Probing Two-Electron Dynamics Of Helium In Time Domain Via Fluorescence Channel

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Time-resolved study of electron correlation in many-electron systems remains challenging both experimentally and theoretically. Recently, our Laser Technology Laboratory has demonstrated a tabletop light source generating pulses with duration of 500 as and energy as high as 1.3 microjoule [E. J. Takahashi et. al., Nat. Commun. 4, 2691 (2013)]. Such high-intensity and short-pulse light source is expected to enhance our ability to probe electron dynamics in time domain. We present a theoretical study for correlation dynamics in coherently excited resonances, using an attosecond pump-probe scheme applied for two-electron system of helium, by solving the time-dependent Schrödinger equation in the hyperspherical coordinates. In particular, we are looking at channel in which fluorescence signal may contain information on the dynamics evolution of correlated wave packet initiated by absorption of two XUV photons. We calculate the delay dependence of helium ion in the first excited state, separating 2s and 2p channels. It is shown that the signal is connected to collective motions of the wave package.

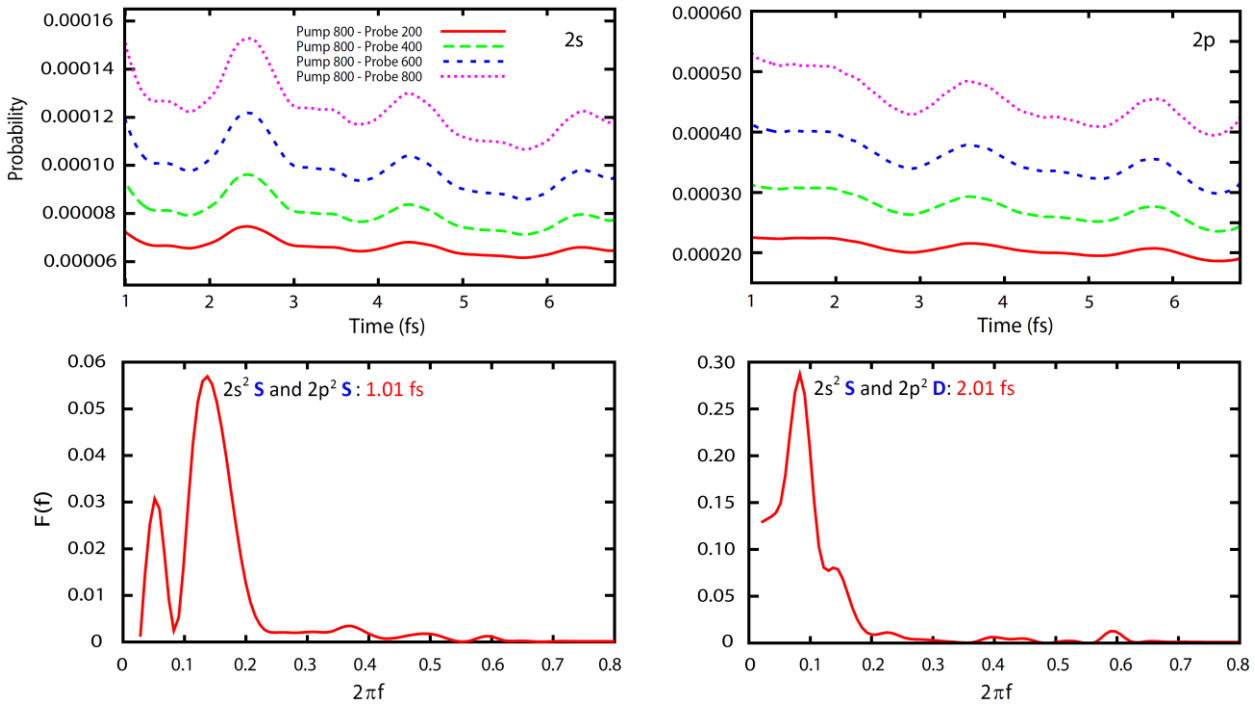

Figure: Upper row: Probability for ion He^+ in 2s and 2p excited states as functions of time delay between two XUV pulses with duration of 600 as and photon energy of 30.2 eV. The intensities (TW/cm^2) of the pump and probe pulses are also indicated. Lower row: Fourier transformation for the case of Pump 800 - Probe 800.