

# **On the influence of the equipartition of energy assumption in kinetic theories for rapidly-flowing, granular mixtures**

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## **Abstract**

For rapidly flowing granular mixtures, existing kinetic-theory descriptions based on an assumed form of the velocity distribution function typically contain one of two simplifying assumptions: a Maxwellian velocity distribution or an equipartition of energy. In the current work, the influence of non-equipartition effects is explored in the context of two flow types: flow in which species segregation does not occur (namely, simple shear flow) and a segregating flow. For the former case, a comparison between existing kinetic theories and molecular-dynamics simulations of a binary system indicates that the incorporation of a non-Maxwellian velocity distribution is critical for reliable stress predictions, as is consistent with previous findings. However, the predictions are fairly insensitive to the equipartition versus non-equipartition treatment, despite the presence of a significant non-equipartition of energy. Nevertheless, an analysis of the diffusion equation for a segregating flow indicates that the presence of a non-equipartition of energy gives rise to additional components of the driving forces associated with size segregation. These additional components involve gradients of the species temperature, whereas theories based on an equipartition assumption only involve gradients in the mixture temperature. Molecular-dynamics simulations of the segregating flow, in conjunction with kinetic theory of binary systems, show that the non-equipartition effects are non-negligible for systems characterized by moderate values of mass differences and restitution coefficients. These simulations also reveal that the more massive particle may exhibit a lower species temperature than its lighter counterpart, contrary to previous observations in non-segregating systems. A physical explanation for this behavior is provided.

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