DFD14-2014-000908

Abstract for an Invited Paper
for the DFD14 Meeting of
the American Physical Society

Brenner's bi-velocity fluid mechanics and gradient effects in general continua

JOE GODDARD, University of California, San Diego

The field of *bi-velocity fluid mechanics* represents a notable contribution to the impressive scientific legacy of Professor Howard Brenner. Dating approximately from 2004, Brenner authored or co-authored some thirty papers concerned with the possible breakdown of the Navier Stokes/Fourier models of momentum and heat transport in fluids, a body of work often cited in the literature on statistical and continuum mechanics. Central to the theory is the notion that the barycentric velocity, which represents inertial terms in the Navier Stokes equations, differs generally from the velocity that represents viscous stress, denoted variously by Brenner as "volume" or "work" velocity. The present paper, based heavily on a previous publication by the present author (*Int. J. Eng. Sci.* **48** 1279-88, 2010), shows that, while the work of Brenner poses a challenge to certain continuum mechanical notions of material points and velocities, it is also subsumed in a more general framework of higher-gradient models of continuous media. Within this framework, linear constitutive models represent weak non-locality as an expansion in spatial wave number or Knudsen number. Some comments are also offered on Brenner's concept of a non-material volume velocity.