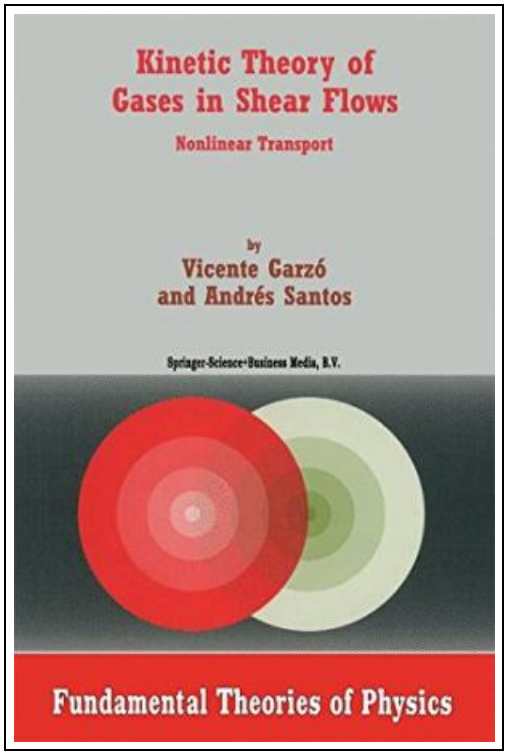
Kinetic Theory of Gases in Shear Flows Nonlinear Transport Fundamental Theories of Physics



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KINETIC THEORY OF GASES IN SHEAR FLOWS NONLINEAR TRANSPORT FUNDAMENTAL THEORIES OF PHYSICS

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Springer. Hardcover. Condition: New. 319 pages. Dimensions: 9.2in. x 7.1in. x 0.9in.This monograph provides a comprehensive study about how a dilute gas described by the Boltzmann equation responds under extreme nonequilibrium conditions. This response is basically characterized by nonlinear transport equations relating fluxes and hydrodynamic gradients through generalized transport coefficients that depend on the strength of the gradients. In addition, many interesting phenomena (e. g. chemical reactions or other processes with a high activation energy) are strongly influenced by the population of particles with an energy much larger than the thermal velocity, what motivates the analysis of high-degree velocity moments and the high energy tail of the distribution function. The authors have chosen to focus on shear flows with simple geometries, both for single gases and for gas mixtures. This allows them to cover the subject in great detail. Some of the topics analyzed include: Non-Newtonian or rheological transport properties, such as the nonlinear shear viscosity and the viscometric functions. Asymptotic character of the Chapman-Enskog expansion. Divergence of high-degree velocity moments. Algebraic high energy tail of the distribution function. Shear-rate dependence of the nonequilibrium entropy. Long-wavelength instability of shear flows. Shear thickening in disparate-mass mixtures. Nonequilibrium phase transition in the tracer limit of a sheared binary mixture. Diffusion in a strongly sheared mixture. The presentation is intermediate between an extensive review article and a text. Similarities with the former are due to its exhaustive treatment of the subject but it is more like the latter in that the results are offered in a pedagogical and self-contained way and make connection with a broader context. The approach involves complementary and reinforcing methods: analytic, numerical, and simulational, so the results are controlled and unambiguous. This distinguishes the book from others that mainly emphasize mathematical methods or realistic phenomenology. The text can be...

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