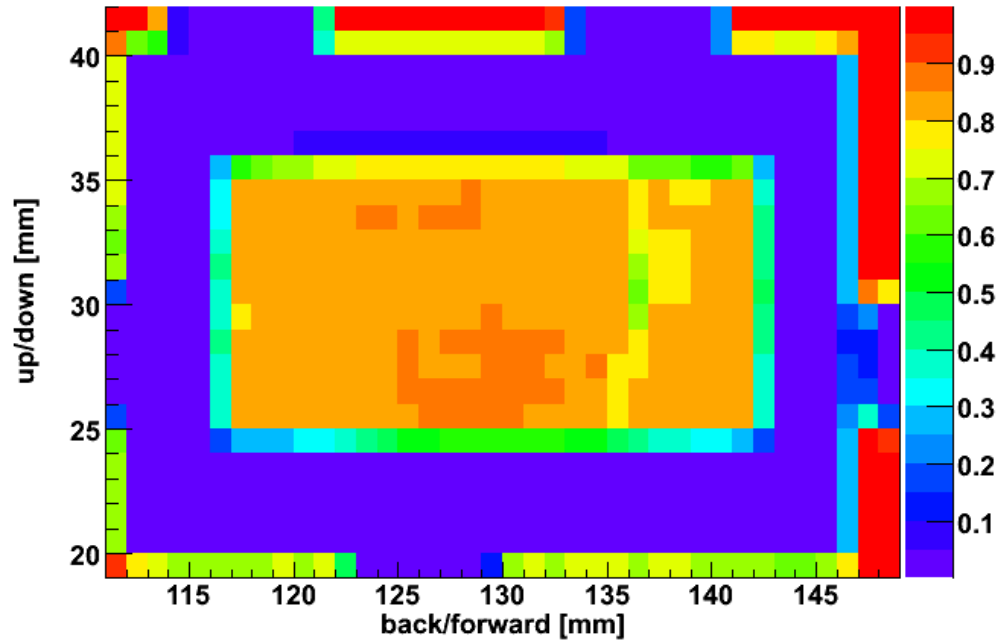
# Plexiglass (acryl glass)

Dim. [W,H,L] in mm: [35,20,900] (quartz: [35,17,800])

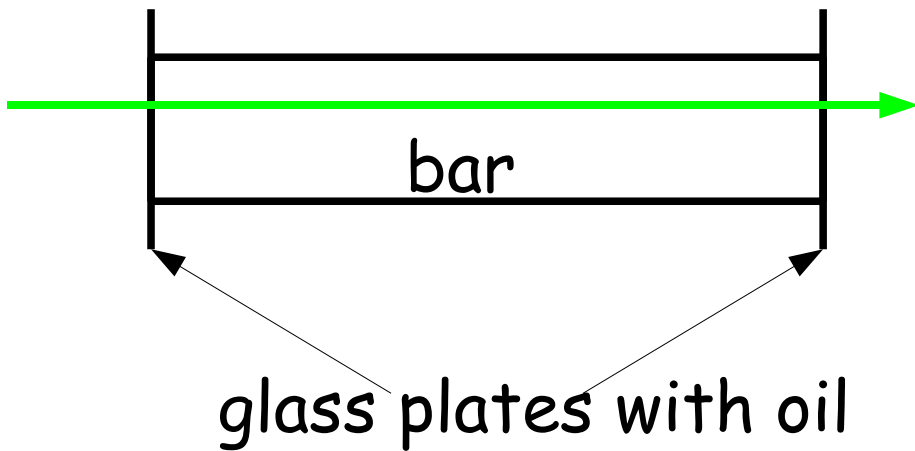
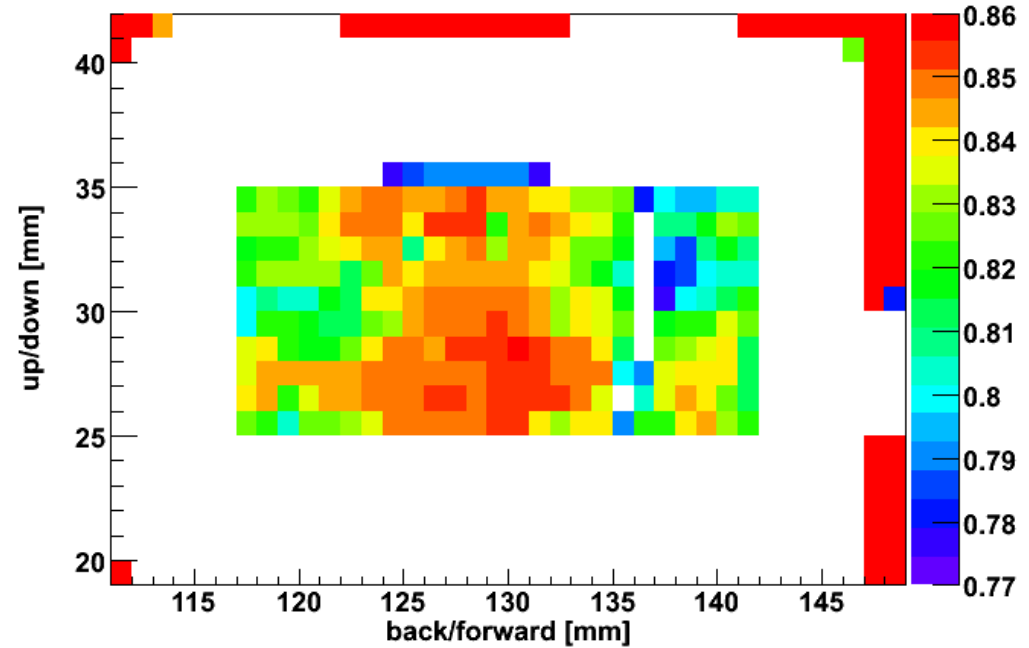


# Bulk attenuation (Plexi)

090218\_bulkMatrix\_Plexi\_covered: several bar positions (matrix)



090218\_bulkMatrix\_Plexi\_covered: several bar positions (matrix)



$$T = 0.8714 \pm 0.0039$$

$$n_{\text{glass}} = 1.5275 \pm 0.0009$$

$$n_{\text{oil}} = 1.470 \pm 0.017$$

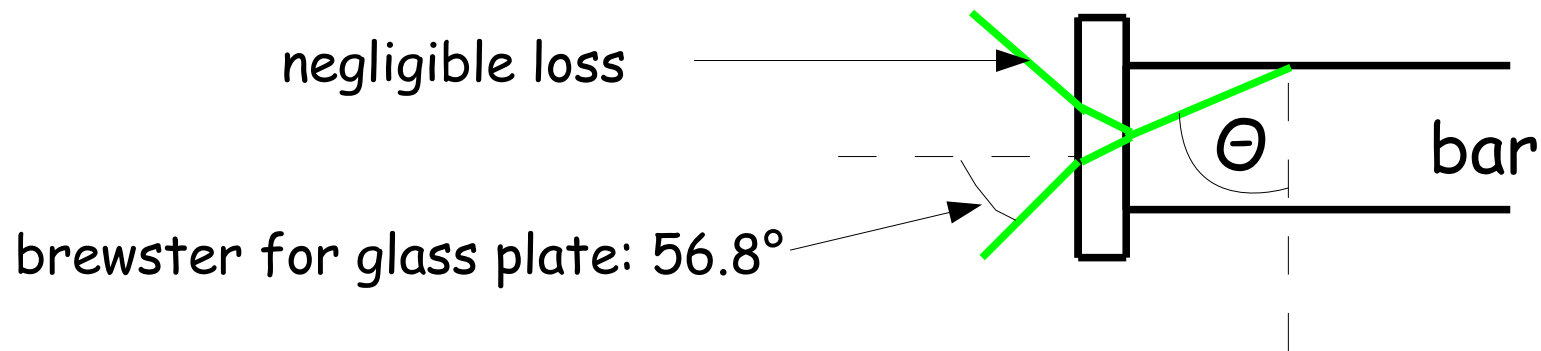
$$n_{\text{acryl}} = 1.495$$

$$\Rightarrow \Lambda_{\text{acryl}} = 18.1 \pm 1.6 \text{ m}$$

# Transmission (Plexi)

No surface inhomogeneity included !

thin lateral (17 refl.):  $T = 0.1216 \pm 0.0003$  ( $\Theta = 56.0^\circ$ )  
(with glass plates, spot very smeared)



wide lateral (30 refl.):  $T = 0.7473 \pm 0.0003$  ( $\Theta = 56.0^\circ$ )  
(with glass plates)

w/o glass plates:  $T = 0.6384 \pm 0.0003$  ( $\Theta = 56.2^\circ$ )

large difference between glass plates and w/o not clear

# Reflection coefficient & roughness (Plexi)

17 refl. with glass plates	30 refl. with glass plates	30 refl. w/o glass plates
$\Theta = 56.0^\circ$ $R[\Theta] = 0.8866 \pm 0.0003$	$56.0^\circ$ $0.9922 \pm 0.0003$	$56.2^\circ$ $0.9870 \pm 0.0003$
$\sigma = 256.4 \pm 0.3 \text{ \AA}$	$67.2 \pm 1.3 \text{ \AA}$	$87.3 \pm 0.7 \text{ \AA}$

only statistical error

- lateral side treated with diamond needle is very rough
- sides produced by float glass technique is 3-4 times rougher than the polished Lithotec quartz bars

# Summary & To-Do-list

- lateral sides of the Heraeus bars are curved
- main error contribution on the reflection coefficient seems to be the surface inhomogeneity  
(need more statistic to separate it from cleaning effects)
- measured roughness of a Lithotec quartz bar is consistent with the specifications
- roughness of a acrylic glass bar is much larger than for the Lithotec bar  
(especially for the sides treated with a diamond needle)
  
- further roughness determinations (Heraeus, Lithotec, Russian)
- analysis of the front surface loss