

## STATE-TO-STATE SPECTROSCOPY AND DYNAMICS OF IONS AND NEUTRALS BY PHOTOIONIZATION AND PHOTOELECTRON METHODS

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Recent advances in high-resolution photoionization, photoelectron, and photodissociation studies based on single-photon vacuum ultraviolet (VUV) and two-color infrared (IR)-VUV, visible (VIS)-ultraviolet (UV), and VUV-VUV laser excitations are illustrated with selected examples. We show that VUV laser photoionization coupled with velocity-mapping (VMI)-threshold photoelectron (VMI-TPE) detection can achieve comparable energy resolutions, but higher detection sensitivities than those observed in VUV laser pulsed field ionization-photoelectron (PFI-PE) measurements. For molecules with known intermediate states, IR-VUV and VIS-UV excitation schemes are highly sensitive for rovibronically selected and resolved PFI-PE studies. The successful applications of the VUV-PFI-PE, VUV-VMI-TPE and VIS-UV-PFI-PE methods to state-resolved and state-to-state photoelectron studies of transient radicals and transitional metal-containing molecules are highlighted. The most recently established VUV-VUV pump-probe time-slice VMI-photoion method is shown to be promising for state-to-state photodissociation studies of small molecules relevant to planetary atmospheres and for the fundamental understanding of photodissociation dynamics.