

Portable Calibration Standard Mission Review

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To examine the millimeter SLR capability, the Portable Calibration Standard (PCS) based on P-PET [1,3,4,5], HP Time and Frequency GPS Receiver, Meteo sensor and Ground calibration targets was installed at different sites (Graz '97 and '99, WLRS '98, Zimmerwald '98, Herstmonceux '98, TIGO '99, Shanghai '01). The ranging jitter (ground and satellite targets) ranges between 1-20 mm [2,5].

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References

1. K.Hamal,I.Procházka, *Picosecond Event Timer for Millimeter Laser Ranging*, Proceedings of the 23rd General Assembly Meeting of the European Geophysical Society, Nice, France, April 1998, published in **Annales Geophysicae** Supplement, Vol. 16, 1998
2. Karel Hamal, Ivan Prochazka, Josef Blazej, *Contribution of the Pico Event Timer to satellite laser station performance improvement*, **SPIE** 3865-05, USA, 1999
3. I.Prochazka, K.Hamal, *Portable Calibration standard for satellite laser ranging, capabilities and limitations*, **SPIE** 4546-12, USA, Sept. 2001
4. Yang Fu Min, Karel Hamal, Ivan Prochazka, *A sub-centimeter single shot ranging accuracy experiment at the Shanghai satellite laser ranging station, to be published in a journal „Science in China“*, Shanghai, China, 2001
5. I. Prochazka, K. Hamal , *Portable Calibration Standard Capabilities*, in this Proceedings
6. K. Hamal, I. Prochazka, *Portable Pico Event Timer Upgrade*, in this Proceedings

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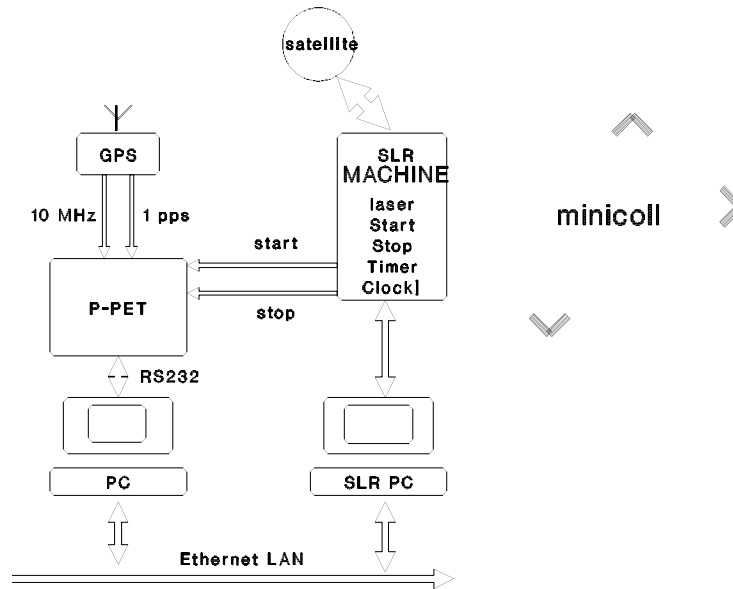
Czech Technical University, Prague, Czech Republic

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Goals

- ground ranging machine diagnostics
- identification of error sources due to :
 - epoch and time interval timing
 - epoch and frequency reference
 - data acquisition, filtering and processing
 - calibration scheme and ground survey
 - operational procedures
 - radio frequency interference
 - other sources (?)

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PCS BLOCK SCHEME



K.Hamal,I.Prochazka, EurOpto, London 1997

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P-PET Main Parameters

- timing resolution 1.2 ps
- timing jitter / channel 2.5 ps
- non-linearity < 2.5 ps
- drift, stability < 0.7 ps/K, 0.5ps/hour
- **adjustment** **NO**
- input signals Start,Stop,1pps,10MHz
- max. repetition rate > 100 readings / sec
 > 2 MHz laser rate
- interface RS232 (3 wires)
- mass (transport config.) 32 kg

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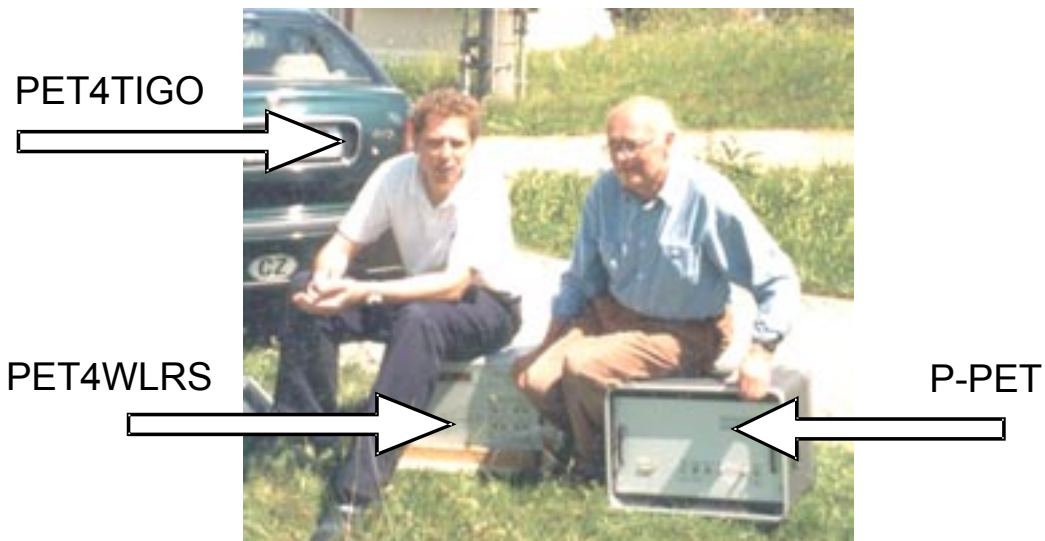
Portable Calibration Standard Missions

Graz	97/98/99	high precision SLR, stability comparison to counter cluster
WLRS Wettzell	97/99	t/r biases, low jitter, stability
TIGO Wettzell	1998	TW, t/r biases, low jitter, stability
Zimmerwald	1998	TW, t/r biases, low jitter, stability
Herstmonceux	1998	counters linearity
Shanghai	2001	t/r biases, low jitter, survey,operation procedures HP5370B counter linearity
Potsdam	2001	low jitter, SR620 counters linearity

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P-PET Mission, WLRS & TIGO, Wettzell 1998

worldwide maximum P-PET density per m²



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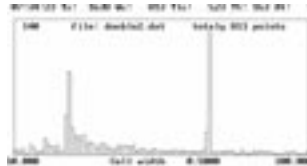
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P-PET Mission, TIGO, 1998, TW SLR

4 x SR620



P-PET

Infrared, 75 ps
1 phot



Blue, 45 ps
1 phot

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PET Mission, Graz, 1999
Comparison to Graz Counter Cluster

PET4TIGO



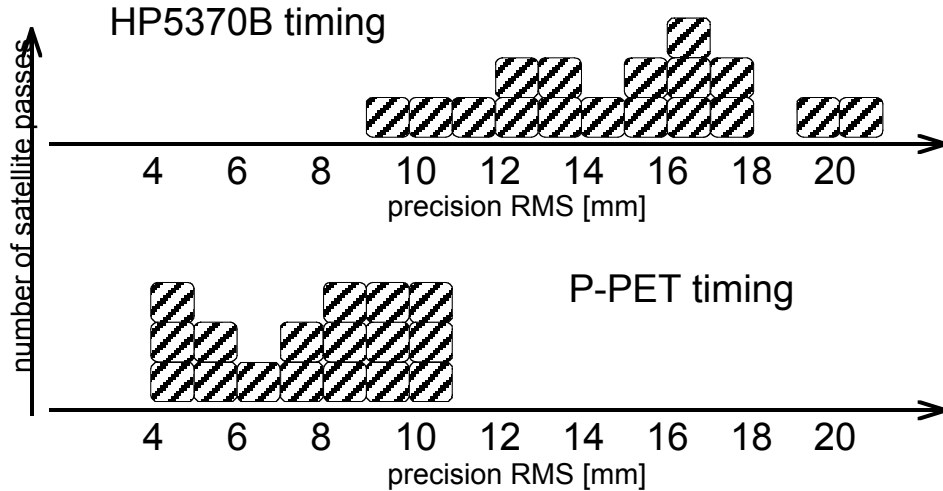
3 x SR620

2 x HP5370

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SLR single shot precision Shanghai 2001



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Zimmerwald, 24hour Mission, May 27-28, 1998 Two wavelength ranging

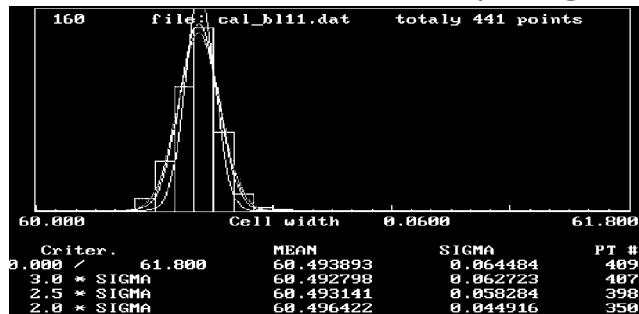
Original station setup 150 psec

After system re-cabling and detectors tuning

SLR system 120 psec

P-PET timing 76 psec @ red

58 psec @ blue



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P-PET Mission, Herstmonceux, 1998
Counters linearity tests

Counters



notebook

P-PET

=> Eurolas Workshop, Herstmonceux, March 2002

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SLR Portable Calibration Standard Mission Review
P-PET Mission, Shanghai, August 2001
Personal Luggage Transportation



Shanghai Observatory SLR

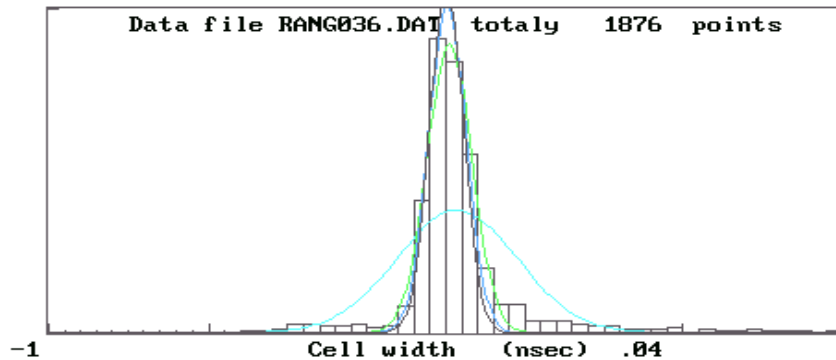


Lufthansa Check-in

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Shanghai SLR, P-PET timing Lageos, Aug. 19, 2001 7.0 mm rms

Range residuals 101 8 19 7603901. at 12:20 UT



	Crater.		MEAN	SIGMA	PT #
Limits	-1.000 /	1.000	0.027430	0.151741	1315
	3 * SIGMA		0.007832	0.056696	1153
	2.5 * SIGMA		0.002507	0.047051	1093
	2.2 * SIGMA		0.000586	0.042044	1041

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Conclusion

- Portable Calibration Standard based on a Pico Event Timer is a powerful tool to identify error sources in the SLR “ranging machine”
- the entire system is compact,
easy to transport,
fast to install and
user friendly
- the calibration mission can be accomplished within
one week time slot,

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