On the velocity decomposition in hydrodynamics

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We assume that velocity in hydrodynamics is an identical form of the gauge potential in electromagnetism where the vorticity is identical to the field strength tensor. Because the gauge potential can be decomposed into local and global parts, the velocity in hydrodynamics could also be decomposed into local and global parts.

Keywords: *velocity, hydrodynamics, decomposition, local part, global part.*

It is well known that the gauge potential has local and global properties[1,2]. It is also well known that the gauge potential has an identical form with a connection where the field strength is identical to the curvature[3].

In the formulation of a knot in Chern-Simons theory in the case of the weak field geometrical optics and Newton's theory of gravitation[4], we treat the helicity in hydrodynamics as a knot and we see that the velocity of fluid flow is identical to gauge potential where the vorticity is identical to the field strength.

Based on the facts mentioned above that the gauge potential can be decomposed into local and global parts and the velocity in hydrodynamics is identical to the gauge potential, *we propose that the velocity in hydrodynamics could also be decomposed into local and global parts.*

Roughly speaking, we could decompose the velocity of fluid flow as

$$\vec{v} = \vec{v}_l + \vec{v}_g \tag{1}$$

where $\vec{v}_l$, and $\vec{v}_g$ are local and global parts of the velocity, respectively. The local part of the velocity represents the velocity of fluid flow associated with local interactions within the field, such as fluid viscosity, pressure gradient, and internal turbulence. These components describe the immediate effects of neighbouring fluid elements on the velocity at a given point in space-time. The global part of the velocity represents the global aspects of the velocity field that arise from broader influences, such as large-scale flow patterns, boundary effects, or external forces[5].

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