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On the Lamb vector divergence as a momentum field diagnostic employed in turbulent channel flow[1] CURTIS W. HAMMAN, ROBERT M. KIRBY, University of Utah, JOSEPH C. KLEWICKI, University of New Hampshire
— Vorticity, enstrophy, helicity, and other derived field variables provide invaluable information about the kinematics and dynamics of fluids. However, whether or not derived field variables exist that intrinsically identify spatially localized motions having a distinct capacity to affect a time rate of change of linear momentum is seldom addressed in the literature. The purpose of the present study is to illustrate the unique attributes of the divergence of the Lamb vector in order to qualify its potential for characterizing such spatially localized motions. Toward this aim, we describe the mathematical properties, near-wall behavior, and scaling characteristics of the divergence of the Lamb vector for turbulent channel flow. When scaled by inner variables, the mean divergence of the Lamb vector merges to a single curve in the inner layer, and the fluctuating quantities exhibit a strong correlation with the Bernoulli function throughout much of the inner layer.

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