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Complex light in linear and nonlinear complex media

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In this talk, first we will discuss several approaches to structured light manipulation on the nanoscale and demonstrate new functionalities, including polarization and OAM conversion, beam magnification and de-magnification, and sub-wavelength imaging potentially enabling a new generation of on-chip or all-fiber structured light applications. In the second part, we will present our recent studies of the phenomenon of spatial modulational instability leading to laser beam filamentation in an engineered soft-matter nonlinear medium. Finally, we will consider the possibilities of guiding, manipulating, and processing radio-and microwave-frequency radiation using photonic structures built of filaments. In particular, we introduce so-called virtual hyperbolic metamaterials formed by an array of plasma channels in air as a result of selffocusing of an intense laser pulse, and show that such structure can be used to manipulate microwave beams in a free space. We discuss the generation of large regular arrays of filaments and consider the interactions between multiple filaments, multiple filament formation, and phase-controlled structured filaments.