Abstract Submitted
for the DAMOP14 Meeting of
The American Physical Society

Quantum entanglement for doubly-excited resonance states of the helium atom[1] Y.-C. LIN, T.K. FANG, Fu Jen Catholic University, Y.K. HO, Institute of Atomic and Molecular Sciences — It is well known that quantum entanglement is relevant to quantum information, quantum computation, quantum teleportation, and quantum cryptography. In our present work, quantum entanglement for doubly-excited resonance states are quantified by calculating the linear entropy (S_L) and von Neumann entropy (S_{vN}) for such states. The linear entropy is defined as $S_L = 1 - Tr\,(\rho_{red}^2)$ and the von Neumann entropy as $S_{vN} = -Tr\,(\rho_{red}\log_2 \rho_{red})$, where ρ_{red} is the reduced density matrix, and Tr denotes the trace of the matrix. In our previous works, we calculated the linear entropy for the bound states of the helium atom in free space [1]. Here, we employ the projection operator method [2] to calculate the energies and wave functions of doubly-excited resonance states in the helium atom. Using the projection operators P and Q with $P\,|\rangle = (1-Q)\,|\rangle$, we can evaluate the eigenvalues of $\langle\,|\,QHQ\,|\rangle = \varepsilon_{res}\,\langle\,|\,QQ\,|\rangle$, and such eigenvalues ε_{res} approximate the resonance energies. Once the wave functions for the resonance states are obtained, we can use them to calculate the von Neumann and linear entropies of the doubly-excited resonance states. In the present work, we investigate the ${}^{1,3}S^{e}$, ${}^{1,3}P^{o}$, ${}^{1,3}D^{e}$, and ${}^{1,3}F^{o}$ resonance series in the helium atom lying below the $He^+(N=2)$ threshold. Our results indicate that different series will have different behaviors for their entropies. The detail of our findings will be presented at the meeting.

[1]Supported by NSC of Taiwan.

Yew Kam Ho
Institute of Atomic and Molecular Sciences

Date submitted: 17 Jan 2014 Electronic form version 1.4