Systematic Study of LED Stimulated Recovery of Radiation Damage in Optical Materials

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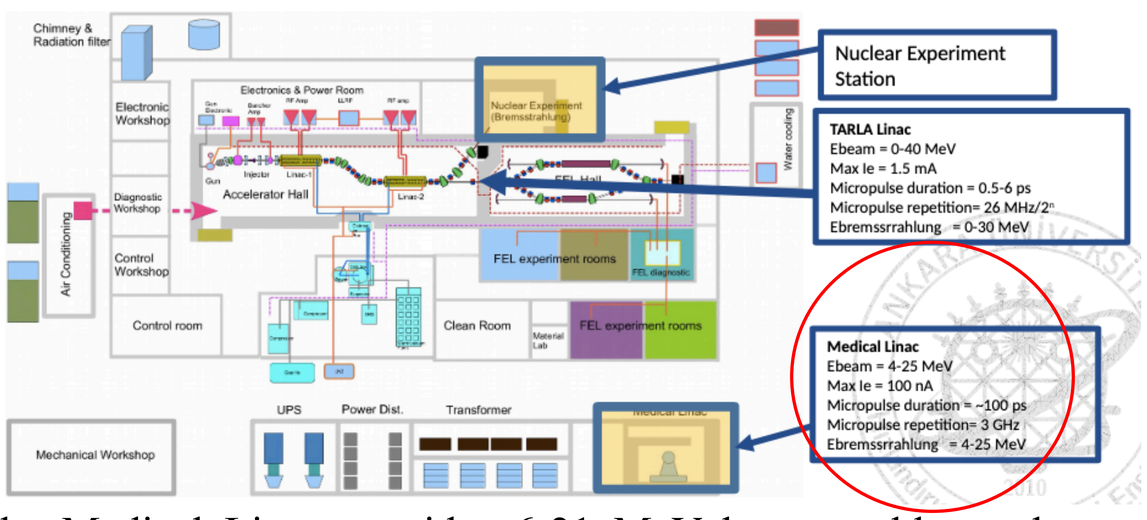
1. The radiation damage in optical materials, mostly manifest as the loss of optical transmission, recovers to some extent in the presence of natural light, and at a faster rate in the presence of stimulating light. On the other hand, the systematic study of the dynamics of the recovery as a function of the stimulating light parameters such as its wavelength, intensity and exposure duration and method has not been performed in detail.

2. In order to perform a systematic study of the recovery mechanisms from radiation damage, we irradiated two sets of glass samples at the Medical Linac Facility of Turkish Accelerator and Radiation Laboratory. The total absorbed dose of the two sets of samples were 3.5 kGy and 7 kGy, both irradiated at a rate of 87.5 Gy/min. Immediately following the irradiation, one sample from each set was placed: in a dark box; in ambient light; at the LED recovery station.

3. The LED recovery station provides pulsed and continuous light at various wavelengths at custom geometries. The optical transmittance of the samples are then measured in 300 nm - 1000 nm range with Shimadzu UV-3600 Plus UV-VIS-NIR Spectrophotometer for an extended period of time. Here we report on the details of the irradiation and recovery setups, and the preliminary results of recovery from radiation damage under different light exposure mechanisms from an ongoing study.

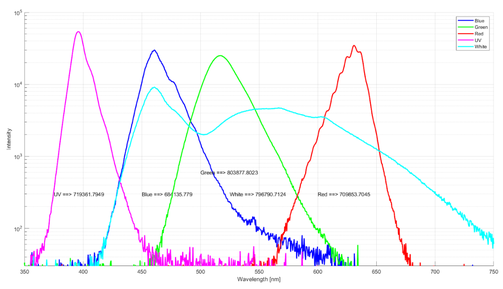
TARLA Electron Linear Accelerator

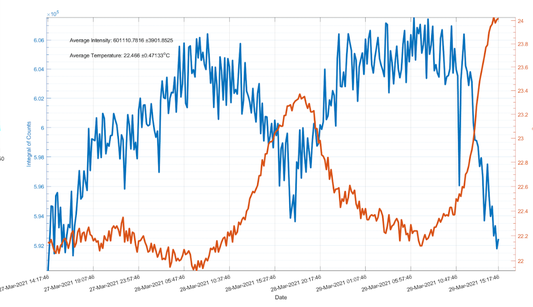


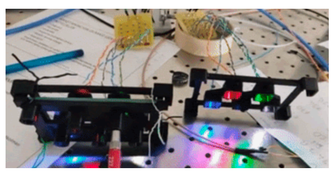
The Medical Linac provides 6-21 MeV bremsstrahlung photons. The beam is approximately 10 cm diameter at the experimental location. The lateral uniformity is within 3 %, and the dose rate can be adjusted up to a maximum of 87.5 Gy/min.

The LED Recovery Stations

Five LEDs pulsed with custom design electronics.

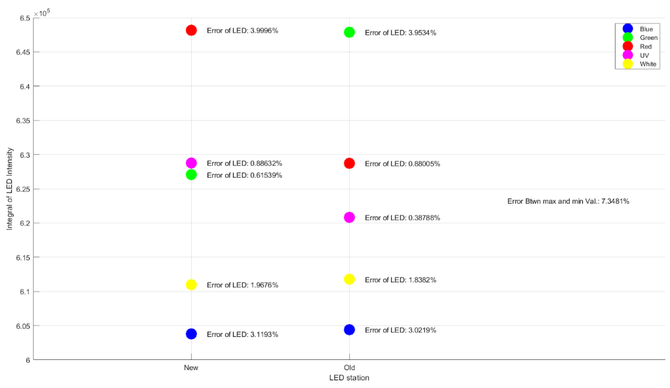




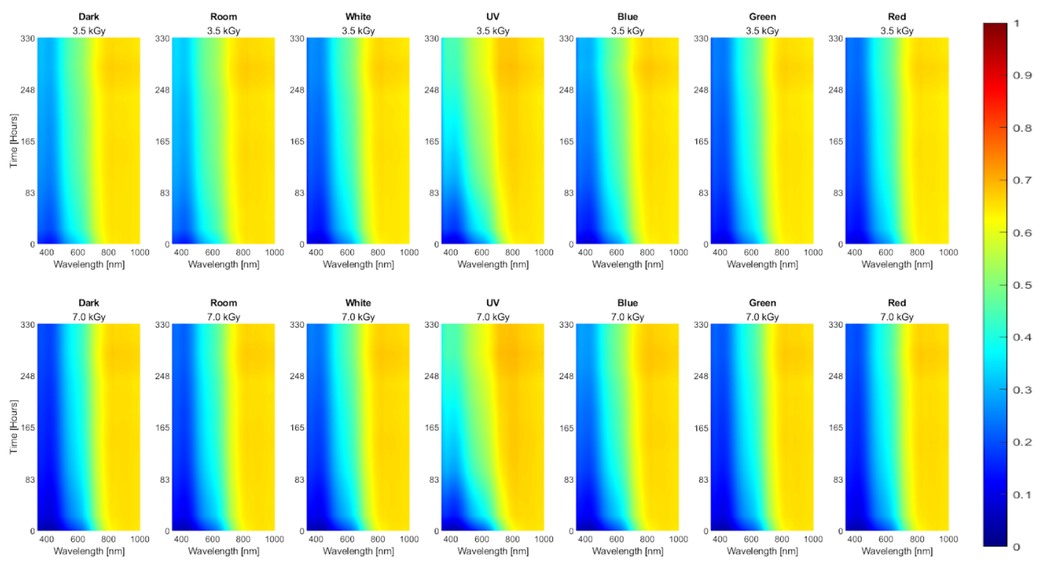


LED stations are operated in temperature/humidity-controlled room.

LED intensities are within 7 % of each other.



Spectral dynamics of recovery from radiation damage



The results of the first few hours of stimulated recovery from radiation damage indicate that UV-blue LED stimulation accelerates the recovery process whereas the effect seems to be minimal for LED wavelengths higher than 500 nm. Final quantization of the results will be possible after an extended period of monitoring and the application of systematic corrections.

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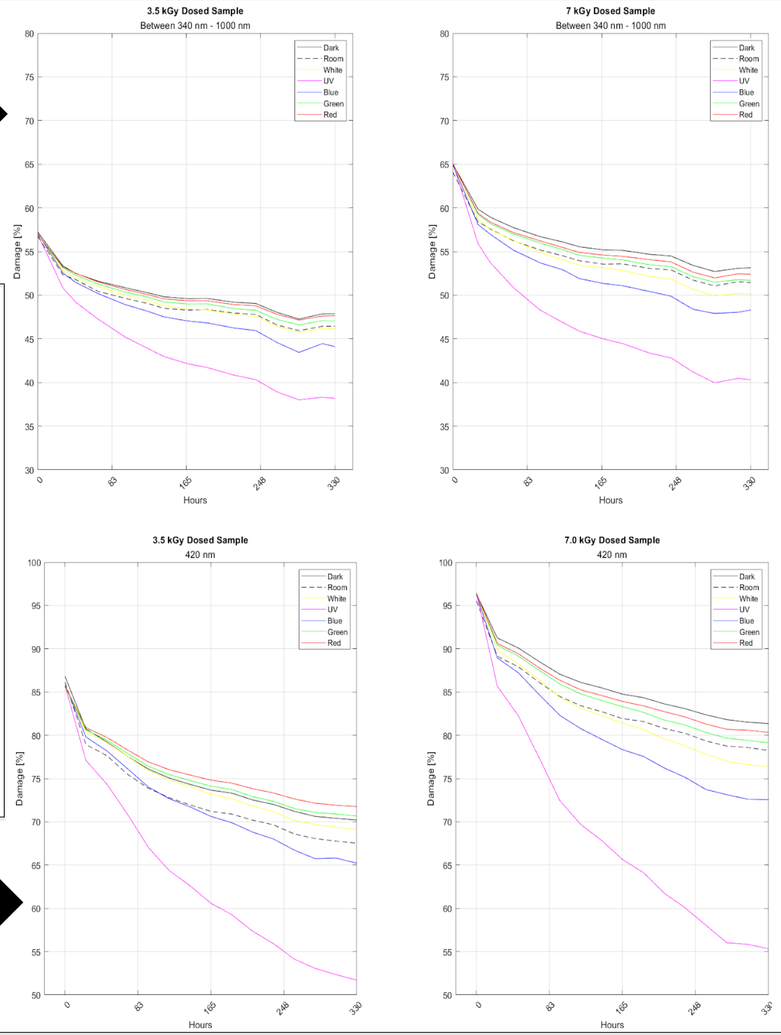
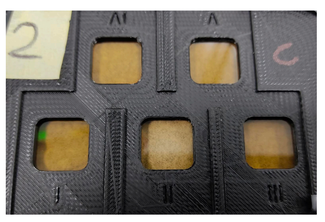
Total damage and recovery in 340 nm – 1000 nm range.



Picture of an irradiated sample with the LED recovery station template.



Transmittance loss measured at 420 nm.