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Manipulating Phase to Enhance Ultrafast Photoassociative Ionization G. VESHAPIDZE, M.L. TRACHY, H. JANG, C.W. FEHRENBACH, B.D. DEPAOLA, Kansas State University — With their broad bandwidths and high degree of coherence, ultrafast lasers hold the promise of efficiently guiding chemical reactions along desired pathways. In this work, we experimentally examine the effects of spectral phase on a prototypical system and process, namely ultra cold atomic rubidium undergoing photoassociation followed by coherent excitation and ionization (PAI). We concentrate on simple, readily modeled spectral phase functions such as

$$\begin{aligned}
\phi(\omega) &= A \sin\left[(\omega - \omega_0)\, T + \phi_0\right] \\
\phi(\omega) &= \begin{cases} 0 & \text{if } \omega < \omega_0 \\ \pi & \text{if } \omega \geq \omega_0 \end{cases} \\
\phi(\omega) &= \begin{cases} \pm\frac{\pi}{2} & \text{if } \omega_L \leq \omega \leq \omega_U \\ 0 & \text{otherwise} \end{cases}
\end{aligned}$$

That is, we concentrate on sinusoidal phase, π-phase steps, and $\frac{\pi}{2}$-phase pulses. When combined with high resolution time-of-flight spectroscopy as a diagnostic, we find that such phase control can yield a tremendous amount of information about the PAI process. The experimental measurements will be compared with the results of simple calculations.

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