

SLR Portable Calibration Standard Mission Review

Karel Hamal , Ivan Prochazka

presented at
the 13th Workshop on Laser Ranging
Washington DC, October 7-11, 2002

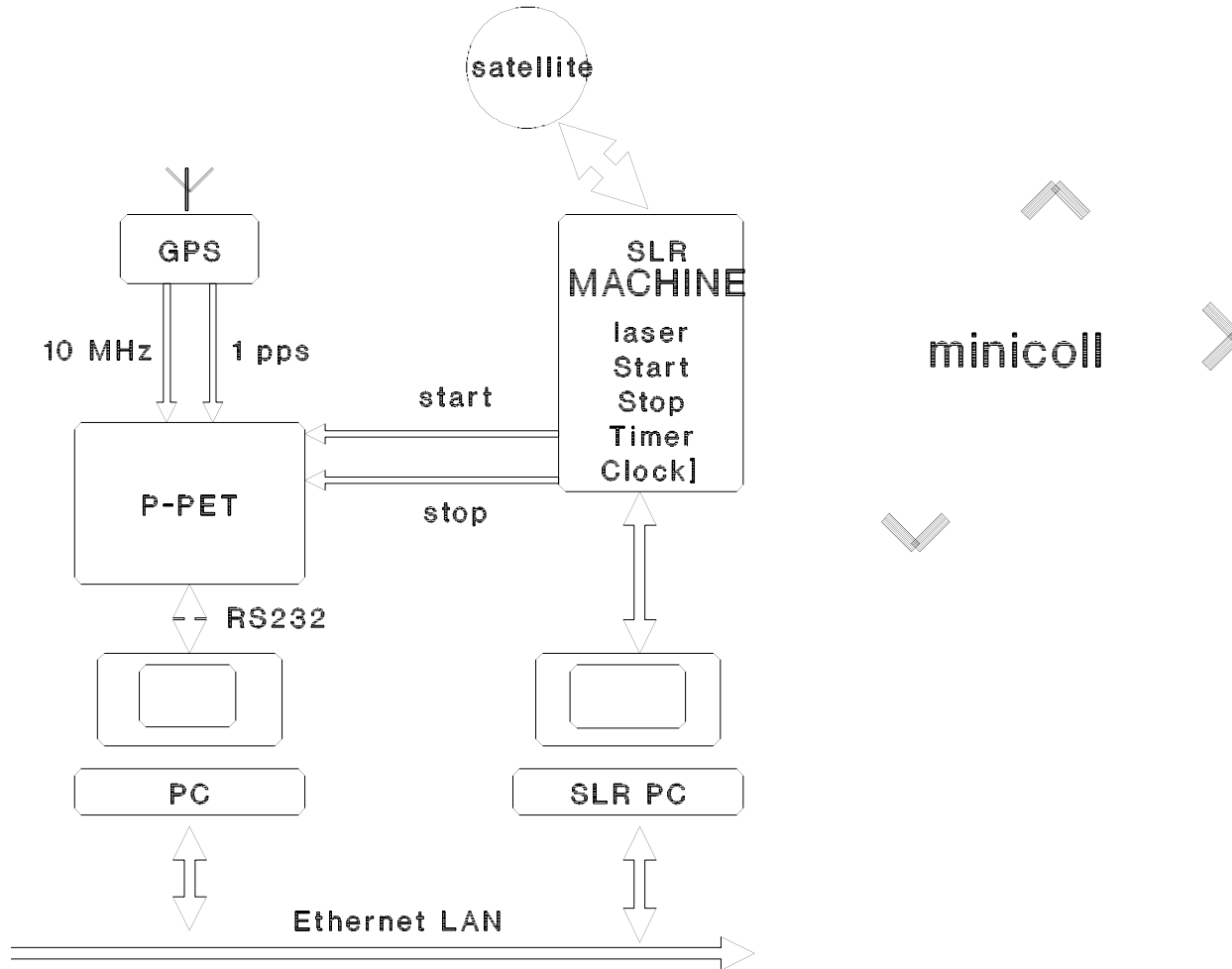
Czech Technical University, Prague, Czech Republic

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 (?)

SLR Portable Calibration Standard Mission Review

PCS BLOCK SCHEME



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

K. Hamal, I.Prochazka,
Washington 2002

SLR Portable Calibration Standard Mission Review

Pico Event Timer Portable Calibration Standard



K. Hamal, I. Prochazka,
Washington 2002

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

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

SLR Portable Calibration Standard Mission Review

P-PET Mission, WLRS & TIGO, Wettzell 1998



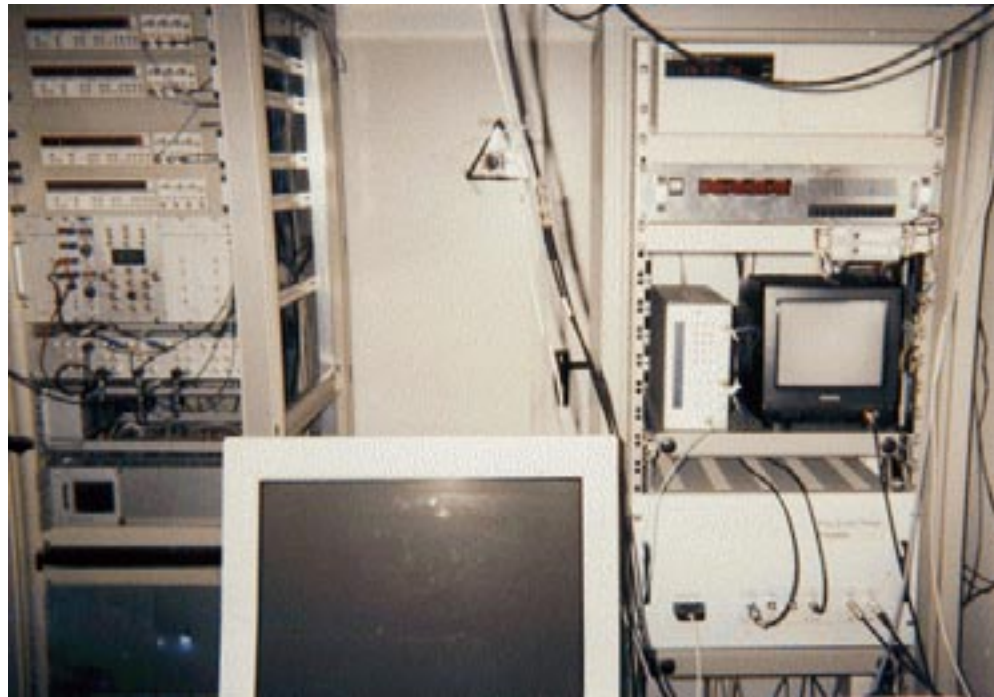
PET4WLRS

P-PET

K. Hamal, I. Prochazka,
Washington 2002

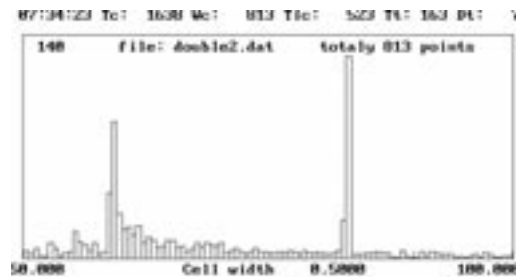
SLR Portable Calibration Standard Mission Review
P-PET Mission, TIGO, 1998, TW SLR

4 x SR620



P-PET

Infrared, 75 ps
1 phot



Blue, 45 ps
1 phot

K. Hamal, I. Prochazka,
Washington 2002

SLR Portable Calibration Standard Mission Review
PET Mission, Graz, 1999
Comparison to Graz Counter Cluster



3 x SR620

2 x HP5370

PET4TIGO

K. Hamal, I. Prochazka,
Washington 2002

SLR Portable Calibration Standard Mission Review

Zimmerwald, 24hour Mission, May 27-28, 1998

Two wavelength ranging

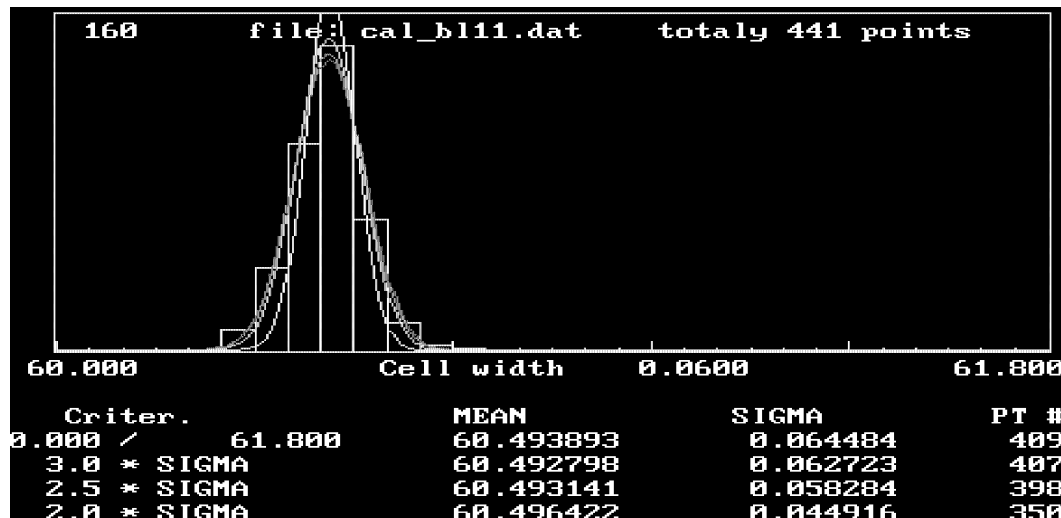
Original station setup 150 psec

After system re-cabling and detectors tuning

SLR system 120 psec

P-PET timing 76 psec @ red

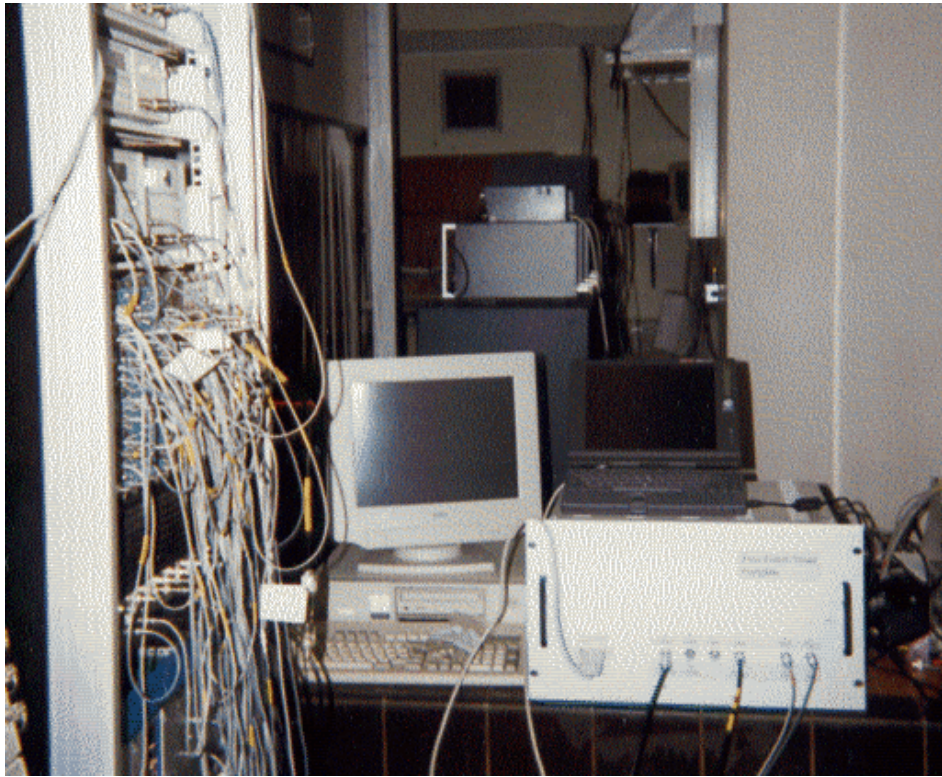
58 psec @ blue



K. Hamal, I. Prochazka,
Washington 2002

SLR Portable Calibration Standard Mission Review
P-PET Mission, Herstmonceux, 1998
Counters linearity tests

Counters



notebook

P-PET

=> Eurolas Workshop, Herstmonceux, March 2002

K. Hamal, I. Prochazka,
Washington 2002

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



Shanghai Observatory SLR



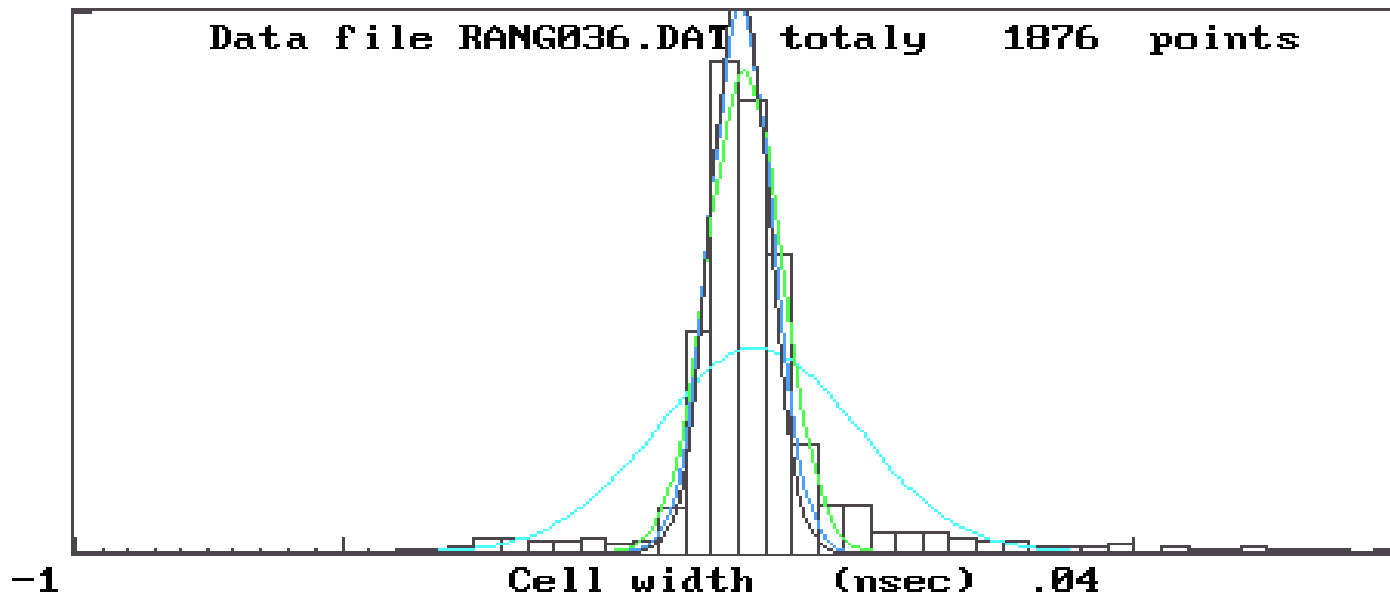
Lufthansa Check-in

SLR Portable Calibration Standard Mission Review

Shanghai SLR, P-PET timing

Lageos, Aug. 19, 2001 7.0 mm rms

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



	Criter.		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

K. Hamal, I. Prochazka,
Washington 2002

SLR Portable Calibration Standard Mission Review

P-PET Results Summary, Shanghai 2001

Satellite	P-PET rms (mm)	SLR rms (mm)	Time bias (us)	Rng. bias (ns)
Starlette	7.5	12.7	0.1	0.02
Beacon-C	9.3	13.8	0.1	0.00
Ajisai	10.9	15.9	0.1	0.00
Lageos 2	10.5	17.3	0.1	-0.01
Starlette	9.0	15.1	0.1	0.03
Lageos 1	8.5	14.2	0.1	0.01
Beacon C	19.2	19.7	0.1	0.02
Topex	22.4	35	0.1	0.00
Topex	4.9	10.8	0.1	0.00
Lageos 1	7.0	13.5	0.1	0.00
Stella	6.1	12.4	0.1	0.00
Beacon C	10.0	16.1	0.1	0.00
Starlette	8.4	12.9	0.1	0.01
Westpac	--	16.6	0.1	0.03
Lageos 2	8.5	16.1	0.1	0.00
Stella	4.8	11.5	0.1	0.00
ERS-2	4.0	10.5	0.1	0.01
mean			0.1	0.01

K. Hamal, I. Prochazka,
Washington 2002

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,