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THE KOLESNIKOV EFFECT IN PLASMA FLOWS

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Abstract. An accurate modeling of dissipative effects in plasmas is crucial to many applications. We propose to calculate the crossed contributions to the mass and energy transport fluxes coupling the electrons and heavy particles, such as atoms and ions, in multicomponent plasmas. This coupling effect was first introduced by Kolesnikov [1]. To derive asymptotic solutions for multicomponent plasmas based on kinetic theory, it is essential to solve the distribution functions in the Enskog expansion up to second-order for electrons and up to first-order for heavy particles [2]. However, the second-order electron transport fluxes should not be confused with Burnett fluxes. The heavy-particle diffusion velocities and heat flux are proportional to an average electron force expressed in terms of the electron diffusion driving force and temperature gradient. Conversely, the electron diffusion velocity and heat flux are proportional to the heavy-particle diffusion driving forces and temperature gradient. The magnetic field induces anisotropic transport fluxes when the electron collision frequency is lower than the electron cyclotron frequency of gyration around the magnetic lines. The explicit expressions for the transport coefficients are obtained by means of a Galerkin spectral method [3].

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