Alignment-Dependent Terahertz Radiation in Two-Color Photoionization of Molecules


The generation of terahertz radiation from an ensemble of aligned air molecules in intense two-color laser fields has been investigated. Our experiments show that terahertz radiation yields are strongly modulated by the alignment of nitrogen and oxygen molecules. We explain this phenomenon in the context of the plasma current model combined with alignment-dependent ionization, in which nitrogen molecules aligned parallel to the laser field yield more ionization and plasma currents, resulting in enhanced terahertz radiation. Our measurements also provide the ratio of the ensemble-averaged ionization rates of nitrogen molecules aligned parallel versus orthogonal to the laser field.

Off-Axis Phase-Matched Terahertz Emission from Two-Color Laser-Induced Plasma Filaments


We observe off-axis phase-matched terahertz generation in long air-plasma filaments produced by femtosecond two-color laser focusing. Here, phase matching naturally occurs due to off-axis constructive interference between locally generated terahertz waves, and this determines the far-field terahertz radiation profiles and yields. For a filament longer than the characteristic two-color dephasing length, it emits conical terahertz radiation in the off-axis direction, peaked at 4–7° depending on the radiation frequencies. The total terahertz yield continuously increases with the filament length, well beyond the dephasing length. The phase-matching condition observed here provides a simple method for scalable terahertz generation in elongated plasmas.

PRESENTATION

Phase-Matched Terahertz Generation in Femtosecond Dichroic Filamentation


Phase matching is crucial for efficient frequency conversion in many nonlinear processes. In this paper, we report a new type of phase matching condition for efficient THz generation in two-color filamentation. We discovered that phase matching naturally occurs in the off-axis direction, resulting in an increase of THz yield with plasma length.