Millimeter Ranging Accuracy the Bottleneck

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Accuracy

- A measure of the closeness of a measurement /average/ to the true value.

- Includes a combination of random error (precision) and systematic error (bias) components.

- It is recommended to use the terms "precision" and "bias", rather than "accuracy," to convey the information usually associated with accuracy.

- *definition according to* USC Information Sciences Institute, Marina del Rey, CA (www)
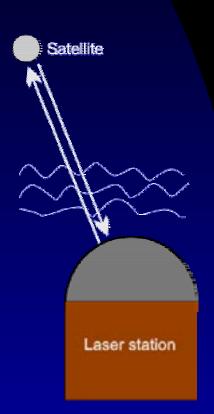
Accuracy check

- Comparison to more accurate method

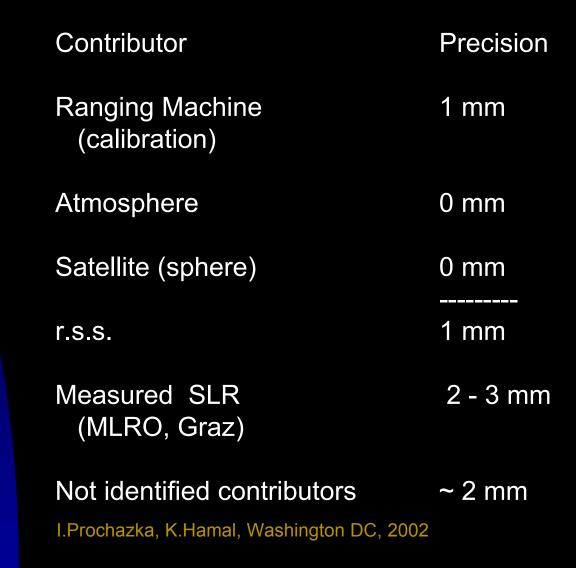 For SLR accuracy check such a method is not available

- characterizing ALL individual error budget contributors, their precision and biases
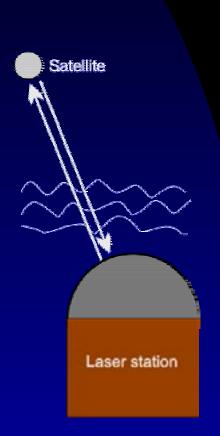 (M. Pearlman, System characterization parameters, Herstmonceux, 1984)

  PROBLEM :
  The list of our error budget contributors is not complete.

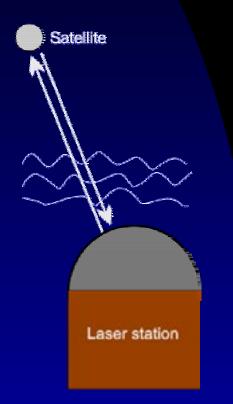I.Prochazka, K.Hamal, Washington DC, 2002

SLR precision discrepancy

Contributor	Precision
Ranging Machine (calibration)	1 mm
Atmosphere	0 mm
Satellite (sphere)	0 mm
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r.s.s.	1 mm
Measured SLR (MLRO, Graz)	2 - 3 mm
Not identified contributors	~ 2 mm

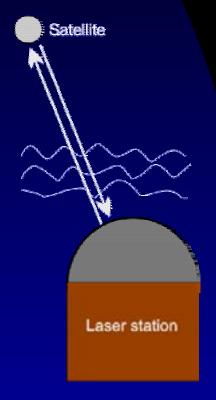I.Prochazka, K.Hamal, Washington DC, 2002

Goals:

Satellite

Laser station

- Identification of ALL the error budget contributors

- Determining the precision and possible biases of all these components

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"New" SLR error budget contributors

Satellite

Laser station

- **Laser wavefront**
  - Most systems calibrate using a near field "sample" of the beam, however, SLR is based on a far field wavefront
- **Reference frequency**
  - RF and harmonic distorsion of the master frequency signal bias the timing
- **Data processing**
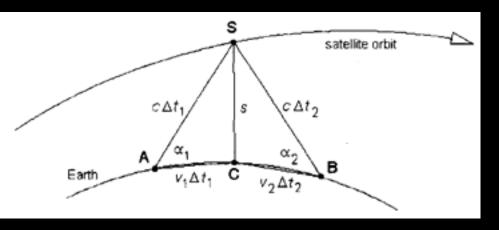 - the "numerical noise" of SLR data processing
- **SLR geometry**
  - the satellite range is not one half of the pulse travel back and forth
- **Timing devices** linearity and biases
- (many ?) Others

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SLR geometry

■ J.Kabelac, "Determination of reflection time", Vermessung und Geoinformation, No.4,97Wien, Austria,1997,pp288-289

■ Consequences
1. The <u>reflection time</u> is not equal to the emission time plus 1/2 of propagation time.
2. The <u>satellite distance</u> is not equal to 1/2 of the beam path length.
3. The range discrepancy may reach 0.5 mm (!)

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