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Upgrade of SLR Station 7841 Potsdam

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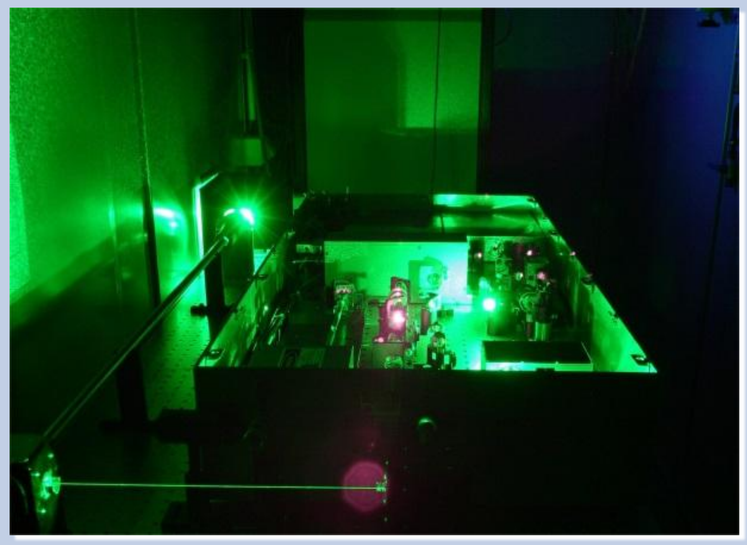
Overview

The SLR Station 7841 Potsdam was upgraded in 2011 from a 10 Hz system to high-repetition rate (2 kHz). The Range Gate Generator (RGG) is an in-house development based on the widely used ARM7 microprocessor with an internal clock frequency of 60 MHz. This allows for a range gate resolution of 16.7 ns which has proven to be sufficient for most applications so far.
The system is operated in strict single-photon regime (few per cent of return rate).

In 2012 the tracking software was transferred and upgraded from the historic DOS-based system to a Linux-based „all-in-one“ system with a lot more flexibility.

Recently, all peripheral (non time-critical) functions were concentrated on a single Windows™ based PC.

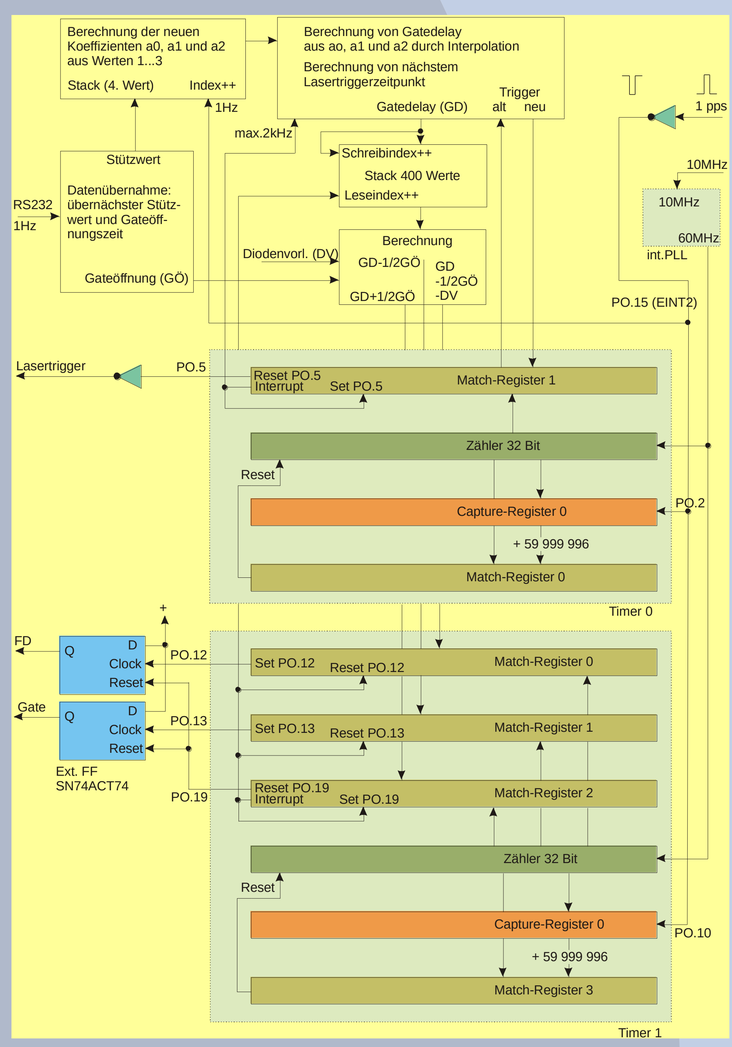
Main System Parameters	
Laser Type	picoREGEN™ (HighQ Inc.)
Repetition Rate	2 – 4 kHz (tested so far)
Wavelegth	532.15 nm
Energy per pulse	400 µJ
Pulsewidth	12 ps
Event Timer Type	A032-ET (Univ. of Riga)
Single shot accuracy	~ 7 ps
Detector type	PMT or SPAD (selectable)
Apertures • Tx telescope • Rx telescope	 13 cm 40 cm
Maximum speed (azimuth and elevation)	12°/sec
Maximum range	Galileo orbit (25000 km)



The Range Gate Generator (RGG)

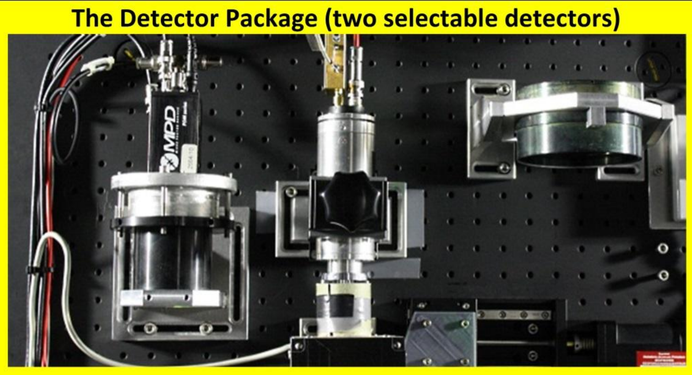
Basic hardware circuit	ARM7 microprocessor
Clock frequency	60 MHz
Timing resolution	16.7 ns
Software for RGG	C++
Input Signals via RS-232 (once per second)	• Predicted Time of Flight PToF (valid for overnext second) • Gate Open Time • Satellite Time Bias
Input Signals via BNC	1 PPS 10 MHz (all from GPS clock)
Output Signals via BNC	• Gate Open Pulse • Gate Close Pulse (in case of no return signal) • Laser Trigger Pulse • SPAD Gate Signal
Internal Software Functionality	• 3rd order interpolation of PToF • Detection of collision between outgoing and incoming laser pulses • Shift of laser trigger epoch (if collision detected)

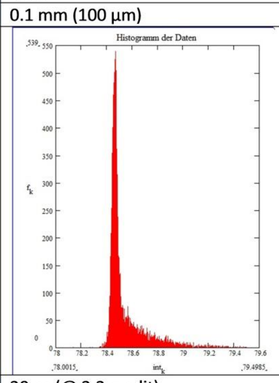
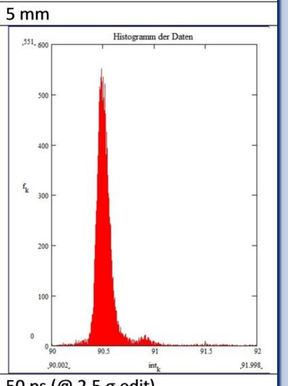
Maximum laser trigger repetition rate is 10 kHz (selectable by external switch)

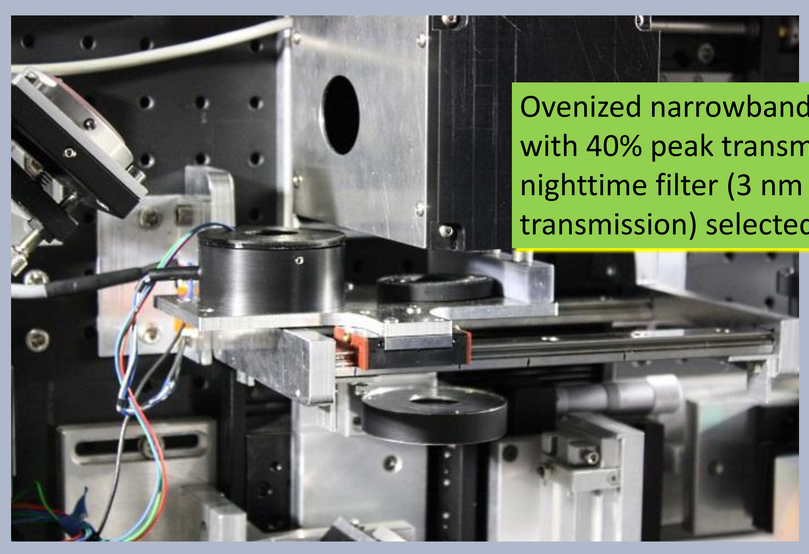


Architecture of RGG

The Detector Package (two selectable detectors)



		
Detector	MPD-1CTC (uncompensated SPAD on two-stage Peltier cooler)	H5320 (PMT)
Manufacturer	Micro Photonic Devices, Inc.	Hamamatsu Photonics
QE @ 532 nm	40 %	8 %
Active area	0.1 mm (100 µm)	5 mm
Histogram at single photon level (target response)		
Jitter of target response	20 ps (@ 2.2 σ edit)	50 ps (@ 2.5 σ edit)
Distribution of residuals	asymmetric	symmetric
Advantages	High detection efficiency Fast timing response Virtually noise-free (even @2 kHz)	Large Field of View (no alignment problems)
Disadvantages	Small Field of View (difficult to align)	Low detection efficiency Inferior timing response (compared to SPAD)



Ovenized narrowband daylight filter (0.4 nm with 40% peak transmission) and wideband nighttime filter (3 nm with 97% peak transmission) selected under PC control.

Sky surveillance cameras selectable between colour CCD for daylight and stacked B&W for nighttime operation; even faint stars and thin clouds are clearly visible.