ELECTRONIC WAVE PACKET INTERFEROMETRY OF GAS PHASE SAMPLES: HIGH RESOLUTION SPECTRA AND COLLECTIVE EFFECTS

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Time-resolved coherent spectroscopy has opened many new directions to study ultrafast dynamics in complex quantum systems. While most applications have been achieved in the condensed phase, we are focusing on dilute gas phase samples, in particular, on doped helium droplet beams. Isolation in such droplets at millikelvin temperatures provides unique opportunities to synthesize well-defined complexes, to prepare specific ro-vibronic states, and study their dynamics. To account for the small densities in our samples, we apply a phase modulation technique in order to reach enough sensitivity and a high spectral resolution in electronic wave packet interferometry experiments. The combination with mass-resolved ion detection enabled us e.g. to characterize vibrational structures of excimer molecules. By extending this technique we have observed collective resonances in samples of very low density ($10^8\,\mathrm{cm}^{-3}$). With a variant of this method, we are currently elaborating the implementation of nonlinear all-XUV spectroscopy.