Luminescence of low-density two-dimensional electrons: Wigner crystal ore Mahan exciton?

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The many-body problem for 2-dimensional electron system (2DES) has no unified theoretical descriptions in the intermediate range of interaction parameter r_s neither for the ground state no for the elementary excitations. The ground state can be considered to be an electron gas, electron Fermi-liquid ore Wigner crystal (WC). High-quality MgZnO/ZnO heterojunctions have emerged as an excellent object for the study of electron-electron interaction effect in 2DES. The values of the interaction parameter r_s up to 10 are readily achieved. The photoluminescence spectra from the 2DES confined at MgZnO/ZnO heterojunction at r_s 6 are studied [1]. Electrons annihilate with the localized valence-band holes, and a quasiholes appear in 2DES. For the lower-density samples well defined lines from Landau levels depend unusually on magnetic field. In [1] this behaviour is connected with the phenomenon of the Mahan exciton [2]. The luminescence shape without magnetic field allowed both explanations: Wigner crystal and Mahan exciton. It is considered this work, that no unusual behaviour gives the taking into account Mahan exciton. For 2D Wigner crystal the Landau levels for vacancions depend differently on magnetic field from maximum and minimum sides of the band [3].

[1] Solovyev V V and Kukushkin I V 2017 *Phys. Rev. B* **96** 115131
[2] Schmitt-Rink S, Ell C and Haug H 1986 *Phys. Rev. B* **33** 1183
[3] Bisti V E 2019 *JETP Lett.* **109** 109