Characterization of low-light cameras for beam diagnostics

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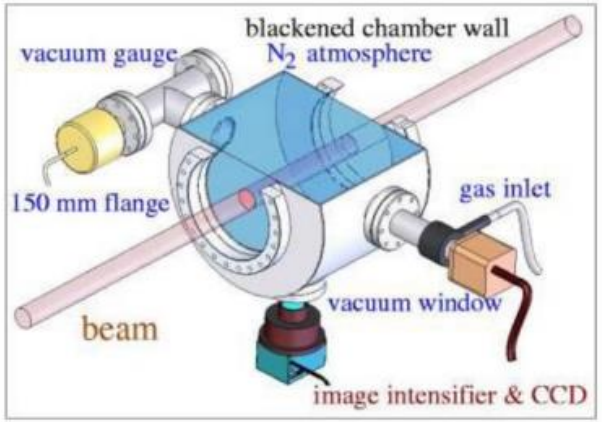
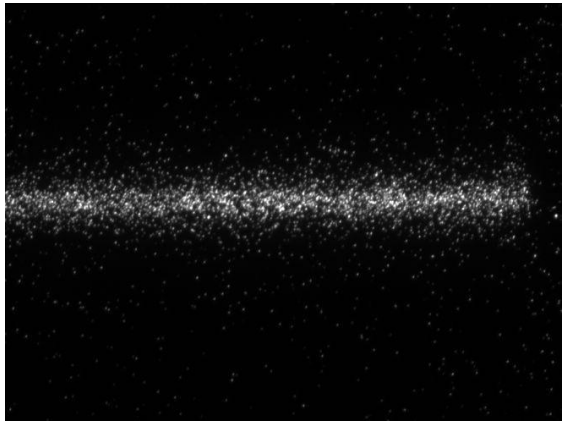
- Low-light cameras are used in beam diagnostics for beam characterization (e.g. imaging beam induced fluorescence)
- Single photon to low-light imaging possible
- Characterization of **EMCCD** (Electron Multiplication Charge Coupled Device), **sCMOS** (Scientific Complementary Metal Oxide Semiconductor) cameras and **ICCD** (image intensifier + CMOS)



Schematic of a BIF monitor

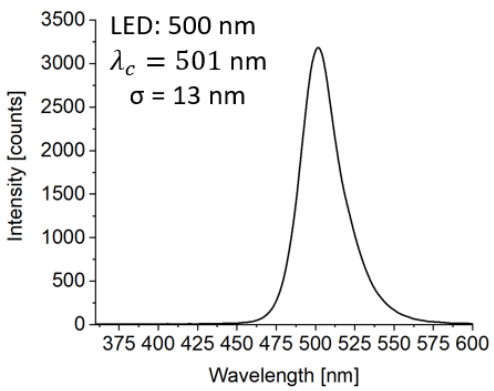


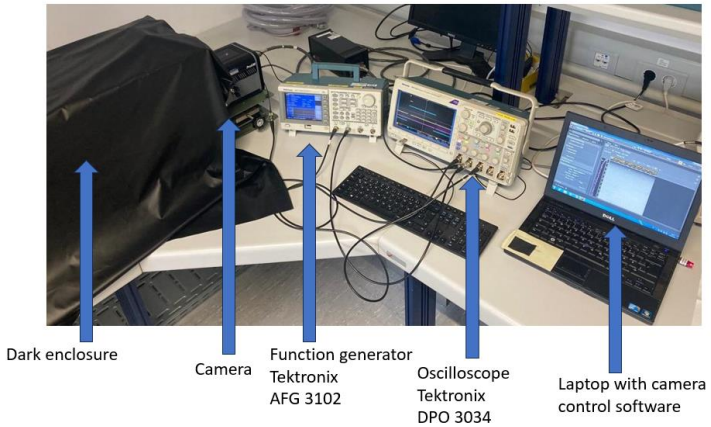
From Christiane Andre (GSI)

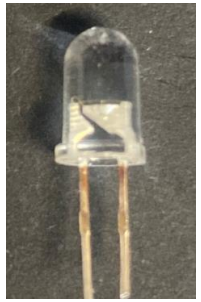
BIF image acquired at GSI (with an ICCD)

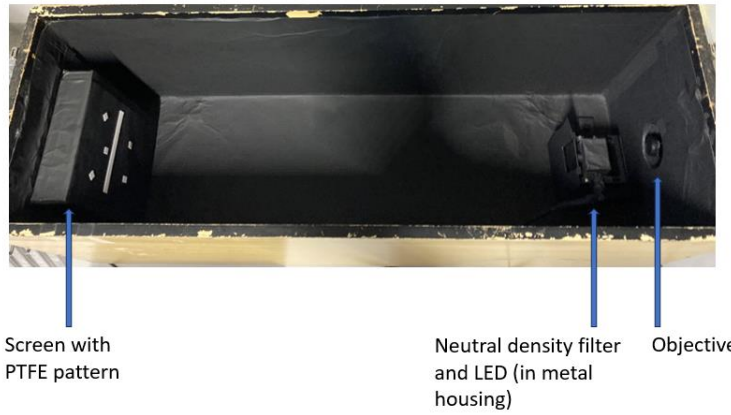
Experimental Set up & LED Characterization

- Pulsed LEDs were used as light source
- Characterization of the LEDs by spectrometer, photodiode and powermeter measurements
- Experimental set up: dark enclosure, camera, function generator, oscilloscope and laptop
- Dark enclosure: walls are coated with blackened aluminium foil (reflectance ≈ 5 %); PTFE pattern (reflectance ≈ 92 %)









Parameter LEDs:
Wavelength [nm]: 500; 470; 430; 400; 390; 385
Light pulse [ms]: 0.5; 1; 2; 4; 8

Measurements

Projections of a ROI

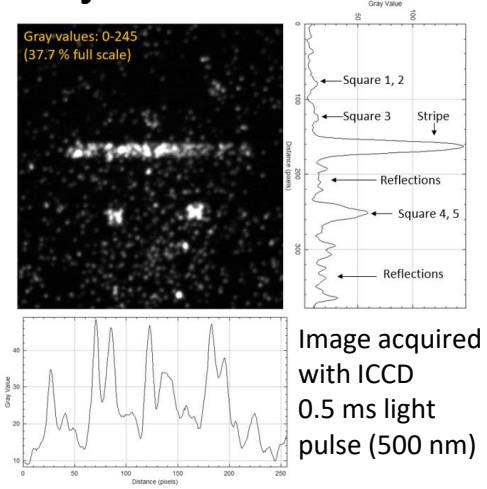
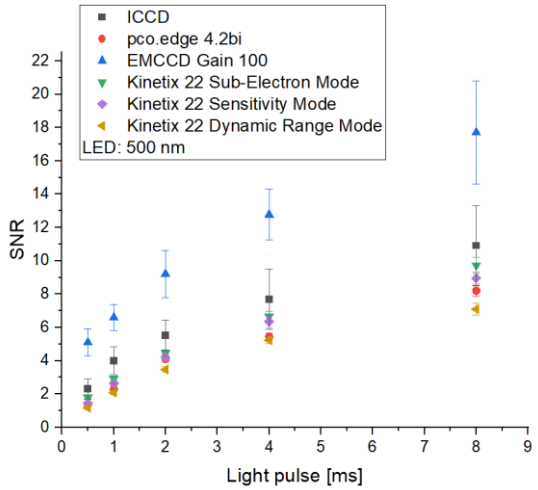


Image acquired with ICCD 0.5 ms light pulse (500 nm)

- sCMOS & EMCCD: horizontal projection is visible starting at light pulse durations of 0.5 ms
- ICCD: 10 times shorter light pulse is sufficient.

Signal-to-Noise (SNR) Ratio



- 500 nm: EMCCD highest SNR
- ≤ 400 nm: ICCD highest SNR

- More results of performed measurements are shown on my poster