



<http://cpdl.kettering.edu>

Microthruster

Mass

$$\frac{\partial r}{\partial t} + \frac{\partial ru}{\partial x} + \frac{\partial rv}{\partial y} = 0$$

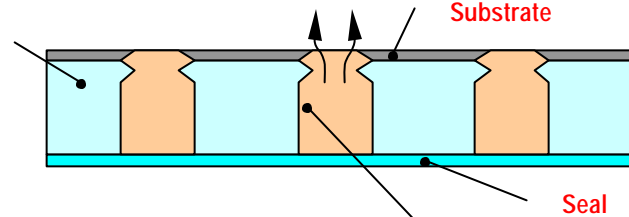
Momentum

$$\frac{\partial ru_i}{\partial t} + u_j \frac{\partial ru_i}{\partial x_j} + \frac{\partial P}{\partial x_i} - \nabla \cdot \mathbf{m} \left(\frac{\partial u_i}{\partial x_j} + \frac{\partial u_j}{\partial x_i} \right) = 0$$

Energy

$$rC_p \frac{DT}{Dt} - \frac{DP}{Dt} - \frac{\partial}{\partial x} \left(k \frac{\partial T}{\partial x} \right) - \frac{\partial}{\partial y} \left(k \frac{\partial T}{\partial y} \right) - \mathbf{m} \left(2 \left(\frac{\partial u}{\partial x} \right)^2 + 2 \left(\frac{\partial v}{\partial y} \right)^2 + \left(\frac{\partial v}{\partial x} + \frac{\partial u}{\partial y} \right)^2 - \frac{2}{3} \left(\frac{\partial u}{\partial x} + \frac{\partial v}{\partial y} \right)^2 \right) = 0$$

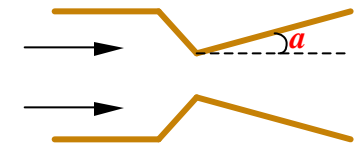
Ceramic



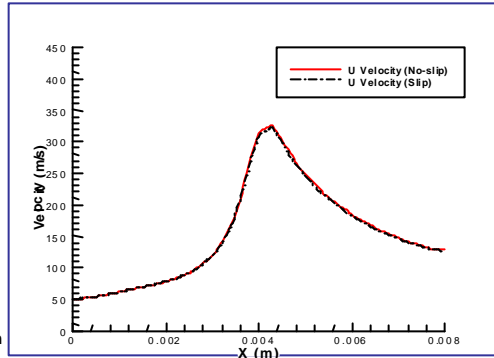
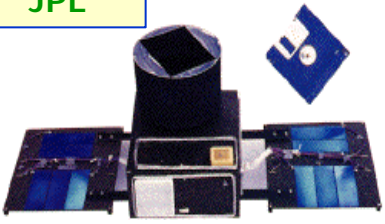
Courtesy Rossi et al. (2000)

Seal

Solid Propellant



Courtesy JPL

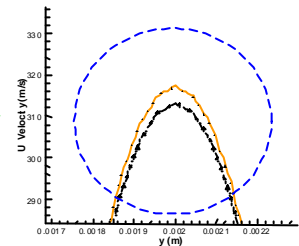
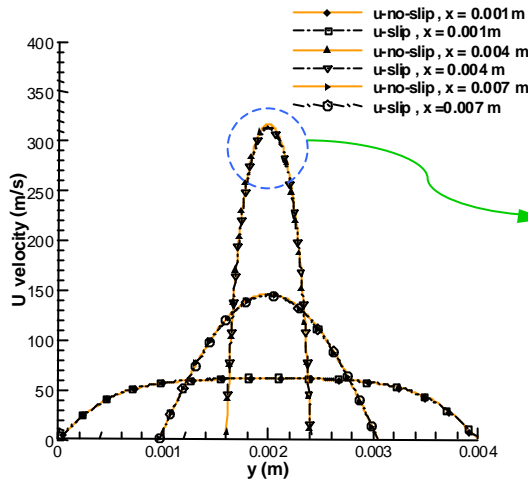


Wall Slip

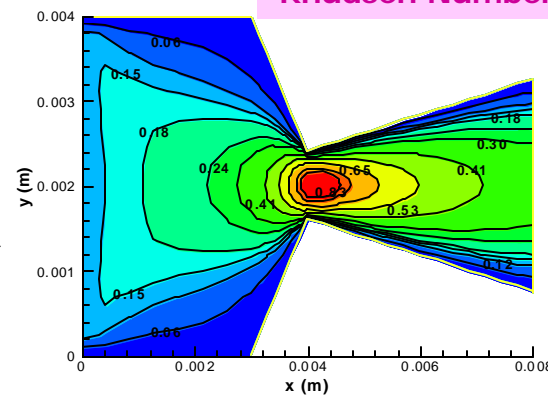
$$u_{gas} - u_{wall} = \frac{2 - s_v}{s_v} \ell \left(\frac{\partial u}{\partial y} \right)_w + \frac{3}{4} \frac{\mu}{\rho T_{gas}} \left(\frac{\partial T}{\partial x} \right)_w$$

Temp Jump

$$T_{gas} - T_{wall} = \frac{2 - s_T}{s_T} \left[\frac{2}{Pr} + 1 \right] \ell \left(\frac{\partial T}{\partial y} \right)_w$$



Knudsen Number



Mach Number

