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Photodissociation of quantum state-selected diatomic molecules yields new insight into ultracold chemistry MICKEY MCDONALD, BART H. MCGUYER, CHIH-HSI LEE, FLORIAN APFELBECK, TANYA ZELEVINSKY, Columbia University — When a molecule is subjected to a sufficiently energetic photon it can break apart into fragments through a process called "photodissociation. For over 70 years this simple chemical reaction has served as a vital experimental tool for acquiring information about molecular structure, since the character of the photodissociative transition can be inferred by measuring the 3D photofragment angular distribution (PAD). While theoretical understanding of this process has gradually evolved from classical considerations to a fully quantum approach, experiments to date have not yet revealed the full quantum nature of this process. In my talk I will describe recent experiments involving the photodissociation of ultracold, optical lattice-trapped, and fully quantum state-resolved $^{88}Sr_2$ molecules. Optical absorption images of the PADs produced in these experiments reveal features which are inherently quantum mechanical in nature, such as matter-wave interference between output channels, and are sensitive to the quantum statistics of the molecular wavefunctions. The results of these experiments cannot be predicted using quasiclassical methods. Instead, we describe our results with a fully quantum mechanical model yielding new intuition about ultracold chemistry.

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