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Role of electric field in transition from two- to single-fluid equilibrium T. KANKI, Japan Coast Guard Academy, M. NAGATA, University of Hyogo — Two-fluid equilibrium with small but non-zero two-fluid parameter ε is identified as a singular perturbation of single-fluid (MHD) equilibrium. It is important to understand the relationship between the two-fluid equilibrium and the single-fluid one, since the single-fluid equilibrium is widely used in the stability analyses of various plasma confinements. However, the formulation for the transition of the two-fluid equilibrium to the single-fluid one was an open problem for several years [1]. Recently, Hameiri has solved this problem by variational formulation [2]. We have formally derived in a different way from Hameiri's one. The two-fluid equilibrium equations are normalized by employing three basic reference scales: global length L_R, magnetic field B_R, and density n_R. From these, the reference scales of electric field E_R and electrostatic potential V_{ER} should be treated as $u_R B_R$ and $u_R B_R L_R$, respectively, where u_R is Alfven velocity expressed by the above basic scales. This treatment can be regarded as a strong electric field (MHD) ordering, since the inertia and pressure terms in motion equation for ion become $O(\varepsilon)$. When calculating the reduction of the two-fluid equilibrium, all terms of $O(\varepsilon)$ can be ignored, except the total enthalpies related to the electrostatic potential appeared in the generalized Bernoulli equations. It is found that such treatments make the smooth transition from the two-fluid equilibrium to the single-fluid one. [1]L.C. Steinhauer and A. Ishida, Phys. Plasmas **13**, 052513 (2006). [2]E. Hameiri, Phys. Plasmas **20**, 092503 (2013).

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