

Plasma optics for ultra-intense light manipulation

We present the recent advances in ionization-based optical components, plasma mirrors and ionization gratings, enabling the manipulation of ultra-intense light beyond the constraints set by the minimum beam size required to prevent optical damage. We demonstrate enhanced harmonic generation utilizing a multi-color laser driver produced within a cascaded plasma mirror setup. Our research shows that harmonic enhancement can be controlled by adjusting the relative phase of the colors in the driving waveform. Furthermore, we show that ionization gratings can serve as a controllable optical switch for high-power light, providing a temporal contrast enhancement over five orders of magnitude with a switching time of under 500 fs. This compares favorably to contrast improvement achievable with alternative methods. Our results show the potential of ionization-based optical components for applications, including laser-driven particle acceleration, high-harmonic generation, ultrafast optical switching as well as pulse cleaning and compression of ultra-intense light.

Bio: Julia Mikhailova, associate professor of mechanical and aerospace engineering and associated faculty at the Andlinger Center for Energy and the Environment and Princeton Plasma Physics Laboratory, investigates optical harmonic generation in plasmas and solids, as well as light propagation in gases, and develops new ionization-based optical components. Previously, she was a postdoctoral researcher with the Max Planck Institute of Quantum Optics in Germany and a scientist with the A.M. Prokhorov General Physics Institute in Russia. She got her MS and PhD in Physics from M.V. Lomonosov Moscow State University in Russia. Mikhailova's honors include a Gordon and Betty Moore Foundation Experimental Physics Investigators Initiative award, a Kavli Frontiers of Science Fellowship of the National Academy of Sciences, an Early Career Award from the U.S. Department of Energy, an Alfred Rheinlein Faculty Award for excellence in teaching and scholarship from Princeton, and a Humboldt Research Fellowship from the Alexander von Humboldt Foundation.