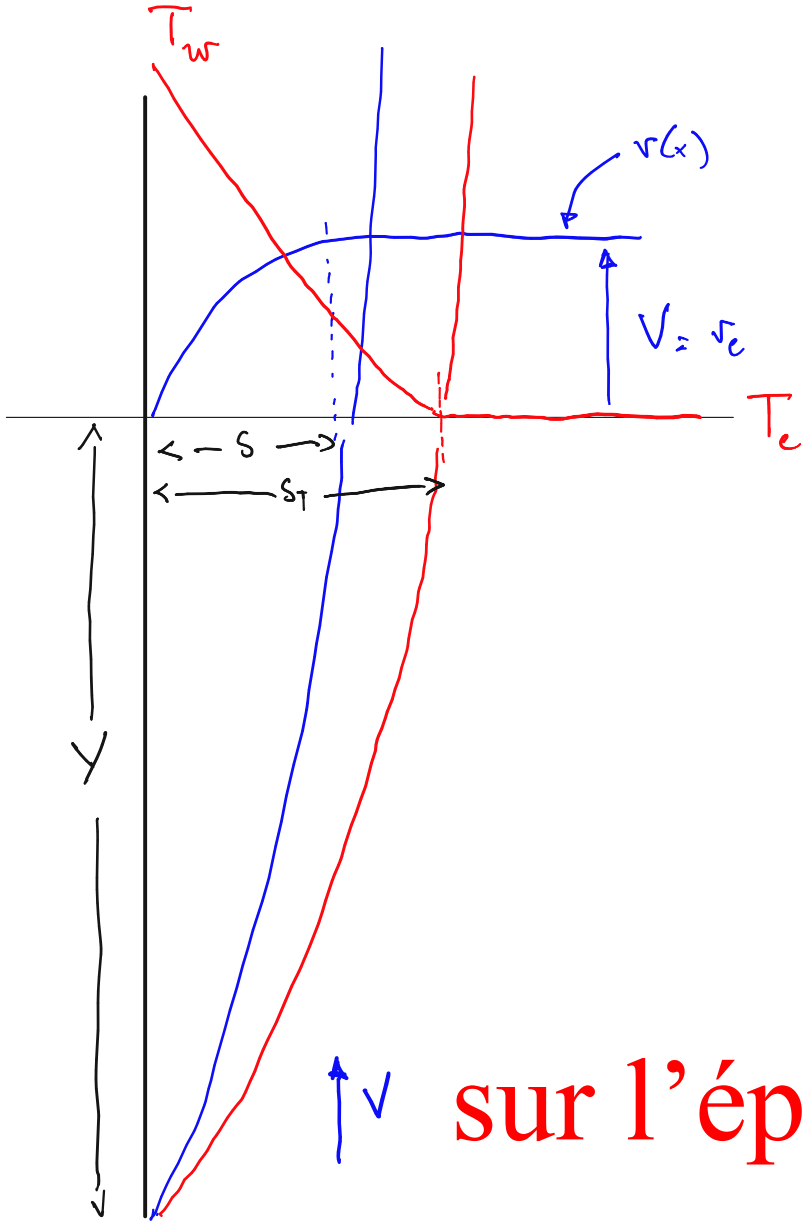
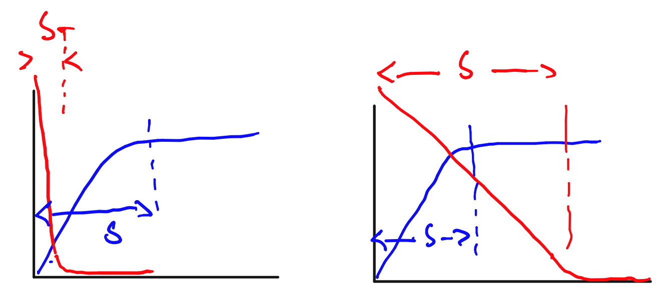




Un petit mot sur l'épaisseur de couche limite thermique

$$\boxed{u\frac{\partial T}{\partial x} + v\frac{\partial T}{\partial y}} = \boxed{\frac{\nu}{c}\left(\frac{\partial v}{\partial x}\right)^2} + \boxed{\alpha\frac{\partial^2 T}{\partial x^2}}$$

CONVECTION

$$V\frac{\Delta T}{Y}$$

DISSIPATION VISQUEUSE

$$\frac{\nu}{c}\frac{V^2}{\delta^2}$$

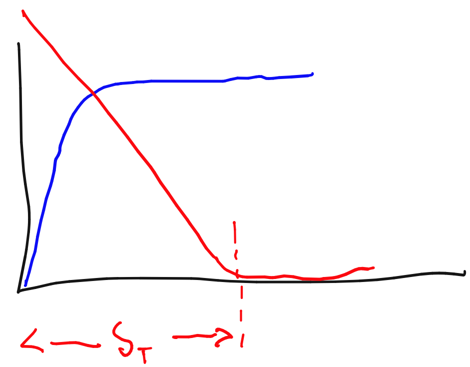
CONDUCTION

$$\alpha\frac{\Delta T}{\delta_T^2}$$

$$\frac{V\Delta T}{Y} \simeq \alpha\frac{\Delta T}{\delta_T^2}$$

$$\boxed{\frac{\delta_T^2}{Y^2} = \frac{\alpha}{VY} = \frac{1}{P_e} = \frac{1}{Re\,Pr}}$$

CAS 1 $\delta \ll \delta_T$



Et δ_T ?

$$\boxed{u\frac{\partial T}{\partial x} + v\frac{\partial T}{\partial y}} = \boxed{\frac{\nu}{c}\left(\frac{\partial v}{\partial x}\right)^2} + \boxed{\alpha\frac{\partial^2 T}{\partial x^2}}$$

CONVECTION

$$V\frac{\delta_T}{\delta}\frac{\Delta T}{Y}$$

DISSIPATION VISQUEUSE

$$\frac{\nu}{c}\frac{V^2}{\delta^2}$$

CONDUCTION

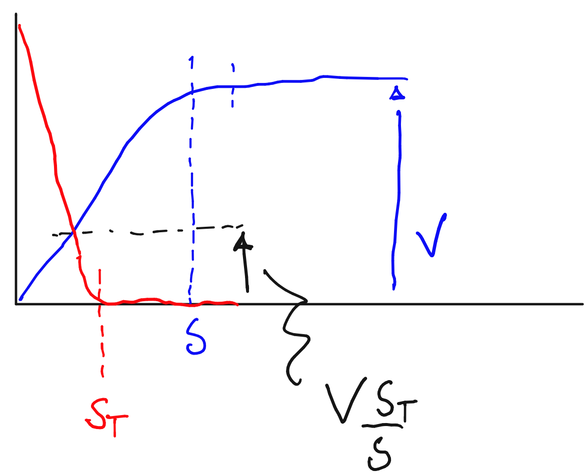
$$\alpha\frac{\Delta T}{\delta_T^2}$$

$$V\frac{\delta_T}{\delta}\frac{\Delta T}{Y} = \alpha\frac{\Delta T}{\delta_T^2}$$

$$\frac{\delta_T^3}{Y^3} = \frac{\alpha}{VY}\,\frac{\delta}{Y} = \frac{1}{Re\,Pr}\,\frac{1}{Re^{1/2}}$$

$$\frac{1}{Pr}\,\frac{1}{Re^{3/2}}$$

CAS 2 $\delta_T \ll \delta$



Et δ_T ?

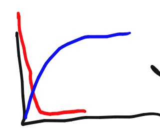
$$u\frac{\partial T}{\partial x} + v\frac{\partial T}{\partial y} = \frac{\nu}{c}\left(\frac{\partial v}{\partial x}\right)^2 + \alpha\frac{\partial^2 T}{\partial x^2}$$

$$\frac{\delta}{Y} = \sqrt{\frac{1}{Re}}$$

$$\frac{\delta_T}{Y} = \sqrt{\frac{1}{Pr}\,\frac{1}{Re}}$$

$$\frac{\delta_T}{Y} = \left(\frac{1}{Pr}\right)^{1/3}\sqrt{\frac{1}{Re}}$$

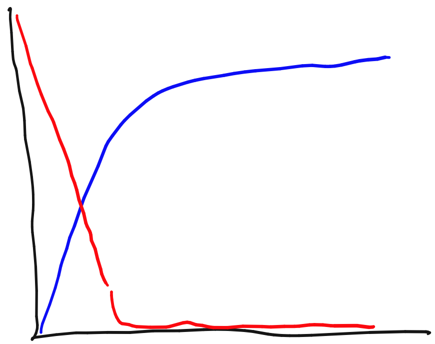
$$\frac{\delta_T}{\delta} = \left(\frac{1}{Pr}\right)^{1/2}$$

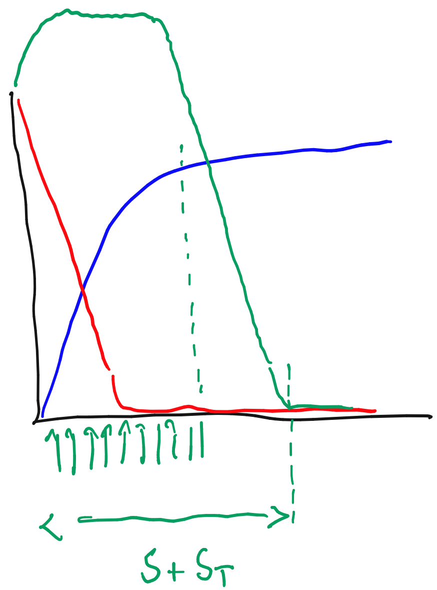


$$\frac{\delta_T}{\delta} = \left(\frac{1}{Pr}\right)^{1/3}$$

Et le rapport δ_T / δ ?

$$u\,\frac{\partial T}{\partial x} + v\,\frac{\partial T}{\partial y} = \boxed{\frac{\nu}{c}\left(\frac{\partial v}{\partial x}\right)^2} + \boxed{\alpha\,\frac{\partial^2 T}{\partial x^2}}$$





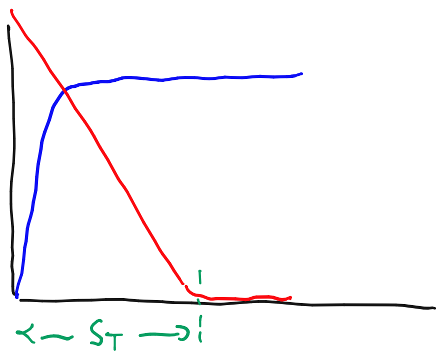
$Ec\,Pr^{1/3} \ll 1$

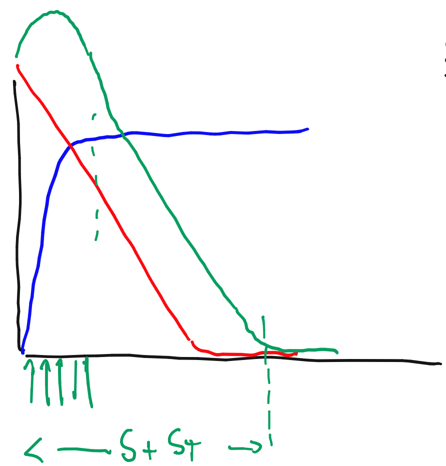
$Ec\,Pr \ll 1$

$Ec \ll 1$

Eckert : dissipation visqueuse ?

$$u\,\frac{\partial T}{\partial x} + v\,\frac{\partial T}{\partial y} \;=\; \frac{\nu}{c}\left(\frac{\partial v}{\partial x}\right)^2 + \alpha\,\frac{\partial^2 T}{\partial x^2}$$





$$\frac{\delta_T}{\delta} \sim \frac{\delta_T + \delta}{\delta} \sim \sqrt{\frac{1}{Pr}}$$

$Ec \ll 1$

Eckert et Prandtl ?