Abstract Submitted
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Particle-laden boundary layers and singularities M.R. FOSTER, RPI — The dusty-gas model for flow in dilute particle suspensions generates a singularity in particle volume fraction in a variety of viscous boundary layer problems. Such a singularity, at say $x = x_s$ along the wall, makes it impossible to continue the solution to the equations. Previously, we have found that computation of the Blasius boundary layer, with a modified equation set that permits fluid volume fraction significantly different from 1, still leads to a velocity singularity at a slightly modified location.[1] Contrary to some published work, the Saffman force has not been found to mitigate the singularity for the conventional equation set, and again here, though the Saffman force does become comparable to the Stokes drag near the singularity, it alters the structure only slightly, and does not remove it. If α_o is the particle volume fraction of the fluid in which the boundary layer is embedded, then in certain re-scaled coordinates, the singularity occurs in a region $\alpha_o \times \alpha_o/|\log \alpha_o|$ about x_s, where a reduced set of equations applies. Within this region, there is a downstream-running ray from the origin on which $\alpha \equiv 1$. However, the vertical fluid and particle velocity components are unbounded on that line. On replacing the line with a solid surface of particle material, a narrow boundary layer may be inserted, in which velocity singularities are removed.

[1] *Foster, Duck & Hewitt*, Bull. Amer. Phys. Soc., November, 2006

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