Abstract Submitted
for the DFD07 Meeting of
The American Physical Society

Three flow regimes of a viscous jet falling onto a moving surface under gravity ANDRIY HLOD, ANNEMARIE AARTS, FONS VAN DE VEN, MARK PELETIER, Eindhoven University of Technology — A thin jet of a viscous Newtonian fluid falling from a nozzle onto a moving surface can fall in three different regimes. In the first one the shape of the jet is convex and the jet makes zero angle with the surface. Here, the viscous force dominates inertia everywhere in the jet. In the second regime the fluid flows down vertically. Here, viscosity dominates near the nozzle, while inertia dominates near the surface. In the last regime, which occurs when the flow velocity at the nozzle is large, the jet's shape is concave, comparable to a ballistic trajectory. Then the fluid flow at the nozzle is aligned with the nozzle orientation, and inertia dominates everywhere in the jet. The model incorporates inertia, viscosity and gravity. Correct boundary conditions for the stationary jet as well as the regions of parameters for the three flow regimes are obtained by studying the characteristics of the equation of motion for a dynamic jet. The theoretical predictions of the three flow regimes correspond with experiments. For each flow regime we prove existence and investigate uniqueness. The solutions might not be unique if the nozzle does not point down vertically. In this case multiple stationary solutions are possible, which leads to instabilities, also observed in the experiments.

Andriy Hlod
Eindhoven University of Technology

Date submitted: 31 Jul 2007 Electronic form version 1.4