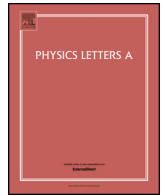




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# Polarization bremsstrahlung process in quantum plasmas including electron-exchange and shielding effects

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## ABSTRACT

The electron-exchange and quantum shielding effects on the polarization bremsstrahlung spectrum due to the electron-shielding sphere encounters are investigated in quantum plasmas. From this work, it is found that the electron-exchange effect strongly suppresses the polarization bremsstrahlung radiation cross section. Additionally, it is found that the polarization bremsstrahlung radiation cross section increases with increasing plasmon energy and, however, decreases with increasing Fermi energy. The variation of the influence of electron-exchange and quantum shielding on the polarization bremsstrahlung spectrum is also discussed.

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The continuum radiation spectra due to the bremsstrahlung process [1–13] have been widely used as the main plasma diagnostic process since the continuum UV and X-ray emissions caused by the projectile–target encounters has provided useful information on various plasma parameters in astrophysical and laboratory plasmas. It has been known that the bremsstrahlung mechanism would be mainly classified as the ordinary bremsstrahlung radiation known as the static electron–ion bremsstrahlung process and the polarization bremsstrahlung radiation caused by the interaction between the projectile electron and the polarized target system [13]. The conventional electron–ion bremsstrahlung radiation process has been extensively investigated in various plasma states by using the screened interaction potentials so-called the Debye–Hückel model for weakly coupled plasmas and the ion-sphere model for strongly coupled plasmas [14]. Recently, aside from the conventional electron–ion bremsstrahlung process, the polarization bremsstrahlung process caused by the interaction between the plasma particle and polarized shielding sphere in plasmas has been extensively investigated since the polarization bremsstrahlung can generate the continuum radiation spectrum in wide spatial radiation domains [11,13,15]. It would be then expected that the low-energy projectile would be more actively involved in the polarization bremsstrahlung process since the polarization bremsstrahlung radiation is known to be produced by the electron–polarized target encounter. Recent years, there has been of a considerable inter-

est in investigating and also searching unique physical characteristics and properties of low-temperature and high-density quantum plasmas since the quantum plasmas have been found in various nano-scale objects in modern sciences and technologies such as nano-wires, quantum dot, semiconductor devices, and also laser produced dense plasmas [16–28]. In these dense quantum plasmas, as we can expect, the screened interaction potential would be quite different from the ordinary Debye–Hückel model in weakly coupled plasmas due to the nonideal multiparticle correlation and quantum-mechanical characters such as the Bohm potential and quantum statistical pressure effects [20]. Very recently, Shukla and Eliasson [27] have shown that the electron-exchange effect caused by the electron 1/2-spin in degenerate quantum plasmas plays a crucial role in the formation of the electric potential and dielectric function. Hence, it has been shown that the screened interaction potential including the fermionic character of plasma electrons in degenerate quantum plasmas is different from the standard Thomas–Fermi screened interaction potential [27] in the form:  $V_{TF}(r) \propto e^{-k_s r}/r$ , where  $k_s$  represents the Thomas–Fermi (TF) screening wave number. Hence, we can expect that the polarization bremsstrahlung emission due to the electron-polarized shielding sphere encounters including the influence of electron-exchange and quantum shielding in degenerate quantum plasmas would be different from that in conventional quantum plasmas represented by the Thomas–Fermi screening length  $k_s^{-1}$ . However, the polarization bremsstrahlung process including the electron-exchange and quantum shielding effects in degenerate quantum plasmas has not been investigated as yet. This polarization bremsstrahlung process would be completely different

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