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Development of ultrafast optics for high intensity lasers

Field of Study: Physical Engineering

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Abstract:

The development of ultrafast optics is essential for ultra-high intensity lasers with a high repetition rate. Multiple technological and scientific limitations are considered as bottlenecks for high power lasers: laser induced damage threshold in gratings, laser induced contamination in optical surfaces, optical components size limitations and stress control. Recent research results indicated the possibility to passively mitigate laser-induced contamination, discoloration and even damage in optical components by controlling coating design and deposition parameters. Currently there are limited technological advancements for providing large scale uniform optical coatings with high resistivity to laser radiation for high intensity ultrafast lasers.

The PhD project aims to develop and optimize large scale optical components for PW class lasers. The main focus will be dedicated to the development of multilayer dielectric diffraction gratings coating designs. Such goal requires the optimization of electron beam evaporation with ion assistance technology to obtain low stress, dense and uniform coatings over one meter scale surfaces. Additionally other components will be developed in parallel: broadband mirrors, antireflection coatings, etc.

The PhD student will learn how to model and deposit many types of optical coatings. The candidate will gain hands-on experience on how to analyze thin films and their properties using the state-of-the-art spectroscopic methods, including high intensity lasers, and directly contribute to the development of advanced coatings in ELI Beamlines.