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Coherent Control of Molecular Ion Production in Cold Rb Vapor[1] M.L. TRACHY, G. VESHAPIDZE, M.H. SHAH, H.U. JANG, B.D. DEPAOLA, Kansas State University — When Rb vapor is exposed to pulses of light from an ultra-fast laser having a central wavelength of about 800 nm, the result is a very large number of atomic Rb ions. This is because, within the bandwidth of the laser pulse, resonant three-photon ionization takes place along the ladder Rb(5s) → Rb (5p) → Rb(5d) → ϵl. The first transition is at 780 nm, the second is at 776 nm, and the third is anything shorter than 1252 nm. Virtually no molecular ions are formed in the interaction of the optical pulse with the Rb vapor. In a series of experiments we show that this natural trend can be reversed, with greatly reduced Rb^+ production and greatly increased Rb_2^+ production. Partly this is accomplished by introducing a weak, quasi-cw diode laser, nearly resonant with the Rb(5p) → Rb(4d) transition. However, an important component in switching from Rb^+ to Rb_2^+ production is shaping the ultra-fast pulse in the frequency and phase domains, putting "notches" in the beam at crucial wavelengths and adjusting the "chirp" of the pulse. For example, removing wavelengths near the D1 and Rb (5p) → Rb(5d) transitions reduced Rb^+ production by nearly two orders of magnitude. A detailed discussion of these and related results will be given.

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