Research opportunity for Bachelor's/Master's thesis

The 10 PW L4 laser at ELI Beamlines will be the most intense laser in the world and will provide focused intensities of $\sim 10^{22}$ W/cm^2. At such high intensities the dynamics of ultra relativistic electrons can be utilized for many applications including ion acceleration and generation of hard photons. However, there is a constant effort to explore laser matter interaction at even higher intensities $\gtrsim 10^{23}$ W/cm^2 where novel physical processes like radiation damping of electrons[1] and radiation pressure acceleration of ions can be observed[2].

One of the most promising techniques to enhance the focused laser intensities is to use ellipsoidal plasma mirrors[3, 4] to tightly focus a laser beam. Such techniques are envisioned to be used for the experiments performed at ELI Beamlines and also on experiments planned by our group on other facilities.

However, the ellipsoidal mirrors can have significant surface errors which may degrade the focused intensity. A deformable mirror can be used to compensate for these surface errors. The proposed undergraduate project is for setting up the proof-of-principle demonstration of this in the laboratory. A setup to characterize the focused intensity from an EPM already exists at ELI Beamlines. As a part of the project the setup will be modified to introduce a deformable mirror and a wavefront sensor[1] in the laser beam's propagation.

At the successful completion of this project it will be implemented on the PEARL laser facility in Nizhny Novgorod, Russia. The student may have an opportunity to continue the research as part of doctoral research and to explore high intensity laser solid interaction in the regime $\sim 10^{22}$ W/cm^2.

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References

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[4] A Kon et al. In: *Journal of Physics: Conference Series* 244.3 (2010), p. 032008.

[1]For a tutorial on adaptive optics see https://www.thorlabs.com/newgrouppage9.cfm?objectgroup_id=3208

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