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Energy-dependent phases more fundamental than "attosecond time delays"[1] GREG ARMSTRONG, B. D. ESRY, J. R. Macdonald Laboratory, Kansas State University — The time delay in photoemission from neighboring atomic valence sub-shells has become an area of considerable recent interest, with delays of tens of attoseconds reported in experiments for a number of atomic targets.The assumption that such delays are particular to electronic dynamics is questionable, given our recent calculation of "attosecond delays" in nuclear motion. Moreover, in both cases, the connection of such delays to physical delays in wavepacket creation or detection is inherently ambiguous, for example, due to gauge-dependence. Previous atomic studies using the RABBIT technique have extracted time delays from phase differences in the energy spectra for different sub-shells as a function of delay between harmonics. We will argue, however, that the more fundamental physical information lies in the energy dependence, which may be related to quantities such as the scattering phase shift. A molecular target such as HeH^+ provides a convenient analog of atomic systems, allowing the investigation of energy-dependent phases in dissociation from adjacent vibrational states. Using a RABITT-like combination of laser pulses, and applying the photon-phase formalism, we extract information on energy-dependent phases and their relation to scattering phase shifts.

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