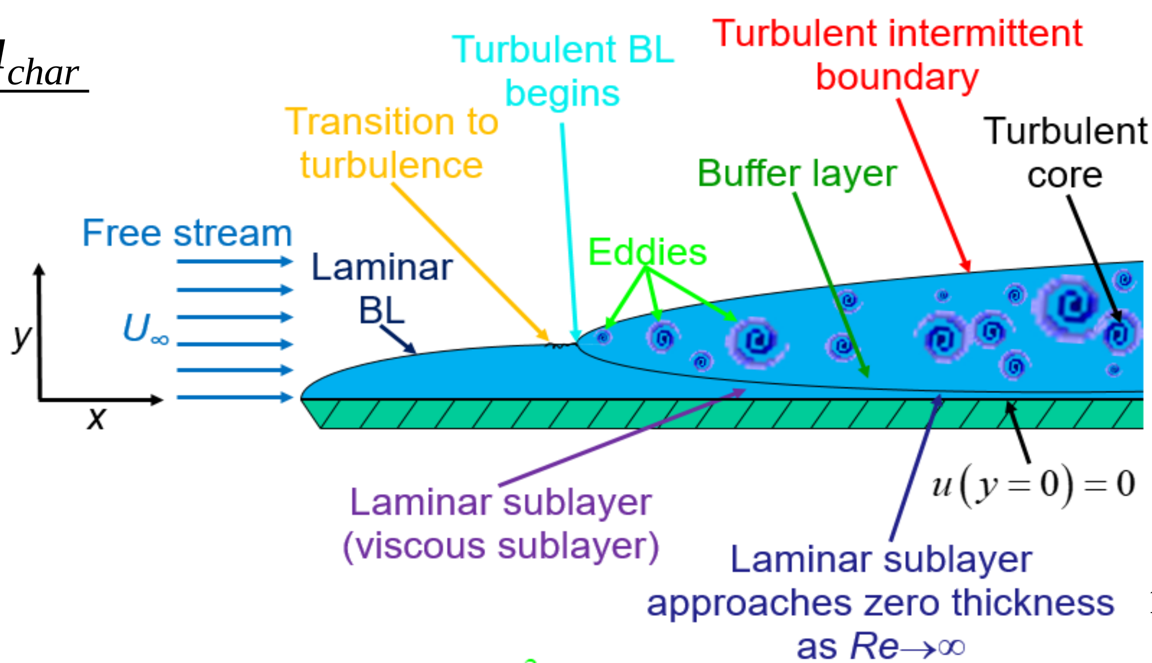
Demystifying y^+

- The dimensionless variable y^+ is a very interesting physical quantity!
- It plays many useful roles, including the location of the turbulent boundary layers and the location for computational nodes.
- It is defined as

$$(3.41)\quad y^+ = \frac{y u_*}{\nu}$$

- y^+ is analogous to Re.

$$(3.43)\quad \begin{cases} y^+ \leftrightarrow Re \\ \dfrac{y u_*}{\nu} \leftrightarrow \dfrac{x_{char} u_{char}}{\nu} \end{cases}$$



y^+ Calculation Procedure

Procedure:

1. Begin by computing *Re* (make sure you use the right *Re* relationship that goes with the appropriate C_f!):

$$Re \equiv \frac{U_{char} x_{char}}{\nu}; \ Re_\delta = \frac{U_\infty \delta(x)}{\nu}, \ Re_x = \frac{U_\infty x}{\nu}, \text{ etc,}$$

U_∞ = free stream velocity

$\delta(x)$ = boundary layer height at location x along flow.

2. Calculate the skin friction via the Schlichting skin friction correlation (the literature has dozens of alternative correlations):

$$C_f = \left[2\log_{10}\left(Re_x\right) - 0.65\right]^{-2.3} \text{ (for } Re_x < 10^9\text{).}$$

3. Use C_f to calculate the wall shear stress:

$$\tau_w = C_f \frac{\rho U_\infty^2}{2}.$$

y^+ Calculation Procedure

4. Use the wall shear stress to compute the friction velocity:

$$u_* = \sqrt{\frac{\tau_\mathrm{w}}{\rho}}, \text{ m/s}$$

5. Use the dimensionless expression, $y^+ = \dfrac{yu_*}{\nu}$.

y = distance perpendicular from the wall, m.

Knowing u_*, now y or y^+ can be determined.