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Phase-dependent electron dynamics of a two-level atom driven by a resonant microwave field H. MAEDA, J. NUNKAEW, T.F. GALLAGHER, Department of Physics, University of Virginia, Charlottesville, VA 22904 — When exposed to a weak radiation field an atom undergoes the Rabi oscillation if the radation frequency is resonant with one of atomic electric dipole transitions. A probability of finding the atom in a ground/excited state oscillates at the Rabi frequency, and the oscillation accompanies absorbing/emitting the energy from/to the radiation field, depending on the relative phase between the field and a dipole moment induced in the atom. Here we have demonstrated these features by detecting phase-dependent motion of the electron along the field axis (z) in a Rydberg atom which is driven by a linearly polarized resonant microwave (MW) field. In the experiment electron motion of Yb and Li Rydberg atoms has been monitored using a sub-ps half-cycle pulse (HCP), which works as a time-resolved detector of the electrons momentum. The HCP is polarized along the polarization axis of the MW field and synchronized to it, so that it can ionze the atoms when the z component of the electrons momentum exceeds a value determined by the HCP amplitude as a function of the the MW phase. We have also studied the phase dependence and change in amplitude of the induced dipole moment around an avoided crossing between neighboring Rydberg states, showing that at the crossing the electron motion is in fact phase-locked to the MW field and the induced dipole moment is maximum. This work has been supported by the NSF.

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