The work is devoted to investigation of interaction of femtosecond laser pulses in atmospheric air and crystalline silicon.

It was shown that sequences of femtosecond laser pulses can control the rotational Raman response of a gas mixture, giving rise to a tunable manifold of echo recurrences in the retarded nonlinear-optical response of the gas. Tailored phase masks for high-intensity ultrashort laser pulses are experimentally demonstrated using molecular rotations in the gas phase driven by optimally time-ordered pulse sequences.

It was shown that origin of stimulated Raman scattering in crystalline silicon is restricted by nonlinear optical effects, such as Kerr nonlinearity and two-photon absorption, in the case of ultrashort laser pulses.