Attosecond Transient Absorption: From Atoms to Band Gap Solids

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Theoretical and experimental problems abound in the pursuit of attosecond science, as the measurements at such short times push the boundaries of fundamental limitations. Moreover, the characteristic transitions addresssed by attosecond pulses are autoionizing or inner shell states of atoms, and the interpretations of these transitions require calculations of potentials for excited states that involve inner shell vacancies. These x-ray transitions are sensitive to charge and electronic state and even exhibit significant shifts upon vibrational excitation. In gases, new investigations involve the development of methods to explore coherent superpositions and timescales for autoionization. In the solid-state, band gap renormalization is probed for the first time, down to subfemtosecond timescales, revealing new signatures of broadening and shifts of the density of states in the conduction band. In each case, theoretical interpretations have been crucial to understanding the phenomena and quantitative determinations.

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