Description for the general public

Pioneer works published by Auzel in 1966 year have stimulated very intensive investigation of conversion of infrared excitation into a shorter wavelength luminescence in rare earth doped crystals and glasses, a phenomenon denoted as anti -Stokes or up-converted emission. Up to now probably thousands of published papers have dealt with up-conversion phenomena and obtained results paved the way for practical application in the design of infrared pumped visible lasers, new light sources and optical sensors. Gathered experimental data made it possible to provide useful generalizations and indicate mechanisms involved in the up-conversion processes:(i) Excited state absorption (ESA), (ii) multistep energy transfer, (iii) multi-photon excitation and (iv) co-operative energy transfer. Commonly, the up-converted emission in the visible is excited employing infrared radiation delivered by lasers operating in CW or pulsed regime with pulse durations between several nanoseconds and several milliseconds.

In the last decade there is a growing interest in up-conversion phenomena excited by femtosecond pulses of infrared radiation. Published papers regarding this topic are not numerous, likely because sources of ultrashort light pulses are very expensive and therefore not commonly available. In virtually all works dealing with this issues the Ti-Sapphire lasers emitting near 800 nm are employed and up-conversion phenomena observed are attributed to mechanism of resonant multiphoton excitation. However, during a propagation of powerful ultrashort light pulses in dielectric media, a number of unique phenomena occur, among others a generation of supercontiuum and promotion of electrons from the valence band to the conduction band of the crystal induced by multiphoton excitation in filaments created by self- focusing effect.

The goal of present project is to investigate and explain the contribution of these phenomena in observed experimentally nonresonant up-conversion characterized in that the intensity and spectral features of up-converted visible emission excited by femtosecond pulses of infrared light do not depend on wavelength of the excitation wavelength.