HEAT AND MASS TRANSFER PROCESSES IN EHD AND EMHD

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ABSTRACT

As is well known, heat and mass transfer processes in the hydrodynamic (HD) flow have well been investigated over the past centuries on the basis of the conservation laws of mass, momentum, and energy, particularly since the advent of the Navier-Stokes equation for a viscous fluid. The study has also been extended and developed more recently for the magnetohydrodynamic (MHD) flow on the basis of a set of MHD equations for a conducting fluid, particularly adding a term giving the Joule heat in the equations of energy transport and heat transfer. For a weakly conducting or dielectric fluid, however, the equation of motion of the fluid and the equations of energy transport and heat transfer must include the ponderomotive (electric) forces that are usually ignored for HD and MHD flows. This is done in this paper, presenting new equations of EHD energy transport and heat transfer, together with the equations of vorticity, magnetic, and electric field transport, based on which the EHD flow and heat transfer enhancements in the presence of electromagnetic fields and pulses are explained for a couple of examples.