Tailoring Nonlinear Optical Phenomena by Artificially Manipulating the Relevant Optical Phases - Toward High-Resolution Laser Spectroscopy in the Vacuum Ultraviolet Region -

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The nonlinear optical process is strongly dominated by phase relationships among the relevant electromagnetic fields (Fig. 1a). If we can manipulate these phase relationships to arbitrary values at desired interaction lengths during the evolution of the nonlinear optical phenomenon, we can tailor the achieved nonlinear optical phenomenon to a variety of ways. This physical nature itself that nonlinear optical process is dominated by such phase relationships, has been described in the general expression of the nonlinear optical process since the birth of nonlinear optics, however, such discussions focusing on the freedom introducing the relative-phase manipulations have hardly been investigated so far. We studied tailoring nonlinear optical processes by applying the above conceptual idea to the Raman-resonant four-wave-mixing process in gaseous parahydrogen as a representative nonlinear optical process (Fig. 1b) [1-4]. Furthermore, we have shown that as a typical application of such tailored nonlinear optical process, a single-frequency tunable laser that can broadly cover the vacuum ultraviolet wavelength region (120 – 200 nm) may be realized. In our talk, we will report some of the results based on the experiments conducted in reality how we may implement such optical phase manipulations in the nonlinear optical medium [5,6], and also as a consequence what new possibilities may be opened in such tailored nonlinear optical processes.

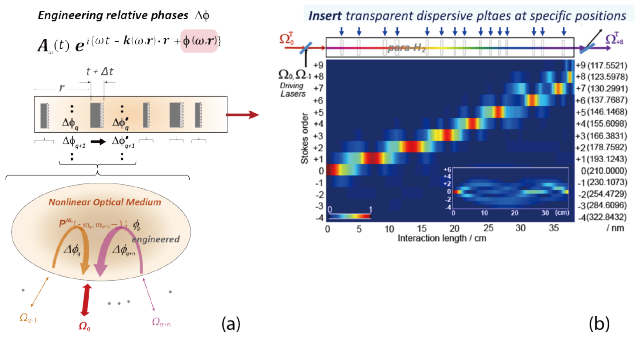

Figure 1: (a) - Conceptual illustration of the engineered nonlinear optical process, (b) - Tailored Raman-resonant four-wave-mixing process in gaseous para-hydrogen (numerically calculated), where the optical phases among the relevant laser fields were artificially manipulated by inserting dispersive plates at desired interaction lengths and precisely controlling their thickness, as illustrated (top)

References

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