Abstract Submitted
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Excitonic Mode and Negative Compressibility in Electron Liquids YASUTAMI TAKADA, ISSP, Univ. of Tokyo — A highly self-consistent theory maintaining the exact functional relations between the electron self-energy and the vertex part[1] is employed to calculate the dielectric function $\varepsilon(\mathbf{q},\omega)$ very accurately in the homogeneous electron gas in two and three dimensions for the range of densities covering the transition region where κ the compressibility of the system changes from positive to negative. The calculated $\varepsilon(\mathbf{q},\omega)$ exhibits a sharp peak-like structure in its imaginary part as a function of ω, indicating the existence of a mode sustained by the attractive electron-hole multiple scattering (the excitonic effect). The eigen energy of the mode becomes soft in proportion to $1/\kappa$ with decreasing the density to make κ diverge. With further decreasing the density to make κ go beyond the divergent point into a negative value, this mode turns into a pole of $\varepsilon(\mathbf{q},\omega)$ on the positive imaginary-ω axis, implying the spontaneous excitation of this mode. This feature can be understood as the microscopic origin to bring about the negative dielectric function occurring in this system at sufficiently low densities.
[1] YT, PRL **87**, 226402 (2001); YT and H. Yasuhara, PRL **89**, 216402 (2002).

Yasutami Takada
ISSP, Univ. of Tokyo

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