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NEW INSIGHTS INTO THE DIFFRACTION OF LIGHT PULSES

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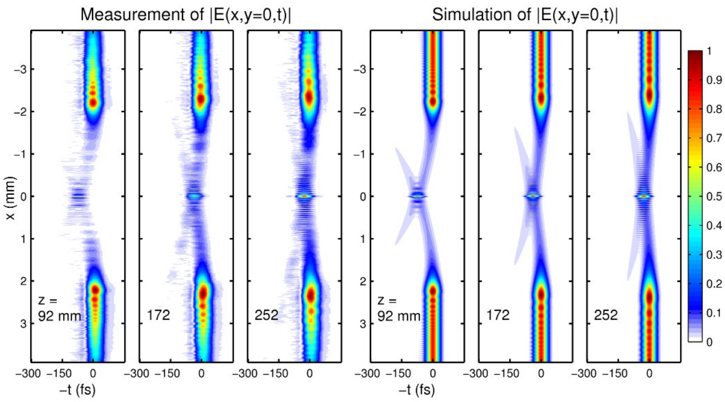

Fig.1. Measured (left) and simulated (right) field amplitude of diffracted ultrashort pulse at three different distances after an opaque disk.

The effects of diffraction of light have been carefully studied since the works of Leonardo da Vinci and the formation of the bright spot of Arago-Poisson is a well known manifestation of the wave nature of light. Contemporary treatment of diffraction relies on the well developed theories of Fresnel-Kirchhoff and Rayleigh-Sommerfeld. The phenomena is traditionally studied under monochromatic illumination, but it is surprisingly enlightening to study the diffraction of ultrashort pulses *i.e.* optical pulses whose time duration is on the order of the femtosecond. Somewhat forgotten, the boundary diffraction wave theory of diffraction works well for intuitively explaining the complex spatio-temporal effects for ultrashort pulse propagation (see [1] and references therein).

Direct measurements of the electric field *E(x,y,z,t)* of ultrashort pulses are possible using a novel technique based on spatiospectral interferometry called SEA TADPOLE [2-4]. It records "snapshots in flight" or spatiotemporal slices of the field amplitude and phase with μm spatial and fs temporal resolutions. The diffraction of the femtosecond pulse by an opaque disk (see fig. 1), circular aperture and annular slit was measured and accompanied by numerical simulations using the boundary diffraction wave theory. Employing time-domain characterization of diffraction has turned out to be useful for modern optics and for general understanding of the diffraction phenomena.

References

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