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Doppler-free spectroscopy of the atomic rubidium fine structure using ultrafast spatial coherent control method[1] MINHYUK KIM, KYUNG-TAE KIM, WOOJUN LEE, HYOSUB KIM, JAEWOOK AHN, KAIST — Spectral programming solutions for the ultrafast spatial coherent control (USCC) method to resolve the fine-structure energy levels of atomic rubidium are reported. In USCC, a pair of counter-propagating ultrashort laser pulses are programmed to make a two-photon excitation pattern specific to particular transition pathways and atom species, thus allowing the involved transitions resolvable in space simultaneously. With a proper spectral phase and amplitude modulation, USCC has been also demonstrated for the systems with many intermediate energy levels. Pushing the limit of system complexity even further, we show here an experimental demonstration of the rubidium fine-structure excitation pattern resolvable by USCC. The spectral programming solution for the given USCC is achieved by combining a double-V-shape spectral phase function and a set of phase steps, where the former distinguishes the fine structure and the latter prevents resonant transitions. The experimental results will be presented along with its application in conjunction with the Doppler-free frequency-comb spectroscopy for rubidium hyperfine structure measurements.

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