Quest for a mass-weighted-averaging turbulence theory, with an unexpected finding about the countergradient diffusion and blockage of heat and matters

Akira Yoshizawa

Institute of Industrial Science, University of Tokyo, Komaba, Meguro-ku, Tokyo 153-8505, Japan

Received 16 March 2004; received in revised form 30 April 2004; accepted 4 August 2004

Communicated by F. Hamba

Abstract

A mass-weighted-averaging theory is formulated of density-variable inhomogeneous turbulence. There the velocity and the concentration of matters are resolved into the mass-weighted means and the fluctuations around them. The essence of the formulation lies in the introduction of mass-weighted fluctuations. With those new variables, a statistical theory of inhomogeneous incompressible turbulence can be extended to the variable-density counterpart in a straightforward manner. One of the unexpected findings by this theory is the striking similarity between the countergradient diffusion in a turbulent combustion and the heat-transport suppression in high-mode confinements of tokamak’s thermonuclear fusion.

© 2005 The Japan Society of Fluid Mechanics and Elsevier B.V. All rights reserved.

Keywords: Turbulence theory; Mass-weighted averaging; Countergradient diffusion; Transport barrier

E-mail address: ay-tsch@mbg.nifty.com.

0169-5983/$30.00 © 2005 The Japan Society of Fluid Mechanics and Elsevier B.V. All rights reserved.
doi:10.1016/j.fluiddyn.2004.08.006