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Fluid Theory with Asymmetric Molecular Stresses: Difference Between Vorticity and Spin Equations

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A b s t r a c t

We present a new development in fluid theory, incorporating into it the velocity and spin fields; special attention is given to the structure of transport.The theory includes asymmetric molecular stresses and independent rotation velocity, *i.e.*, spin. Our approach is based on our former studies on the asymmetric continuum theory with the balance and constitutive laws for displacement velocity and independent rotation motion, and points out the role of a related characteristic length unit. It is assumed that the vorticity caused by velocities can induce a spin transport counterpart. Thus, under certain conditions, an additional transport term due to rotational velocity fields may be incorporated to the velocity transport, which may lead to the vortex fields included directly into the theory.

The Coriolis effect, important for the vortex processes, is considered and it is demonstrated that the motion equations in our asymmetric theory include this effect automatically. When confinining to 2D case, some compatibilities are found between the relations derived for the rotation motions and the moment formed by the Coriolis forces and applied to such motions. This is an important argument supporting our approach.

The obtained nonlinear vortex equations (solitons) are derived and discussed for a stationary case.

Key words: molecular stresses, vorticity, circular transport, Coriolis effect, asymmetric continuum.