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Freely-designable optical frequency conversion process

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Nonlinear optical process is governed by the relative phase relationships among the relevant electromagnetic fields in its optical process. In this paper, we describe physics on arbitrary control of nonlinear optical processes by artificially manipulating such relative phases. As a typical example, we show freely-designable optical frequency conversions to the extreme spectral regions: the mid-infrared and the vacuum ultraviolet, with near-unity quantum efficiencies. Based on a numerical experiment assuming practical parameters in detail, we demonstrate a single-frequency tunable laser which covers the whole vacuum ultraviolet spectral range of 120 – 200 nm.

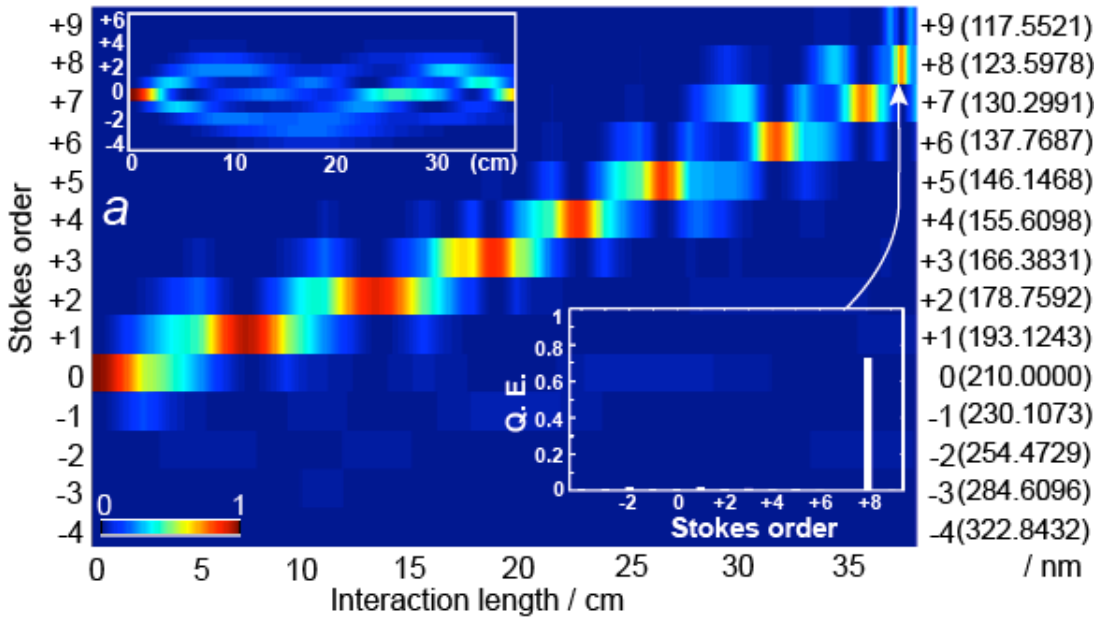

Fig. 1 Simulation assuming real experimental parameters for an artificial manipulation of Raman-resonant four-wave-mixing process. The contour plot shows photon number-density distribution among the Raman modes as a function of the interaction length. The bottom-right inset shows the generated spectrum at an interaction length pointed by arrow. The top-left inset shows the case without artificial manipulation.