MaxwellIAN plasma and quantum fluctuations

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Usually they construct the theory of high temperature classical electron –ion plasma being in thermodynamical state using Vlasov’s equation [1,2]. In such a way one gets the plasma oscillations with frequency . This frequency does not depend on wave length. The quantum electrodynamics by taken into account the quantum properties of electromagnetic field adds in theory the dimensionless parameter [3]

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This parameter connecting with Planck constant  dramatically changes the results of the theory. Here . Theoretically the Maxwell plasma may be present as in state  (without the quantum fluctuations of electromagnetic field) and in state (in present of the quantum fluctuations of electromagnetic fields). The Vlasov’s theory deals with the case. The linear with respect to Z correction terms to the Vlasov’s theory are inversional proportional to , This fact excludes as the limit  and the existence of Vlasov’s theory itself. The aggressive action of thermal exciting Langmuir waves on plasma electrons and ions describing by Z parameter dramatically changes the dispersion equations. In real conditions the parameter  is much larger then unity. That is why the properties of plasma dramatically differ of Vlasov’s equation descriptions. Instead of Langmuir’s frequency  one deals now with another character quantum frequency

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The two branches of electron oscillation appear. One of them describes the electron sound with the velocity . The ions of plasma possess as the sound branch of spectrum and another branch which rests finite by small wave numbers [4]. The properties of transversal and longitudinal dielectric permittivity’s dramatically differ each to another especially at small wave numbers.

References

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