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Rarefaction effects in dilute granular Poiseuille flow: Knudsen minimum and temperature bimodality ACHAL MAHAJAN, MEHEBOOB ALAM, Jawaharlal Nehru Centre for Advanced Scientific Research, Jakkur PO, Bangalore 560064 — The gravity-driven flow of smooth inelastic hard-disks through a channel, analog of granular Poiseuille flow, is analysed using event-driven simulations. We find that the variation of the mass-flow rate (Q) with Knudsen number (Kn) can be non-monotonic in the elastic limit (i.e. the restitution coefficient $e_n \to 1$) in channels with very smooth walls. The *Knudsen minimum effect* (i.e. the minimum flow rate occurring at $Kn \sim O(1)$ for the Poiseuille flow of a molecular gas) is found to be absent in a granular gas with $e_n \leq 0.99$, irrespective of wall roughness. Another rarefaction phenomenon, the *bimodality* of the temperature profile, with a local minimum at the channel centerline and two symmetric maxima ($T_{\max}$) away from the centerline, is studied. We show that the inelastic dissipation is responsible for the onset of temperature bimodality [i.e. the excess temperature, $\triangle T = (T_{\max}/T_{\min} - 1) \neq 0$] near the continuum limit ($Kn \sim 0$), but the rarefaction being its origin (as in molecular gas) holds beyond $Kn \sim O(0.1)$. The competition between dissipation and rarefaction seems to be responsible for the observed dependence of both mass-flow rate and temperature bimodality on Kn and e_n. [Alam etal. 2015, JFM (revised)].

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