

# The vignetting field stop procedure: A new physical measurement principle for the Deflectometric acquisition of big Optical Surfaces - DaOS

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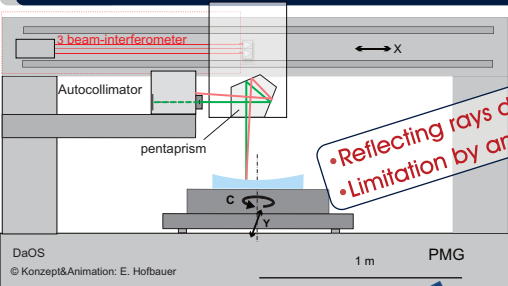
\*TH Deggendorf, \*\*Berliner Glas

## Requests from industry / motivation

- Large optical Surfaces
  - Easy and flexible
  - In Situ
- High accuracy  
High repeatability  
Convex and concave

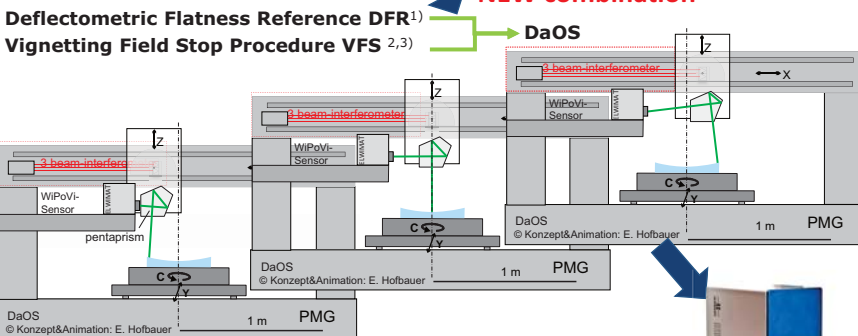
Interferometry not successful at all  
e.g. very large and convex

## Deflectometric Flatness Reference for flat surfaces

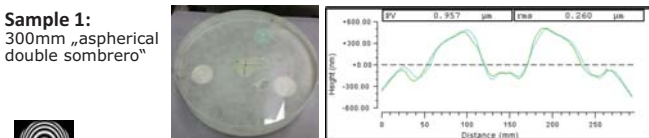


Reflecting rays do not fill aperture  
Limitation by angle and distance

## NEW combination



## Round robin test on 300 mm „aspheric double sombrero“ flat surface with Interferometry and Deflectometric Flatness Reference DFR<sup>1)</sup>



Interferometric results:  
Instrument SSI-A with TF 4" and TF 6" 12"-Vertikal-Interferometer at BG)\*

DFR-Results:  
Measurement w. electronic autocollimator ELWIMAT\_AKF with 4 sections (0°, 45°, 90°, 135°) and reconstruction of surface with software from Taylor Hobson.

evaluated at	PV / $\mu\text{m}$	Rms / $\mu\text{m}$	Power / $\mu\text{m}$
DFR with AKF	<b>0,965</b>	<b>0,253</b>	<b>-0,752</b>
Difference of both Methods:	<b>-0,020</b>	<b>0,002</b>	<b>-0,029</b>

## Acknowledgements:

- 1) E. Debler, K. Zander: „Ebenheitsmessung an optischen Planflächen mit Autokollimationsfernrohr und Pentagonprisma“, PTB Mitteilungen Forschen + Prüfen, 89. Jahrgang, 1997
- 2) E. Hofbauer, M. Lenz: „Vignettierung als physikalisches Messprinzip“, Technisches Messen 75, 3/2008
- 3) DGaO Proceedings 2014 - <http://www.dgao-proceedings.de> - ISSN: 1614-8436 - urn:nbn:de:0287-2014-P014-9 eingegangen: 25.07.2014 veröffentlicht: 18.08.2014

## Industrial partners:

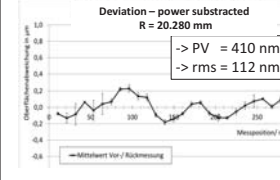
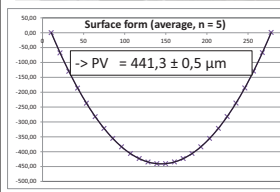
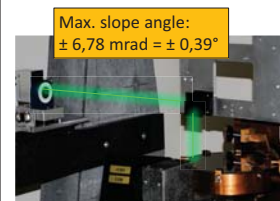


## First Results and Conclusion

- ✓ Systematic influence of radiation characteristics is important
- ✓ Luminance deviation in object field can be compensated
- ✓ First results in full surface reconstruction  $< 0.7 \lambda$  PV @633nm
- ✓ Absolut Radius measurement  $< 1\%$  at  $R = 3.114$  mm
- Improvement of sensor for higher S.N. ratio is needed
- Practical measurements with higher accuracy will follow

## First Results with Vignetting Sensor at spherical curved surfaces

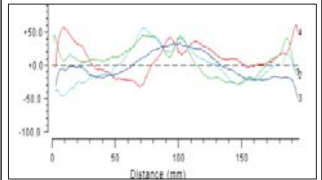
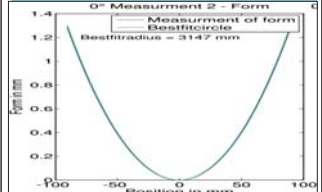
Sample one: coated mirror, Diam. 300 mm, R = 20 m



Sample two: uncoated mirror, Diam. 200 mm, R = 3.114 mm

Max. slope angle:  $\pm 29$  mrad =  $\pm 1,66^\circ$

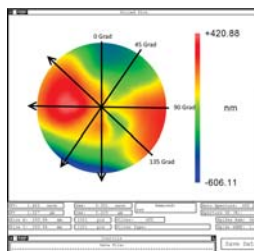
Dia mm	Slope	$\mu\text{m}$	Radius mm
180	29 mrad = $1,66^\circ$	1287 $\pm 2$	3148 $\pm 12,5$
Reference*		1300,85	3114 $\pm 0,7$
Deviation		13 $\mu\text{m}$	34 mm (1%)



\*) Optasens Projekt at THD at 2013

## Validation of DaOS with Vignetting Field Stop Procedure VFS<sup>2,3)</sup>

Sample 1: 300mm „aspheric double sombrero“ flat (round robin test)



evaluated at	PV / $\mu\text{m}$	Rms / $\mu\text{m}$
Averaged 4", 6", 12" - with Interferometry	<b>0,985</b>	<b>0,251</b>
DFR with AKF	<b>0,965</b>	<b>0,253</b>
DaOS ELWIMAT normal	<b>0,591</b>	<b>0,115</b>
reverse	<b>1,027</b>	<b>0,209</b>
Difference: rev.- norm.	<b>0,430</b>	<b>0,094</b>

Error in Surface Reconstruction  $< 0,7 \lambda$  PV and  $0,14 \lambda$  rms @633nm  
 $\rightarrow$  signal-to-noise-ratio for uncoated surfaces is not yet sufficient.

## Project Information

Research Institutes: Deggendorf Institute of Technology  
Fakultät NuW - Labor Optical Engineering  
01. Mai 2012 - 30. Juni 2015  
Project period:  
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