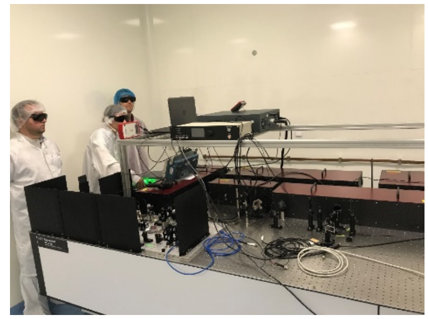
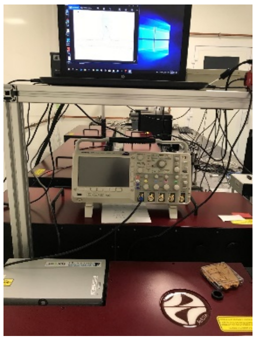
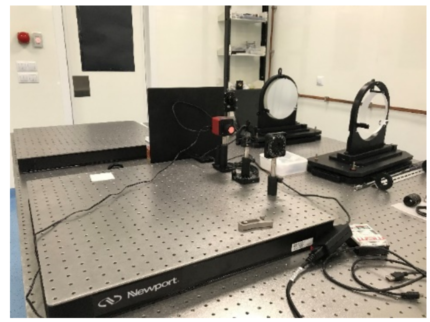
The cutting edge technology available in the Optics Laboratory of the Extreme Light Infrastructure –Nuclear Physics Research Center makes the research facility the ideal place for laser pulse characterization, beam diagnostics, wavefront analysis, laser induced damage threshold, interferometry and so on. The lab itself is an ISO 6-ISO 7 cleanroom facility provided with all necessary cleanroom access equipment.

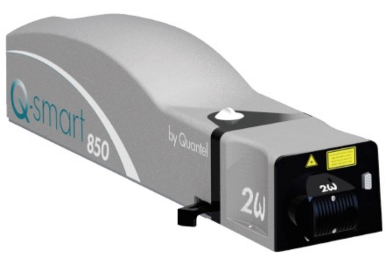




The research teams interested in using our facility or collaborating with our top notch scientists, are provided with multiple optical tables and optical boards, wide range of optics and opto-mechanic equipment, high end optical instruments, and all auxiliary electronic devices such as computers, oscilloscopes, power supplies, delay pulse generators, multimeters, etc.

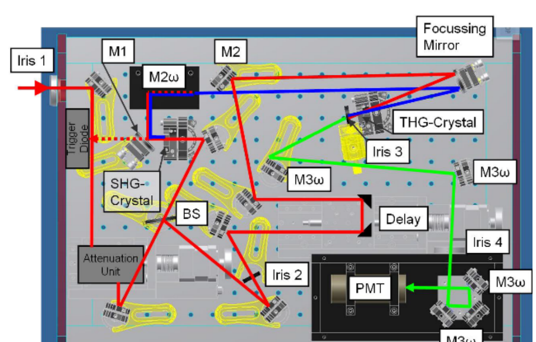


Among existing instruments in the laboratory, it is worth mentioning the AVESTA *Ti:Sapphire Multi-Stage Modular Amplifier RAMPA-10-KIT* The laser system uses chirped pulse amplification (CPA) scheme. First, femtosecond laser pulses are stretched in temporal domain by means of a Martinez-type stretcher with a single diffraction grating. Stretched pulses go through a Faraday isolator. After it, a single laser pulse is injected into a regenerative amplifier (RA) by the first Pockels cell RPC1. After necessary number of resonator round trips, amplified laser pulse is released from the RA resonator by the second Pockels cell RPC2. After RA, the laser pulse goes through the gate subsystem (pulse picker) — the third Pockels cell placed between two crossed polarizers. The pulse picker enhances the contrast and allows controlling the laser output by an external gate signal. After the pulse picker, the laser pulse can be amplified further in a multipass amplifier (MPA). To prevent damage of the optical elements of the compressors (first of all, the grating), the beam is expanded by a telescope. Finally, the pulse is compressed to femtosecond duration.



The pump source for the AVESTA kit mentioned above is a Quantel laser emitting radiation in 1064 nm, 532 nm via the laser and modular heads. Additionally, the lab equipment includes an AVESTA Mode-Locked Femtosecond Titanium:Sapphire Laser, Model TiF-Kit-20.

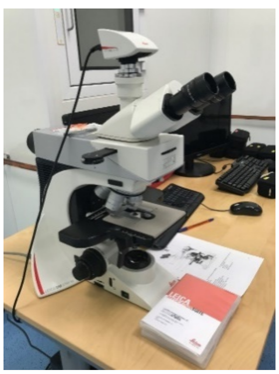
The laser pulses are characterized in the lab by means of a high dynamic range autocorrelator Tundra, built by Ultrafast Innovations which works on basic principle of overlapping a pulse with a replica of itself in a nonlinear process in order to produce a sum-frequency signal in such a way that each photon in the up-converted light is generated by the addition of one photon of each of the two pulses. In a third-order autocorrelator, one of the two replicas is frequency-doubled before the sum-frequency generation takes place. As shown in the figure to the right, in the sum-frequency mixing (SFM) step one photon with a frequency of



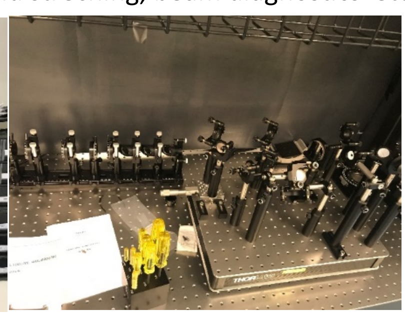
2ω is combined with one photon of fundamental frequency ω to yield one photon with the third-harmonic frequency 3ω. The resulting signal differs not only in frequency, but also in its propagation direction from the input beams. Since in this scheme it is impossible that one of the beams alone generates the 3ω signal, the measurement is inherently background-free and thus allows very high measurement dynamics. An additional advantage is the asymmetry constituted by the fact that one of the two pulses is up-converted to the second harmonic before autocorrelation: the resulting correlation traces are asymmetric as well and thus allow for distinguishing between pre- and post-pulses.

Chromatis dispersion instrument is another designed and built by KMLabs and capable to measure group delay dispersion in 1" and 2" optical components for femtosecond applications. The Hamamatsu Streak camera is an ultrahigh-speed detector which captures femtosecond light pulses.

Nano and micro layer characterization is performed in the laboratory with the HORIBA UVISEL 2 Scientific spectroscopic ellipsometer. The optical system allows for the characterization of an interface or a film between two media. The ellipsometric method is based on the resulting process from the polarization variation. This variation occurs every time controlled polarized light is reflected from or transmitted through the interface or film. The ellipsometer allows the user to analyze the polarized light according to the reflection angle and the beam wavelength.



Two high quality Leica materials microscopes (Leica DM2700 M) are used for inspection tasks in the field of metallography, earth science, for forensic investigation, quality control and research. Basler GigE cameras, energy meters, and temperature sensors are also available for complete testing and validation.
Thorlabs training kits are available for those wanting to understand geometric optics, spectrometry, interferometry, polarization, delay lines, laser amplification, pulse compresion and streching, beam diagnostics etc.


The Optics Laboratory team of technicians and scientists is very instrumental in helping the users with all necessary equipment and provide support in the testing process.

Document in preparation by Dr. Viviana Vladutescu, Dr. Daniel Ursescu, and Dr. Ioan Dancus, August, 2018.