A general formula for long-range electronic correlation energy formula with off-diagonal interactions for pi electron systems has been given, which is beyond the nearest-neighbor electron-electron interactions[1]. Now a formula for long-range electronic correlation energy for excited states for pi electronic systems is given at the first time, by which we can discuss the effects of the long-range electronic correlations on problems of exciton and polaron in pi electron systems. We discussed the effects of the long-range electronic correlation on band gap, charge transfer along the molecular chain, and polarization.

The off-diagonal electron-electron interactions are clearly related to the long-range correlation effects. It is found that the effects of the off-diagonal interactions $W$ and $X$ on the correlation energies are opposite, but the influence of $X$ on the correlation energies is counteracted by the integral $J$ due to $|X|\sim|J|$, and the correlation energies decrease with increasing the screening effect. According to the general formula of the long-range correlation energy, we have put forward to a correlation Hamiltonian. Due to the possible connection of the off-diagonal interaction $X(<0)$ to superconductivity and the connection of the off-diagonal interaction $W$ to ferromagnetism, these correlation effects maybe imply an significance to the pi electron systems with such physical properties.