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Extracting momentum distributions from time-dependent wave functions[1] J.H. MACEK, University of Tennessee and ORNL, S.Y. OVCHINNIKOV, J.B. STERNBERG — Time dependent state vectors for atomic processes are computed numerically and amplitudes for transitions to bound states obtained by projecting time-dependent state vectors onto bound state vectors at large times. Similar projections onto plane waves are used for continuum states. This requires large times since only then do plane waves represent particle motion. To use finite times, one projects onto asymptotic state vectors. Since the asymptotic states are often not known other procedures are sought. One such procedure replaces coordinates by the their classical counterpart, namely $\mathbf{v}t$, where $\mathbf{v}$ is the velocity, and uses that coordinate space wave functions go over to momentum space wave functions at large times. This gives momentum distributions directly. In essence, if an exact wave function is obtained then there is no need to project that wave function onto imperfectly known asymptotic states to extract electron momentum distributions. We show how more familiar projection procedures derive from this simple prescription, which we call "The Imaging Theorem" since it shows that momentum distributions image time-dependent wave functions.

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