



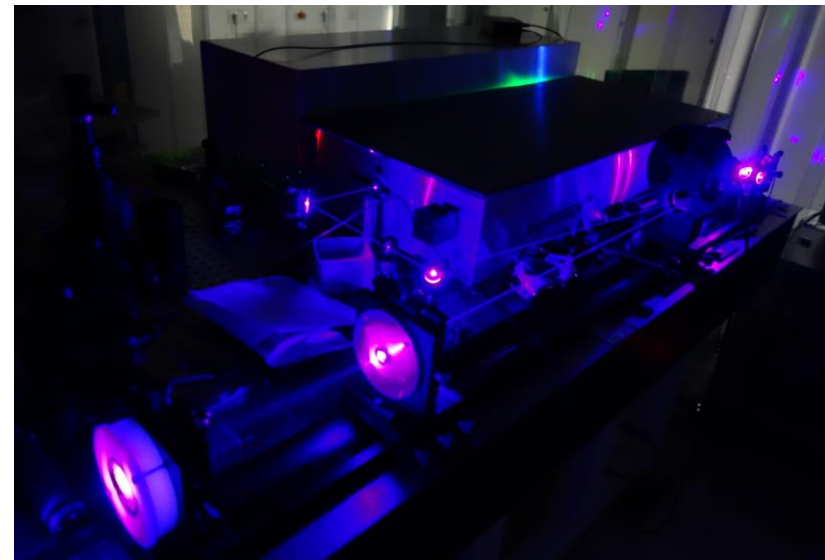
# Autonomous tracking with high repetition rate systems

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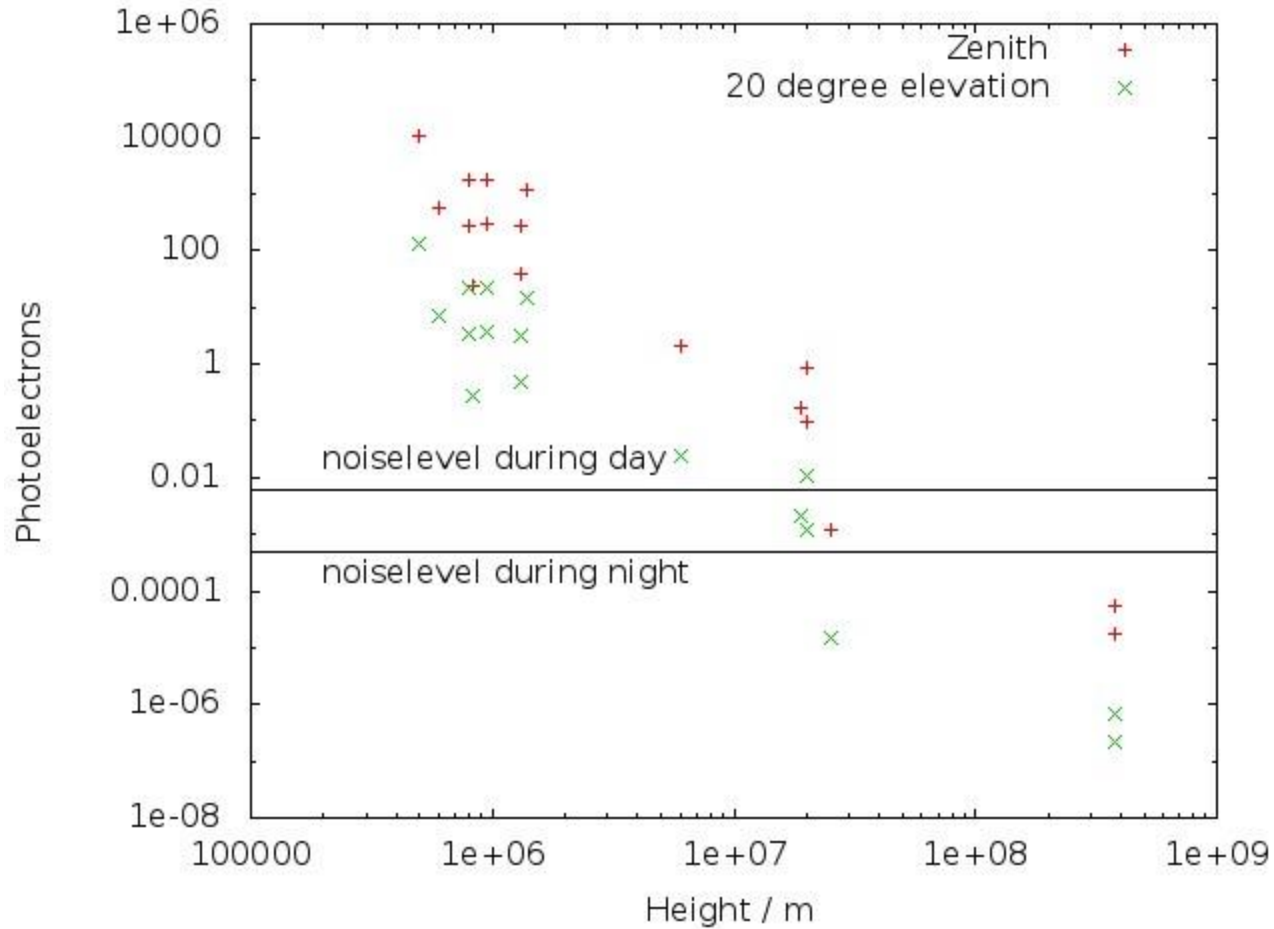
- bistatic kHz-SLR System
- strict single photoelectron mode
- 15 cm transmit, 50cm receive aperture
- Currently operated with 1mJ@849.8nm and 1 kHz





# General requirements for realizing autonomous SLR

- In-sky laser safety system
- Interlock system for dangerous areas for unattended operation
- Precipitation sensor
- Atmospheric Transmittance Sensor
- Cloud Coverage Sensor (Nubiscope), no realtime availability
- LIDAR or Atmospheric Backscatter Analysis, realtime availability
- Pass scheduler
- Deterministic behaving SLR system with well defined software interface
- Utmost possible signal to noise ratio (for GNSS targets) i.e.
  - 15 arcsecond field of view
  - tight 5 arcsecond beam
- Ordinary detector, no quadrant detector





- Non-autonomous software realized in C++ with GUI and core functionality interface for
  - Eventtimer
  - Transmit Receive Unit (Field of View and Attenuation Control)
  - Telescope
- SWIG - generated Python bindings to core functionality interface (see [www.swig.org](http://www.swig.org))
- Enables for compact and flexible script coding, no compilation required
- Python interpreter is a very handy debug tool
- GUI can be used to monitor autonomous actions



# Algorithm for Tracking Assistant

- Setup telescope, eventtimer and transmit receive unit with target parameters
- Determine actual noise level, if low enough continue
- Start pointing spiral search
- Stop spiral search if signal in one histogram bin has reached triggerlevel
- Perform 4-step pointing optimization and attenuate if required
- Observe a view seconds then switch to next target
  
- This eliminates the most tedious observer's job, namely searching for returns



- Lageos acquisition
- Starlette signal optimization
- BeaconC signal optimization with automatic attenuation control



- kHz-repetition rate laser with tight 5 arcsecond beam ensures comfortable linkbudget up to GNSS orbits for SOS-W
- 1 percent return rate trigger level for automatic return detection works with negligible false detection
- Spiral search is an effective tool to acquire satellites under nonoptimum Coude alignment conditions
- Automatic Coude alignment will be implemented to reduce acquisition times
- 4-step pointing optimization makes quadrant detector obsolete
- Atmospheric backscatter analysis will be implemented for feedback if or if not an observation is possible