















C. Guttin, and Ph. Gandit (Institut Néel) nor without the financial support of the ANR (Grant No. ANR-05-BLAN-0316, “TSF”) and the Région Rhône-Alpes.

We thank also R. Kaiser for his contribution during data acquisition, T. Haruyama (KEK, Japan) for support with several pressure transducers, and L. Chevillard and F. Chillà (ENS Lyon) for fruitful discussions.

## APPENDIX: DERIVATION OF THE STAGNATION PRESSURE SIGNAL

We consider the total pressure  $U(t)$  measured by a stagnation pressure probe in a classical incompressible fluid,

$$U(t) = \frac{1}{2}\rho v(t)^2 + P(t), \quad (\text{A1})$$

where  $\rho$  is the density of the fluid,  $v(t)$  the local velocity, and  $P(t)$  the local static pressure. Equation (A1) can be rewritten using Reynolds decomposition  $v(t) = \langle v \rangle + v'(t)$  and  $P(t) = \langle P \rangle + P'(t)$ ,

$$U(t) = \frac{1}{2}\rho \langle v \rangle^2 + \langle P \rangle + \rho \langle v \rangle v'(t) + P'(t) + \frac{1}{2}\rho v'(t)^2. \quad (\text{A2})$$

We recall the definition of the turbulence intensity  $\tau$ ,

$$\tau = \frac{\sqrt{\langle v'^2 \rangle}}{\langle v \rangle}. \quad (\text{A3})$$

The typical magnitude of the static pressure fluctuation  $P'$  can be estimated for isotropic and homogeneous turbulence,<sup>38–40</sup>

$$\frac{\sqrt{\langle P'^2 \rangle}}{\frac{1}{2}\rho \langle v'^2 \rangle} \approx 1.4. \quad (\text{A4})$$

Therefore, the terms of Eq. (A2) can be divided in orders of  $\tau$ ,

$$\begin{cases} U_0 = \frac{1}{2}\rho \langle v \rangle^2 + \langle P \rangle = \mathcal{O}(1) \\ U_1(t) = \rho \langle v \rangle v'(t) = \mathcal{O}(\tau) \\ U_2(t) = P'(t) + \frac{1}{2}\rho v'(t)^2 = \mathcal{O}(\tau^2), \end{cases} \quad (\text{A5})$$

where  $U_0$  is a constant offset, used only for calibrating the probe,  $U_1(t)$  is the signal of interest, and  $U_2(t)$  is the second-order corrective term, considered as a spurious signal for stagnation pressure probes. The relative weight of  $U_2$  versus  $U_1$  can be estimated versus the turbulent intensity  $\tau$ ,

TABLE V. Typical relative weight of each term contributing to the signal measured by a stagnation pressure probe for various turbulence intensity  $\tau$  using estimate (A6).

$\tau$ (%)	$\rho \langle v \rangle v'(t)$ (%)	$P'(t)$ (%)	$\frac{1}{2}\rho v'(t)^2$ (%)
1	98.8	0.7	0.5
2	97.6	1.4	1
10	89.2	6.3	4.5
20	80.6	11.3	8.1
30	73.5	15.5	11.0

$$U_1(t) = \rho \langle v \rangle v'(t) \sim \rho \langle v \rangle^2 \tau, \quad (\text{A6})$$

$$U_2(t) = \begin{cases} P'(t) \sim 0.7 \rho \langle v \rangle^2 \tau^2 \\ \frac{1}{2} \rho v'(t)^2 \sim 0.5 \rho \langle v \rangle^2 \tau^2. \end{cases}$$

Some values are given in Table V. We can see that for turbulence intensity larger than 20%, like those obtained in Von Kármán cells, and in wake or “hunk flows, almost 30% of the measured signal comes from second-order correction terms. However, for turbulence intensities of grid flows, less than 2% in our case, more than 96% of the measured signal comes from the linear velocity term.

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