11/29/05
SPS

Flat-Plate Compressible B.L.

Scaling of Wall-Normal Coordinate

$$\eta = \frac{u_e}{\sqrt{2\xi}} \int_0^y \rho \, dy$$

$$\xi = \rho_e u_e \mu_e x \qquad \frac{\rho}{\rho_e} = \frac{T_e}{T} = \frac{h_e}{h} = \frac{1}{g}$$

$$\eta = \frac{u_e \rho_e}{\sqrt{2\rho_e u_e \mu_e x}} \int_0^y \frac{\rho}{\rho_e} dy = \sqrt{\frac{\rho_e u_e}{2\mu_e x}} \int_0^y \frac{1}{g} dy$$

Now look at const. x. From CRC or other, (p. 320)

$$\frac{d}{dq} \int_p^q f(x) dx = f(q), \text{ where } p = \text{const.}$$

So $$\frac{d\eta}{dy} = \sqrt{\frac{\rho_e u_e}{2\mu_e x}} \frac{1}{g}, \text{ or } d\eta = \sqrt{\frac{\rho_e u_e}{2\mu_e x}} \frac{dy}{g}$$

or $$dy = \sqrt{\frac{2\mu_e x}{\rho_e u_e}}\, g\, d\eta$$

$$dy = \sqrt{2} \times \sqrt{\frac{\mu_e}{\rho_e u_e x}}\, g\, d\eta$$

$$\frac{y}{x}\sqrt{Re_{xe}} = \sqrt{2}\int g\, d\eta \quad \& \text{ when } \eta = 0,\ y = 0, \text{ so}$$

$$\frac{y}{x}\sqrt{Re_{xe}} = \sqrt{2}\int_0^{\eta} g\, d\eta$$