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Studies of Stimulated Recovery of PWO crystals

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- **Introduction**
- **Experimental setup**
- **Results**
- **Summary and outlook**

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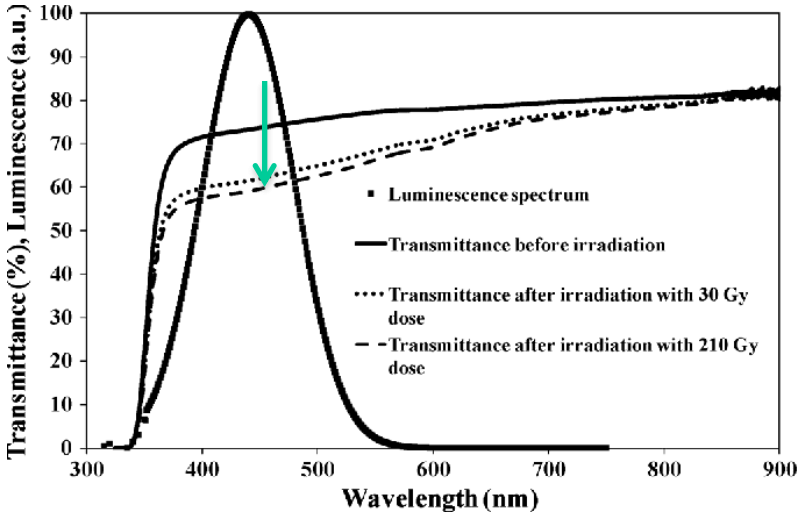
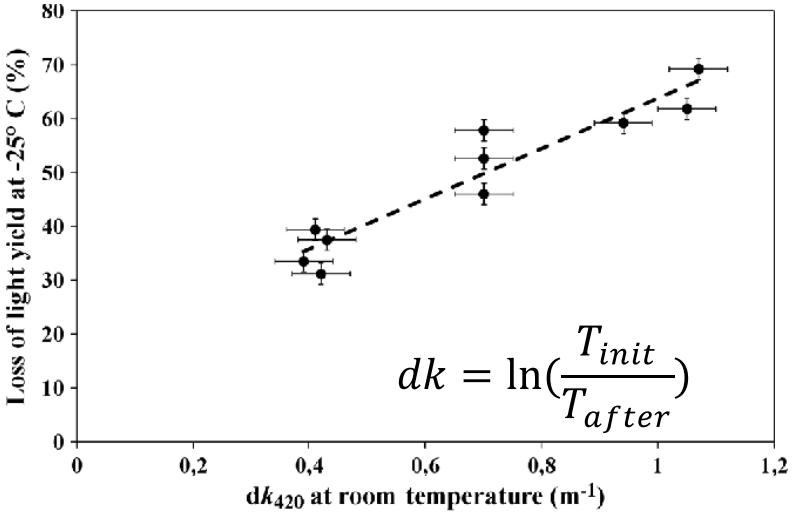
Transmission after the irradiation of crystals with different radiation doses



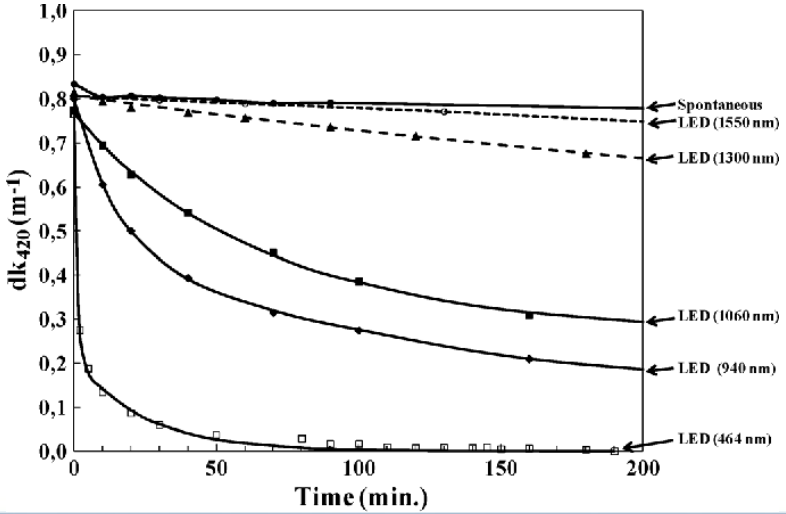
The irradiation leads to the population of color centers (induced absorbtion) => Degragation of the transmission

=>Reduction of the light yield
=>Deterioration of the energy resolution

Induced absorbtion vs light yield



Stimulated recovery with different LED types



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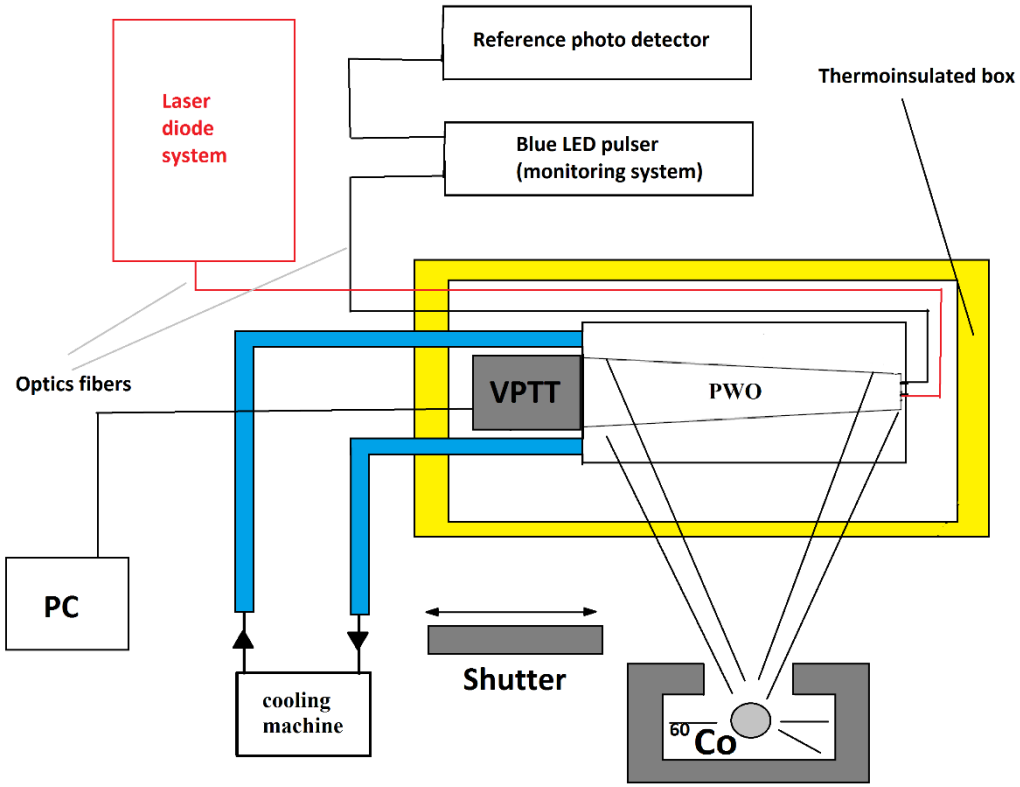
Schematic layout of the experimental setup



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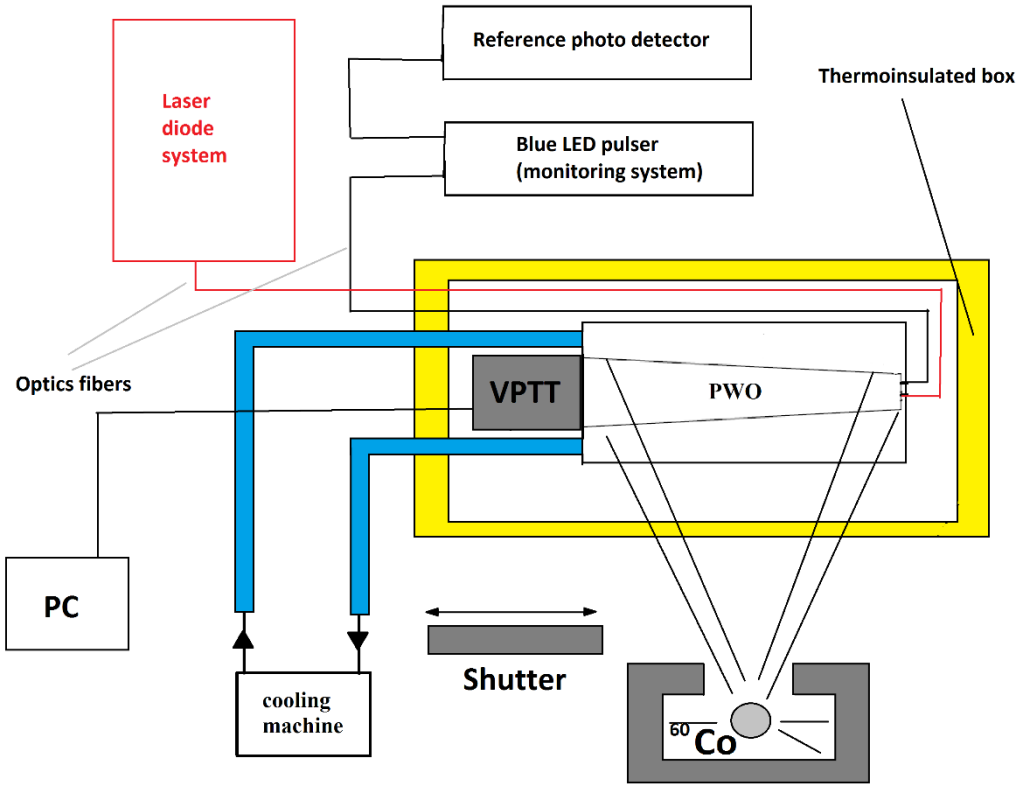
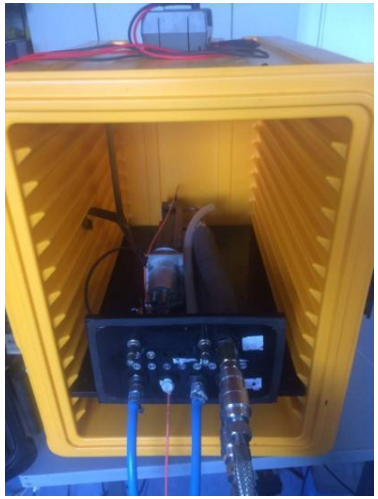


Thermoinsulated box



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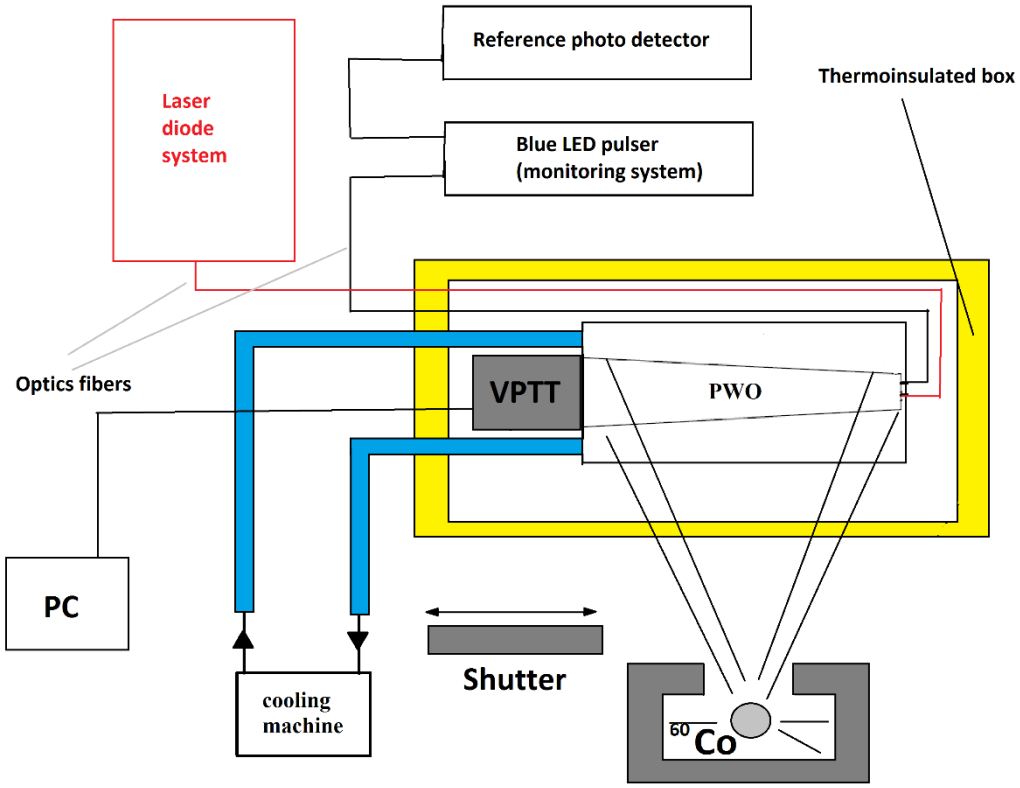
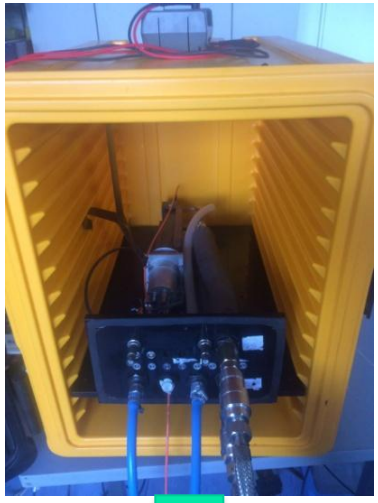
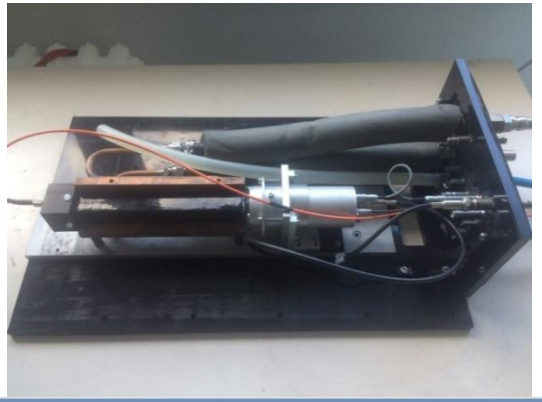


Thermoinsulated box



Board with PWO and VPTT



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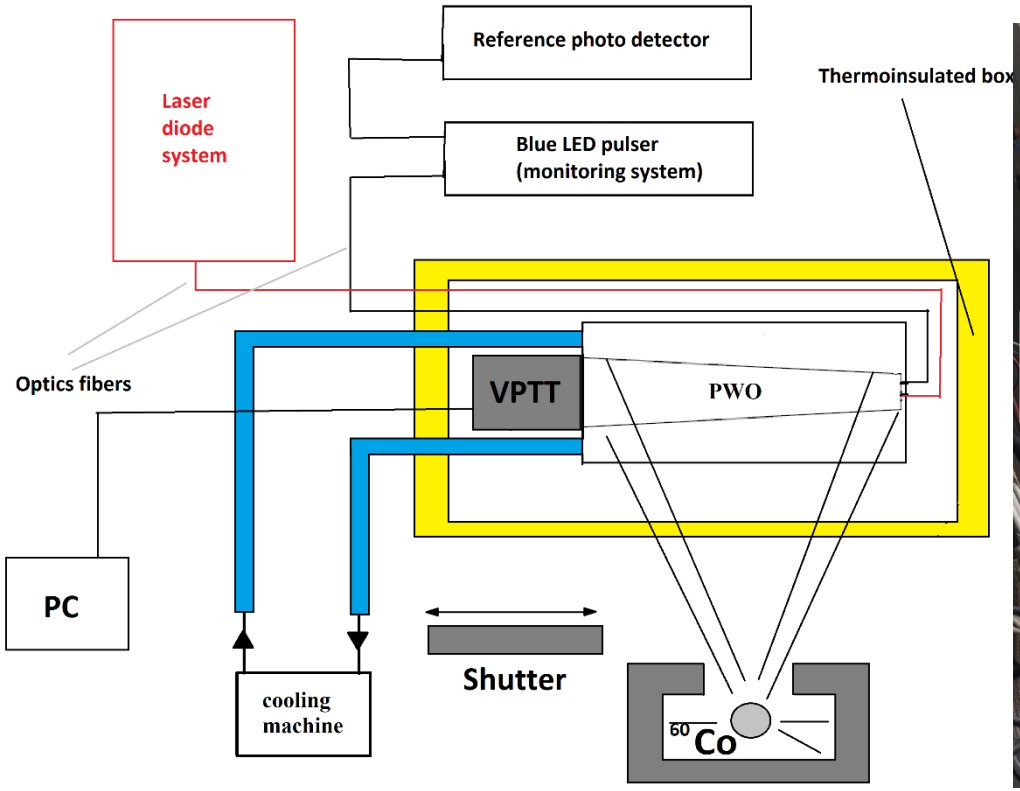

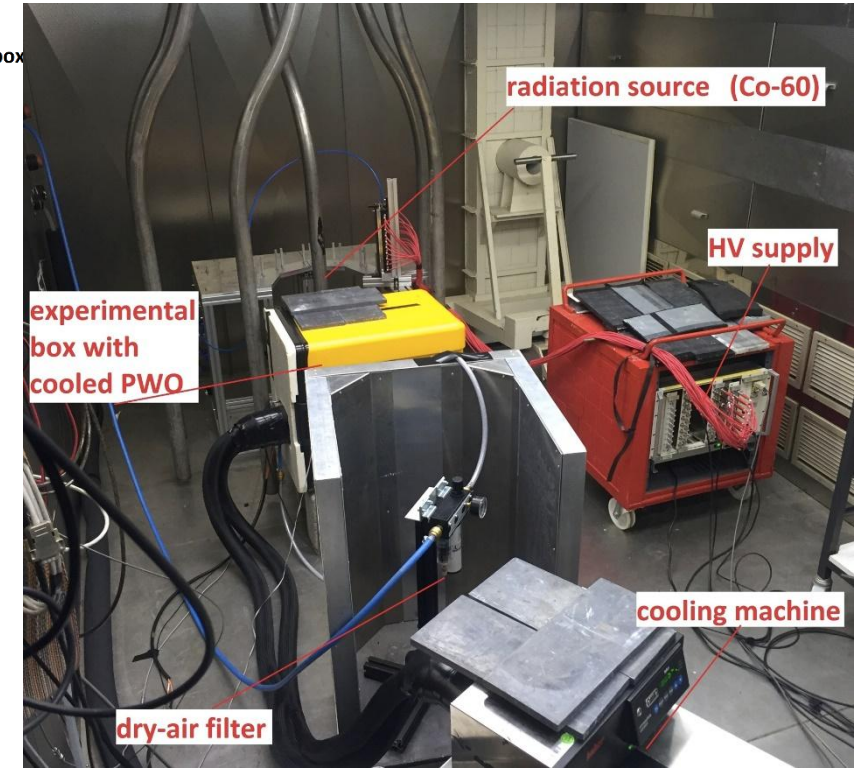

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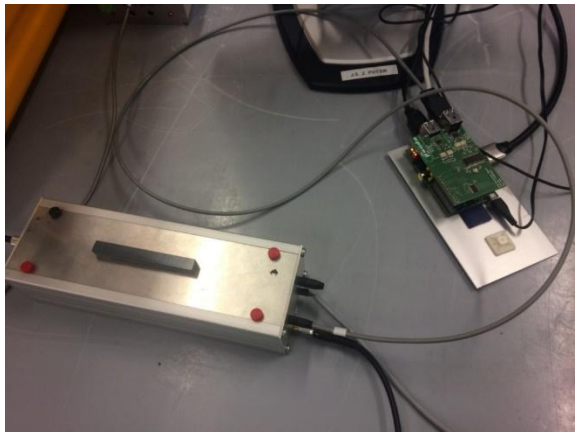
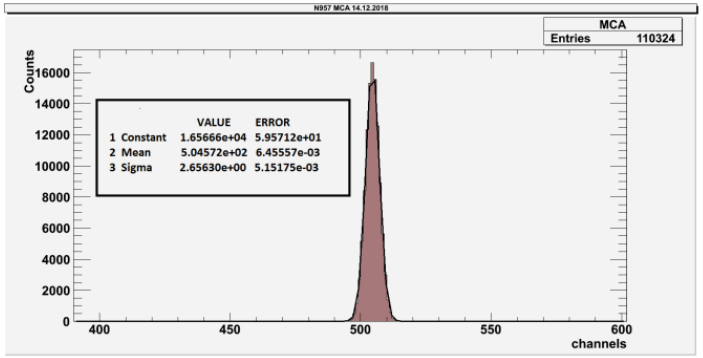
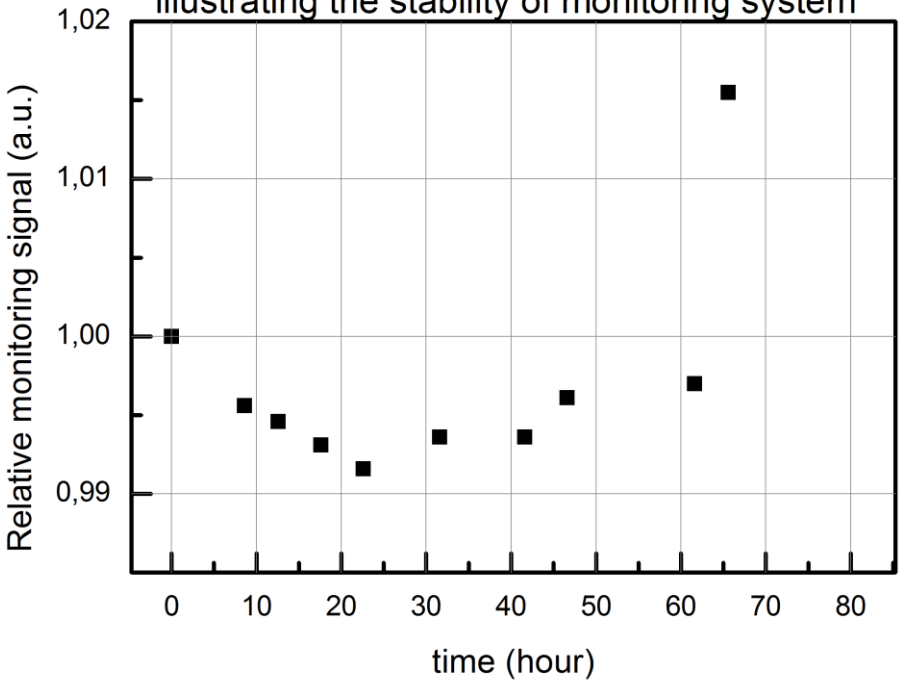
- Monitoring system



A response of the VPTT on the monitoring signal



Relative change of rate responses VPTT/PMT on monitoring signal provided by the blue emitting LED illustrating the stability of monitoring system



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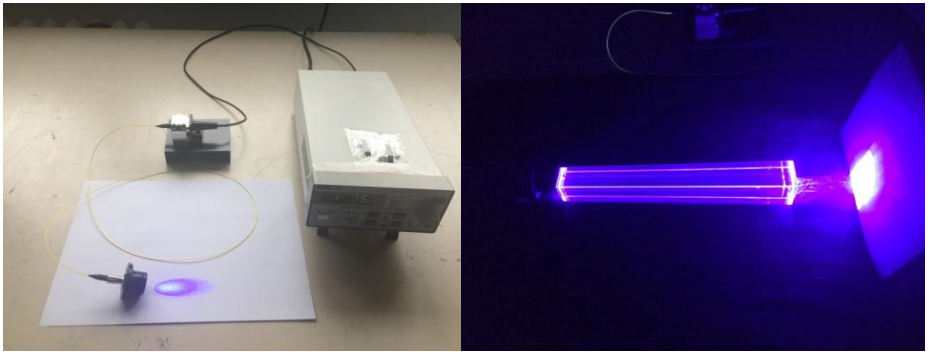
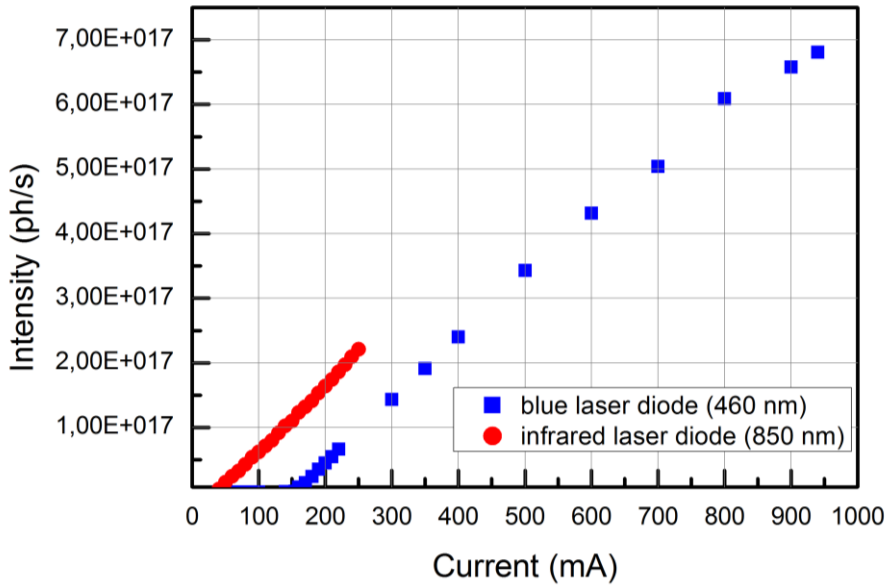
- Laser diode system





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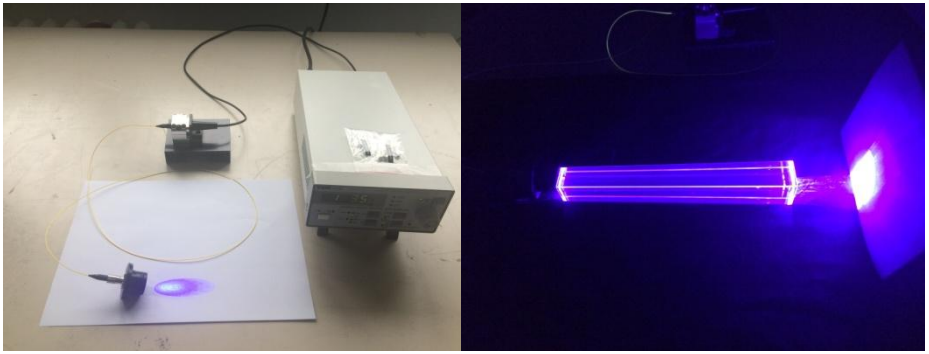
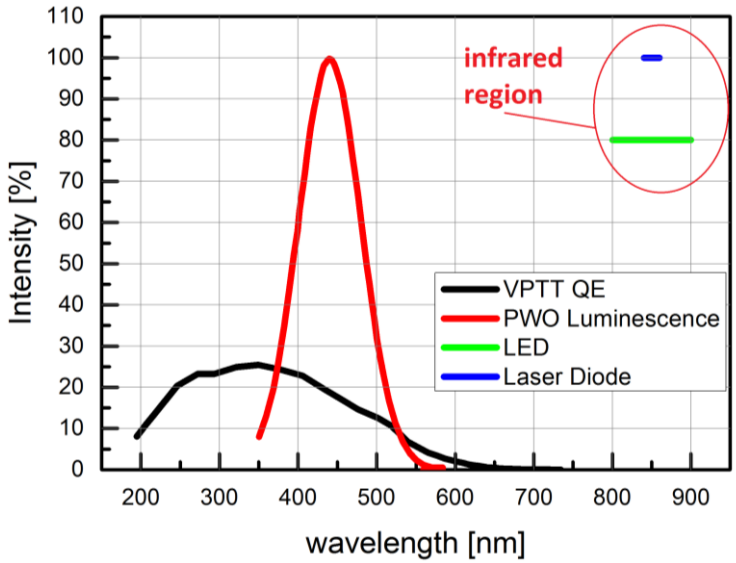
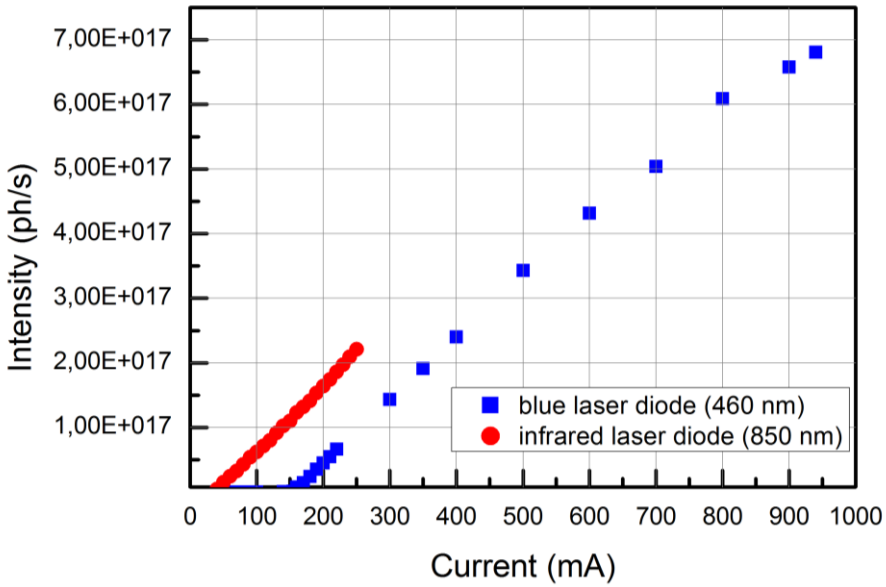
- Laser diode system







2 modes of the stimulated recovery:

•"offline" mode - stimulated recovery process via the illumination *after the* irradiation (during beam-off periods)
•"online" mode – the illumination *during* the calorimeter operation

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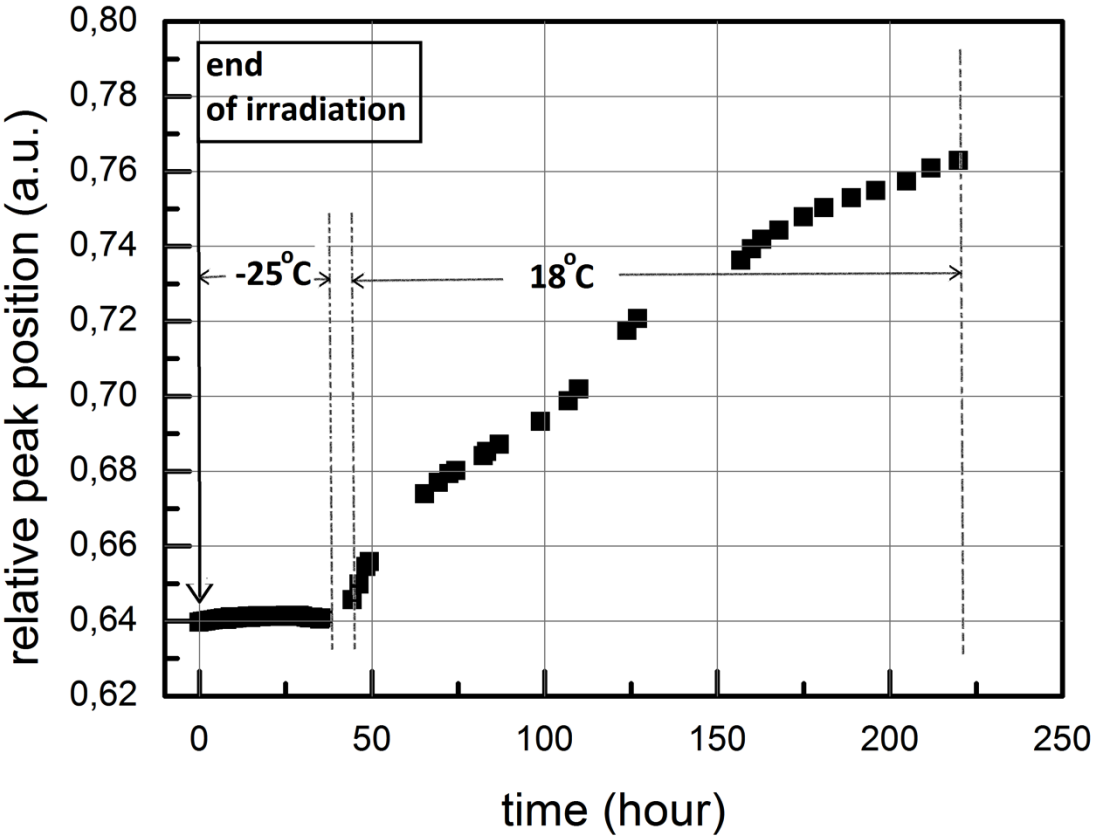
Spontaneous recovery of the PWO crystal after the irradiation at +18 C and -25 C



Dose rate of 4.6 Gy/h during 6.5 h (integral dose = 30 Gy)

- no significant spontaneous recovery at the low temperature during 40 hours of the measurement.

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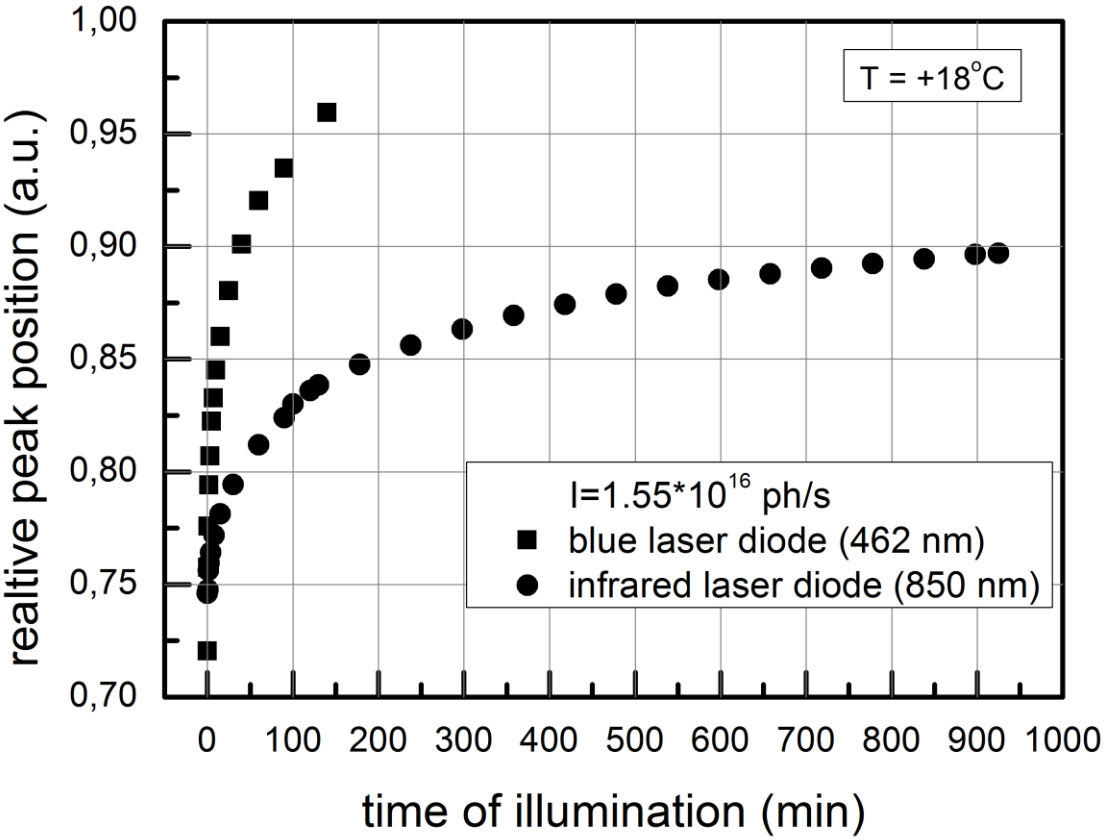
Recovery curves of the PWO crystal after the irradiation as a function of the integral duration of the illumination with blue and infrared laser diodes at +18 C



Dose rate of 4.6 Gy/h during 6.5 h (integral dose of 30 Gy)

- blue light illumination more effective and a perfect tool for fast recovery

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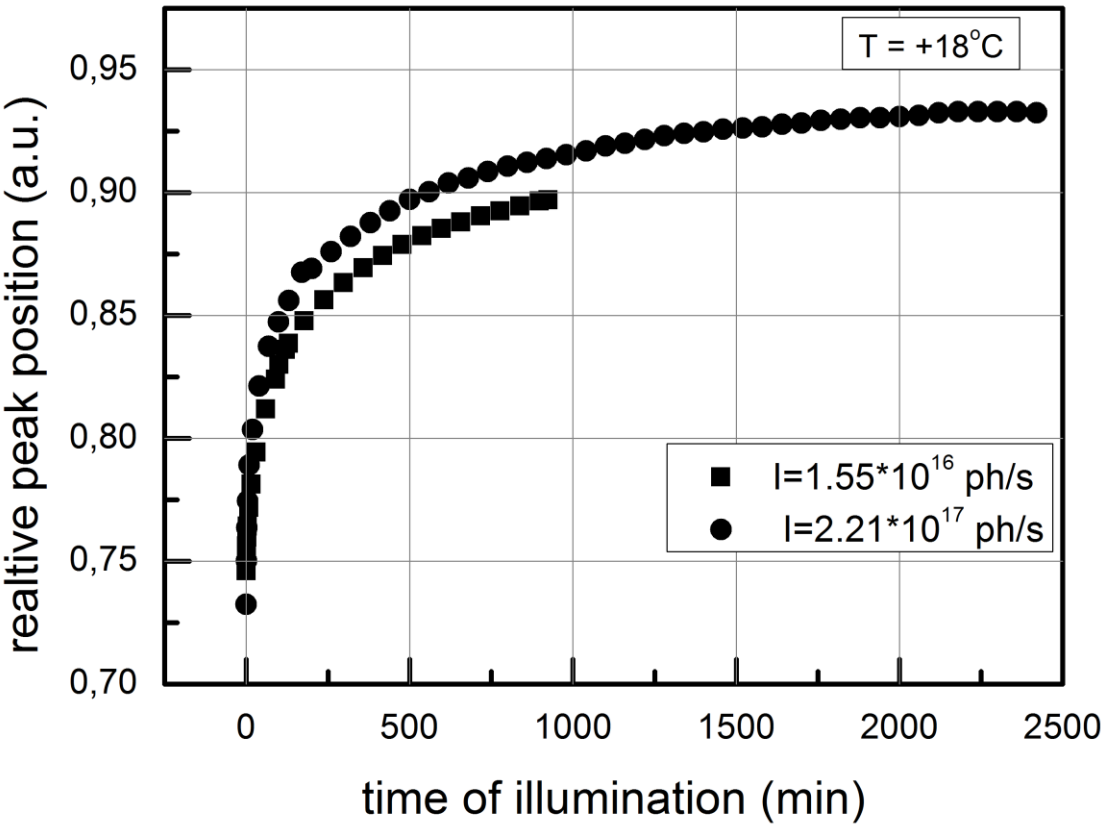
Recovery of the PWO crystal after the irradiation as a function of integral duration of illumination with infrared laser diodes at +18 C with different intensities



Dose rate of 4.6 Gy/h during 6.5 h (integral dose of 30 Gy)

- stimulated recovery is accelerated with the increase of the intensity at *+18 C.*
- nearly 95% during 2 days

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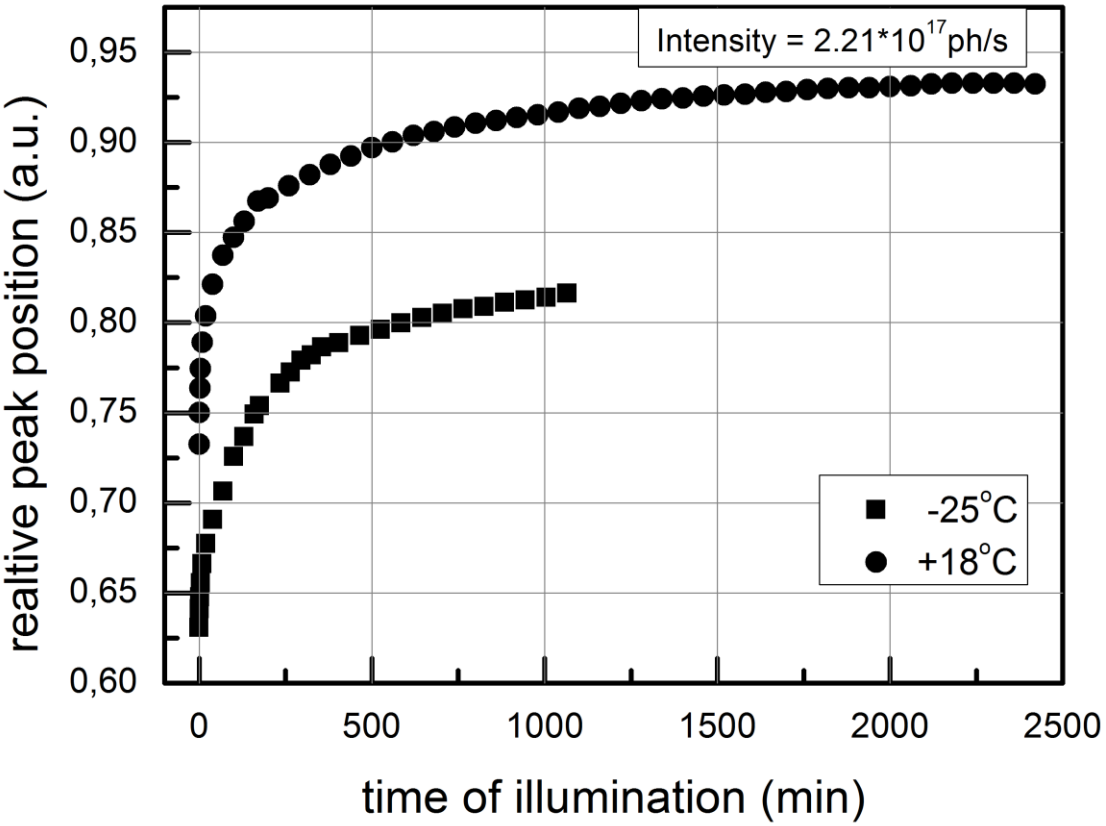
Recovery curves of the PWO crystal after the irradiation as a function of the integral duration of the illumination with infrared laser diodes at +18 C and -25 C



Dose rate of 4.6 Gy/h during 6.5 h (integral dose of 30 Gy)

- stimulated recovery process for infrared laser diode at -25 C was observed

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Summary

- The stimulated recovery process is an effective application to reduce radiation damage of the EMC units.
- The stimulated recovery with blue light can be implemented only in “offline” mode.
- Since VPTT has a negligible quantum efficiency in the infrared region, the stimulated recovery with light in this range opens an opportunity for the “online” recovery mode.
- The infrared laser diode with peak wavelength above 850 nm can be a possible candidate for “online” recovery mode at low temperature.

Outlook

- Further tests to define wavelength limit and minimal intensity at fixed dose rate.