

EFFECTS OF THE ATMOSPHERE ON THE SLR PRECISION

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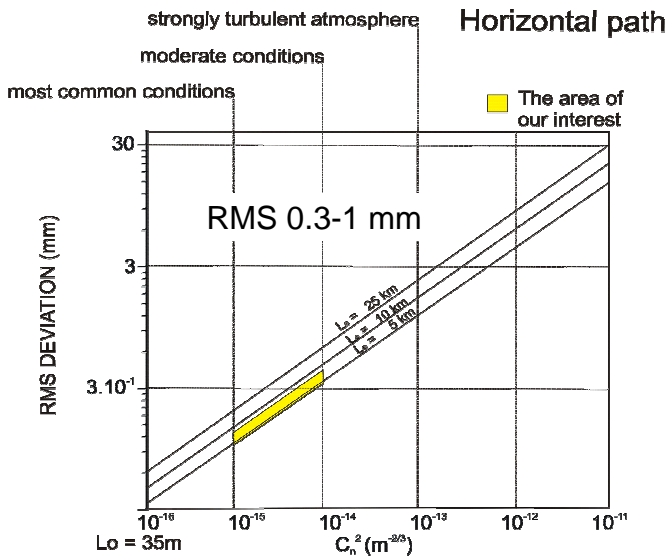
Abstract

The influence of the atmosphere has been examined at the Graz SLR station using several targets: 6 km ground, retro on balloon and others. The precision of 6km ranging is 6 psec rms. The experimental results are compared with the Greenwood-Tarzano atmospheric fluctuations spectral model.

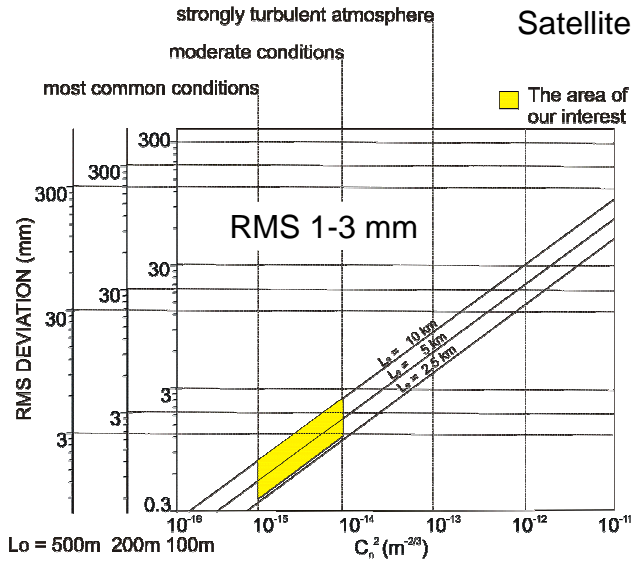
Introduction

- Goals:
 - precise measurement of range by using a laser beam and a retro-reflector
 - prediction of the influence of atmospheric effects on the precision of the measurement
 - using an atmospheric model for correction of the measurement results
- My task:
 - study of known atmospheric effects and theoretical background of laser ranging
 - writing a computer model of the atmosphere and checking its results experimentally

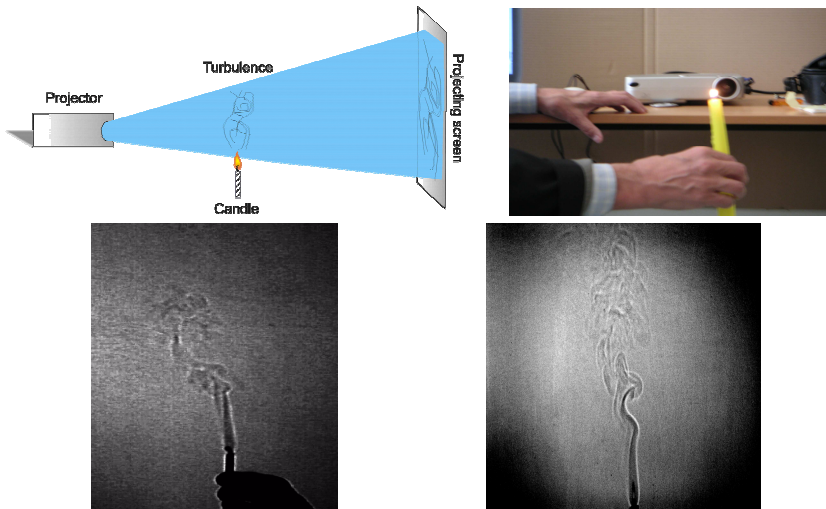
Gardner Greenwood-Tarazano model



Gardner Greenwood-Tarazano model

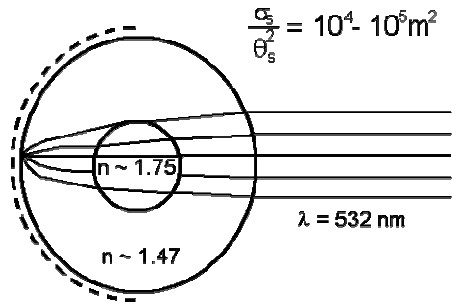


Clear Air Turbulence Prague Indoor Tests, June 2004



Retroreflector

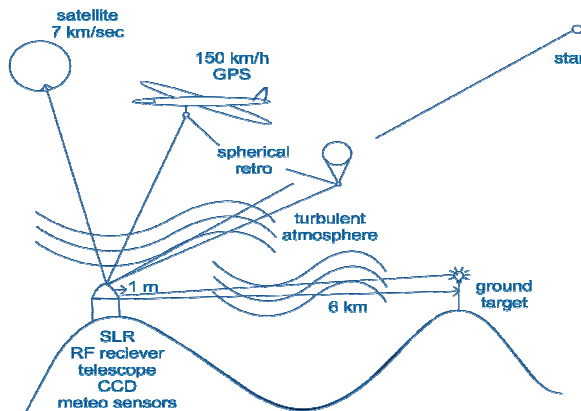
- Spherical retro
- cross-section $\sim 10^4 - 10^5 \text{ m}^2$



V. B. Burmistrov, N. N. Pharkomenko, V. D. Shargorodsky, V. P. Vasiljev

Introduction to the experiments

- measured on the Graz observatory, using all the retros

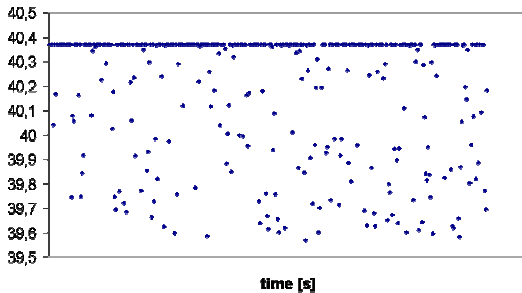


6 km target results

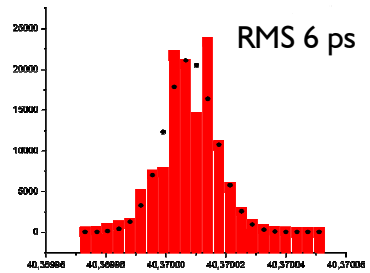
Graz, 30. 9. – 2. 10. 2003

- for the horizontal path the RMS was predicted and measured 1 mm (6.6 picoseconds)

6 km target Graz (file LONGTAR)



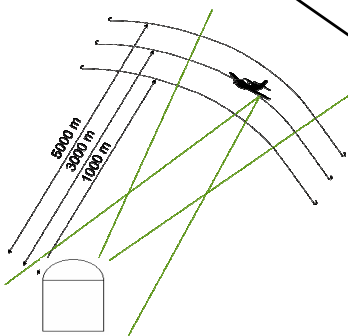
6 km processed results - RMS



Motoglider I

Graz, 30. 9. – 2. 10. 2003

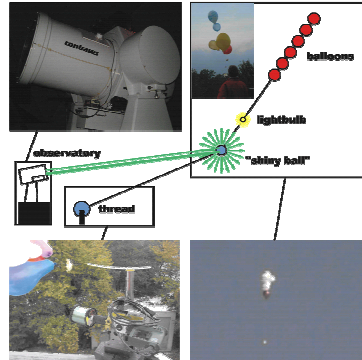
- to check the theoretical prediction of RMS for non-horizontal path also not to space
- first attempt: a corner retro on the wing of a motoglider



Balloons carrying “shiny ball”

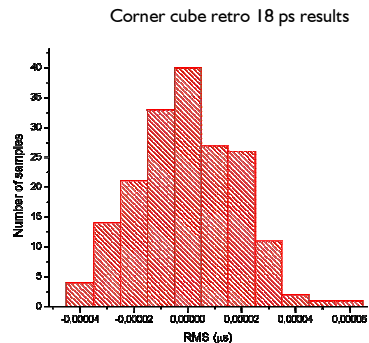
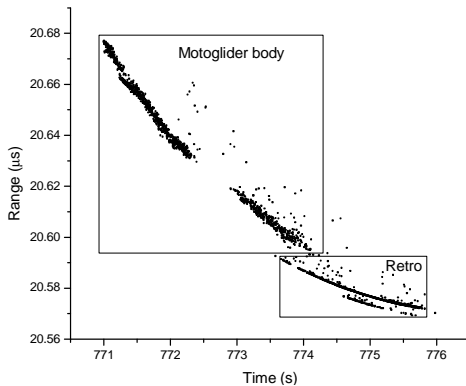
Graz, 25. 10. -27. 10. 2003

- the next experiment was based on the same purpose - to check the predicted value of pathlength deviation on the slant path to closer target experimentally
- the balloons were bound on thread, equipped also by a searchlight for easier targeting
- the whole set was light and cheap, which allowed us to launch more of them
- the shiny ball = silver coated sphere for Christmas trees
- range 0 – 300 m



Motoglider 2 results

- Reflections from the sphere, corner cube and even the body of the glider were recognized
- depicted the reflection from the corner cube retro result



Predicted and measured RMS

6 km target	7 ps	7 ps
Motoglider 1	7 ps	none
Balloons & „shiny ball“	7 ps	27 ps
Motoglider 2 corner cube retro	7 ps	18 ps
Motoglider 2 spherical retro	7 ps	13 ps

Conclusion

- Long term Graz and perhaps the other millimeter ranging stations show a discrepancy between the ground target RMS 1 mm and SLR 3 mm.
- Clear Air Turbulence CAT modeled by Gardner and Greenwoon-Tarazano might explain contribution to the overall SLR RMS.
- Our experiments (2 kHz laser) using several retros: “Shiny ball” equipped balloons, the Roof Prism and Spherical Retro equipped motorglider, show 2-4 mm RMS consistent with the Gardner and T-G model.
- 6 km – 4 km horizontal path shows routinely 1 mm RMS consistent with the Gardner and G-T model close to the machine RMS.
- Due to the signal strength RMS dependence more info might be expected from the Signal Strength Monitor build in Pico Event Timer 2k.