SREEN1

Mike Schultz (and Karen Flack)

Is Townsend's hypothesis OK?

$K/\delta < \frac{1}{50}$

Re large

k^+ large enough for $C_f \neq f(Re)$

$\delta^+ > 4K$

$Re^* \sim 9\times10^5 - 11\times10^6$

(water tunnel)

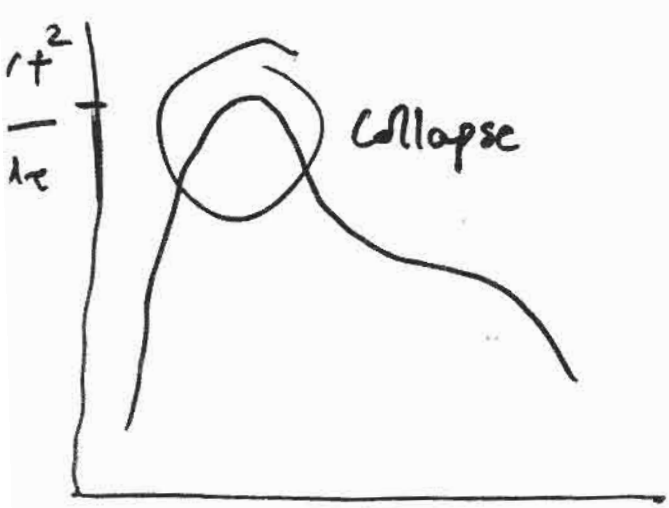
LDV — volume of measurement

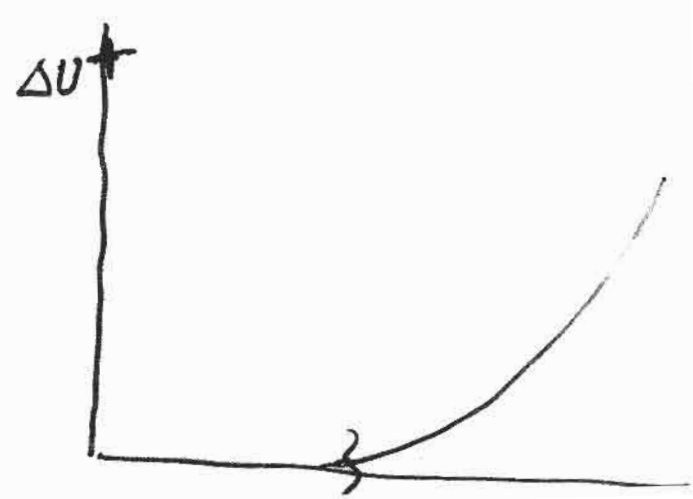
(1·3 – 15 in wall units)

$K_{rms} = 23\cdot6$ μm

$K_{max}/\delta \sim 10^{-3}$

K_y^+ up to 26, δ^+ up to 10k

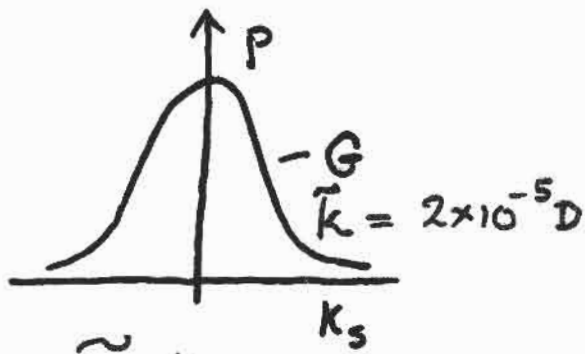




Smits

Flow in rough pipes

$(5.7\times10^4 < Re < 3.5\times10^7)$



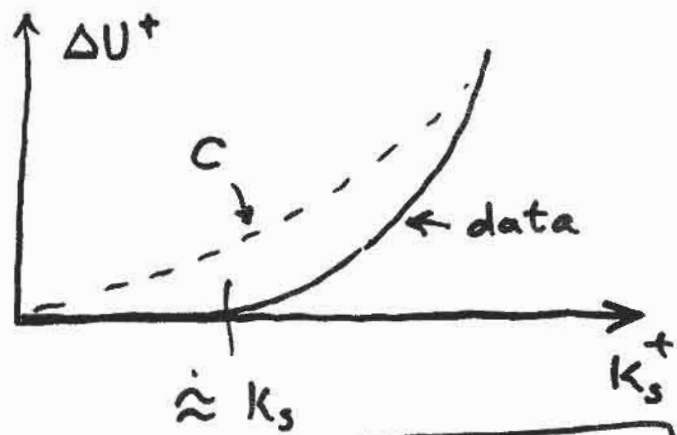
$\tilde{k}_s / k_{mean} = ?$

Smooth pipe data of superpipe were indeed smooth for $Re < 2\times10^7$ $\sim 10^7$

TWO CONCLUSIONS

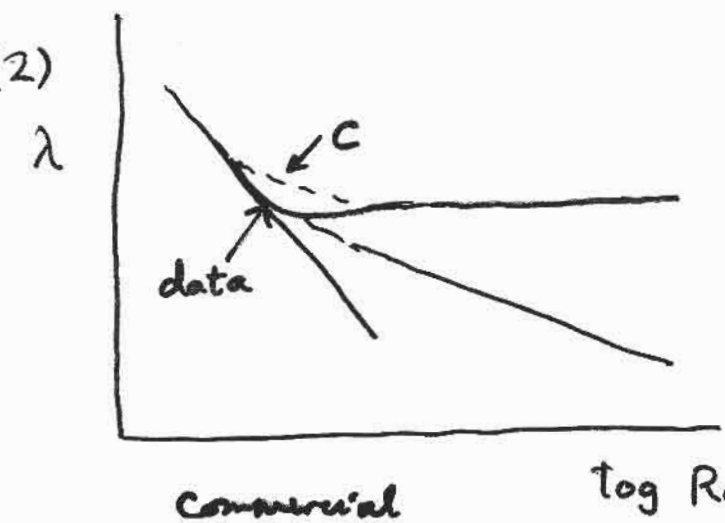
(1) Colebrook is wrong

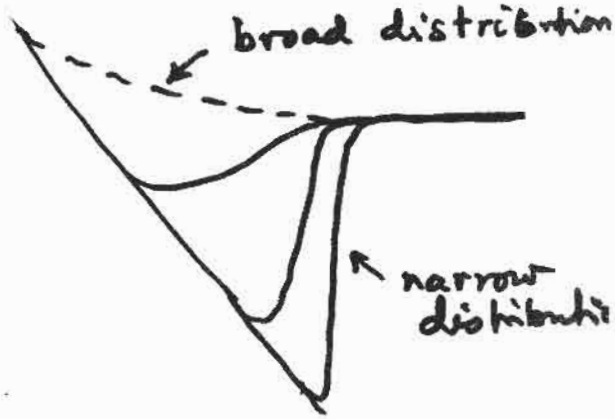
Simple Interpolation scheme



SPECULATION

(2)





McKeon

Inertial scaling

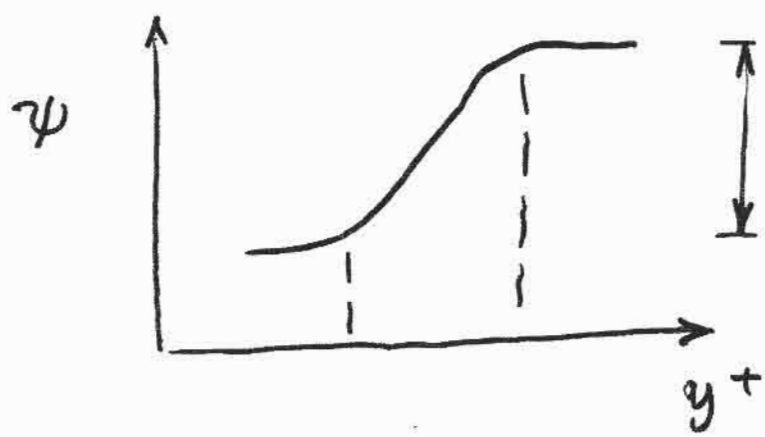
$$\delta_v,\ \eta,\ \lambda,\ y,\ \lambda_s,\ R$$

λ ⇑ Taylor, λ_s ⇑ shear $\qquad \lambda_s = \sqrt{\dfrac{\varepsilon}{S^3}}$

$$\lambda > \lambda_s > \eta$$

⋮

Full similarity needs $Re > 3\times10^5$



$$\psi = U^+ - \frac{1}{\kappa}\ln y^+$$

κ ↑ from friction data

"Mixing transition" begins at 7.5×10^4

Full similarity $\qquad 3\times10^5$

Mid-Re, high-Re ranges need to be separated!

$$\underline{\lambda_s = \sqrt{\frac{\varepsilon}{s^3}}}$$

In the wall region,

$$\varepsilon = u_\tau^4/\nu \,, \quad s = \frac{u_\tau^2}{\nu}$$

$$\lambda_s = \nu/u_\tau$$

$$\eta = \nu/u_\tau$$

In the intermediate region

$$\varepsilon = u_\tau^3/y$$

$$s = u_\tau/y$$

$$\lambda_s = (\nu/u_\tau)$$

$$\eta = \frac{\nu}{u_\tau} \cdot \left(\frac{y u_\tau}{\nu}\right)^{\frac{1}{4}}$$

In the Outer region

$$\lambda_s \approx R \,, \quad \eta \approx \frac{\nu}{u_\tau}\left(\frac{u_\tau \delta}{\nu}\right)^{\frac{1}{4}}$$

Morrison

large eddies are weak
(Townsend 1956, 1976)

Self-similarity $600 < y^+ < 0.12R^+$

2nd order str. fn. and spectra
used to deduce influence
of outer scales on the inner

Outer influence — weak

Kunkel

Two aspects:

(1) Nanohotwire

20 nm × 20 nm × 2 μm

— Have yet to make it work, main remaining task is to lift the sensing element off the large substrate — but progress has been steady.

— Issues of the "free stream" flow in High Pr facility have been reexamined, work has been done to fix them

Issues of resolution

At some Re

$$\ell^+ \approx 76 \quad , \quad \ell/\eta \approx 30 \; ?$$

Perhaps OK, perhaps not —

but would be worth repeating

(either in the same flow with better ~~interaction~~ resolution, or a different facility with better resolution)

Turbulent flow in ducts & pipes

(MONTY)

$Re_{max} \approx 180\,K$ for both

Similarity in pipe flow for 50 D

Not true for ducts!

Remarks for skewness (not ~~overlapping~~ collapsing)

u' collapses

Casimir van Doorne

& Frans Nieuwstadt

Turbulence measurements in pipes
using high speed PIV

TRANSITION

$\Downarrow$

$\boxed{\text{travelling waves}}$

Self-sustaining vs transient growth

$\boxed{\text{7 talks}}$

Talamelli

CICLOPE

$Re_D = 2 \times 10^6$, $U_{CL} = 50\ m/s$

$D = 0.9\ m$, $L = 10^2\ m$

130 m

Roughness ~ 10 μm

Marusic

Construction to begin Spring 06

Report on the previous meeting at the CICLOPE cite

Total cost ~ 4 M €

(50 % instrumentation)

600 K from Bologna

250 k from Stockholm

Regione, EU

Synchrotron sources, CERN international facilities