On the origin of Stark effect of rotons in He-II and the existence of p=0 condensate

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Abstract: Linear Stark effect of roton transition, experimentally observed through microwave absorption in He-II (superfluid He-4) in the presence of varying external electric field, is critically analysed. We find that: (i) The effect cannot be explained in terms of conventional microscopic theory (CMT) of He-II which presumes the existence of p = 0 condensate and concludes that He-4 atoms even at T = 0 have random motions and mutual collisions which do not support the basic factor (viz. an ordered arrangement of atomic electric dipoles) needed for its occurrence. (ii) The desired order is concluded, rather, by a non-conventional microscopic theory (NCMT) as an intrinsic property of He-II. Accordingly, all atoms in He-II define a close packed arrangement of their wave packets (CPA-WP) with identically equal nearest neighbour distance (d), per particle zero-point energy (epsilon(0) = h(2)/8md(2)) and equivalent momentum, h/2d. (iii) The CPA-WP prevent atoms from having relative motions and mutual collisions capable of disturbing any order of atomic dipoles. As such the NCMT and the observed Stark effect have strong mutual support; whereas the former concludes CPA-WP necessary for the occurrence of the effect, the latter strengthens the experimental support for the former, which means that the observation does not support the presence of p = 0 condensate in He-II.

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