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Nonlinear effects in optical fiber transmission systems

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Nonlinear effects in optical fibers impose different limitations on the communications link, and an understanding of such effects is almost a prerequisite for actual light wave-system designers. On the other hand, they offer a variety of possibilities for all-optical signal processing, amplification and regeneration. Using conventional optical fibers for these applications, a length of several kilometres is usually required due to their relatively small nonlinear parameter ($\gamma \sim 1.3W^{-1}/km$). Such long fibers pose some practical limitations, concerned namely with the size and stability of the system. The required fiber length is reduced to about 1 km using highly nonlinear silica fibers with a smaller effective mode area, and hence, a larger nonlinear parameter ($\gamma \sim 11W^{-1}/km$). A further reduction in fiber length by one order of magnitude has been achieved in recent years using nanowires and micro structured optical fibers with an extremely small effective mode area and significantly enhanced nonlinear characteristics. Another main advance was the production of highly nonlinear fibers using materials with a nonlinear refractive index higher than that of the silica glass, namely Lead Silicate, Tellurite, Bismuth glasses and Chalcogenide glasses. Using such fibers, the required fiber length for nonlinear processing can be dramatically reduced to the order of centimetres. In this paper we review the effects – both detrimental and potentially beneficial of optical nonlinearities both in conventional and in highly nonlinear fibers.

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Hot carriers THz harmonic generation in graphene

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In this talk, we will discuss the onset of sharp resonances exhibited by hot carriers in graphene under the influence of a DC and a-c fields in the presence of spatially and temporarily modulated scattering. These resonances occur when the period of the a-c field corresponds to the time taken by quasi-ballistic carriers to drift over a spatial scattering period, provided the latter is shorter than the distance taken by carriers to emit an optic phonon. Such system can be achieved with inter-digitated gates energized with an a-c bias on graphene layers. Gate separation and fields to achieve ballistic transport would result in resonances in the terahertz range, with the generation of higher harmonics characterized by large Q-factors, which are tunable with gate spacing, and well suited for THz detection.

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