Abstract Submitted
for the DFD17 Meeting of
The American Physical Society

The Granular Blasius Problem: High inertial number granular flows[1] JONATHAN TSANG, STUART DALZIEL, NATHALIE VRIEND, Univ of Cambridge — The classical Blasius problem considers the formation of a boundary layer through the change at $x = 0$ from a free-slip to a no-slip boundary beneath an otherwise steady uniform flow. Discrete particle model (DPM) simulations of granular gravity currents show that a similar phenomenon exists for a steady flow over a uniformly sloped surface that is smooth upstream (allowing slip) but rough downstream (imposing a no-slip condition). The boundary layer is a region of high shear rate and therefore high inertial number I; its dynamics are governed by the asymptotic behaviour of the granular rheology as $I \to \infty$. The $\mu(I)$ rheology (Jop *et al.* 2006) asserts that $\mathrm{d}\mu/\mathrm{dI} = \mathrm{O}(1/\mathrm{I}^2)$ as $I \to \infty$, but current experimental evidence is insufficient to confirm this (Saingier *et al.* 2015). We show that 'generalised $\mu(I)$ rheologies', with different behaviours as $I \to \infty$, all permit the formation of a boundary layer. We give approximate solutions for the velocity profile under each rheology. The change in boundary condition considered here mimics more complex topography in which shear stress increases in the streamwise direction (e.g. a curved slope). Such a system would be of interest in avalanche modelling.

[1]EPSRC studentship (Tsang) and Royal Society Dorothy Hodgkin Fellowship (Vriend)

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Date submitted: 21 Jul 2017 Electronic form version 1.4