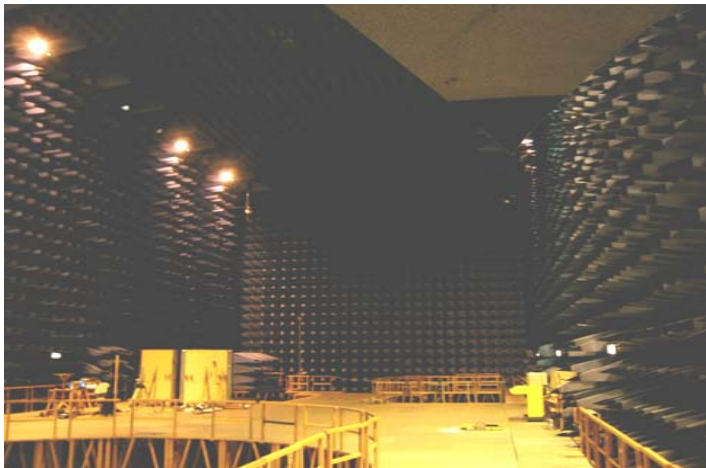







New anechoic chamber results and comparison with field and robot techniques



B. Görres, J. Campbell, M. Siemes
Geodätisches Institut der Universität Bonn

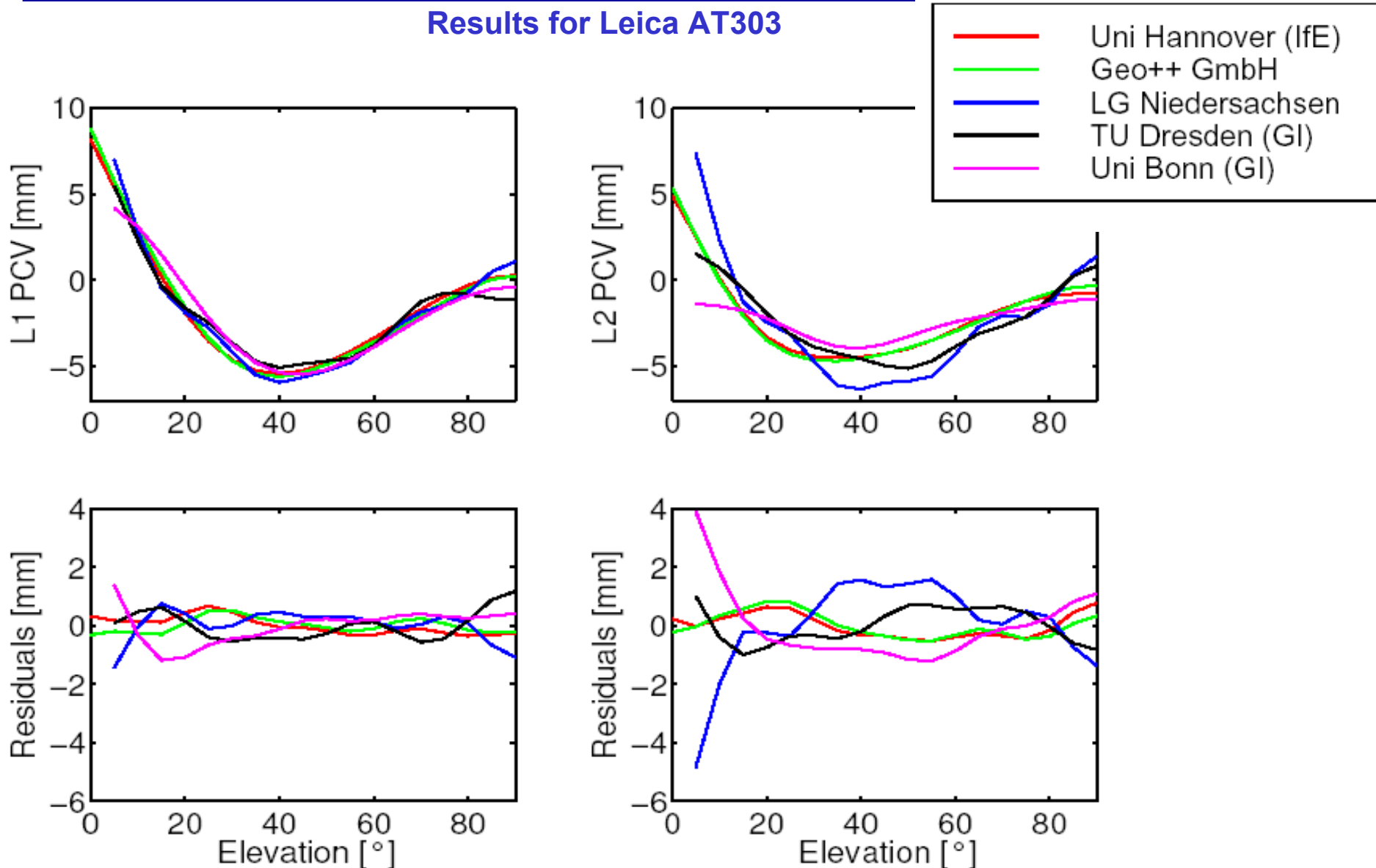
M. Becker
Universität der Bundeswehr, München

Motivation: get better insight into the performance of different calibration methods
by **calibration of a set of identical** antennas at different institutions

Institution	Calibration Method	used Software	Antenna
University of Hannover	robot – absolute	GNPCV	<p>Novatel 503 Choke Ring with Radome NOV503 NOKE</p> 
Geo++ Garbsen	robot – absolute	GNPCV	<p>Trimble microcentered with Ground Plane TRM33429.20+GP</p> 
State Survey... Niedersachsen	relative field calibration	WaSoft/Kalib	<p>Leica AT with Radome LEIAT303 LEIC</p> 
University of Dresden	relative field calibration	WaSoft/Kalib	 <p>Leica AT 502 LEIAT502</p>
University of Bonn	relative field calibration	Bernese GPS Software	 <p>Trimble Zephyr geodetic TRM39105.00</p>
University of Bonn	chamber test	not available in spring '02	

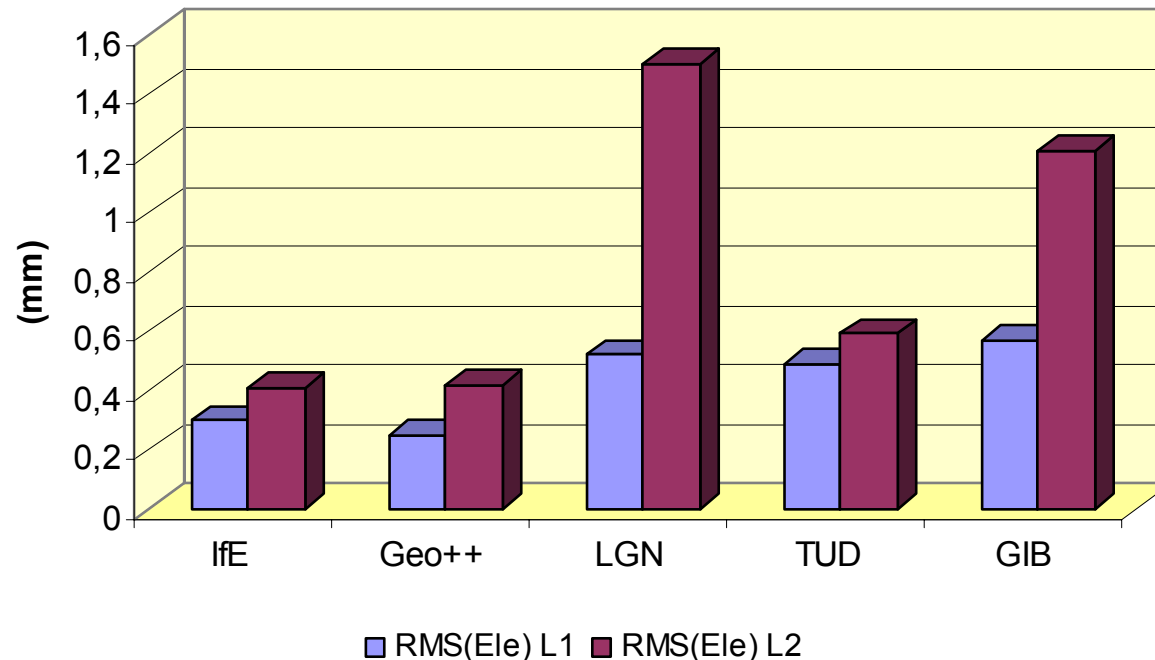
(Feldmann-Westendorff 2002)

Results for Leica AT303



German bench mark test 2002

Results for Leica AT303 (elevation-dependent PCV)



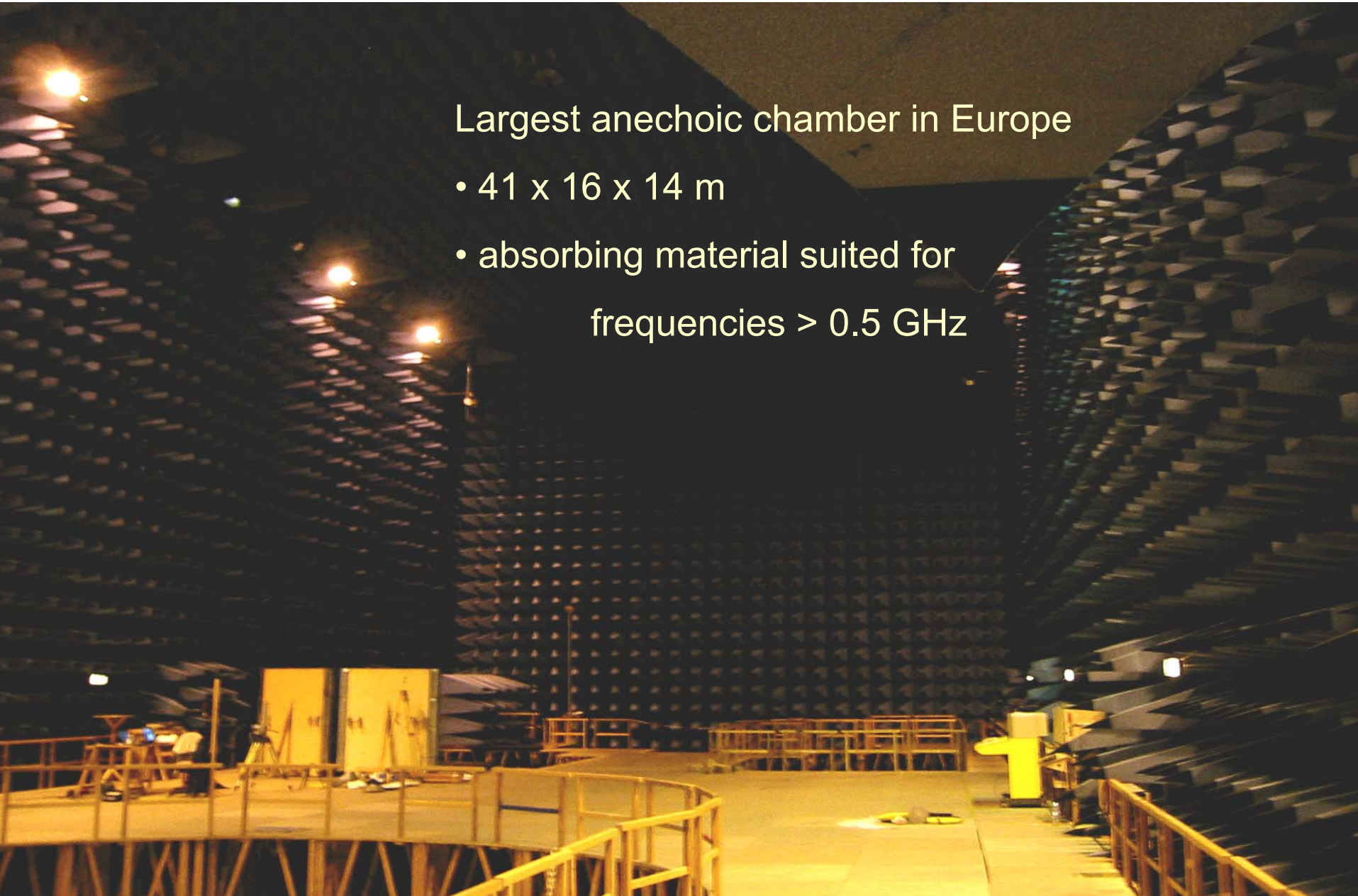
the robot measurements (IfE and Geo++) agree on the level of 1mm

the standard field calibrations display larger variations of 2 mm (L1) and 4mm (L2)

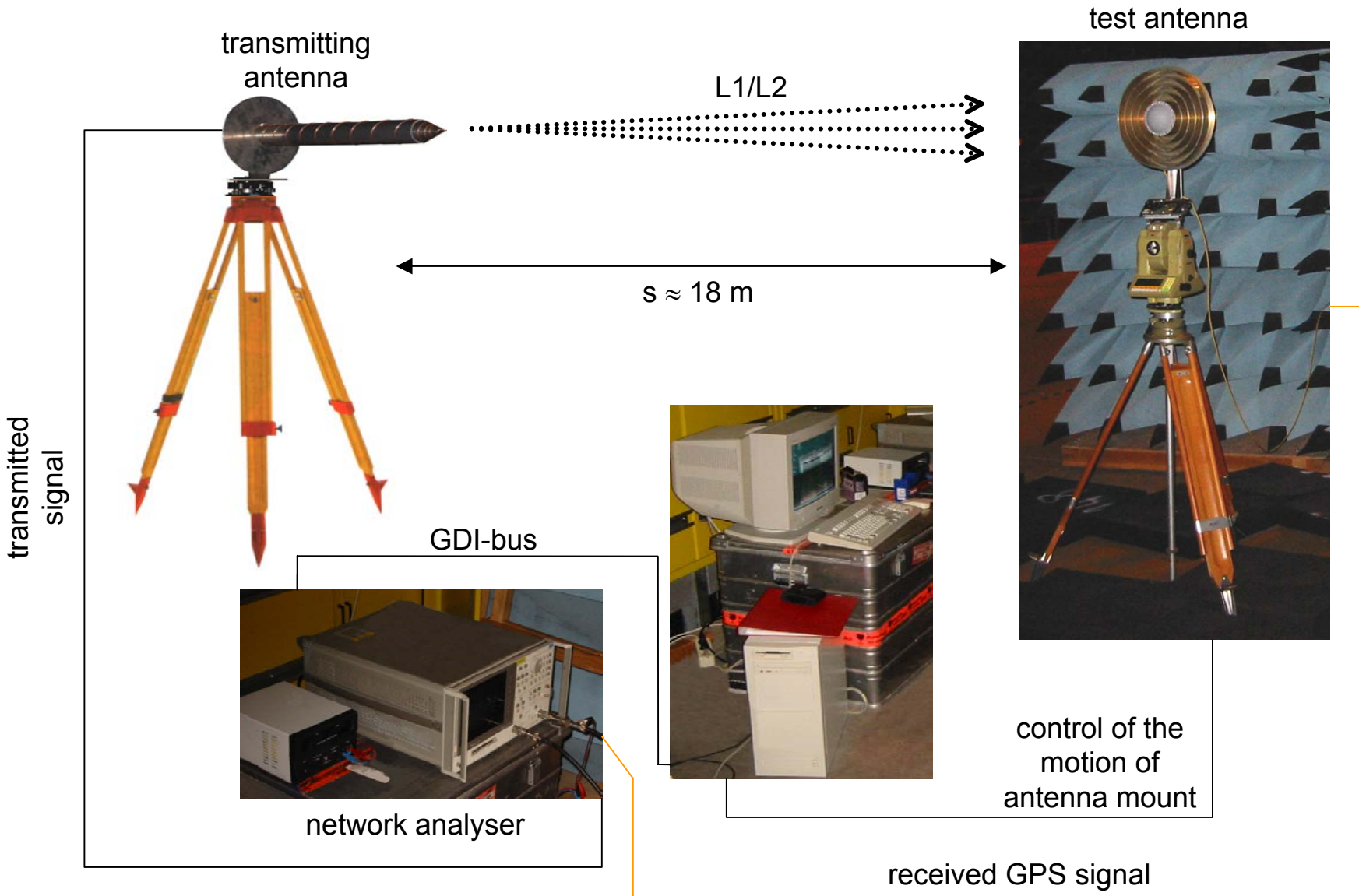
? Confirmation of absolute results by an independent technique and identical antenna ?

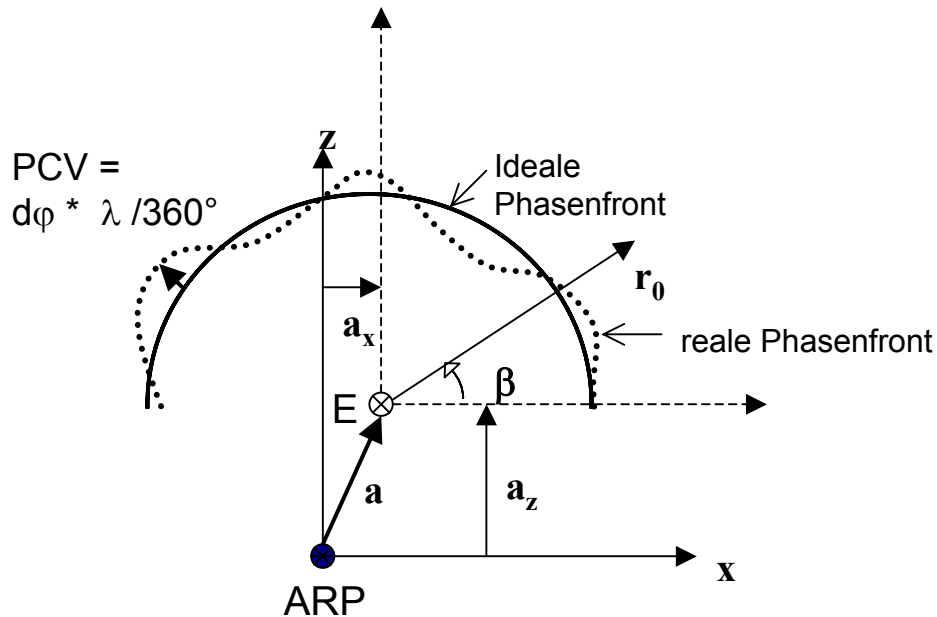
Largest anechoic chamber in Europe

- 41 x 16 x 14 m
- absorbing material suited for frequencies > 0.5 GHz



in the Greiding chamber





$$dr(\alpha, \beta) = \mathbf{a} \cdot \mathbf{r}_0 + \lambda \cdot d\varphi(\alpha, \beta)$$

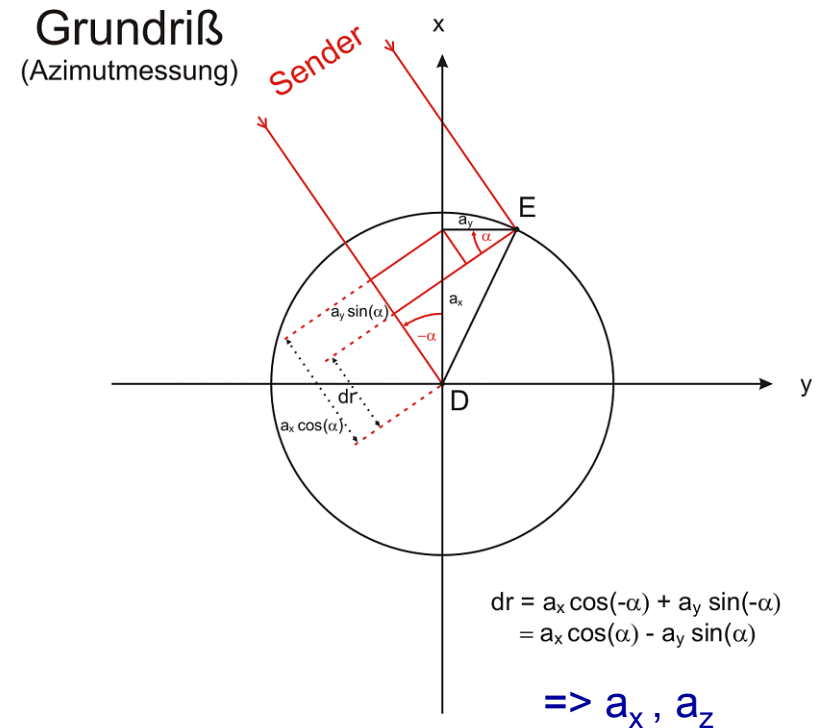
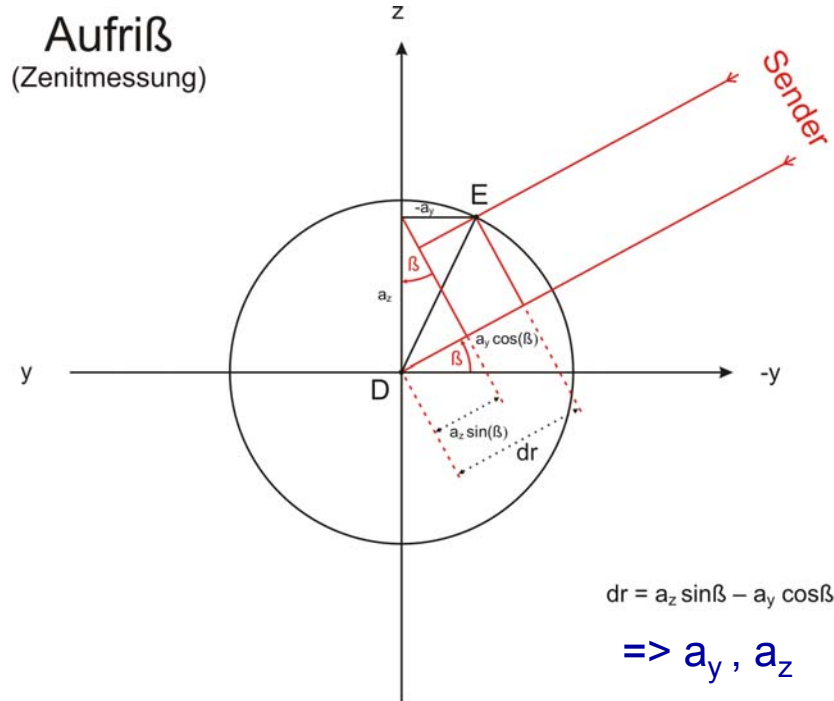
with PCO: $\mathbf{a}(\varphi) = (a_x, a_y, a_z)$

Two - Step Processing

1. Estimation of mean phase center offset (PCO) \mathbf{a} with respect to the ARP:
 $\Sigma d\varphi(\alpha, \beta)^2 = \text{Min!}$
2. PCV directly (no fit required!)

Estimation of PCO and PVC

geometric situation within the Chamber setup (pilot phase)



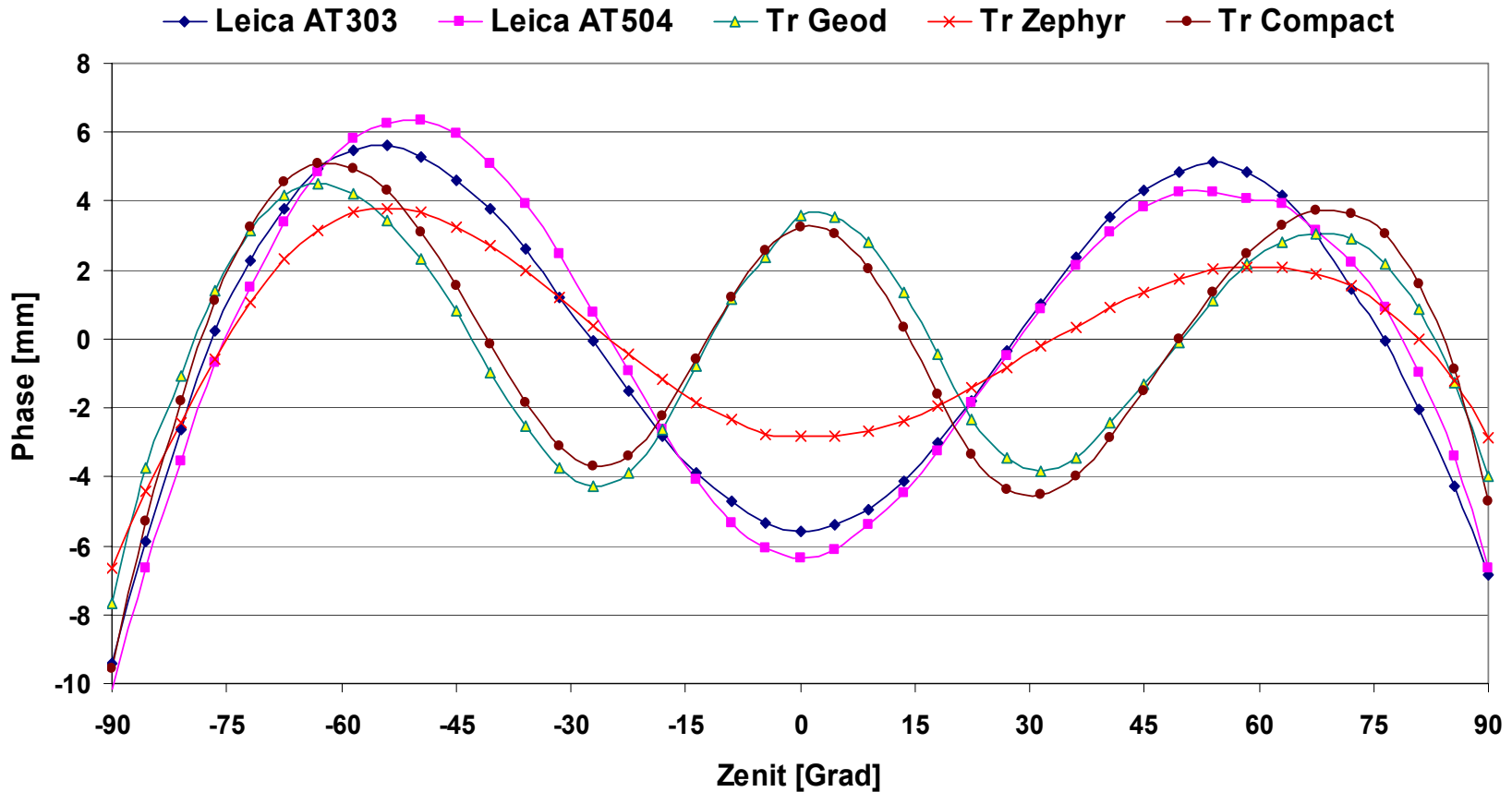
to get information about the scatter:

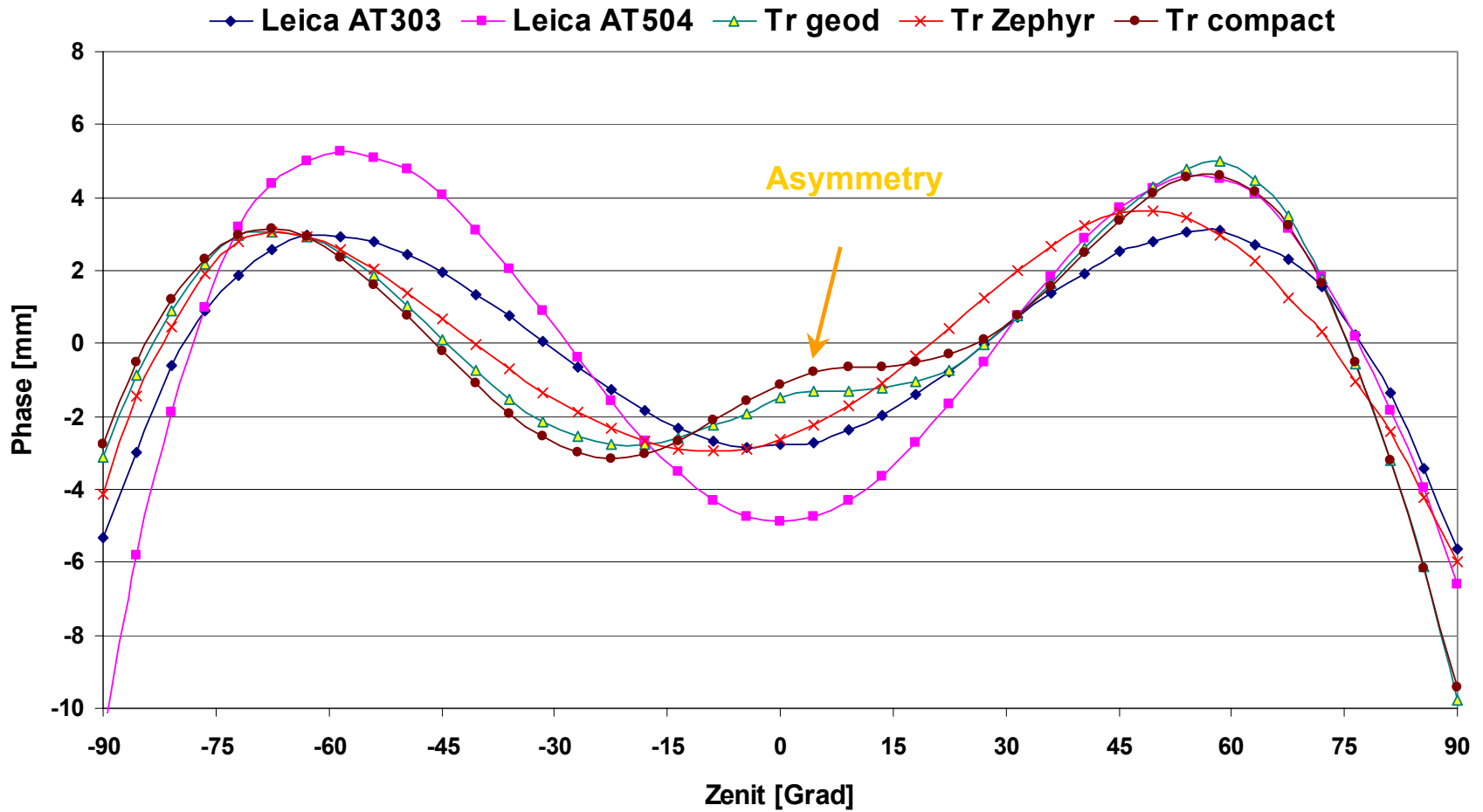
- 3a. Definition of a model function for the PCV
e.g.: harmonic function $dr(\beta) = \sum (a_k \cos \beta + b_k \sin \beta)$, $k = 0, \dots, 3$, or 5
- 3b. Reprocessing of step 1 and re-estimation of normalized RMS



Antenna Type	IGS-Code	
Trimble compact	TRM22020.00+GP	with groundplane
Trimble Zephyr geodetic	TRM41249.00	stealth groundplane (anti-reflex)
Trimble geodetic	TRM14532.00	
Leica AT 504	LEIAT504	Dorne Margolin Antenna with chokerings (designed after D/M T)
Leica AT 303	LEIAT303_LEIC	micropuls antenna with chokerings (identical to AT503)

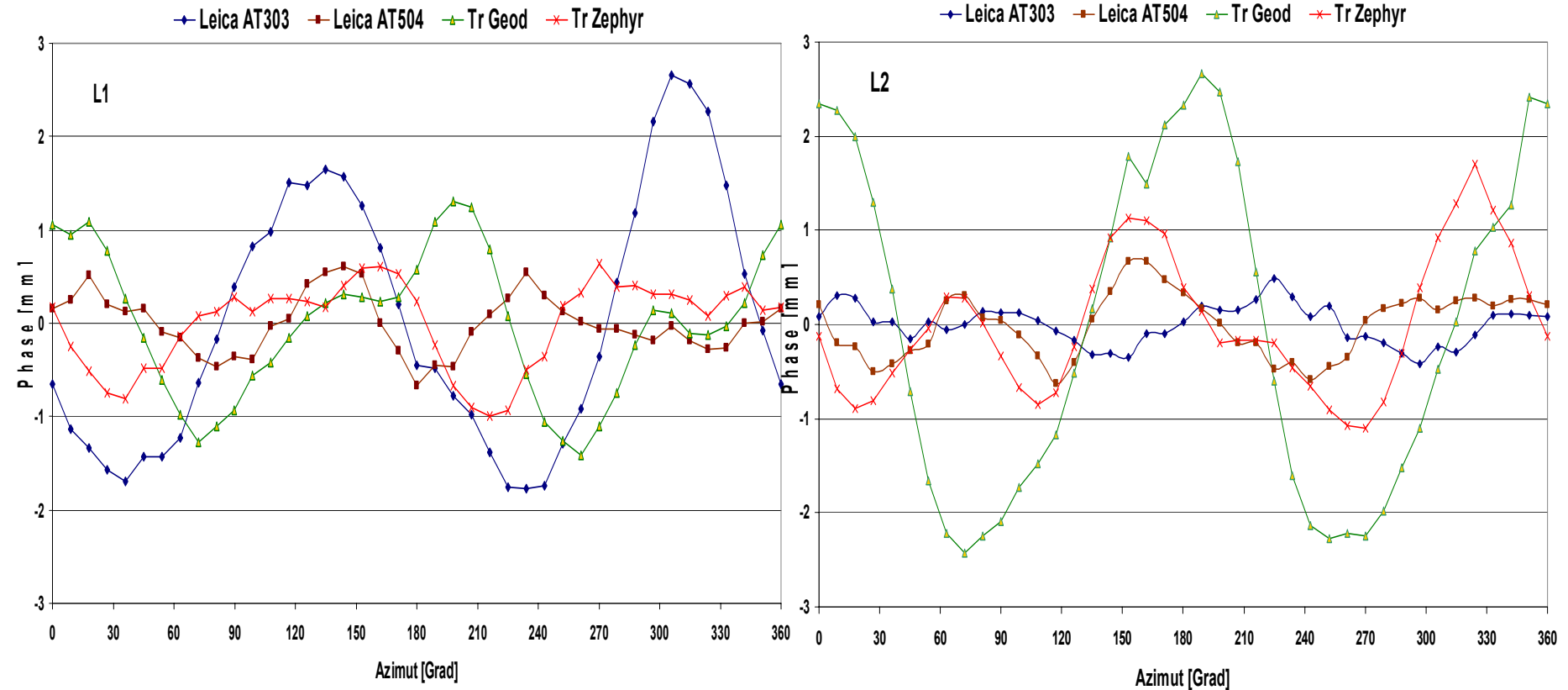
measured PCV values, no fitting function !





Phase pattern (Azimuth - Dependence)

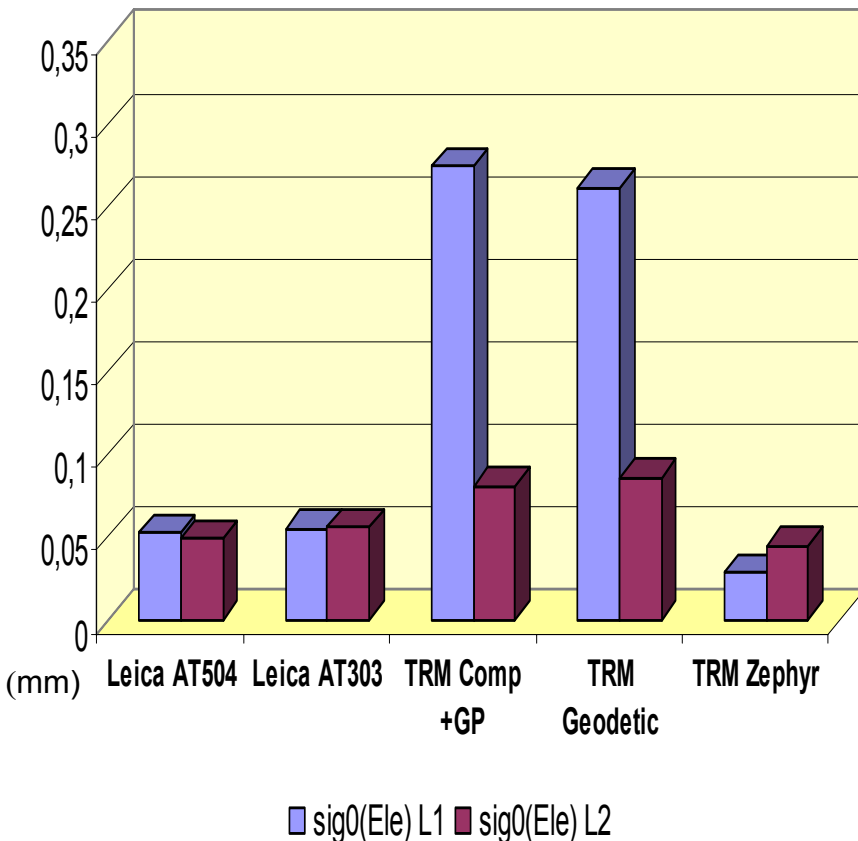
Elevation 12.5°



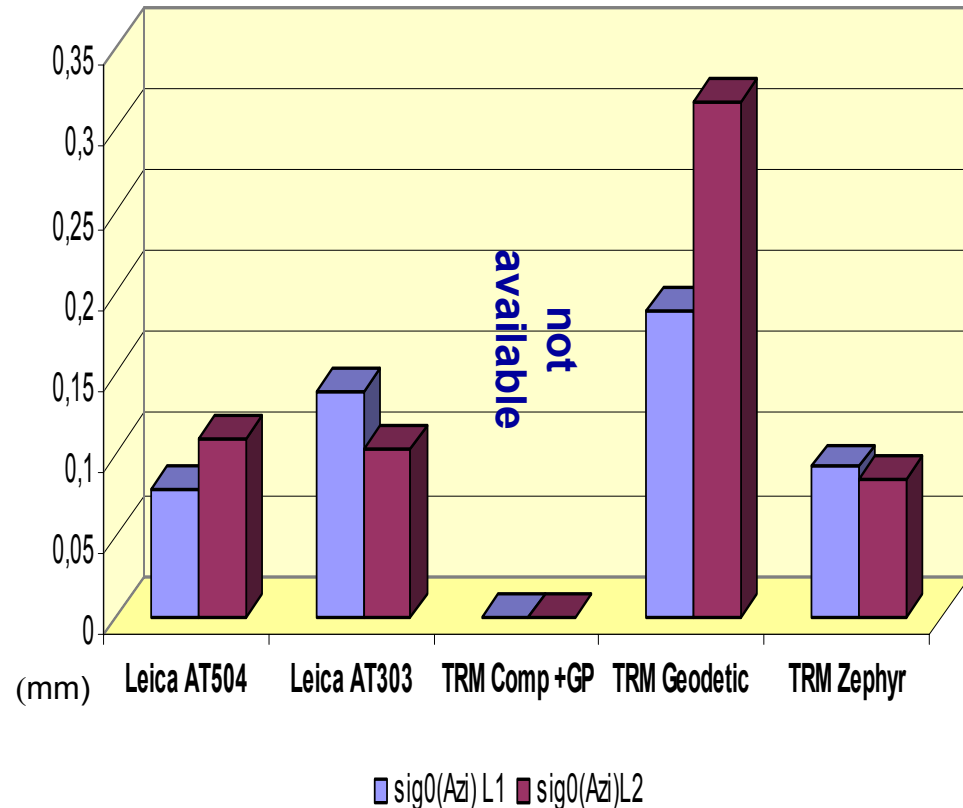
Normalized RMS of PCV (mm)

gives information about the scatter
after implementation of a harmonic function

of elevation-dependent PCV

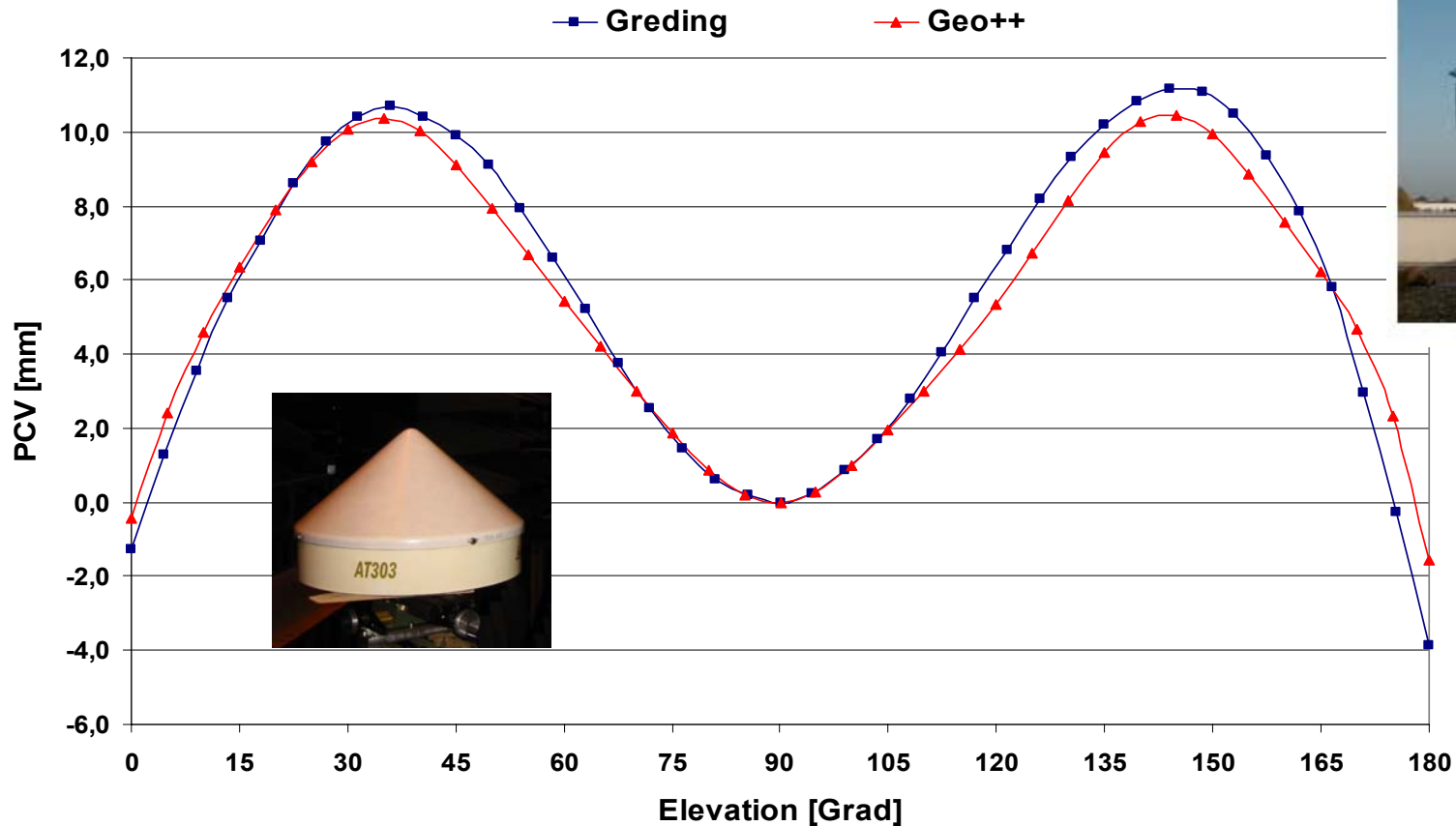


of azimuth-dependent PCV



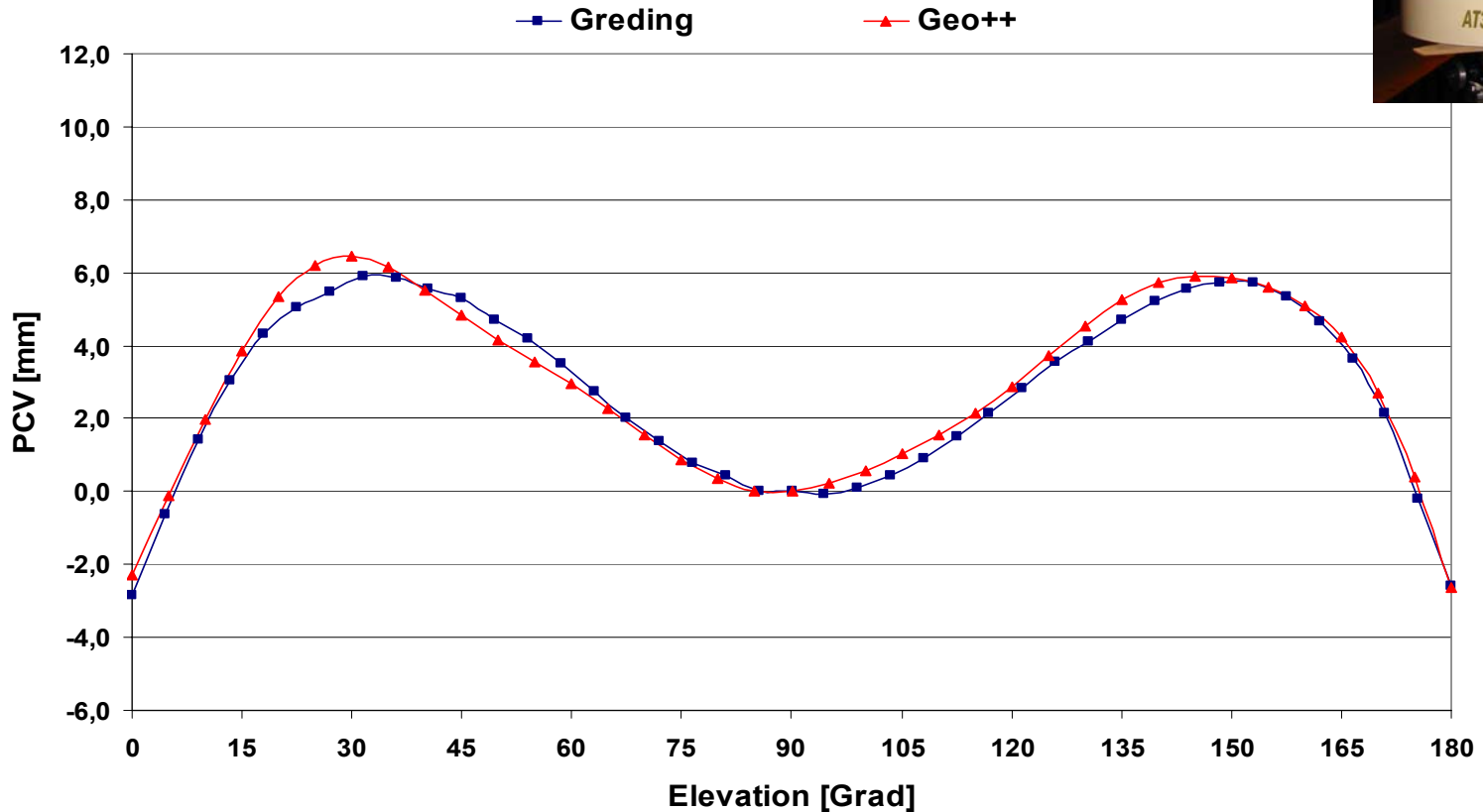
Chamber (Greding) - absolut field calibration with robot (GEO++, Hannover)

Leica AT 303 (identical antenna)



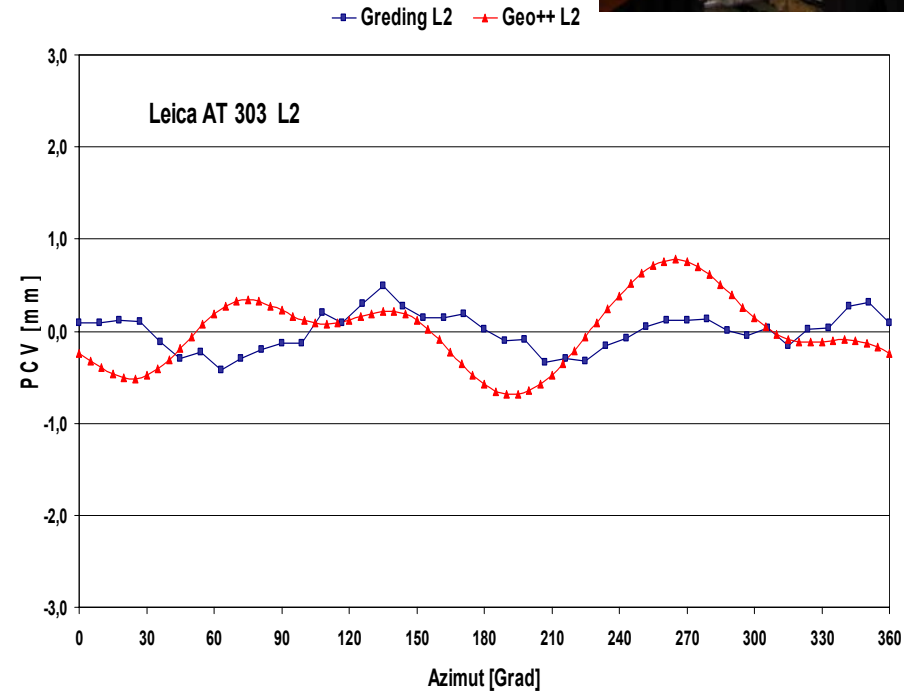
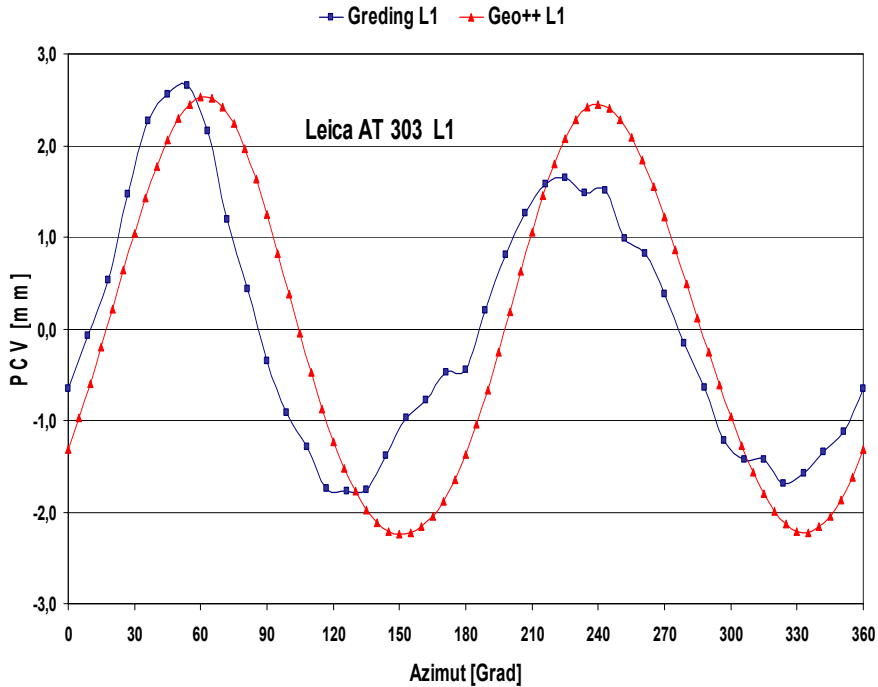
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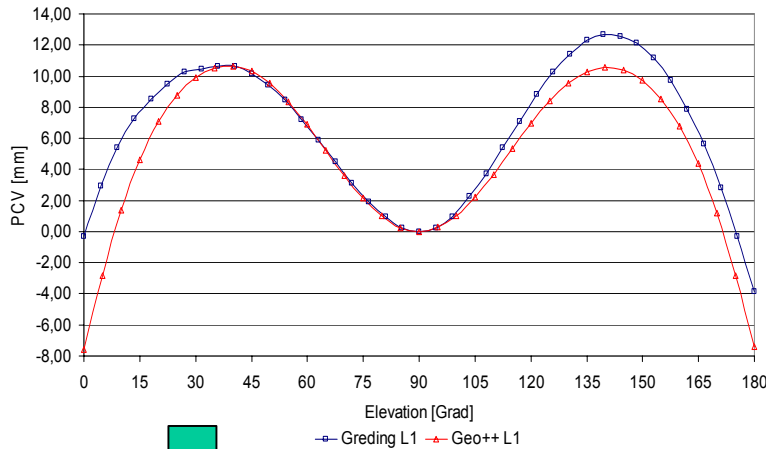
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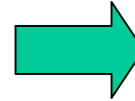
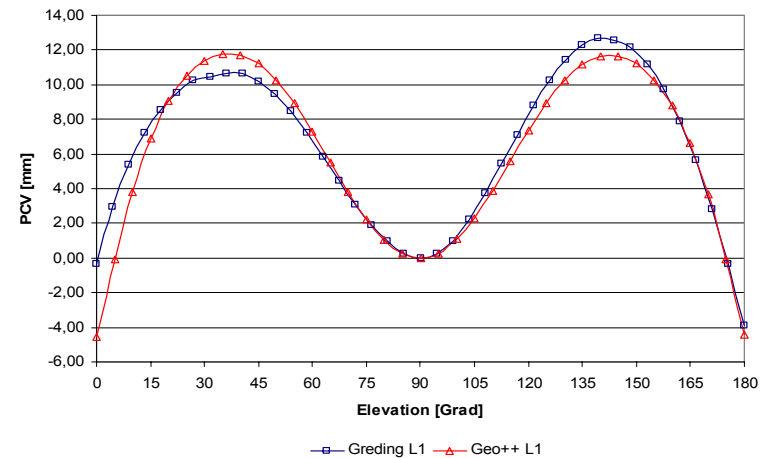


Comparison of the Offsets between Chamber (Greding) and robot (GEO++)

Leica AT504 L1

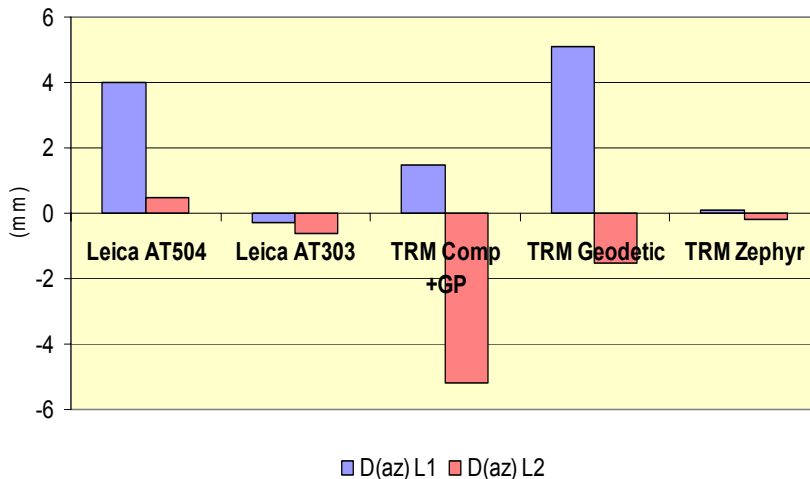


Leica AT504 L1



Residual-Offsets

from best-fit between both patterns



critical moment:

$$\Rightarrow \sigma_{\text{antcal}}^2 = \sigma_{\text{PCO/PCV}}^2 + \sigma_D^2$$

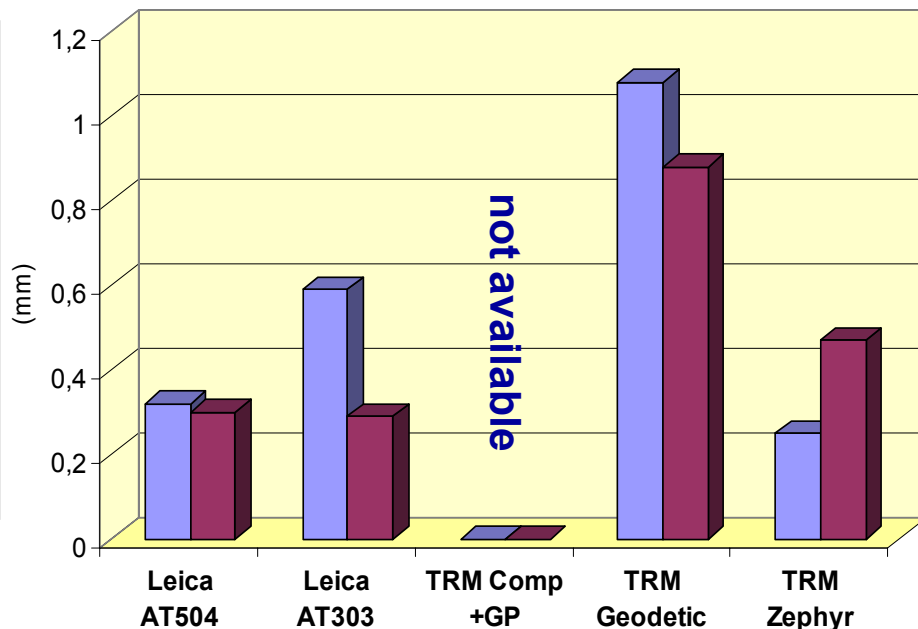
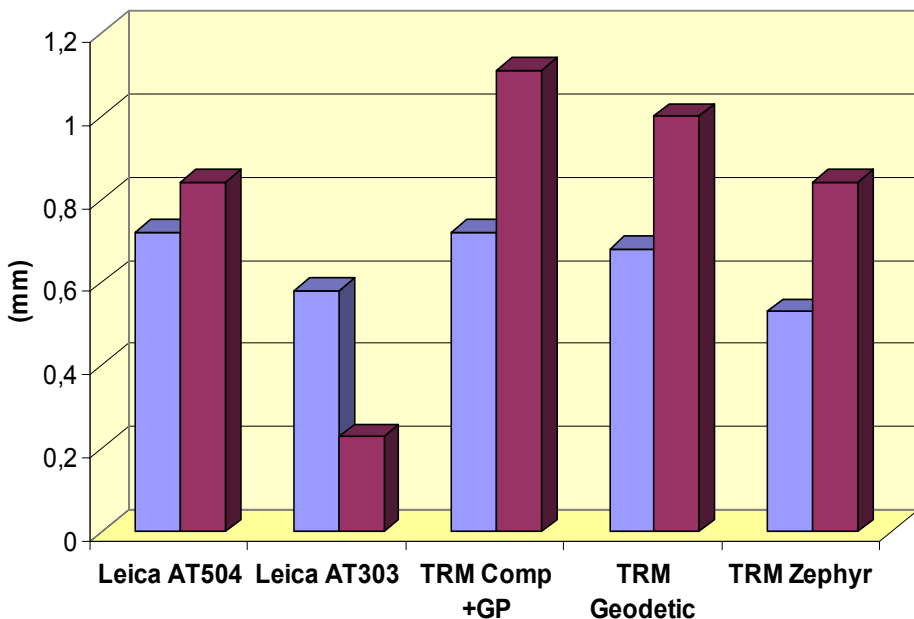
together with definition of ARP

elevation-dependent

azimuth-dependent

■ sig0(Ele-comp)L1 ■ sig0(Ele-comp)L2

■ sig0(Az-comp)L1 ■ sig0(Az-comp)L2



Scatter between two different PCV patterns

after best-fit

High potential for (receiver) antenna calibration in the anechoic chamber

- **Absolute calibrations from chamber measurements and robot agree on the 1 mm - level (identical antenna)**
- **Significant variations in quality between antennas of different design**
- **Anechoic chamber and robot permit homogenous distribution of observations and quality of the PCV results with regard to the antenna hemisphere**
- **Direct representation of the measured PCV values (no fitting function needed)**
=> possibility to study the characteristics of the patterns in detail

Future: Develop operational procedure for chamber measurements by improved control of the motion of antenna mount
=> measure the whole hemisphere in an automatic mode